Music, Imagery Training, and Sports Performance

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Submitted in fulfilment of the requirements of the degree of

Doctor of Philosophy by Research

March, 2014

Doctor of Philosophy Declaration

"I, Garry Kuan, declare that the PhD thesis entitled 'Music, Imagery Training, and Sports Performance' is no more than 100,000 words in length, exclusive of tables, figures, appendices, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work."

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ABSTRACT

Imagery is widely used in performance enhancement in sport. Music is also used to enhance sports performance. In this thesis, I examined the role of relaxing and arousing music during imagery on subsequent sports performance in three linked studies. The purpose of Study 1 was to investigate the effects of relaxing and arousing music on physiological indicators of arousal level and subjective psychological perception of arousal during imagery of a sport task. First, appropriate music excerpts were selected with the involvement of professional musicians, sport psychologists, and sport science students. They selected three unfamiliar relaxing music (URM) excerpts, three unfamiliar arousing music (UAM) excerpts, and three familiar arousing music (FAM) excerpts from 90 pre-selected classical music excerpts generated in an initial search for use with imagery. In this study, unfamiliar music excerpts were chosen to minimise the confounding effects of individual past associations which affect arousal level in unpredictable ways. FAM excerpts were added to test the differences between familiar and unfamiliar arousing music. After that, 12 skilled shooters performed shooting imagery while listening to the three preselected music excerpts of each type (URM, UAM, and FAM) each in random order. Using a ProComp+ system and BioGraph Software version 5.0 from *Thought Technologies*^{TM}, I monitored participants' galvanic skin response (GSR), peripheral temperature (PT), electromyogram (EMG), and heart rate (HR) during each type of music, which was played concurrently with imagery. Each participant listened to three classical music excerpts representing each of the three categories (nine pieces in total). Three music excerpts were played in each

of the three training sessions, with resting levels of physiological measures being recorded before conducting the next imagery session. Between these excerpts, participants rested until normal arousal levels were regained. Results from subjective music ratings, physiological and psychological measures showed UAM was the most arousing and URM was the most relaxing music. In Study 2, I aimed to test whether relaxing, arousing, or no music affected the subjective experience of the imager, and the performance of a dart throwing sport task. Participants in this study were 63 sport science students with intermediate imagery ability, measured by the Sport Imagery Ability Measure (SIAM; Watt, Morris, & Andersen, 2004). Participants were matched into three groups: 1) unfamiliar relaxing music during imagery (URMI), 2) unfamiliar arousing music during imagery (UAMI); and 3) no music during imagery (NMI - control). A pre-test-intervention- post-test design was used with 40 trials of throwing darts at a concentric circles dartboard at pre-test and post-test. The Competitive State Anxiety Inventory-2R (CSAI-2R; Cox, Martens, & Russell, 2003) was administered before the pre-test and after the post-test dart-throwing performance. All participants completed 12 sessions (four weeks) of imagery. In Session 1 and 12, participants' GSR, PT, and HR were measured. Manipulation checks indicated that URMI showed the lowest levels of arousal and arousal level in this condition reduced most from the start to end of sessions. UAMI howed the highest levels of arousal and NMI levels were between those of URMI and UAMI. One-way ANOVA of dart-throwing gain scores revealed that there was a significantly greater gain score for performance for URMi than the other conditions, F (2, 62) = 5.03, p = .01, eta^2 = .14. Gain scores were URMI = 37.24

± 25.94, UAMI = 17.57 ± 24.30, and NMI = 13.19 ± 28.15. Post Hoc Tukey tests indicated that there was a significant difference in gain scores on dart-throwing performance for URMI versus UAMI, p = .04, and URMI versus NMI, p = .01. However, there was no significant difference between UAMI and NMI, p = .85. In the final study, Study 3, I examined the effects of relaxing and arousing music during imagery on the subsequent performance of high-arousal power and fine-motor skill tasks, and the subjective experience of both relaxing and arousing music during imagery training, using a match-mismatch approach. The study included a pre-test – intervention – post-test design. Participants were semi-professional elite shooters (n = 26) and weightlifters (n = 25). All participants had moderate to high imagery ability measured by the SIAM and had at least two years of competitive experience at State level. In both sports, participants were assigned at random to one of two interventions: unfamiliar relaxing music during imagery (URMI), and unfamiliar arousing music during imagery (UAMI). This produced four conditions: fine motor task (pistol shooting) with either relaxing (URMI; matched) or arousing (UAMI; mismatched) music, and power task (weightlifting) with either relaxing (URMI; mismatched) or arousing (UAMI; matched) music. Shooting performance was measured in a standard 10m air-pistol shooting simulated competition, and weightlifting performance was measured on a simulated competition of a standard Olympic event – Clean and Jerk. All participants completed 12 sessions of imagery over four weeks before the post-test was conducted. In Session 1 and 12, participants' GSR, PT, and HR were measured. The CSAI-2R was administered prior to pre-test and post-test performance. For pistol shooting, results from the independent samples t-test

showed that differences across type of music used with imagery were significant on the gain-score for competition performance $t(24) = 2.71$, $p = .01$, Cohen's $d = 1.06$, with a significantly larger increase in performance for URMI than UAMI. For weightlifters, results from the independent samples *t*-test revealed the differences between conditions were significant in terms of gain-scores for competition performance $t(23) = 5.63$, $p < .001$, Cohen's $d = 2.26$, with a significantly greater gain score with unfamiliar relaxing music than unfamiliar arousing music. Contrary to previous findings when music was played before or during actual sports tasks, in this study unfamiliar relaxing music facilitated imagery of both fine-motor and power sports tasks, suggesting that relaxation plays a role in the imagery of sports skills. If this finding is replicated for the use of music with imagery across other strength and power tasks that are usually enhanced by arousing music prior to or during actual performance (Karageorghis et al., 2009; Simpson & Karageorghis, 2006), it has important implications for the use of particular types of music with imagery, and supports the proposition that relaxation is beneficial for imagery.

ACKNOWLEDGEMENTS

I would like to take this opportunity to thank and express my appreciation to many wonderful individuals that have provided so much love and support during my thesis. First and foremost, I would like to specially thank my principal supervisor, Professor Tony Morris, for his professional guidance, persistent feedback, open communication, attention to detail, encouragement, continual support and patience throughout the research. His advice on all aspects of the development of this thesis, and his support in publishing my research findings and involving me in other research, has been invaluable for the successful completion of this thesis. I will always be indebted to you for your diligence and friendship in the latter part of my professional development.

I would also like to thank my associate supervisor, Professor Peter Terry from the Department of Psychology, University of Southern Queensland, for his kind support and advice on music and sports research. Thank you for your kind words, and encouragement to keep me motivated and inspired in completing my thesis writing. Thank you for your help in contacting the elite shooters for Study 3. I honestly felt very privileged and honoured to have this great opportunity to work with both supervisors and have such an exceptional and dedicated supervisor throughout my PhD journey.

Also a very special thanks to the pistol shooting and weightlifting coaches, athletes, and clubs allowing me to complete my Study 1 and Study 3. I am also grateful to the coaches, who facilitated contacts with participants, patiently checking and re-validating my imagery script, and offered their time to work closely with me and with the elite athletes. Their kindness and hospitality in offering their time and accommodation for me during interstate travel has played a pivotal role in completing the thesis.

I would like to acknowledge the staff members and colleagues from the College of Sport and Exercise Science, with whom I worked closely, and who also helped to promote my research to the sport science students to participate in Study 2. Also, thank you to the students, who volunteered to participate in the Study 2. Special thanks to Mr. Ian Fairweather, for providing tangible support with regard to the physiological equipment used in this thesis.

I am very thankful to Victoria University Chancellor George Pappas, who provided constant mentorship, support, and encouragement to complete the research. Thank you for your interest in my research, and your recommendations to other sports organizations to apply my research. I would also like to express my appreciation to many of the Victoria university Council members, with whom I had the privilege and honour to work. Your friendship has been so valuable.

A special person also played a strong role in my leadership skills at Victoria University is Danielle Hartridge, Associate Director of International Student Support. Thank you for your belief, mentorship and dedication in giving me the opportunity to serve as a student leader at Victoria University.

To the most important people in my life – my parents, my beloved wife, Erica, and my baby daughter Gabriella, no words can describe how blessed and thankful I am to have such a loving and supportive family throughout my PhD journey in Melbourne. To my beloved parents, despite being located so far away, have always given me their unreserved support, thank you for your unceasing prayer for my family and me.

Erica, I want to particularly thank you for your continuous support, motivation, and inspiration throughout my journey in completing the PhD. Your unfailing love has accompanied me throughout this journey, making it a joyous one. I am thankful for my lovely daughter, Gabriella who was born during the last stage of thesis writing. Gabriella, you have been the most wonderful reward that I received in my PhD completion.

Last, but not least, my sincere thankfulness also goes to all my church friends, my relatives and friends in Australia and Malaysia, who have given their constant support and countless prayers throughout my PhD. All have contributed in their special ways, and have been an important part of reaching the research goals.

LIST OF PRESENTATIONS AND AWARDS

Symposium and Oral Presentations

Kuan, G., Morris, T. & Terry, P. C. (2013, July). *The superior effect of unfamiliar relaxing over arousing music during imagery training for fine motor and power skill tasks.* Symposium presented at the ISSP 13th World Congress of Sport Psychology, Beijing, China.

Kuan, G., Morris, T. & Terry, P. C. (2012, July). *Examining the effect of music during imagery on performance in elite sport.* Oral session presented at the International Convention on Science, Education and Medicine in Sport (ICSEMIS), Glasgow, UK.

Kuan, G., Morris, T. & Terry, P. C. (2012, July). *Measuring psycho-physiological indicators to explore the use of music for enhancing mindfulness imagery experiences.* Poster session presented at the International Convention on Science, Education and Medicine in Sport (ICSEMIS), Glasgow, UK.

Kuan, G., Morris, T. & Terry, P. C. (2011, November). *Mystery of imagery: Use of arousing music or relaxing music for competitive weightlifters.* Oral session presented at the 6th Taipei ASPASP International Congress on Sport Psychology, Taipei, Taiwan.

Kuan, G., Morris, T. & Terry, P. C. (2011, September). *Frontiers of imagery research: A comparison of the effects of arousing and relaxing music during imagery among weightlifters*. Oral session presented at the 2011 Annual Postgraduate Symposium: Institute of Sport, Exercise and Active Living, Melbourne, Australia.

Kuan, G., Morris, T. & Terry, P. C. (2011, July). *The effect of arousing and relaxing music on imagery for dart throwing.* Oral session presented at the 13th European Congress of Sport Psychology, Madeira, Portugal.

Kuan, G., Morris, T. & Terry, P. C. (2010, July). *Quantification of familiar arousing music, unfamiliar arousing music and unfamiliar relaxing music on physiological arousal during imagery in elite shooters.* Symposium presented at the 27th International Congress of Applied Psychology, Melbourne, Australia.

Kuan, G., Morris, T. & Terry, P. C. (2010, December). *The use of physiological parameters (GSR, PT, and BVP) for quantification of the relaxing and arousing effects of different types of classical music during sport-specific imagery of skilled shooters*. Oral session presented at the 3rd Victorian Sport Psychology Conference, Melbourne, Australia.

Kuan, G., Morris, T. & Terry, P. C. (2009, June). *Effect of unfamiliar music on psychophysiological measures during imagery.* Symposium presented at the 12th ISSP World Congress of Sport Psychology, Marrakesh, Morocco.

Kuan, G., Morris, T. & Terry, P. C. (2009, December). *The use of galvanic skin response (GSR) and superficial temperature (ST) to monitor relaxation during mindfulness imagery with relaxing music.* Oral session presented at the 1st International Conference on Sport and Exercise Science (ICSES), Bangkok,Thailand.

Kuan, G., Morris, T. & Terry, P. C. (2009, December). *Galvanic skin response (GSR) and blood volume pulse (BVP) during arousing or relaxing unfamiliar music and sport imagery.* Oral session presented at the 1st International Conference on Sport and Exercise Science (ICSES), Bangkok, Thailand.

Awards

1) International Scholars – Young Researcher, by Podium: The further and higher education unit for the 2012 Olympic Games to attend the International Convention on Science, Education and Medicine in Sport (ICSEMIS), Glasgow, UK.
2) Atsushi Fujita Research Student Scholarship, in recognition of outstanding PhD research in the field of sport and exercise psychology and motor learning. Presented at the 6th ASPASP International Congress on Sport Psychology, Taipei, Taiwan.
3) Best Postgraduate Presenter, at the 2011 Annual Postgraduate Symposium: Institute of Sport, Exercise and Active Living, Melbourne, Australia.

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CHAPTER 1

INTRODUCTION

Imagery is a form of mental practice whereby an individual recalls and performs sensory experiences in the absence of external stimuli (Murphy, 1994). Guided imagery is a psychological skill that is commonly used by athletes to enhance their sporting performance (Taylor & Wilson, 2005). It is a form of mental practice that has been widely used for the acquisition of sporting skills. In this thesis, "mental practice" refers to a particular application of mental imagery in which performer "practice" in their heads, or rehearse their skills symbolically, before actually executing them (Moran, 2012, p. 168-169), and "imagery" refers to "an internal representation that gives rise to the experience of perception in the absence of the appropriate sensory input" (Wraga and Kosslyn, 2002, p.466). Munroe-Chandler and Morris (2011) stated that imagery is the most widely referenced technique in sport psychology. Morris, Spittle, and Watt (2005) wrote "Imagination is terrifically powerful – by mentally rehearsing a routine before a major competition, athletes can prepare themselves to achieve their optimal performance when it counts most" (p. 5). Imagery is a prerequisite for elite golf performance (Thomas, 2002). According to professional golf player Jack Nicklaus (Nicklaus & Bowden, 1974, p.79), mental practice is a highly important skill. He explained saying "I never hit a shot, even in practice, without having a very sharp, in-focus picture of it in my head… First, I 'see' the ball where I want it to finish...and I 'see' the ball going there; its path, trajectory, and shape, even its behaviour on landing. The next scene shows me making the kind of swing that will turn the images into reality” (p. 79). Researchers have concluded that imagery is an effective sport performance enhancement technique (e.g., Gregg & Hall, 2006a; Martin, Moritz, & Hall, 1999; Morris et al., 2005; Shearer, Thomson, Mellalieu, & Shearer, 2007), which can also be used to manipulate psychological variables, such as anxiety, confidence, and motivation (Morris, Spittle, & Perry, 2004), but the factors that enhance or detract from the effect of imagery in sport performance are still not clearly understood. This creates a gap in imagery research, which is yet to be examined comprehensively.

Despite the frequent use of music in many sports, and the recognition by many athletes that music can help to create a winning mind-frame, research examining the mechanism by which music influences sport performance is scarce. Several researchers have demonstrated that music has an ergogenic effect on sport performance (Karageorghis, Terry, & Lane, 1999; Ward & Dunaway, 1995) and can increase exercise duration and heart rate (e.g., Copeland & Franks, 1991; DeBourdeaudhuij et al., 2002; Szmedra & Bacharach, 1998). Music has also been shown to enhance performance in a variety of sports, such as power, endurance, long distance, and sprinting events. For example, in power sports, boxers often walk to the ring with their favourite track blaring in the background. In team sports, such as football and basketball, teams can be found getting “amped up” in the locker room, listening to a playlist of songs specifically designed to prepare them mentally for the game. Performers in long-distance sports, such as tri-athletes or long-distance cyclists, use their MP3 players as synchronised music to motivate them to run or cycle longer and faster (Edworthy & Waring, 2006; Karageorghis & Priest, 2012a). For example, professional athlete, Haile Gebrselassie, used a high-tempo popular music song to synchronise his strides in order to optimise his pace to win a 5000m race in 2003 (Finn, 2008). Even for sprinting sports, the eighteen-time Olympic swimming gold medallist, Michael Phelps, in almost every photo shot of him at the pool, can be seen wearing his earphones, attached to his ‘Apple iPod’, while readying himself for competition.

Music is also claimed to create changes in mind and body during listening. Music has the power to increase arousal, energise, soothe, change emotional outlook, boost immunity, reduce pain, lower blood pressure, speed recovery, improve focus, and increase IQ (Ambroziak, 2003; Chafin, Roy, Gerin, & Christenfeld, 2004). In addition to this, music has been shown to have psychophysical effects, which include lowered perceived effort, arousal control, improved affective states, and synchronization effects (Boutcher & Trenske, 1990; Copeland & Franks, 1991; Karageorghis & Terry, 1997).

Music has been used to incorporate into imagery interventions in order to create more vivid scenes, increase emotional control, and facilitate the production of imagery. Earlier researchers, including Osborne (1981), and Quittner and Glueckauf (1983) found that participants reported more visual imagery (images) when listening to music, and suggested that music may facilitate the production of imagery. In addition, Dorney, Goh, and Lee (1992) found that imagery with music was associated with significant increases in heart rate during preparation for muscular endurance tasks (sit-ups), but heart rate was not related to task performance.

Several studies examining the effect of music on performing various tasks have shown that fast-tempo music has enhancing effects on performance, and slow tempo music can be detrimental to sport performance by facilitating relaxation (Beaver, 1976; Ferguson, Carbonneau, & Chambliss, 1994; Karageorghis, Drew, & Terry, 1996). Aside from the impacts of tempo, arousing music has been shown to increase arousal during exercise, which may also be a contributing factor to enhanced sport performance (Karageorghis et al., 2005).

Music may be used as part of an effective preparation strategy when power or muscular endurance exercises are performed; in contrast, this same music may also be counter-effective for activities that require high levels of concentration and coordination. Many researchers and applied sport psychologists have proposed that relaxation facilitates imagery (e.g., Perry & Morris, 1995). For example, Suinn (1976) combined relaxation training with visual and multi-sensory imagery training using the Visuo-Motor Behavior Rehearsal (VMBR) imagery technique. He found more effective imagery rehearsal than for non-relaxation imagery training. Lampl (1996) and Meyer (1994) have stated that certain kinds of music serve to increase relaxation during performance of a sport task, which may enhance imagery. This indicates that relaxing music can facilitate relaxation, which might be beneficial to imagery, regardless of the task performed.

Based on their review of theoretical and experimental work, Karageorghis et al. (1999) proposed that the use of asynchronous motivational music leads to three psychophysical responses: arousal control, reduced ratings of perceived exertion (RPE) and improved mood. Such responses within the context of a single bout of exercise may lead to the long-term behavioural outcomes of increased adherence to exercise. On the other hand, for short-term responses, both mood and arousal may be influenced by music that is played before as well as during a bout of exercise, whereas perceived exertion is affected by music that is played concurrently.

Despite the importance of imagery in sport performance, the mechanisms that may facilitate imagery, through its incorporation with music, are still ambiguous. As imagery is a powerful tool, the use of imagery to achieve the best effects still needs further study, and the use of music is one factor that could influence performance that is influenced by the utilisation of imagery on sport tasks. Nevertheless, there is still much to be learned in relation to various issues that are yet to be fully explored, particularly in the area of psycho-physiological responses, in the study of different types of music on imagery and sport performance. It is important to understand the mechanisms underlying the imagery process, so that the use of imagery can be optimised. According to Morris et al. (2005), often researchers examine an idiosyncratic issue in the imagery domain, and then move on to another area of sport psychology research. Thus, until recently, there has been a shortage of systematic applied research on issues such as the role of music combined with imagery in sport.

This thesis will examine the effects of different types of music in facilitating the production of imagery of the performance of different types of sport tasks, including power/strength/endurance tasks (such as weightlifting) and fine motor skill activities (such as shooting). This research is designed to further extend imagery research by examining the extent to which imagery is enhanced by music. In other words, it examines the extent to which music can affect imagery training in sports. This thesis will also enhance knowledge on the psychological effects of different types of music, which could be beneficial to imagery training for sport performance in different types of sport tasks. The impact of the subjective experience of different types of music during imagery on imagery and subsequent performance will also be discussed.

CHAPTER 2

LITERATURE REVIEW

In this chapter, I establish the relationship between imagery, arousal, music, and sport performance. Firstly, I discuss literature that relates to imagery and its use for enhancing sport performance. Here, definitions of imagery, models and theories of imagery, imagery measures, and the use of imagery in connection to sport performance are presented. The chapter then presents an overview of research that has examined the use of imagery for enhancing sport performance. Following this, I define arousal and relaxation in the context of sport performance, theories, measures of arousal, and the importance of achieving either optimum arousal or relaxation in facilitating performance, depending on the type of sport involved. Then, in the next section, I discuss the use of music in sport and exercise research, citing current research on the effect of music, and propose extensions of this information to identify ways in which music acts as an ergogenic aid in enhancing sport performance. Finally, I will present research on imagery with music and how music can facilitate the positive effect of imagery on sport performance.

Imagery

According to Morris et al. (2005) imagery is a well-researched topic in the field of sport psychology. Imagery is regarded as the most popular form of mental training technique used in psychological skills training (PST) programmes for athletes (Morris et al., 2005). Orlick and Partington (1998) stated that 99% of a total of 235 Canadian athletes who participated in the 1984 Olympic Games reported using imagery techniques in their training regimen at least once a day, four days per week, about twelve minutes each time. Most of these athletes performed their imagery techniques approximately two to three hours prior to commencement of their competition. Similarly, research on US Olympic athletes indicated that they used mental imagery extensively while training for competition (Ungerleider & Golding, 1991). In a meta-analysis, Driskell, Copper, and Moran (1994) reported that systematical use of imagery training and rehearsing in the mind has been shown to produce actual physical movements without any direct engagement. According to Hardy, Jones, and Gould (1996), many of the world's highest-level athletes reported using imagery to improve their routines and they attributed at least some of their success to their use of mental imagery. According to professional golfer Tiger Woods, "You have to see the shots with imagery and feel them through your hands before addressing the ball" (quoted from Pitt, 1998, p. 5). Similarly, Mike Atherton, the former England cricket batsman and captain, highlighted the value of mental rehearsal for test matches saying "I do the imagery – what's going to come, who's going to bowl, how they are going to bowl, what tactics they will use … so that nothing can come as a surprise" (quoted in Selvey, 1998, p. 2). Gould, Guinan Greenlead, Medbery, and Petersen (1999) reported that mental training was an important component in the preparation of US Olympic athletes. John Regis described his training for major championship mentioning that "imaging the perfect race and the feeling I got when I was running the perfect race. When that happens it's called being in the zone, because you just don't seem able to lose or run badly" (Grout & Perrin, 2004, p. 103). Olympic swimmer Janet Evans said, "I continue to visualise all my races days and weeks before they happen… I have never been to a competition, including the Olympic Games, where I didn't see myself win in my mental images before I got there. It is just part of the whole training package (cited from Ungerleider, 2005, p. 165). Ding, Yin, Lu, Zheng, and Xu (2009) acknowledged that the Chinese gymnastic and weightlifting athletes extensively used imagery combined with psycho-physiological measures in their psychological skill training in preparation for the 2008 Beijing Olympic Games, and attributed the success of these athletes in winning the top position in both competitions to an imagery-based mental training programme. In addition, 18-time Olympic gold medallist swimmer Michael Phelps said, "Before the Olympic trials, I was doing a lot of visualization (imagery). And I think it helped me to get a feel of what it was gonna be like when I got there" (Phelps & Ledwell, 2011).

Imagery has been acclaimed as a "central pillar of applied sport psychology" (Perry & Morris, 1995, p. 339). It has been considered an integral part of athletic success in sports (Cumming, Hall, & Shambrook, 2004). Researchers have found that imagery is the most widely used psychological skill training (PST) technique in sport settings, used for many years in the enhancement of sporting performance (e.g., DeFrancesco & Burke, 1997; Gould, Tammen, Murphy, & May, 1989; Hall, 2001; Orlick & Partington, 1988). Most sport coaches who are looking back on their career, agreed that they used imagery training more than any other mental training technique in sport psychology, and felt that it was the most useful technique that they used with their athletes (Bloom et al.,1997; Hall & Rodgers, 1989). In addition, successful, professional, high performance athletes who used imagery rigorously and systematically, achieved superior outcomes compared to less successful athletes, who did not use imagery systematically (Calmels, D'Arripe-Longueville, Fournier, & Soulard, 2003; Cumming & Hall, 2002; Salmon, Hall, & Haslam, 1994). Athletes can employ imagery techniques for many purposes including: learning and practice of skills; pre-performance routines and game planning strategies; previews and reviews; mental warm-ups and development of psychological skills; problem solving and stress management; increasing concentration and confidence levels; and recovering from injury and rehabilitation (Evans, Hare, & Mullen, 2006; Morris et al., 2005; Short, Ross-Stewart, & Monsma, 2006; Strachan & Munroe-Chandler, 2006). Hall (2001) suggested that greater use of imagery by elite performers reflected a greater commitment to their sport. In addition, Olson, Short, and Short (2007) confirmed that coaches acknowledge the potential of the performance-enhancing benefits of imagery used by their athletes. Moreover, Munroe-Chandler & Morris (2011) summarise in the following way: "imagery remains a leading tool for enhancing sporting performance, solving problems, reviewing skills, building confidence, coping with stress, focusing attention, easing pain, and facilitating recovery from injury or heavy exercise" (p. 294). A review by Cumming and Williams (2012) showed that imagery is not just of interest in the field of sport psychology, but it also gains interest from cognitive psychology, neuropsychology, neurophysiology, neurorehabilitation, motor learning, motor control, and physiotherapy (Lotze & Halsband, 2006; Munzert, Lorey, & Zentgraf, 2009). Recently, MacIntyre, Moran, Collet, and Guillot (2013) suggested a new paradigm using the "strength-based" approach. They proposed that interaction between cognition and action (motor cognition), the integration of multi-sensory information in perception of stimulation, and the role of conscious thought and knowledge in imagery (metacognition) futher enhance the efficacy of mental imagery especially in visual imagery and visual cognition.

DeFrancesco and Burke (1997) found that imagery techniques were the most commonly used strategies by both female and male professional tennis players. Vealey and Greenleaf (1998) suggested that elite athletes possess a clearer and more accurate image of what a specific skill should look like, as opposed to novices who are just beginning to form a mental representation of the skill inside their minds. In different ways all these studies indicate that imagery is important for athletes in their preparation for performance. Woolfolk, Parrish, and Murphy (1985) found that golfers who imagine negative conditions performed golf-putting tasks significantly worse than golfers who envisage positive conditions. In addition, research done by Taylor and Shaw (2002) showed that “positive” imagery improved performance and “negative” imagery substantially impaired performance. According to Short et al. (2002), negative imagery is synonymous with negative outcomes or debilitative cognition, whereas positive imagery is equated to positive outcomes, which have positive effect on learning and performce, and positive cognitions such as increased self-efficacy to regulate arousal and anxiety. As positive imagery training is most prevalent in elite athletes (Hall, 2001; Martin et al., 1999), it becomes more important as the competition increases in level, from national to major international competitions, such as World Championships or Olympic Games.

As imagination is immensely powerful (Morris et al., 2005), athletes can use this technique to prepare themselves to achieve their optimal performance, mentally rehearsing routines related to their respective sports before a competition. For example, a tennis player who is about to compete in a major event might be able to generate a vivid image of the venue, picture the colour of the walls and the playing surface, see the spectators filling the stands, and hear their applause as she moves around on the centre court. She can feel the sensation in her muscles as she serves, powerfully and precisely, 200 km/h shots to her opponent. She can see her opponent stretching, struggling to return the powerful shots, and hear the opponent's gasps of frustration when their desperate efforts result in yet another missed shot.

Although imagery is a highly complex process that needs to be well understood in order to optimise its benefits (e.g., Hall 2001; Morris et al., 2004), a paucity of research has been conducted in the context of elite sport performance (Morris et al., 2005). There has been investigation into the objectives of using imagery (Hall, 2001), the types of imagery athletes use such as internal or external imagery perspectives (e.g., Hall, Buckolz, & Fishburne, 1992; Morris et al., 2005), the psychophysiological factors associated with imagery use (Collins & Hale, 1997), the measurement of imagery ability (Hall, Mack, Paivio, & Hausenblas, 1998; Watt & Morris, 2000), the PETTLEP model of motor imagery (Wakefield, Smith, Moran & Holmes, 2013), and sport performance enhancement imagery (e.g., Short et al., 2006; Strachan & Munroe-Chandler, 2006). These studies reveal that fully understanding the use of imagery for sport performance enhancement purposes continues to be somewhat of a challenge for researchers in sport psychology. This gap between research and practice creates the opportunity for more research work to address a fuller understanding of reapping the optimum benefits from imagery training, especially for professional competitive athletes.

Definitions of Imagery

There are multiple definitions to define imagery, with an earlier constructive, operational definition from the imagery assessment perspective described by Anderson (1981) as follows:

> Imaginary experiences - refer to an awareness of sensory-like qualities in the absence of environmental stimuli appropriate to the sensation. This will usually involve awareness of visual qualities, but not always. Along with the minimum requirement of sensory awareness, imaginary experiences may also include thought segments of part of, or that occur in the context of, the imaginable sensory awareness (p. 151).

Richardson (1983) analysed a large collection of existing definitions, and concluded that imagery is,

> Either a class of inferred cognitive constructs or processes, or a class of more or less precept-like experiences... it includes all quasi-sensory and quasi-perceptual experiences of which we are self-consciously aware and which exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts (p. 36).

In adapting the concept of visualization from clinical psychology, Suinn (1976; 1993, 1997) used a kind of imagery known as visuomotor behavior rehearsal (VMBR):

> The imagery of visuomotor behavior rehearsal apparently is more than sheer imagination. It is a well-controlled copy of experience, a sort of body-thinking similar to the powerful illusion of certain dreams at night. (Suinn, 1976, p. 9).

Suinn also stated that:

> Imagery is a covert activity, whereby a person experiences sensory-motor sensations that reintegrate reality experiences, and which include neuromuscular, physiological, and emotional involvement (Suinn, 1994, p. 41).

Suinn's definition reflects an important finding that imagery is a multimodal experience that can be generated by visuomotor behavior rehearsal, related to mental experiences (1997). Another important element of Suinn's VMBR work is his proposition that the process of imagery is holistic and multisensory, involving the reintegration of experiences derived from visual, auditory, tactile, kinesthetic, and emotional cues (1997). Thus, VMBR has proved to be an adequately detailed and systematically analysed popular technique in applied sport psychology practice.

Based on the VMBR multisensory approach to imagery, Vealey (2001) further defined imagery as "using all the senses to re-create or create an experience in the mind" (p. 248). Following this, Morris et al. (2005) developed an understanding of imagery as seeing an image, feeling movements as an image, and experiencing an image of smells, tastes or sounds, without actually experiencing the real thing. Morris et al. (2005) were able to include most existing elements into their operational framework for sport imagery as follows:

> Imagery, in the context of sport, may be considered as the creation or re-creation of an experience generated from memorial information, involving quasi-sensorial, quasi-perceptual and quasi-affective characteristics, that is under the volitional control of the imager, and which may occur in the absence of the real stimulus antecedents normally associated with the actual experience (p. 19).

Although there are some reported definitions that indicate the cognitive activity that occurs during behaviour, few researchers have used a psycho-physiological perspective to define fundamental imagery processes. Morris et al. (2005) discussed these problems of trying to define the imagery process in a sports context and suggested that there is a lack of consistency in the features that constitute the process, and the focus of each definition seems to vary depending on the purpose for which the imagery description is used (Morris et al., 2005). Therefore, to reflect the psycho-physiological focus of the present thesis and the strong underlying assumption that imagery shares at least some anatomical substrate with physical execution, this thesis adopts a modified version of the working definition of Morris et al. (2005) as follows:

Imagery, in the context of sport, may be considered as the generation or regeneration of psychological activity involving psycho-physiological, cognitive, and somatic reaction to sensorial, perceptual and affective characteristics that *are primarily under the conscious control of the imager, and which may occur in the absence of perceptual and afferent activity to the actual sporting experience.*

Different Terminologies used Relating to Imagery

A range of terms have been used in relation to imagery in the context of sport psychology literature and research. These terms include imaginary practice, implicit practice, mental practice, mental training, mental rehearsal, covert rehearsal, imagery rehearsal, imagery practice, symbolical rehearsal, psychomotor rehearsal, cognitive rehearsal, cognitive practice, behavioural rehearsal, visual motor behaviour rehearsal (VMBR), visualisation, and sensory re-enactment (Murphy & Jowdy, 1992; Morris et al., 2005; Munroe-Chandler & Morris, 2011; Moran et al., in press). Early sport scientists referred to this skill as visualization because athletes could see themselves performing in their mind's eye. However, the term "visualization" can be too limiting as it places too much emphasis on the visual component. The utilisation of imagery involves a process in which a person recalls, restructures, and creates vivid pieces of information from past experiences in all sensory modalities to reconstruct into meaningful, powerful images designed to elicit particular responses. Grouios (1992) proposed that mental rehearsal normally involves practising imagery within a psychological training program, similar to a physical practice-training program. Grouios simplified it as "a repeated practice of an act or a sequence of events in the mind, without observable movement" (p. 2). Conversely, Decety and Ingvar (1990) used a method called "motor imagery". Suinn (1994) with added visuo-sensory-motor experiences, which he called "visuo-motor behavioural rehearsal" (VMBR) (Suinn, 1972; 1976; 1983; 1994; 1997). VMBR refers to a specific imagery technique whereby the imagery process is preceded by a relaxation exercise. Building on this idea, White and Hardy (1998) proposed that imagery is usually “a process”, whilst mental rehearsal is regarded as “a specific form of training”. According to Munroe-Chandler and Morris (2011) “visualization” has been used by most coaches and athletes. Karageorghis and Terry (2011) in their new book also use the term “visualization”, suggesting that visualization is the process by which athletes “recreate experiences in their minds using information stored in memory, creating pictures in the mind, seeing with your mind’s eye, or create or recreate sporting experiences” (p.170).

Although many terminologies have been used in relation to imagery, in this thesis the term “imagery” has been selected as the accurate, direct, and appropriate term. “Mental practice” has not been considered appropriate because it could include other elements, such as observable movement, verbal, and non-imaginal thinking. Other terms, including “visualisation”, which over-emphasises the aspect of visual imagery, are also less appropriate. As VMBR is used in particular types of imagery training not applicable to this thesis, this term has also been considered as inappropriate.

Theories and Models in Imagery

Major Theories in Imagery

More than twenty imagery theories have been developed in the literature of psychology, and most of them have been used in the area of sport psychology (see Moran et al., 2012; Morris et al., 2005). Here, I will only discuss the theories that are more closely related to this thesis.

Psychoneuromuscular theory. Jacobson (1930) proposed that imagery improves the neuromuscular activity within the body to facilitate a person's learning skills. When performing mental imagery, the brain sends subliminal electrical signals to the muscles, similar to the signals given when a physical movement is performed. Jacobson proposed that imagery rehearsal duplicates the actual motor pattern being rehearsed (Vealey & Walter, 1993). Therefore, whenever athletes actually perform a movement or vividly imagine performance of the same movement, similar neural pathways to the muscles are activated. This theory suggests that the neural pathways generated in imagery rehearsal are identical to those activated when physically performing the particular movement (Suinn, 1993). In this way the correct neural pathway to the muscles for performance of the task becomes more familiar, thus, aiding actual performance of the task. This has been referred to as "the theory of muscle memory" or "the neuromuscular feedback theory" (Harris & Robinson, 1986; Vealey & Walter, 1993).

To demonstrate the psychoneuromuscular theory, evidence of task-specific muscle activation is needed. Evidence in support of the psychoneuromuscular hypothesis includes earlier studies of electrical activation in muscles during the utilisation of imagery that pertains to a task that involves those muscles (Jacobson, 1930; Schmidt, 1988). Jacobson conducted several studies with various imagined and actual activities, such as bending the arm, sweeping, and performing a biceps curl. He concluded that there was muscle activity that was specifically related to the muscle movement, which occurred during the exercise of the imagination. However, a much lower rate of muscle activity was observed during the application of imagery than was the case during actual movement. Researchers in a number of studies have also reported that muscle responses are located to the specific muscles involved in the activity being imagined (e.g., Bird, 1984; Hale, 1982; Harris & Robinson, 1986; Wehner, Vogt, & Stadler, 1984); whereas some other studies have not found evidence of this (e.g. Shaw, 1938). Vealey and Walter (1993) suggested that the evidence for muscle activity during actual and imaginary practice being located to the specific muscles involved in the activity being imagined, is inconclusive. This muscle activity could just be a general increase in readiness for performance, or a by-product of central processes. Even when the activity was present to provide strong evidence for the psychoneuromuscular theory, researchers still needed to go a step further to demonstrate that it was the cause of the performance improvements.

Vealey and Walter (1993) concluded that the psychoneuromuscular theory was supported by the finding that imagery elicited muscle innervation, whereas the occurrence of low-level muscle innervations was not shown to relate to performance improvement. However, Perry and Morris (1995) questioned most research on this topic on the grounds that the low-level muscle innervations had been measured on physical actions with no performance element and it was not possible to link these interventions to performance enhancement. Even if the innervations and performance enhancement were to be shown contiguously (i.e., together), Perry and Morris argued that it could be that muscle innervations are a byproduct of imagery for performance enhancement, which occurs through another process. Therefore, the vexed question that needs to be addressed is whether or not this research can be replicated when studying skilled performance in such a way that results demonstrate that low level muscle innervations can facilitate performance. In addition, the psychoneuromuscular theory also could not encompass all five types of imagery, as suggested by Hall (2001). At this stage, it is still difficult to demonstrate the applicability of this theory in applied setting based on the limitations suggested.

Bioinformational theory. Lang (1979, 1985) proposed that all knowledge can be represented in memory as units of information about objects, relationships, and events, known as “propositions”. Lang suggested that there are three fundamental categories represented in a person’s memory including “stimulus propositions”, “response propositions”, and “meaning propositions”. Stimulus propositions relate to the external environment, and response propositions (including motor activity and autonomic changes) are the responses of the individual to stimuli in a scene. Meaning propositions are based on interpretative or analytical decisions, adding components of information not available from the stimuli in the situation. These propositions are used to define the significance of events and the consequences of action. According to Lang (1985), the activation of response information in memory leads to the production of physiological responses represented in memory related to planning of an event, through efferent activities being transmitted to task-relevant muscles and organs. Then, meaning propositions must be processed to fully access the memory of an action, explaining that enhanced performance is obtained by the accessing and subsequent strengthening of memory representations.

Examining Lang's (1979, 1985) hypothesis that imagery scripts (including both stimulus and response propositions) are more effective in producing behavioural change than those including only stimulus propositions, Smith, Holmes, Whitemore, Collins, and Devonport (2001) found that imagery scripts (including both types of proposition) produced greater improvements in hockey penalty flick performance than stimulus proposition-only scripts. Smith and Collins (2004) examined movement-related brain activity (the late contingent negative variation, or CNV) prior to the imagery of a finger strength task and a computer game. Identical late CNV waves occurred prior to imagery and actual performance of the finger task, in both a stimulus proposition-only condition and a stimulus and response proposition condition. This stimulus and response proposition condition led to greater improvements in performance than the stimulus proposition-only condition.

In optimizing imagery interventions, the importance of response propositions appears to be well established. Lang (1985) proposed that there is a greater conceptual match between memory and the imagined scene, and greater efferent activity, if the image is relevant to the individual. Therefore, as the response and meaning information coded in memory for a specific event vary between individuals, response propositions need to be personalised to produce optimally effective imagery (Cuthbert, Vrana, & Bradley, 1991).

Attention-arousal set theory. According to this theory (Schmidt, 1982), imagery functions as a preparatory set that assists performers in achieving an optimal arousal level. This optimal level of arousal allows athletes to achieve peak performance. Optimal arousal helps to enhance performance by focusing attention onto task-relevant cues and screening out task-irrelevant or distracting cues. Researchers (Hale, 1982; Harris & Robinson, 1986) have found low-level muscle innervations associated with imagery. Schmidt (1982) proposed that it could be that these innervations are indications of the performer “preparing for the action, setting the arousal level and generally getting prepared for good performance” (p. 520). Feltz and Landers (1983) suggested that this minimal tension helps prime the muscles and lower the sensory threshold to assist in producing focused attention. Wilkes and Summers (1984) found a post-hoc relationship between self-reports of attentional focus and strength performance following imagery, providing indirect support for an attention-arousal set theory. In opposition to these findings, Lee (1990) found that task-relevant imagery produced greater improvement on an endurance task than irrelevant imagery, but that imagery effects were not a result of affective mood states. The evidence does not provide adequate support for an attention-arousal explanation of imagery effects. In addition, this sort of explanation does not adequately explain the facilitative effects found for imagery training programs that do not use imagery just as a pre-performance readiness tool, but as a part of daily training programs (Blair, Hall, & Leyshon, 1993; Shambrook & Bull, 1996).

The arousal theory suggests that imagery helps athletes to set the optimal arousal level for performance and to focus attention on the relevant aspects of the task. More specifically, it is proposed that imagery establishes a level of arousal or physiological activation that is optimal for the performance in question (Suinn, 1993). Schmidt (1982) observed that the "performer is merely preparing for the action, setting the arousal level and generally getting prepared for good performance" (p. 520). Vealey and Walter (1993) referred to this as a "mental set" perspective. After studying the moods of a task-relevant group that imaged performing well at the task and another group that remembered positive mood state experiences, Lee (1990) reported that the relevant image group produced significantly superior performance compared to the general positive mood group. Another study conducted by Lee (1990) using 142 male participants, concluded that the content of the imagery is important, but that the imagery effect does not occur by affecting mood state. Feltz and Riessinger (1990) compared the influence of "in vivo emotive imagery" plus feedback versus feedback alone on muscle endurance and self-efficacy. The emotive imagery involved generating “images that were assumed to elicit feelings of competence and being psyched-up... [and] holding out longer than the opponent and being successful” (p. 135). They concluded that in vivo emotive imagery is effective in increasing one's sense of perceived efficacy to endure muscular isometric performance, and to a lesser extent actual performance (Feltz & Riessinger, 1990). The weakness of the arousal/activation theory is that it does not specifically explain how imagery optimises arousal and attention, nor has the theory been validated by research. Nevertheless, from an applied perspective this theory has great practical appeal because performers can readily apply the theory to their imagery training. Performers can also associate with the idea that by using productive imagery prior to competing performance can be facilitated.

Major Models in Imagery

Over the past decade, many imagery models have been developed specifically for applying imagery to sports performance. These models are an essential component to strengthening the understanding of the applicability of research in sport settings. Among the models are the “Applied Model of Imagery Use in Sports” (AMIUS; Martin, Moritz, & Hall, 1999; Hall, 1998, 2001), “PETTLEP Model” (Holmes & Collins, 2001), “Three-level Model of Sport Imagery” (Murphy & Martin, 2002), “Sport Imagery Ability Model” (Watt, Morris, & Andersen, 2004), “The Tripartite Working Model” (Fournier, Deremaux, & Bernier, 2008), “The Neurocognitive Model of Imagery in Sport, Exercise and Dance” (Murphy, Nordin, & Cumming, 2008), “The Motor Imagery Integrative Model in Sport” (MIIMS; Guillot & Collet, 2008), and “Functional Equivalent Multi-Modality Account” (FEMMAC; MacIntyre & Moran, 2010). Although some of these models have not yet undergone rigorous empirical analyses, they have received support and are popular among sport psychologists and applied sport psychology practitioners. These models are discussed here.

Applied Model of Imagery Use in Sport (AMIUS) – AMIUS was initially influenced by Paivio’s functional analysis of imagery framework in relation to a behaviour meditation (Paivio, 1985), using a 2 x 2 imagery model which combines the dimensions of cognitive and motivational processing relationships, and the dimensions of general and specific behavioural goal achievements. Each dimension in the meditation was based on its image content and later developed by Hall et al. (1998) into five distinct classes of imagery usage. These include motivational general-mastery (MG-M; imagery of being self-confident, mentally tough, focused and positive), motivational general-arousal (MG-A; imagery of stress, anxiety and arousal), motivational specific (MS; imagery of goal achievement), cognitive general (CG; imagery of strategies, routines and game plans) and cognitive specific (CS; imagery of skills). Each of these types was represented by a subscale on the Sport Imagery Questionnaire (SIQ, Hall et al., 1998), which will be discussed in the SIQ subsection of the measurement of imagery use in sport.

Martin et al. (1999) then adapted AMIUS for the use of research and interventions using SIQ. They suggested that applied research practitioners should follow the type of imagery suited to achieving the most effective result. Although this model received some empirical support (see Watt, Spittle, Jaakkola, & Morris, 2008). Martin et al. (1999) found some limitations and encouraged researchers to continue with further testing. Subsequently, Nordin and Cumming (2008) identified a neglect of individual differences in this model, and Short et al. (2002) highlighted problems due to confounding imagery contents that disagreed with intended functions when designing imagery scripts (see Short et al., 2002, p. 64). Consequently, some research lacked clarity on intervention types, and attempts to replicate and validate results using the five types of imagery were unsuccessful.

PETTLEP Model of Imagery. Holmes and Collins (2001) proposed a different theoretical based approach using an evidence-based model that includes a checklist for the optimal implementation of imagery interventions. This model, which derived from sport psychology, cognitive psychology and neuroscience in order to provide practitioners with a set of practical guidelines to aid imagery use, contains seven elements: physical, environment, task, timing, learning, emotion and perspective.

In the seven elements of this model, "physical" is related to the nature of imagery reflecting the actual performance. For example, a soccer player performing imagery training should assume a characteristic posture, dress in a soccer jersey, and imagine the physical responses that occur in actual performance. "Environment" refers to the physical environment that the imagery is performed in as being similar to the actual performance environment. For example, imagery of a penalty kick in soccer should ideally be performed using a soccer goal or soccer pitch. "Task" includes the requirement that the nature of the imagery task should correspond as closely as possible to the actual task. "Timing" relates to the importance of the timing of the task during imagery mimicking actual performance durations, for example, real time performance. "Learning" relates to the use of imagery in the acquisition of new motor skills and for the correction of the technical aspects of the movement. "Emotion" refers to imagery that incorporates all the emotions and the level or pattern of arousal typically experienced during actual performance. Finally, "perspective" provides guidance from a visual perspective that most closely reflects the view adopted by athletes when actually performing the task. Wakefield et al. (2013) reviewed 15 years of research using the PETTLEP model of motor imagery. They reported that "functional equivalence" between imagery, perception and motor execution were missing in this model. Therefore, Wakefield suggested that applied sport psychologists should identify functional equivalence of the imagery performance environments and behavioural function to further enhance sport performance of athletes.

Holmes and Collins (2001) suggested the importance of timing or temporal characteristics. Arguing that the speeds at which actions are performed should be the same when mentally imaging the action as when actually performing it (Calmels, Holmes, Lopez & Naman, 2006; Guillot & Collet, 2005; Louis, Guillot, Maton, Doyon, & Collet, 2008). Nideffer (1985) also had suggested that images should always unfold in real time because athletes tend to rush through actual performances during competition (due to increased anxiety levels), emphasizing the importance of real-time images allows athletes to imagine themselves performing perfectly at appropriate execution speeds. Nideffer (1985) also suggested that real-time images could reduce athletes' anxiety levels, which then increases the probability of an enhanced performance.

Morris et al. (2005) argued that the "real time-only" imaging guideline should be interpreted with some degree of caution, as most research has failed to unequivocally demonstrate that real-time speed is indeed the most effective speed at which to image. Thus, it would be illogical to assume that image speed use can function unaffected by other variables such as environmental factors or athletes' arousal levels. O and Munroe-Chandler (2008) found empirical support for their contention such that all timing groups in the study performed equally well in a soccer-dribbling task. Recent research on the timing of motor imagery (see review Guillot, Hoyek, Louis, & Collet, 2012) has shown that "timing" was adversely affected when people performed motor imagery in a relaxed condition (see Louis, Collet, & Guillot, 2011). In addition, Holmes and Collins (2001) pointed out, the idea of performing imagery in a relaxed state seems contradictory to what we know about the relatively high arousal states displayed by most athletes performing in competitive settings.

PETTLEP has also received support from neuroscience literature (Ganis, Thompson, & Kosslyn, 2004; Szameitat, Shen, & Sterr, 2007) because of its strong conceptual validity that is well documented in sport psychology literature (Callow, Robert, & Fawkes, 2006; Smith, Wright, Allsopp, & Westhead, 2007). A number of studies highlighting the PETTLEP imagery model have provided evidence to suggest that increasing the functional equivalence of imagery with actual performance is an effective way to enhance motor performance. In particular, empirical evidence demonstrates that manipulating the physical and environmental (Smith & Collins, 2004; Smith et al., 2001; Smith et al., 2007) elements of the PETTLEP model, as well as combining all seven elements (Smith et al., 2007), can be beneficial to performance. This initial research testing of the PETTLEP model is promising, but as suggested by Holmes and Collins (2001), further testing in a range of settings is required. Furthermore, it would also be useful to test each element in isolation as well as examine the additive and interactive effects of the different elements. For example, there is no specific evidence thus far to support the inclusion of the “Emotion” element in the model. Wakedield et al. (2012) found that it was loosely based upon evidence from cognitive and practice based research.

Three-Level Model of Sport Imagery (Murphy & Martin, 2002). This model describes three levels of sport imagery, (1) nature of imagery, (2) use of imagery to achieve goals or performance goals, and (3) meaning of the image to the athlete. Level 1 refers to an overview of the physiological and cognitive processes associated with imagery. Level 2 refers to both general use of imagery by athletes and how incorporating imagery within mental preparation affects the performance goals. Level 3 refers to the imagery construct in relation to sport imagery, and discusses the importance of interlinking between levels 1 and 2, which are associated with the physiological, cognitive, and usage perspectives of imagery. Overall, the model represents a tool for uniting the massive range of theoretical and empirical information on imagery into a framework that, through its simplicity, can also be used in analysing the complex construct of imagery (Morris et al., 2005).

Sport Imagery Ability Model (Watt, Morris, & Andersen, 2004). The framework of this model constitutes a three-tier framework comprised of general imagery-ability factors leading to “image generation”, “feeling” and “sense”. First, the image generation factor includes components of vividness, control, duration, speed, ease, and visual sensorial modalities. Second, the feeling factor includes the components of kinaesthetic, tactile and emotion feeling modalities, associated with body-feeling states. The third factor, individual sense, includes auditory, taste and smell components to examine the dimensional, emotional and sensorial characteristics of generating mental images of sporting situations. From this model, a Sport Imagery Ability Measure (SIAM; Watt & Morris, 1998, 1999, 2001) was created to measure all three-tiers in the model.

According to Watt et al. (2004), confirmatory factor analysis is then performed to test variations in the SIAM structure, paying particular attention to the positioning of the visual modalities and emotional experience. Watt et al. concluded that more ongoing testing on the theoretical measurement of imagery would provide confirmation of the accuracy of representations in imagery constructs.

The Tripartite Working Model (Fournier et al., 2008). This model was suggested based on the content of mental imagery including focus of attention (what is seen in the image) and perspective (internal vs. external), both of which emphasise the function, characteristics and situation of the image experienced by the athlete. The authors used two qualitative studies to guide them in developing a model that contained three elements (content, characteristics and function) which is in accordance to the demands of the situation. They suggested that other characteristics that emerged from the imagery use of the studies were speed, vividness and colour. Thus, they maintained that these characteristics would eventually correspond to the reasons why mental images are imagined. For example, one normally uses mental images in learning for motivational purposes. Here, the imagery functions are linked to the roles attributed to mental images, and to the goals through the use of mental images. Fournier et al. (2008)'s model has assisted in better understanding the concept of imagery, even though the relative importance of its three factors needs further clarification.

Neurocognitive Model of Imagery in Sport, Exercise, and Dance (Murphy et al., 2008). This model comprises three major components in accordance to the neurocognitive approach and establishes the link between cognitive processes, paying attention to the imagery outcome or the behavioural, affective and cognitive effects of imagery. In addition, it moves beyond application to explore cognitive processes, function, outcomes, and interaction with self-talk. Murphy et al. (2008) included spontaneous imagery into the model and pointed out that the situation of the imagery will influence the imagery use. The content and the characteristic of the mental images generated will then co-respond to the needs or the functions in specific situations (easy or difficult sequences or different steps of the preparation for an activity). Nordin and Cumming (2005) observed the differences in imagery content according to time (times of day, practice, performance, certain periods of the year) and stated that it is necessary to consider and define the notion of "situation" of the imagery. In fact, many elements (e.g., time, context, specificity of the task) that can be classified as situational, will ultimately influence the use of imagery. Hence, Nordin and Cumming concluded that the situational is "a combination of all the things that are happening and all the conditions that exist at a particular time in a particular place". However, although this model successfully described and accounted for the findings in some research, it has yet to provide a testable hypothesis model in applied settings.

The Motor Imagery Integrative Model of Imagery in Sport (MIIMS; Guillot & Collet, 2008). MIIMS explores the role for imagery specifically for rehabilitation, which includes the role of environmental factors, individual differences and also the level of expertise of the athlete. According to the authors, athletes often experience MI, but they may perform mental rehearsal to achieve several distinct goals. Thus, by investigating this model using some research and the empirical applications suggested by the coaches, four imagery outcomes are suggested in this model: (i) motor learning and performance, (ii) motivation, self-confidence and anxiety, (iii) strategies and problem-solving, and (iv) injury rehabilitation. MIIMS suggests that to achieve these goals, many types of MI might be performed concurrently including the internal or external visual imagery perspective, as well as kinaesthetic, tactile, auditory or olfactory. The ultimate goal of these combinations of different imagery types forms a multimodal, which completes the mental representation of all movement (although it only focuses on a specific type of imagery). Although MIIMS seems to be a highly comprehensive model, some of the components of MI are expected to interact between each element and thus more research is encouraged.

Functional Equivalent Multi-Modality Account (FEMMAC; MacIntyre & Moran, 2010). This model was proposed based on investigations of Motor Imagery (MI) use and meta-imagery processes among elite athletes. The authors then revised their imagery use framework, adding a question on how imagery should be performed in an ecological context, based on qualitative and productive studies conducted among elite athletes. The general dimension of the hierarchical structure in this meta-imagery includes the definitions, outcomes and importance of MI for elite athletes. In addition, the structure of imagery use includes the functions of MI to review the use of both positive and negative mental images.

This model further provides support on issues surrounding classifications of the cognitive and motivational functions of MI. McIntyre and Moran’s (2007) approach is clearly interesting in giving instructions for MI application within the sporting domain because it highlights athletes’ understandings of the nature of imagery, strategies when coping with negative images, and the role of the coach in facilitating the use of MI. However, even though there is the possibility of using MI in injury recovery, the authors suggested that further testing is needed to give stronger theoretical support for outcomes of the imagery.

According to Munroe-Chandler and Morris (2011) imagery is such a rich field of study that models generated have each tended to look at one or a few facets. Thus, although each model successfully provided some or more information on the use of imagery in sport settings, the current models still demonstrate some limitations, which need to be addressed. Moreover, the models are too general to be of great value at this stage. Thus, more research into a strong comprehensive holistic model is still warranted.

Measurement of Imagery Abilities

Researchers have shown that imagery use is most effective for those individuals who are more effective imagers and those who are higher in imagery abilities (Martin et al., 1999; Murphy, 1994). Given that imagery abilities significantly impact athletes' use of imagery, it is important to consider athletes' imagery abilities when conducting sport imagery research. To do so, valid and reliable instruments are important for assessing imagery abilities. The current and major instruments measuring imagery ability in a sport or movement context are presented.

Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks, & Russell, 1986). VMIQ consists of 24 items that measure the vividness of visual imagery of movement and the imagery of kinesthetic sensations, which is associated with movement. Items examine participants' abilities to image-specified basic body movements and movements requiring precision and control in upright, unbalanced, and aerial situations. The VMIQ requires individuals to rate the vividness of their imagery on a 5-point rating scale, which ranges from 1 (*perfectly clear and as vivid as normal vision*) to 5 (*no image at all; you only know that you are thinking of the movement*), rating the 24 items on vividness of imagery of the movements or actions for both an external perspective (watching somebody else) and an internal perspective (doing it yourself). The VMIQ assesses strictly vividness of visual and kinesthetic movement imagery abilities (Campos & Perez, 1990). VMIQ possesses adequate psychometric properties (Atienza, Balaguer, & Garcia-Merita, 1994). Scores on the VMIQ have been linked to improvements in motor skills (Isaac, 1992). It is a relatively easy questionnaire to administer to a large group of participants. However, a problem with the VMIQ is that the instruction to imagine as if watching somebody else is not what is generally agreed to reflect external perspective imagery. Following the original description by Mahoney and Avener (1977), external perspective imagery refers to imagery of oneself from an external perspective, for example watching oneself kick a goal from a seat in the stand.

Movement Imagery Questionnaire (MIQ; Hall, Pongrac & Buckolz, 1985). The MIQ was designed to assess kinesthetic and visual movement imagery abilities. MIQ completes over 4 phases, and consists of 18 items. The items include 9 items on the visual subscale and 9 items on the kinaesthetic subscale. For each item there is a 7-point Likert rating scale, from a 1 (*very easy to picture or feel*) to 7 (*very difficult to picture or feel*). During the 4 phases, the participants are asked to physically complete the movement sequence and then resume the starting position and recreate the experience using the visual imagery, which is then followed by using kinaesthetic imagery. The reliability of the MIQ is acceptable, with a test-retest coefficient of .83 for a 1-week interval and internal consistency coefficients of .87 for visual subscale and .91 for kinaesthetic subscale (Atienza et al., 1994; Hall et al., 1992). However, in the MIQ, a lower score represents greater imagery ability, which was criticised because it seems counterintuitive.

Movement Imagery Questionnaire Revised (MIQ-R; Hall and Martin, 1997). Hall and Martin (1997) modified the MIQ to create a more compact revised version, known as the MIQ-R. MIQ-R consists of only an 8-item questionnaire constructed to assess 4 items on the visual subscales and 4 items on the kinaesthetic subscales respectively. The response to each item uses the same four steps used in the original MIQ. Hall and Martin reversed the scoring so a rating of 1 (*very hard to see or feel*) reflects weak imagery ability and 7 (*very easy to see or feel*) indicates strong imagery ability. Thus the major modifications of the MIQ included reducing the number of items from 9 to 4 for each subscale, reversing the rating values, so that higher scores are related to higher imagery abilities, and then rewording certain items to improve the clarity of the questionnaire, with the goal to reduce administration time and eliminate those items that some participants would refuse to physically perform (Hall, 1998). Interpretation of the MIQ-R is that higher scores are indicative of strong imagery abilities. A concern with both the MIQ and the MIQ-R for research in elite sport, as well as applied work, is the content, which relates to very simple body movements. Therefore its ecological validity is questionable for those purposes. Munroe-Chandler and Morris (2011) commented on the limitations of the MIQ and MIQ-R questionnaires, stating that both MIQs only measure two sense modalities whereas imagery comprises multisensory modalities.

Vividness of Movement Imagery Questionnaire – 2 (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008). Roberts et al. (2008) later modified by the VMIQ to assess the vividness of both visual and kinesthetic imagery, known as VMIQ-2. The VMIQ-2 consisted of 12 items, asking the respondents to imagine a variety of motor tasks and then rate the image from external visual imagery perceptions, internal visual imagery perceptions, and kinesthetic imagery perception. The 12 items are measured on a 5-point scale ranging from 1 (*perfectly clear and as vivid as normal vision*) to 5 (*no image at all; you only know that you are thinking of the skill*). Although VMIQ-2 provides stronger validity as well as adequate factorial, concurrent, and constructs validity, VMIQ-2 only measures the visual and kinesthetic sense modalities, and not multisensory modalities.

Researchers have indicated that all these measurements are useful measures of movement imagery ability (e.g., Goss, Hall, Buckolz, & Fishburne, 1986; Hall & Martin, 1997). The VMIQ, MIQ, MIQ-R, and VMIQ-2 provide a very general picture of how good an individual is at imaging specific movements, or how good they are at using cognitive specific imagery. However, these instruments are limited in their usefulness for measuring the imagery abilities, which are multisensory modalities. These instruments assess imagery ability of movements in general and were not designed specifically to examine images related to sport. Thus, other measures on imagery abilities are encouraged.

Sport Imagery Ability Measure (SIAM; Watt, Morris, & Andersen, 2004). The SIAM is a 48-item questionnaire designed to measure task-oriented, multimodal, and multidimensionality of imagery ability. Participants choose a sport-specific version of each of four generic sport-related scenes and image each scene for 60 seconds. An example of a scene from the SIAM is a slow start in which athletes imagine making a slow start to a game and having to stimulate themselves to play at 100 percent. The four specific sport scenes includes the home venue, a successful performance, a slow start, and a tough training session. After imaging each scene, participants are instructed to respond to 12 items assessing five imagery dimensions (vividness, control, ease of generation, speed of generation, duration), involvement of six senses during imagery (visual, auditory, kinaesthetic, olfactory, gustatory, tactile), and the experience of emotion. Participants are instructed to make their responses on 100mm visual analogue scales. Each 100mm line separates two opposing anchor statements (for example, "no feeling" and "very clear feeling" for the tactile modality). Then, the 12 subscale scores are calculated by adding together the relevant dimension or sensory-item score for each of the four scenes. Finally, summarising the scores across the four scenes produces a subscale score with a range from 0 to 400.

According to Watt and Morris (1999), the SIAM showed good to very good internal consistency with coefficients ranging from .66 (speed subscale) to .87 (gustatory subscale). Test-retest reliability results from 58 participants over a 4-week interval revealed moderate to very good correlations for the specific subscales, varying from .41 for auditory to .76 for gustatory. Watt and Morris

(1998; 1999, 2000, 2001) proposed that the SIAM is a suitable tool for assessing sport imagery abilities in both research and applied settings. It has also been used extensively in Australia (Watt et al., 2004), Finland (Watt, Morris Lintunen, Elfving, & Riches, 2001) and has been translated into different languages such as Hebrew, Swedish and Thai (Munroe-Chandler & Morris, 2011).

Motivational Imagery Ability Measure for Sport (MIAMS; Gregg & Hall, 2006b). The MIAMS is a new measure developed to measure the motivational function of imagery rather than cognitive or movement of the imagery such as MIQ or VMIQ. It consists of four MG-M and four MG-A imagery scenarios. Each scene is rated on a 7-point Likert scale into two distinctive characteristics, namely emotion (1 = *no emotion*, to 7 = *very strong emotion*) and ease (1 = *not at all easy to form*, to 7 = *very easy to form*). Each subscale has demonstrated acceptable internal consistency. Gregg and Hall (2006b) found that athletes participating at a higher competition level scored higher on the MIAMS scoring compared to the athletes participating at a recreational level.

Confirmatory factor analyses determined that the MG-M and MG-A imagery were grouped into two factors, with each factor assessed on two rating scales – emotion and ease. In addition, internal consistencies for the items were constructive (Gregg & Hall, 2006b). However, there are some limitations on this measure. For example, the samples were homogenous in only predominantly university-aged athletes. Besides, the authors also suggested the need for longitudinal research rather than the normal correlational and cross-sectional. Furthermore, Williams and Cumming (2011) said MIAMS is limited to the assessment of motivational general imagery only to the exclusion of MS imagery and both forms of cognitive imagery.

Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). SIAQ is a 20-item questionnaire designed to measure athletes' ease of imaging different types of imagery content, such as sport specific, cognitive and motivational imagery content within the SIQ framework developed by Hall et al. (1998). SIAQ reviews five factor model assessing skill, strategy, goal, affect, and mastery imagery ability. For example, athletes who scored higher in competitive level also found it significantly easier to generate sport images. SIAQ demonstrated good test-retest reliability with good factorial validity, internal and temporal reliability, invariance across gender, and an ability to distinguish among athletes of different competitive levels. As SIAQ is still a new measure, Williams and Cumming (2011) suggested that future research is still needed to continue to validate the SIAQ, such as comparing the SIAQ imagery abilities with other measures of imagery ability, and other characteristics that influence sporting performance.

Measurement of Imagery Use in Sport

Sport Imagery Questionnaire (SIQ; Hall et al., 1998). The SIQ contains 30 items that measure five functions of imagery (i.e., cognitive specific, cognitive general, motivational specific, motivational general-arousal, motivational general-mastery). Thus, this is a measure that assesses both the cognitive and motivational types of imagery. All items are measured on a 7-point scale, and each item is rated from 1 (*rarely*) to 7 (*often*) for how frequently athletes use five functions of imagery. The results of factor analysis have supported the five-factor of the SIQ. The SIQ has acceptable internal consistency coefficients of .70 to .88. According to Morris et al. (2005) SIQ is the preferred instrument used to measure the frequency of imagery in both research and applied use. The multimodal, multidimensional design is sound and the five scenes are well described, but the test lacks any reference to generation and duration of images. In their critique of SIQ, Abma, Fry, Li, and Relyea (2002) pointed out that it does not address the athletes' perceptions of the purpose and goals of each type of imagery. Besides this, Munroe-Chandler and Morris (2011) stated that other categories of imagery may exist, which will not be classifiable into one of the five categories in SIQ, thus constituting a limitation to this measure. Given that previously, researchers have reported that athletes use the motivational functions of imagery more frequently (Beauchamp, Bray, & Albinson, 2002; Hall et al., 1998) than the cognitive functions, it would be appropriate to tailor imagery ability measures to reflect this preference.

Other general measures of mental skills that include imagery.

There are still many other psychological questionnaires that also include information on imagery use other than mental skills. These include the Psychological Performance Inventory (PPI, Loehr, 1986), Test of Performance Strategies (TOPS; Thomas, Murphy, & Hardy, 1999) and Ottwa Mental Skills Assessment Tool (OMSAT; Durand-Bush, Salmela, & Green-Demers, 2001). While these types of questionnaires only provide general information on the use of a number of psychological skills, including imagery, they do not provide any detailed information on the use of imagery or psychometric properties of the imagery.

Although there are many tests available in both research and applied settings, no single measure is yet to be holistically perfectly suited for use in imagery-ability or imagery-use assessment in sport psychology research (Morris et al., 2005). Each measure has contributed on measurement of imagery abilities and its use or functions in a sporting context; however, there are some gaps, which need a range of measures. Thus, there is still a need for more valid and reliable measures in order to further understand the imagery abilities and its usage in sports (Moran et al., 2012).

Imagery and Sport Performance

In the applied sport psychology literature, there is a great deal of evidence that has demonstrated that imagery training improves sporting performance (e.g., Bell & Thompson, 2007; Driskell, Copper, & Moran, 1994; Martin et al., 1999; Morris et al., 2005; Smith et al., 2007). Hinshaw (1991) examined the effectiveness of imagery for performing a motor task compared to no practice from 21 studies, revealing that across the 44 effect sizes there was a moderate effect of imagery on task performance. In a review of over 200 scientific studies on imagery, the majority of investigations indicated that imagery interventions improved sporting performance (Martin et al., 1999). Hall (2001) explained that most research literature generally suggests that imagery use can have a beneficial influence on sport skills performance. Similarly, according to Short, Tenute, and Feltz (2005), there are over 200 studies that have been conducted providing information on how imagery works, what images are used, as well as when, where and why imagery is used in sport. Imagery training and sporting performance enhancement also includes interviews or testimonies of outstanding professional athletes, such as Jack Nicklaus (golf), Greg Lougannis (diving), and Chris Evert (tennis) (Morris et al., 2004). Examples of activities in which imagery have been used successfully to enhance sporting performance include baseball (Kendall, Hrycaiko, Martin, & Kendall, 1990), basketball (Post, Wrisberg, & Mullins, 2010; Rodlo, 2007), golf (Bell & Thompson, 2007; Smith, Wright, & Cantwell, 2008), gymnastic (Post & Wrisberg, 2012), hockey (Smith et al., 2001; 2007), rugby (L. Evans, Jones, & Mullen, 2004), soccer (Jordet, 2005; Monsma, Peters, & Smith, 2003; Pain, Harwood, & Anderson, 2011), swimming (Hanton & Jones, 1999; Post, Muncie, & Simpson, 2012; Wade, Munroe-Chandler, & Hall, 2007), tennis (Malouff, McGee, Halford, & Rooke, 2010) and volleyball (Afrouzeh, Sohrabi, Torbati, Gorgin, & Mallett, 2013). In this section, we can only present a brief summary based upon the main research topic involving imagery and sporting performance.

Suinn (1976) used a cognitive training technique called Visio-Motor Behavior Rehearsal (VMBR) that combines relaxation training with visual and multi-sensory imagery training. He proposed that relaxation is a foundation that facilitates imagery, so it precedes imagery rehearsal in this the VMBR technique. Several studies using VMBR have shown that this technique was effective, suggesting that relaxation is important for imagery (e.g., Lane, 1978; Noel, 1980). On the other hand, Woolfolk et al. (1985) concluded, “while relaxation may interact with imagery, it is not a critical variable in producing imagery effects upon performance” (p. 34). They cited many studies in which imagery was effective even though it was not preceded or accompanied by relaxation. Despite this argument, most researchers and practitioners have claimed that, as a precursor to imagery, relaxation facilitates imagery, arguing that although participants in many imagery studies were not instructed to relax when imaging, relaxation occurred naturally, and relaxation during imagery typically shows significant effects on performance (Perry & Morris, 1995). Perry and Morris (1995) stated that the role of relaxation as a basis for imagery is still empirically under-studied. There remains a need to examine the role of relaxation in imagery under different circumstances, to monitor the level of physiological arousal, and to determine whether increase in arousal level could be associated with stronger imagery.

Mckenzie and Howe (1991) examined the effect of imagery on tackling performance in rugby using 74 male rugby players. The conditions were mental imagery, physical practice, and mental imagery plus physical practice. The results showed that mental imagery plus physical practice significantly improved tackling performance over physical practice or mental imagery alone. Barr and Hall (1992) showed that athletes across all competitive levels use imagery extensively, and athletes with higher competitive levels reported using more imagery compared to the lower competitors. This study also reported that athletes used more visual and kinaesthetic imagery, and the participants used imagery more coincidentally with competition compared to during practice. Savoy and Beitel (1996) also examined the effect of two conditions, a combined physical practice and imagery intervention and physical practice only in foul shooting for 10 highly skilled basketball players, revealing that the combination of physical practice and imagery had positive effectiveness on performance when compared to physical practice only.

In an unrelated study, Hall et al. (1992) showed that athletes with high ability imagers were able to use imagery more effectively to enhance their motor skills performance, however, low imagery ability imagers had little or no effect. Some researchers even pre-screened their participants according to imagery ability scores and excluded the low imagery ability participants from further study (e.g., Short, Monsma, & Short, 2004).

Smith et al. (2001) examined the effects of imagery training for field hockey players on penalty flick performance, based on bioinformational theory (Lang, 1977) and using Lang's imagery perspective in presenting stimulus and response propositions. Twenty-seven novice field hockey players of both genders completed the Movement Imagery Questionnaire (MIQ-R; Hall & Martin, 1997) and they were assigned to one of three conditions: a stimulus imagery condition, a stimulus and response imagery condition, and a control condition. Stimulus imagery included experience of the external environment, such as noise made by the crowd and sight of the goal when taking a penalty flick in the final minute of a close field hockey match. Response imagery involved responses of individuals to the stimuli, such as muscle contractions, dry mouth, and sweaty palms. The results showed that players in the stimulus and response imagery condition significantly improved their performance when compared to those in the stimulus imagery condition and control condition players. Smith et al. concluded that, when conducting intervention studies, the imagery script should include response propositions as well as stimulus propositions to be more effective. The study by Smith et al. also demonstrated that a mixture of internal and external imagery could be more effective for enhancing performance.

Singer and Anshel (2006) referred to one use of imagery as “forming a mental picture of a desirable performance in a forthcoming context, be it in practice or real competition” (p. 82). According to Singer and Anshel, such training is useful for athletes to enhance their performances in sport; it can also serve as a reminder for the athlete of certain skills or strategies to overcome their opponent. In addition, imagery used in this way can help athletes to predict and anticipate their opponents’ actions, to seek answers or solutions to overcome each situation mentally. Most professional athletes use imagery as part of their mental homework away from their physical training environment to rehearse their sporting skills mentally during practice or competition (Nordin & Cumming, 2005). The use of imagery to predict and imagine their own personal actions and strategies may enable them to enrich their actual performance in competition. They may be able to predict their opponents’ competitive strategies, employ certain specific skills to achieve success, or they may imagine how they will respond to different situations, thus, allowing them to seek solutions via problem-solving for each situation specifically. Sometimes, athletes will also imagine the playing intensity, duration, attitude, emotions, or other behaviours or conditions that might be appropriate in their respective sports. Mattie and Chandler (2012) found that imagery use significantly predicted mental toughness. Specifically, motivational general-mastery imagery from SIQ emerged as the strongest predictor for all dimentions of mental toughness, providing support that imagery use has the potential for developing or enhancing mental toughness in athletes.

Many sport psychologists and coaches believe that the athlete should designate mental rehearsal sessions about when, who, what, where, and how, in their sporting performance or practice situation (e.g., Orlick & Partington, 1998). A possible approach is to allocate morning, late afternoons or early evenings, when they can be alone and relaxed (Nordin & Cumming, 2005). Perhaps approximately 15 minutes a session, 3 times a week, could be a good strategy (Dickstein & Deutsch, 2007), although this is anecdotal because there is still no established research evidence about the most effective session frequency and duration. Thus, athletes should work closely with their coach, to determine what works best for them in terms of holding their interest and clarity of images, which will then lead to performance enhancement.

Research has also shown that preparatory imagery, or using imagery immediately before performance, can improve performance on strength tasks, muscular endurance tasks, and golf putting (Vealey & Greenleaf, 2006). Imagery has been shown also to be effective in enhancing self-confidence (Callow, Hardy & Hall, 2001; L. Evans et al., 2004; Garza & Feltz, 1998; Hale & Whitehouse, 1998; Hardy, Woodman, & Carrington, 2004; McKenzie & Howe, 1997; Short et al., 2002; Ross-Stewart & Short, 2009), increasing intrinsic motivation (Martin & Hall, 1995), attentional control (Calmels, Berthoumieux, & d'Arripe-Longueville, 2004), visual search abilities (Jordet, 2005) of athletes during competition, and reducing anxiety (Carter & Kelly, 1997; Gould & Udry, 1994). In a meta-analysis, Driskell et al. (1994) provided evidence that imagery positively improves motor skill execution for both cognitive and physical tasks, as well as being helpful for both novice and experienced participants. Specific types of imagery were effective in changing athletes' perceptions of anxiety from harmful and negative to facilitative and challenging (L. Evans et al., 2004; Hale

& Whitehouse, 1998; Page, Sime, & Nordell, 1999). A study conducted by Cumming, Nordin, Hoton, and Reynolds (2006) reported that participants using a combination of facilitative imagery and self-talk can enhance their dart-throwing performance whereas debilitative imagery and self-talk can worsen their performance.

Overall, the previous studies demonstrated that the content of imagery was an important element for the enhancement of performance. Thus, imagining using a mixture of internal and external perspectives such as using imagery for relaxation, using imagery before performance, using imagery related to performance tasks, and facilitative imagery have the potential to provide positive effects on sporting performance.

Imagery and competitive anxiety. Research has suggested that imagery is an effective strategy for controlling levels of competitive anxiety (Hall, 2001; Vadocz, Hall, & Moritz, 1997). Most sport psychology researchers have used the multidimensional conceptualization of competitive state anxiety and separated it into somatic and cognitive components (see anxiety section in the literature review). VanDenberg and Smith (1993) compared the imagery and relaxation of high school wrestlers on a nine-week program; found that cognitive state anxiety and somatic state anxiety decreased significantly for the intervention group but not the control (no training) group. The results suggested that imagery combined with relaxation training could reduce competitive state anxiety. Vadocz et al. (1997) investigated the relationships between imagery use and anxiety and self-confidence in elite roller skaters between the ages of 12 and 18 years; they found that motivational imagery use was related to both cognitive and somatic state anxiety and self-confidence. From the results, Vadocz et al. (1997) concluded that imagery can be used to control competitive anxiety levels, thus enhancing self-confidence. Similarly, Page et al. (1999) found that positive imagery intervention could reduce the pre-competition anxiety of female intercollegiate swimmers.

Monsma and Overby (2004) examined the role of imagery and anxiety performance among 131 female auditioning ballet dancers, suggesting dancers are encouraged to focus on mastery images for increasing confidence and decreasing anxiety. Research from the type of imagery used also indicated that MG-A imagery was a significant predictor for lower cognitive anxiety as well as higher self-confidence for young female baton-twirlers (Strachan & Munroe-Chandler, 2006). Thus, based on the evidence in the literature review, the results have supported that appropriate imagery can reduce both cognitive and somatic state anxiety before competition, after competition (post-test) and possibly during competition as well.

Based on the literature review on imagery, there can be little doubt about the effectiveness of imagery as a psychological training tool and its applicability for athletes. Whilst it is apparent that imagery has a positive connection to increased self-confidence and self-efficacy, decreased somatic and cognitive state anxiety and enhanced sporting performance, bearing in mind the literature review, there is still no research examining the use of relaxing music or arousing music on sport performance. Moreover, there are no studies that examine the effects of relaxing music or arousing music in fine-motor skills sport and power skills sport using the match and mismatch approach.

Imagery and self-confidence. Research examining the relationship between imagery and self-efficacy has received much interest (Short et al., 2005; Vealey, 2001). According to Short et al. (2005), since 1999, many researchers have continued to suggest that the mechanism for imagery and sport performance enhancement is via self-efficacy and state sport confidence. Although similar, these two constructs differ slightly, such that self-efficacy beliefs relate to confidence for a specific situation or task, whereas state sport confidence reflects confidence levels at a specific moment in time (Shearer et al., 2007). The reason many researchers emphasise the importance on self-confidence and self-efficacy in sport research is because they have a strong relationship to athletic performance and success (Moritz, Feltz, Fahrbach, & Mack, 2000). Self-efficacy is the belief in one's ability to successfully perform a specific behaviour or a set of behaviours that are required to obtain a certain outcome (Bandura, 1986; 1997). Bandura (1997) suggested that there is a close relationship between imagery and self-efficacy whereby facilitative imagery is considered to be a source of efficacy information. He concluded that having people imagining themselves completing an activity skilfully raises their perceived confidence that they will be able to perform better and it boosts their perceived efficacy for performance enhancement (Bandura, 1997). Hall (1995) proposed that individuals who imagine themselves performing the way they want to perform, could also increase their self-efficacy.

Imagining positive strategy or facilitative imagery, as proposed by Short el al. (2002) leads to desirable outcomes such as improved self-confidence and performance (Cumming et al., 2006; Murphy & Martin, 2002; Williams, Cumming, & Balanos, 2010). On the other hand, negative imagery (debilitative) appears to have harmful consequences (Hanton, Mellalieu, & Hall, 2004; Cumming et al., 2006). Many applied sport psychologists recognise the importance of using positive imagery interventions to enhance self-efficacy and self-confidence (e.g., Abma et al., 2002; Mills, Munroe, & Hall, 2000; Short et al., 2002). Research has also indicated that imagery use by athletes is predictive of their levels of self-efficacy (e.g. Beauchamp et al., 2002) and can be used as an intervention to increase both self-efficacy perceptions (Jones, Mace, Bray, MacRae, & Stockbridge, 2002) and state sport confidence (Callow et al., 2001). Callery and Morris (1997) found that imagery enhanced self-efficacy in the footballers' goal kicking. In addition, a study conducted by Short et al. (2005) showed that the more athletes used imagery, the more confidence they exhibited, as shown in the Sport Imagery Questionnaire (SIQ), and a self-efficacy measure developed according to Bandura's (1986) recommendations. A study conducted by Callow and Waters (2005) investigated the effect of a kinaesthetic imagery intervention on sport confidence in three flat-race horse jockeys, using a single case, multiple-baseline design. The Sport Sport Confidence Inventory (SSCI) was used to assess state sport confidence and the MIQ-R was used to measure visual and kinaesthetic imagery ability. There were six sessions of the kinaesthetic imagery intervention conducted twice weekly for three weeks. The results showed the significant effect of kinaesthetic imagery in increasing performance and confidence in two jockeys out of three. Callow and Waters argued that the jockeys might have prepared for their performance using kinaesthetic imagery, which has a cognitive function, and this influence enhanced their self-confidence.

Recently, in order to use imagery successfully, researchers have recommended that the type of imagery used should match the intended outcome. This suggests that to increase an athlete's feelings of efficacy, an intervention that focuses on MG-M imagery content would be most appropriate (Martin et al., 1999). Studies exploring the link between imagery functions and sport confidence (e.g. Abma et al., 2002; Callow & Hardy, 2001; Mills et al., 2000), and imagery function and self-efficacy (Beauchamp et al., 2002; Shearer et al. 2007; Mills et al., 2001), have indicated that athletes high in these constructs use specific types of imagery. For example, Callow and Hardy (2001) found that CG and MG-M imagery were associated to state confidence in lower skilled netball players, whereas MS imagery was associated to state confidence in higher skilled netballers. They suggested that the low-skilled sample used MG-M type imagery as a source of performance accomplishment information to enhance efficacy expectations, while the high-skilled sample used MS type imagery to image specific images associated with goal achievement. Similarly, Mills et al. (2001) observed that athletes high in self-efficacy in competition situations used more motivational types of imagery than athletes who had low self-efficacy. Abma et al. (2002) investigated the differences on imagery content and imagery ability between 101 high and low trait confident track and field athletes. There were three measures: the Trait Sport Confidence Inventory (TSCI; Vealey, 1986) to assess confidence, the SIQ to assess imagery use, and the MIQ-R to assess imagery ability. The results showed that highly confident athletes used significantly more of all types of imagery compared to athletes with low confidence. On the other hand, there was no difference in imagery ability between high and low confident track and field athletes. The study supported the proposition that using a variety of imagery more frequently might help reduce athletes' anxiety and enhance performance and confidence.

Short et al. (2002) examined the effect of imagery functions on self-efficacy and performance in a golf-putting task. The cognitive specific (CS) and motivation general mastery (MG-M) imagery functions and facilitative and debilitative imagery direction were examined. Facilitative imagery was imagining a positive outcome, such as making the putt, and debilitative imagery was imagining a negative outcome, such as missing the putt. Thus, it is hypothesized that facilitative imagery would improve performance and delibitative imagery would result in performance decrements. The 83 golfers were divided into seven conditions: CS and facilitative imagery, CS and debilitative imagery, MG-M and facilitative imagery, MG-M and debilitative imagery, CS imagery only, MGM imagery only, and a control condition. The results revealed that facilitative imagery helped improve performance, while debilitative imagery decreased performance. In addition, Shearer et al. (2007) also suggested MG-M imagery as a potential technique to improve levels of collective efficacy, which is the group capabilities to organise or to execute the action (defined by Bandura, 1997), although the competitive level may moderate the effectiveness of the intervention. Further, Munroe-Chandler, Hall, and Fishburne (2008) suggested that youth athletes, regardless of their competitive level, should focus on using the MG-M function to increase their self-confidence or self-efficacy through the use of imagery training.

Arousal in Sport

Sports performance in training and competition, and especially striving for the goal of attaining peak performance, can be highly physically and mentally arousing. When people participate in sport, their heart rates and mental alertness increase. In some circumstances this has a positive effect on the performance. Conversely, there are also situations in which a high level of arousal can be detrimental to performance. As arousal is such a pervasive phenomenon and almost an inevitable consequence on sport performance, understanding the relationship between arousal and performance has become of increasing interest for many sport psychologists and sport practitioners, who seek solutions as to how athletes can regulate their arousal in order to reap the optimum benefits and gain victory over their bodies and minds, to achieve peak performance.

Definitions of Arousal

Perkins, Wilsons and Kerr (2001) define the character of arousal as "Unidimensional, emotionally neutral, and measurable on the physiological, psychological, and behavioural levels" (p.239). Landers (2007) attempted to define arousal in sport as "drive, tension, activation, excitement, or being "worked up" or energised" (Landers, 2007, p.17). Arousal involves the activation of the reticular activating system in the brain stem, autonomic nervous system, and endocrine system, leading to increases in heart rate, blood pressure, and respiratory rate due to the body's readiness to respond as a defence mechanism (Higuchi, 2000). Although many different neural systems are involved in what is collectively known as the "arousal factor", four major systems originate from the brainstem. These have connections extending throughout the cortex, releasing the brain's neurotransmitters, which are known as acetylcholine, norepinephrine, dopamine, and serotonin. When these systems are activated, the receiving neural areas become sensitive and responsive to incoming arousing signals (Perkins et al., 2001).

Gould, Greenleaf, and Krane (2002) explained that intensity of arousal from a sport and exercise psychology perspective falls along the continuum of a straight line, ranging from not at all aroused (e.g., comatose) to completely aroused (e.g., frenzied). However, whenever most researchers attempt to illustrate the state of being aroused, they mean their arousal level is high, whereas the bodily system is always "aroused", and it can be high or lower arousal, unless a person is dead (comatose). Thus, in this thesis the term "aroused" is used in its more colloquial sense of having a moderate to high arousal level.

Arousal can be measured centrally in the brain by means of an electroencephalogram or peripherally using autonomic measures, such as heart rate, peripheral temperature, blood volume pulse rates, and muscle tension as indicators (Landers, 2007). In sport, arousal can be manifested in three ways - mental, physical, and behavioural (McNally, 2002, p. 4). In terms of the mental aspect of arousal, when athletes are overly worried about their performance or considering whether they should or should not perform in a competition, negative emotions, such as anxiety may occur. This in turn could cause physical changes or physiological reactions, including increases in heart and respiratory rates, or increases in muscle tension, that is increased arousal level. Overly high levels of arousal might then cause changes in behaviour, for example an overly aroused soccer player inaccurately passing a ball to the opposition because of an incorrect decision, or poor skill execution in passing the ball to a teammate. In these ways, arousal can cause detrimental effects to athletes' mental and physical state, negatively affecting their behaviour. Mentally, athletes may worry about their performance, whereas physically they may experience symptoms of arousal, such as muscle tension and increased respiratory rate, which affect their behaviour.

Some researchers (e.g., Hanin, 1997; Weinberg & Gould, 1999) have argued that arousal is closely related to levels of sport performance. Oxendine (1970) proposed that high levels of arousal can benefit maximal strength performance, but high arousal levels can also inhibit athletic performance, depending on the situation. Gale and Edwards (1986) demonstrated that psycho-physiological aspects of arousal were generally closely related to efficiency of performance enhancement. Although many researchers have suggested that high levels of arousal could negatively influence sports performance (O'Brien & Crandall, 2003), literature on the arousal-performance relationship suggests mixed results (e.g., Arent & Landers, 2003; Singer & Anshel, 2006). Perkins et al., (2001) also reported that high levels of positive arousal are a feature of successful performance. Perkins et al. (2001) proposed that high arousal experienced as unpleasant anxiety in the telic state, could be detrimental to performance, whereas in the paratelic state, high arousal is likely to be experienced as pleasant excitement, which may benefit athletic performance. According to Steve Bull, a former English soccer player for 15 years:

> Nerves and butterflies are fine – they're a physical sign that you're mentally ready and eager. You have to get the butterflies to fly in formation, that's the trick (cited from Price & Budzynski, 2009, p. 465).

Although it is important to understand the relationship of arousal and performance in sports contexts, there is still a lack of research on this aspect. One aspect of arousal that challenges researchers is that physiological and psychological components of arousal are constantly in flux. It is important to understand how athletes regulate their arousal to use it as an advantage for optimal performance enhancement, rather than allowing it to diminish their performance skills.

Physiological and Behavioural Aspects of Arousal

Many researchers have attempted to explore the physiological, biochemical, and behavioural aspects of arousal (e.g., Perkins et al., 2001). From the physiological perspective, arousal can be quantified from various physiological indicators in the body, including heart rate, respiration rate, galvanic skin response, blood pressure, hormonal activity, brain wave activity, and temperature. Physiological arousal in the form of increased heart rate (Landers, Qi, & Courtet, 1985), respiratory rate (Landers, 2007) and systolic blood pressure (Noteboom, Bamholt, & Enoka, 2001) indicates changes in both the autonomic nervous system and the endocrine system. From the biochemical perspective, differences in testosterone or cortisol level could react as the result of being aroused. Salvador, Suay, Gonzalez-Bono and Serrano (2003) demonstrated that when judo athletes experienced a “highly aroused” situation, before simulated competition, their cortisol excretion levels from the adrenal cortex increased accordingly. Similarly, Filaire, Alix, Ferrand, and Verger (2009), examining tennis players’ first single match tournaments, found that cortisol levels were significantly higher for losing players.

Arousal can also cause behavioural changes, such as decrease in awareness, decrease in attention control, slowness in information processing, decrease in body defence mechanism (Beuter, Duda, & Widule, 1989; Higuchi, Imanaka, & Hatayama, 2002; Tanaka & Sekiya, 2010; Yoshie, Shigemasu, Kudo, & Ohtsuki, 2009), increased (Tanaka & Sekiya, 2006) or decreased (Higuchi, 2000) variability of displacement, and increased motor movement reaction time (Beuter & Duda, 1985). These psychological, physiological, biochemical, and behavioural factors have been linked strongly to personality traits, such as nervousness (Fumoto, Yamaji, & Kaneko, 1992), high self-consciousness (Baumeister, 1984; J. Wang, Marchant, & Morris, 2004), and high trait anxiety (Hashimoto & Tokunaga, 2000). Arousal is an important precursor for motivating certain other behaviours, including mobility, flexibility to react, the pursuit of more nutrition, or the fight-or-flight response. It can also affect human's emotional states, such as anger or joy (Blumenstein, Bar-Eli, & Tenenbaum, 2002).

Measurement of Arousal

Physiological aspects of arousal. Humphreys and Revelle (1984) divided arousal into aspects that are evident at the micro or macro levels. At the micro level, arousal is very transient, changes in milliseconds, can be measured by changes in heart rate, heart rate variability, galvanic skin responses, serum adrenaline (epinephrine), electromyography, and electroencephalograph (Blumenstein et al., 2002; Kahneman, 1973). At the macro level, arousal is of much longer duration, changes in minutes, relates to the general feelings of alertness or activation (Thayer, 1989), body temperature (Blake, 1967), hormonal excretions (Frankenhaeuser, 1975), and could be attributed to stress (Selye, 1976). However, researchers have shown that several factors might affect the intensity of the emotional response, such as stimulus content (Bradley, Codispoti, Cuthbert, & Lang, 2001), previous experience with the eliciting stimulus (Codispoti, Ferrari, & Bradley, 2006, 2007), and individual differences (Cook & Turpin, 1997). In the following subsection, some of the physiological measures will be discussed, which represent a more universally agreed physiological index for measurement of arousal.

Blood volume pulse (BVP). BVP also known as photoplethysmography, is a noninvasive measuring of the physiological changes associated with the heart's activity, but its functions are varied based on different principles. BVP works by bouncing infrared light against a skin surface and measures the amount of reflected light against the skin surface. This amount will vary with the amount of blood present in the skin. At each heartbeat (pulse), there is more blood in the skin, blood reflects red light and absorbs other colours and more light is reflected. Between pulses, the amount of blood decreases and more red light is absorbed, so the reflection of the infrared light is reduced (Peper, Shaffer, & Lin, 2010). BVP sensors attached by a Velcro band to the fingers to monitor the temporal artery record higher levels when more blood is flowing and lower levels when blood is not flowing so strongly. The sensor's output then shows a recognizable beat pattern that is used to calculate the time between consecutive beats, known as the Inter-Beat Interval (IBI). From a series of such IBI values, a number of mathematical processes can be applied to extract the standard metrics used for measuring arousal (Peper et al., 2010).

The IBI measured by BVP is an indication of vasomotor activity and a very good indicator of sympathetic arousal. Since vasomotor activity is controlled by the Sympathetic Nervous System (SNS), BVP measurements can display changes in sympathetic arousal, which means that the increase in BVP amplitude indicates decreased sympathetic arousal and greater blood flow to the peripheral vessels. Andreassi (2000) suggested that physiological measures (e.g., skin conductance, blood volume pulse) are good indicators for reflecting levels of autonomic nervous system activity. This gives researchers natural, non-invasive, and reliable data sources, to objectively evaluate physiological arousal levels. BVP can also measure the phasic change in blood volume with each heartbeat, heart rate, and heart rate variability (HRV), which consists of beat-to-beat differences in intervals between successive heartbeats.

Heart rate (HR). HR is commonly recorded as a measure of physiological arousal. Heart rate is the number of heartbeats per unit of time, also known as beats per minute (bpm). It varies according to the body's need to absorb oxygen and excrete carbon dioxide, so as this need changes, such as increasing during increased activity or decreasing during sleep, HR increases or decreases respectively. Medical professionals use HR extensively in their diagnosis and tracking of medical conditions. In sports, many elite athletes also use HR to control their arousal level in order to gain maximum benefits in their training routines. Higher heart rate is associated with an increase in oxygen uptake due to stress, arousal, or workload.

In sport performance, the heartbeat pattern has been closely associated with performance. For example a slow HR is linked with good shooting performance in archery and pistol shooting (e.g., Kruse, Ladefoged, Neilsen, Paulev, & Sorensen, 1986; Tremayne & Barry, 2001). Landers and colleagues demonstrated that HR decelerates in the seconds prior to release of the arrow in experienced archers who performed well in competition (Landers et al., 1994; M. Q. Wang & Landers, 1986). Similar patterns have been shown in other fine motor skill sports, such as shooting (Hatfield, Landers, & Ray, 1987) and golf (Boutcher & Zinsser, 1990). According to Raglin (1992), increases in arousal will cause elevated heart rate and it is one of the most accepted indicators for stress assessment. Studies among competitive athletes, such as automobile drivers, racquetball players, and swimmers, reported an elevation in heart rate for high arousal activities (Falk & Bar-Eli, 1995). Blumenstein et al. (2002) stated that heart rate measurement is commonly used to index the arousal level in sport psychophysiology, and several investigations have shown a general tendency for HR deceleration to be a sign of effective preparation, but this is not necessarily associated with increases in sporting performance. Brosschot and Thayer (2003) showed that heart rate response is longer after negative emotions than after positive emotions. Thus, higher heart rate takes longer to reduce (person to become relaxed) for individuals experiencing negative emotions. This is consistent with the view that prolonged activation of negative emotions, such as stress, worry, or anxiety necessitates longer recovery from the negative emotions.

Heart rate variability (HRV). HRV is a non-invasive measure of cardiac performance that has been shown to be a powerful predictor of cardiovascular functioning in response to stress or anxiety (Malik, 1996), and it is closely related to emotional arousal (Howland, 2007; Lane et al., 2009; Sandstrom & Russo, 2010). It is a physiological phenomenon where the time interval between heartbeats varies, which is measured by variations in the beat-to-beat interval.

Under resting conditions, heartbeat rhythms are the results of automaticity between the sino-atrial node and modulation of the autonomic nervous system (ANS). The ANS is comprised of the sympathetic nervous system (SNS) and parasympathetic nervous system (PNS). According to Glick, Braunwald, and Lewis (1965), as arterial pressure falls, heart rate increases as a result of an augmentation of impulses travelling to the sino-atrial node through the sympathetic system’s efferent fibers, and causes a decrease of vagal inhibitory impulses. Conversely, the fall in heart rate that occurs when arterial pressure rises, has been attributed to increased parasympathetic activity, coupled with a diminution of sympathetic stimulation. Thus, when a person gets aroused, anxious or in a stressful situation, SNS accelerate the sino-atrial node’s electric discharge speed, causing the heart rate to increase; on the other hand, when a person is at rest or sedentary, PNS decelerates the sino-atrial node’s electric discharge speed, causing the heart rate to decrease.

There are three components on the frequency domain of HRV: high frequency (HF), low frequency (LF), and very low frequency (VLF). Lo, Huang, and Hung (2008) examined the relationship between HRV and archery performance in 16 pre-elite archers. They found that HF was higher, LF was lower, and the LF/HF ratio was lower for the best performing archers. The results also suggested that high levels of sympathetic activity (such as over-arousal), could lead to detrimental outcomes in a sport that requires relatively low stimulation. They concluded that HRV is related to archery performance in that higher parasympathetic activity and a better balance between parasympathetic and sympathetic activity were beneficial to performance enhancement in fine-motor sport.

Galvanic skin response (GSR). GSR is a measurement of the electrical conductance in a person's peripheral skin, which is affected by variations in the moisture level of the skin. GSR is closely related to sweating and the temperature of the skin. It is based on the concept of weak electrical current passing through the skin (between the fingers) and measuring the amount of current change during its passage. As human skin is a good conductor of electricity, the changes in the skin's conduction of electricity can be measured as either skin resistance or its reciprocal, skin conductance.

GSR is also known as skin conductance (SC), skin conductance level (SCL), skin conductance response (SCR), skin resistance level (SRL), skin resistance response (SRR), skin potential response (SPR), electrodermal response (EDR), electrodermal activity (EDA), or psychogalvanic reflex (PGR) (Dawson, Schell, & Filion, 2000; Dindo & Fowles, 2008). GSR is a linear correlation to arousal level, so higher GSR reflects higher levels of arousal and lower GSR reflects lower levels of arousal, that is, relaxation (Khalfa, Isebelle, Jean-Pierre, & Manon, 2002). GSR also reflects emotional responses (Lang, 1995). Conesa (1995) illustrated that GSR has been widely used in psychological research due to its cheap and effective nature, for measuring the sympathetic nervous system's reaction to arousing stimuli. GSR is a very quick and simple measure of arousal level. GSR is a "gold standard" for monitoring the physiological changes in response to arousal or emotional stimuli, as suggested by Barry and Sokolov (1993).

In sports, GSR has been recognised as a way to gain objective access to physiological arousal (Conesa, 1995). The electrical conductance increases with skin moisture because current flows more easily through the salty moisture on the skin surface, and conductivity decreases as moisture decreases. This method has also been recognised as a distinctively sensitive analyzer for transit emotional and mental stress. According to Zaichkowsky and Fuchs (1988), GSR is usually applied in conjunction with skin temperature in biofeedback training, together with other relaxation techniques, to measure the relaxation response that might be used to combat pre-competition anxiety. Zaichkowsky and Fuchs (1988) stated that many studies use temperature and GSR measures as a treatment for athletic anxiety, and examine GSR to understand state anxiety control. Thus, changes in skin conductance accord with the changes in arousal level. A decrease in autonomic arousal (relaxation) usually results in a decrease in skin conductivity.

Stern, Ray, and Quigley (2001) found GSR and pulse rate (PR) to be excellent barometers of stress (anxiety) and relaxation; and Blumenstein et al. (2002) cited that most biofeedback modalities that have inspired voluminous research over the last 10 decades are concerned with the electrical activity of the skin. Bradley, Miccoli, Escrig, and Lang (2008) reported that there is a close relationship between sympathetic activity and emotional arousal, although one cannot identify which specific emotion is being elicited, such as fear or anger. GSR is a simple and subtle technique to understand the link between cognition and physiology. There are some studies conducted on the effect of music on physiological arousal (Burns et al., 2002; Sudheesh & Joseph, 2000). Burns et al (2002) measured the psycho-physiological responses of classical music, arousing hard rock music using GSR, muscle tension, and HR, whereas Sudheesh and Joseph (2000) measured the effect of music and meditation on GSR. Both studies concluded that GSR is a good indicator for physiological measure in the study of arousal, mental states, and also listening to music on emotional states.

Peripheral temperature (PT). PT, also referred to as finger temperature (FT) or finger skin temperature (FST), is a measure of the temperature of the skin extremities. Peripheral areas of the skin, such as the fingers, vary in temperature according to the amount of blood suffusing to the skin in those peripheral locations. PT is dependent on the state of sympathetic arousal of the autonomic nervous system. When sympathetically aroused, the muscles contract causing vasoconstriction, reducing blood flow to the skin and producing a decrease in temperature (Kluger, Jamner, & Tursky, 1985). The arterioles, which supply blood to the tissues, are surrounded by smooth muscle fibres that are innervated by the sympathetic nervous system (SNS). Therefore, when a person becomes stressed, their fingers tend to get colder. In contrast, activities like relaxation training, meditation, or deep breathing are usually associated with an increase in PT.

Jones (1976) showed that concrete self-suggestions and imagery can be effective in raising or lowering PT. Jones explained that when people experience stress, they often have a sense of coldness in their hands. This is because the blood vessels contract in the hands, thereby decreasing peripheral blood flow.

Conversely, when one is calm and relaxed, an increase in the temperature of the extremities is detected.

Peper and Schmid (1983) studied the positive effects of PT, EMG, and HR with progressive relaxation, autogenic training, and imagery among members of the US rhythmic gymnastics team. They reported that these combinations of psychological training created relaxation in the gymnasts who were able to control their arousal levels and reenergise, which then enhanced their athletic performance. Alden, Dale, and DeGood (2001) showed that the imagery group produced higher PT and hand-pain tolerance ratings than a non-imagery group. This showed that imagery could affect PT.

Electromyography (EMG). EMG is used to evaluate and record the electrical activity produced by the muscles. It is performed using an analytical instrument known as electromyography, to produce recording known as electromyogram. An electromyography detects electrical potential generated by the muscle cell, and send signals for analysis The results of EMG can be used for many purposes, such as facilitating the relaxation of the tense muscles (Peper & Schmid, 1983), activating muscles that are injured or partially paralysed (Zaichkowsky & Fuchs, 1988), a diagnosis of neurological and neuromuscular problems (Conrad, Issac & Roth, 2008), and recently it has been used in isokinetic muscle training for rehabilitation where no movement is produced (Kuroda, Thatcher & Thatcher, 2011).

EMG measures (in microvolts) the electrical energy discharged by the motor nerve endings signalling a muscle to contract. Similar to EEG, which uses the alpha rhythm on the occipital cortex to measure arousal, EMG also uses similar principles to measure arousal, in which greater muscle activity or resting tone in various muscle groups such as the corrugator muscles on the forehead, which is commonly referred as frontal (forehead) EMG, are measured.

In sport psychology practice, the placement of electrode sites for different muscle groups must be very carefully considered (Zaichkowsky & Fuchs, 1988). There are many variations in the placement of electrodes, and the user may find some are more applicable than others in a particular situation. Most studies agreed that frontal muscle activity is a valid measure on levels of arousal and muscle tension (Blumenstein, Bar-Eli, & Tenenbaum, 1995; Zaichkowsky & Fuchs, 1988).

Improvement in muscle performance with EMG biofeedback training is well documented in clinical practice (Newton-John, Spence, & Schotte, 1995) and sport application (Landers & Boutcher, 1998; Zaichkowsky & Fuchs, 1988). Croce (1986) found that a training combination of isokinetic exercise and the EMG feedback training program produced significant gains in maximal force and EMG activity of key extensor muscles. Studies reviewed by Zaichkowsky and Fuchs (1988) stated that nearly 60% of studies showed EMG feedback yielded positive effects on sports performance.

Bar-Eli, Dreshman, Blumenstein, and Weinstein (2001) investigated the relationship between mental training with biofeedback (EMG, GSR, HR) and performance, using an adapted version of the Wingate five-step approach as a mental preparation technique for enhancing the swimming performance of 11- to 14-year-old child swimmers, indicating that the experimental group (mental training with biofeedback) exhibited substantially greater increases (after 3.5

months) in training performance over time (although the control group also displayed some minor improvements).

A combination of many other measures have been used concurrently with EMG training. To provide some examples, HR, EEG, and respiratory biofeedback have been used concurrently with EMG biofeedback in aiming tasks (archery, shooting, golf); PT, GSR, and EMG biofeedback indicate how relaxation is induced in sports where mental relaxation and concentration are important (e.g., gymnastics); and EMG and GSR training are used in combat sports (e.g., judo, wrestling); EMG, GSR and breathing exercises are also used in swimming and biathlons (Blumenstein et al., 2002; Zaichkowsky & Fuchs, 1988).

Subjective Psychological Measure of Arousal. Taking subjective measurements is the most frequently used method in measuring anxiety, given its simplicity and convenience, and its quantitative results are more valid. These psychometric tests have been employed to measure both trait and state anxiety. Among the more popular measurements used are the Sport Competition Anxiety Test (SCAT; Martens, 1977), Sport Anxiety Scale (SAS; Smith, Smoll, & Schutz, 1990), The Competitive State Anxiety Inventory-2 (CSAI-2; Martens, Burton, Vealey, Bump & Smith, 1990), Anxiety Rating Scale (ARS; Cox, Russell, & Robb, 1998), and Sport-Grid (Raedeka & Stein, 1994).

The Sport Competition Anxiety Test (SCAT; Martens, 1977). SCAT is a 10-item inventory that purports to measure trait anxiety in sport performers. Items include the following complaints: “When I compete I worry about making mistakes” and “Before I compete I get a queasy feeling in my stomach”.

Respondents are required to indicate their agreement with each item by selecting their preferred answer from three categories: “hardly ever”, “sometimes” and “often”. Reverse scoring is used on certain items (for example “Before I compete I feel calm”). Scores on this measure range from 10 to 30. Internal consistency coefficients range from 0.8 to 0.9 and test-retest reliability values cluster around 0.77 (Smith, Smoll, & Wiechman, 1998). Validation studies suggest that the SCAT is mainly a measure of somatic anxiety. Evidence of the test’s convergent validity comes from studies, which show that it is correlated moderately with various general anxiety inventories. Smith et al. (1998) concluded that although the SCAT “has been a very important research tool within sport psychology” (Cox et al., 1998), it needs to be revised as a multidimensional test, reflecting the distinction between somatic and cognitive anxiety.

Sport Anxiety Scale (SAS; Smith et al., 1990). SAS is a 21-item self-report, sport-specific multidimensional test that measures the intensity of cognitive and somatic trait anxiety. The SAS measures individual differences in somatic anxiety (nine items) and in two classes of cognitive anxiety: namely worry (seven items) and concentration disruption (five items). Individuals rate each item on a 4-point scale in terms of how they usually feel from 1 (not at all) to 4 (very much). High internal consistency values for these SAS subscales have been reported in a number of studies with Cronbach alpha coefficients ranging from, $\alpha = 0.71$, to 0.92 for somatic anxiety, and from $\alpha = 0.70$ to 0.86 for worry (Smith et al., 1990). Smith et al. also found the SAS to obtain appropriate levels of convergent and discriminant validity. Factor analyses have also confirmed that the SAS assesses three separate dimensions: somatic anxiety, cognitive anxiety/worry, and concentration disruption (Dunn, Dunn, Wilson, & Syrotuik, 2000). In 2001, Hanton, Evans, and Neil attempted to modify the SAS to include a directional scale. Since its development, the SAS has been used in a variety of sporting contexts and as a measure of cognitive and somatic sport performance anxiety (e.g., Giacobbi & Weinberg, 2000).

The Competitive State Anxiety Inventory-2 (CSAI-2; Martens et al., 1990). CSAI-2 is one of the most frequently used multidimensional tests of state anxiety in sport, and it measures the constructs of cognitive anxiety, somatic anxiety and self-confidence. It is a 27-item measure, with each of the three subscales represented by nine items, measuring cognitive anxiety, somatic anxiety and self-confidence. A sample item in the cognitive anxiety subscale is “I am concerned about losing”. Typical items in the somatic anxiety subscale are “I feel nervous” and “My body feels tense”. The self-confidence subscale is included in the test because a lack of confidence is believed to be a sign of cognitive anxiety. On a 4-point scale (with 1 = “not at all” and 4 = “very much so”), respondents are required to rate the intensity of their anxiety experiences prior to competition. Following a review of 49 studies using the CSAI-2, Burton (1998) reported that internal consistency estimates for these three subscales ranged from 0.76 to 0.91. Vealey (1990), who conducted a meta-analysis of fifteen studies investigating the interrelationship between CSAI-2 components for its independence construct, found moderate dependence among all three constructs measured by the CSAI-2. However, the fact that CSAI-2 takes between five to fifteen minutes or even more, to complete the questionnaire often makes it impractical and less valid for use in an actual competitive environment where distractions and delays between assessment and performance are deemed problematic.

Anxiety Rating Scale (ARS; Cox et al., 1998). ARS measures the cognitive anxiety, somatic anxiety and self-confidence before and between performances. It is comprised of three seven-point Likert items taken directly from the original CSAI-2. Later, another revised version of ARS-R (Cox, Robb, & Russell, 2000) was developed to improve athletes' interpretation of the items. According to Ward and Cox (2004), the major limitation of ARS is its inability to measure the construct of arousal, to distinctively separate somatic arousal and physiological arousal.

Sport-Grid (Raedeke & Stein, 1994). The sport grid is a simple and brief instrument, which is capable of measuring arousal and psychological mood immediately prior to, and between, performances. The Sport Grid measures arousal by utilizing the concept of felt arousal. This is simply "how aroused or activated a person felt, independent of whether the feeling associated with arousal was positive or negative" (Raedeke & Stein, 1994, p.364). Many researchers, such as Coventry and Hudson (2001) and Logan, Walker, Staton, and Leukefeld (2001), reported that felt arousal and physiological arousal are related. In fact, many researchers have used felt arousal as the main measure of physiological arousal (e.g., Kerr & Tacon, 1999). Although the Sport Grid provides a viable measure of felt arousal, it confounds the measurement of cognitive anxiety with self-confidence on the other dimension, which does not support the conceptualization of cognitive anxiety and self-confidence as bipolar opposites. Thus, to address this perceived shortcoming of Sport Grid, the revised Sport Grid

(Sport Grid-R) was developed by Ward and Cox (2004), to demonstrate the independence of the two constructs that measure cognitive anxiety and felt arousal. Ward and Cox have also suggested that Sport Grid-R is a better measure of cognitive anxiety than Sport-Grid and CSAI-2.

Competitive State Anxiety Inventory-2 Revised (CSAI- 2R; Cox et al., 2003). CSAI-2R is a 17-item scale that measures cognitive state anxiety (5 items), somatic state anxiety (7 items) and self-confidence (5 items) in a competitive setting. The main reason for modifying the CSAI-2 was to produce a more psychometrically sound measure. Respondents rate their feelings before competition on the 17-item instrument (e.g., *I feel jittery, I am concerned about losing*) using a 4-point Likert scale from 1 (*not at all),* through 2 (*somewhat),* and 3 (*moderately so),* to 4 (*very much so*). Subscale scores are calculated by summing items in each subscale, dividing by the number of items, and multiplying by 10. The score range is 10 – 40 for each subscale. Higher scores indicate higher intensities of cognitive and somatic state anxiety, as well as higher levels of self-confidence. The factorial validity of the CSAI-2R was previously established by Cox et al. (2003), using confirmatory factor analysis (CFA) on data from 331 athletes, which showed a good fit of the hypothesised measurement model to the data (CFI = .95, NNFI = .94, RMSEA = .05) and Cronbach alpha coefficients for each subscale of the CSAI-2R showed sound internal consistency (somatic anxiety = .88, cognitive anxiety = .83, self-confidence = .85).

Qualitative Measures of Arousal. This qualitative method has also been used by some sport psychologists, but only to a limited extent. The psychologist observes the actions or activities, either directly or indirectly, then rates the person's anxiety based on their observations. Sometimes, other experts or psychologists will also use a video recording of the situation so that the psychologist can trace back the observed actions, or conduct face validity. However, a drawback of this method is that confusion may arise when the interpretations are based on subjective experiences, guessing or doubt. For example, a shivering swimmer may be either terrified or just feeling cold from the swimming pool rather than having anxiety due to the competition. Another drawback is that a weightlifter might seem over-aroused before a competition but in actual fact, they are just pumping up to warm up their body so they are ready to lift the bar, or to prevent injuries. Another example is the All Blacks (New Zealand National rugby team), who collectively pump up to issue a Maori challenge known as "Haka" just before the start of each game to display a unified strength to intimidate their opposition. This influence of this upon opposing team is variable, some teams might actually feel de-motivated, or slightly intimidated by this act, however, other teams might counter attack by using their own national ritual to demonstrate strength and unity, which might motivate them more to win.

Arousal-Performance Theories

Some important theories on arousal-performance need to be discussed in order to understand the relationship between arousal and sport performance, and regulating it (arousal) by turning adversity into advantage in competitive situations. The dominant models of arousal-performance relations are the Inverted-U hypothesis (Yeskes & Dodson, 1908), the drive theory (Spence &

Spence, 1966), the Catastrophe theory (Hardy & Fazey, 1987), and the Multidimensional anxiety theory (Martens et al., 1990). These theories are related to the present thesis.

Inverted U-hypothesis (Yeskes & Dodson, 1908). The inverted U-hypothesis explained that optimum performance occurs when we experience a moderate level of arousal, and performance is poor when arousal is either high or low (see Figure 2.1). This view of the arousal performance relationship suggests that the effects of arousal on performance are curvilinear. As arousal increases from low to moderate levels, performance will gradually increase correspondingly. Then, when arousal increases from moderate to high levels, performance gradually decreases. According to Mahoney and Meyers (1989), it is hypothesised that extremely low and extremely high levels of arousal will impair performance, while moderate arousal levels are thought to facilitate performance.

According to Landers and Boutcher (1998), there are two main factors that influence the arousal and performance relationship, which are divided into task complexity and individual differences. Sports of different complexities require different task execution, and different tasks in sport require different levels of arousal for optimum performance. For example, a complex task such as golf putting requires a lower arousal level compared to weightlifting. Another example: a male rugby player’s required optimal arousal levels in general play are probably not as high as when he is attempting a penalty kick.

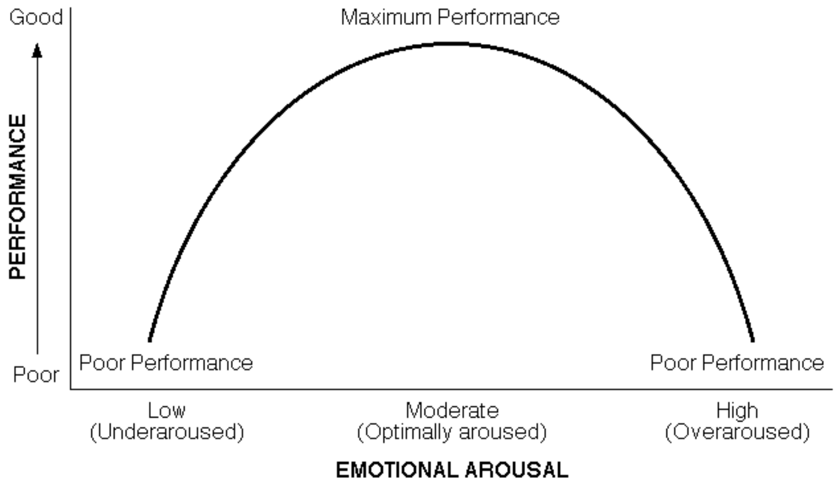


Figure 2.1: Inverted U-hypothesis

Regarding individual differences, athletes can differ in their trait anxiety, level of extroversion or introversion, and their skill level. Most athletes have a different level of perception of what provokes their arousing. An athlete with high competitive trait anxiety will probably become more anxious and highly aroused during most of the competitions in which they participate. On the other hand, a pistol shooter with lower perceived anxiety and lower arousal for competition will probably be less anxious during the competition, and might be able to perform better. Furthermore, athletes can also be classified into broader terms as extroverted or introverted, and their arousal levels are both different. Extroverted athletes are more likely to enjoy social situations, such as being at the center of attention or fame, more outgoing, predominantly ego-oriented, more motivated, and self-confident. They will tend to focus less on themselves and more on external events and stimuli. In comparison, highly introverted athletes may be lower in self-confidence, less outgoing, and less prone to socializing. Thus, introverted athletes should have an optimum level of arousal lower than extroverted athletes. Highly skilled athletes, e.g., Roger Federer in tennis, are able to cope better with high levels of arousal compared to less skilled athletes. This illustrates that higher skilled athletes are able to perform at peak performance with higher levels of arousal than less skilled athletes.

Researchers noted that most early research done on Inverted U-hypothesis has a lack of accreditation. Most of these early research studies have fewer than 20 participants and only 3 to 5 levels of arousal, making it unrealistic to expect a perfectly symmetrical bell-shaped curve. Arent and Landers (2003) conducted a study on 104 college-age participants on a simple reaction time task while riding a bicycle ergometer, with CSAI-2 measured prior to cycling. The results showed a significant trend for arousal, reaction time and optimum performance on this simple task, which was 60% to 70% of the maximum arousal.

Future researchers should pay more attention to the conditions that enhance productive arousal as well as those that reduce it. Thus, more studies were proposed on mental tasks, and environmental information and different comparisons on task performances were suggested.

Drive theory (Spence & Spence, 1966). Drive theory is one of the oldest theories, which refers to an individual's performance level, which is determined by his or her current level of arousal, or "drive". The theory predicts that at any given skill level, performance is dependent on the arousal in a simple linear way, such that, the greater the arousal, the better the performance. Although drive theories have been useful in accounting for some types of performance failures, this theory falls short in a number of ways. First, drive theories are more descriptive than prescriptive. This is because drive theories link arousal and performance, but they do not explain how or why arousal exerts its impact. Secondly, in drive theory models, there are often debates on how the notion of arousal should be conceptualised (such as physiological construct or emotional construct). Finally, it has trouble accounting for observed behaviour, especially in sports, which can be influenced by many factors, such as environmental, situational, and emotional or the nature of the sports. Thus, in subsequent research with more complex tasks and factors, it was found that less than 50% of studies provided supportive findings. Therefore, this theory has long been superseded.

Catastrophe theory (Hardy & Fazey, 1987). Catastrophe theory was derived from a French mathematician, Rene Thom (1975), but was adopted into sport contexts by British sport psychologists Hardy and Fazey in 1987 (Hardy, 1996). The main objective of this theory is to provide a three-dimensional descriptive model to seek a relationship between cognitive anxiety, physiological arousal and sport performance (Hardy & Parfitt, 1991). In the catastrophe model, the level of performance can be represented like a mountain surface. Performance is represented on the vertical axis, whereas physiological arousal rises from left to right, and cognitive anxiety rises from the back to the front. When cognitive anxiety is low, performance takes the shape of a shallow ‘inverted U’. However, as physiological arousal increases so too does performance until the optimum level. The performance will follow the ‘inverted U’ profile until just over the optimum arousal level, and then drops off the edge of the performance surface. This catastrophic fall is where the theory gets its name. The model proposes that cognitive anxiety acts as a splitting factor, which determines whether the effect of physiological arousal will be small and smooth, or large and catastrophic (Hardy & Parfitt, 1991).

The striking aspect of the catastrophe theory is that it considers physiological arousal rather than somatic anxiety. Physiological arousal could influence performance by two different paths. Firstly, it could cause "direct hit" effects upon performance by altering the cognitive and physiological resources (Hardy, Parfitt, & Pates, 1994; Parfitt, Jones, & Hardy, 1990). Next, it could also influence performance through performers' positive or negative interpretations of their physiological symptoms (Bandura, 1977). This model allows the possibility that physiological arousal may influence a performance, either directly or indirectly. Thus, this could be a major limitation, as it does not take into account autonomic reactions of the emotional response to involuntary, unconscious functions of internal systems and organs, which are mediated by the peripheral part of the nervous system. Besides, the lack of information regarding the relationship between physiological arousal induced by competition and cognitive anxiety might be another concern of the catastrophe model (Binboga, Guven, Catikkas, Bayazit, & Tok (2012).

From the catastrophe theory, when cognitive anxiety is high, there will be catastrophic effects on performance. Physiological arousal will then reach a higher level. It can also deal with the fact that in sport, players can suffer from “choking”, a sudden dramatic inability to “get their game together”. One famous example of this occurred in the 1993 Wimbledon tennis final between Jana Novotna and Steffi Graf. Novotna appeared to be cruising and needed one more point in her service game to go 5–1 up in the final set. Going for broke on her second serve, she double-faulted and lost the game, and every remaining game, to throw away the championship. In addition to accounting for catastrophic losses in performance the theory helps us to understand why recovery from a catastrophic drop in performance is likely to require more than simply reducing anxiety back to pre-catastrophic levels. Finally, the theory can also explain why cognitive anxiety is sometimes positively related, and sometimes negatively related, to performance.

Multidimensional anxiety theory (Martens et al., 1990). Recent research on anxiety-performance relationship proposed that anxiety is not a unitary concept but made up of a mixture of a cognitive and a somatic component that make it necessary to create new ways of thinking about the relationship. Sport psychologist Rainer Martens took up the challenge and developed a theory known as multidimensional anxiety theory (Martens et al., 1990). This theory claimed that the relationship between anxiety and performance takes a different form for the two types of anxieties. It was proposed that cognitive anxiety would always be detrimental to performance, and that the relationship between cognitive anxiety and performance would be negative and linear. In contradistinction, the somatic component of anxiety was predicted to relate to performance in a curvilinear way, taking the form of an “inverted-U hypothesis”. Studies investigated whether these two different forms of the extant relationship have produced a mixed result. Strong support for the theory would be provided if both predictions were confirmed within the same study. This has occurred in only one or two cases (Burton, 1988). More often studies find support for either the cognitive prediction, or the somatic prediction, but not both. In direct contradiction to the theory, some research has demonstrated that cognitive anxiety is associated with improved performance. Still other studies showed no significant relationship between anxiety and performance at all. Craft, Magyar, Becker, and Feltz (2003) conducted a meta-analysis of the relationship between CSAI-2 scores and performance, which showed only a small correlation between performance and both somatic and cognitive anxiety (see Craft et al., 2003). Another problem is that anxieties cannot always be deteched from an observation in a sport scenario. For example, as anxiety arises, the performance does not gently fall away, rather it slumps dramatically, such as predicted in the "Catastrophe theory". Thus, researchers argued that cognitive anxiety, which relates to worry issues, does match expectations; thus, the self-evaluation should raise cognitive anxiety without directly affecting somatic anxiety. Similarly, because of its nature, the precursors of somatic anxiety are argued to be those features of the sporting environment that have become a conditioned stimuli, which is associated with the competitive situation.

Arousal and Sport Performance

As discussed above, athletes' arousal levels are important in terms of attaining a high level of performance; the level of arousal is different between sports, skills, motivational level, levels of competition, and personality. Therefore, if the athletes' arousal levels are not optimal, whether moderate, low or high in absolute terms, their performance may suffer. For example, Neumann and Thomas (2009) conducted a study on the effect of individual differences in skill level for golf putting. They found that immediately prior to the putt, experienced and elite golfers showed a pronounced phasic deceleration in heart rate, greater heart rate variability in the VLF band, and a greater tendency to show a respiratory pattern of exhaling compared to novice golfers (fine-motor sport). Therefore, the individual differences in arousal are not only different in psychophysiological measurements, the differences can also impact on the performance.

In many fine motor sports skills, the heartbeat pattern has been closely associated with superior performance. For example a slow HR is linked with good shooting performance in elite archery and pistol shooting (e.g., Kruse et al., 1986; Tremayne & Barry, 2001). Similar patterns were shown in other fine motor skill sports, such as billiards, bowling, golf putting, and snooker (Boutcher & Zinsser, 1990; Hatfield et al.,1987; Neumann & Thomas, 2009).

There are some strategies used to manage arousal levels, which can also be applied to manage anxiety. Landers and Arent (2001) suggested that relaxation training, imagery, and self-talk, are effective strategies to manage arousal levels. Jones (1976) found that concrete self-suggestions and imagery can be effective in raising or lowering PT. Peper and Schmid (1983), who studied the positive effects of PT, EMG, and HR with progressive relaxation, autogenic training, and imagery among members of the US rhythmic gymnastics team, reported that these combinations of psychological training created relaxation in the gymnasts who were able to control their arousal levels and reenergise, which then enhanced their athletic performance. Blumenstein, Bar-Eli, & Tenenbaum (1995) demonstrated some positive effects of combining EMG biofeedback training with sedative music, and showed that the combination is effective in terms of managing arousal levels. Singer (2002) suggested seven strategies, which are useful for managing arousal levels (Singer, p. 367). By using these strategies, Singer found that it increases athletes' perception of control over their performance, reducing the cognitive effects of arousal, and the physical and behavioural elements. As a result, athletes who carried out the strategies could execute a particular skill (e.g., shooting an arrow) automatically, with little conscious input to disrupt their skilled performance. In addition, Pineschi and Pietro (2013) discussed the use of relaxation and psyching-up techniques within the scope of support by Brazillian sport psychologists with different Olympic sports' athletes showed athletes successfully reduced their arousal level leading to improvement of their sporting performance.

In conclusion, athletes' arousal levels seem to influence subsequent performance. Based on the theory and research, optimum arousal differs among athletes. Useful strategies such as relaxation, imagery and self-talk, can be used by athletes to increase or decrease their arousal levels.

Music in Sport

Introduction to Music

Music has been widely used since ancient times as a catalyst for stimulating the emotions and responses, and facilitating rest and relaxation. Greek philosophers from the fifth century BC began to prescribe different types of music to be played for different hierarchical positions in social groups (The Larousse Encyclopedia of Music, 1992, p. 63). The "mode" in which the music was written was also thought to have specific health benefits. For example, Plato (428BC-348BC) declared the Dorian mode fitted steadfast endurance, whereas the Phrygian mode was considered fitting to acts of peace and acquiescence (The Larousse Encyclopedia of Music, 1992, p.87). In that early period, music was already highly regarded as an important element in the formation of moral fibre in society, and Plato attributed to it the following:

> Music is a moral law. It gives a soul to the universe, wings to the mind, flight to the imagination, a charm to sadness, and life to everything. It is the essence of order, and leads to all that is good, just and beautiful, of which it is the invisible, but nevertheless dazzling, passionate, and eternal form. (Wordsworth Dictionary of Musical Quotations, 1991, p.45).

Over the intervening centuries poets, playwrights, and authors have also written about the power of music to alter moods and excite the human senses. “If music be the food of love, play on” wrote Shakespeare (Twelfth Night, 2000, Act 1, Scene 1, p. 42), and “Music hath charms to soothe a savage breast, to soften rocks, or bend a knotted oak” (Congreve, The Mourning Bride, 1697) are two timeless testaments to the effects of music on human emotions.

Some people called music a “universal language”, although this might not be literally correct, as it clearly does not have the same syntactic and sematic structure of formal communicative language. However, music does share some characteristics with language. For example, Arieti (1976) claimed that music is an extension of speech, especially in regard to intonation and articulation. Music is also strongly related to movement, rhythm, and dance (Areiti, 1976). Additionally, music is commonly used in social functions, such as ceremonies, marriage celebrations, or even courtship. Radocy and Boyle (1997) suggested that music also performs a role in highlighting individuality and individual expression, and in this respect may reinforce personal identity, and emotional expression, at the same time as giving voice to the inner psychological processes.

Since the 1950s, physicians have been measuring the effect of music on physiological functions of the body, such as heart rate and respiration (Rodocy & Boyle, 1988). The key element of such research has been the playing of recorded music. In fact, recorded music has been a preferred independent variable in the measurement of emotional responses to music, since it can be controlled. In reference to music listening, Merriam (1964) asserted that "There is probably no other human cultural activity which is so pervasive and which reaches into, shapes and often controls so much of human behavior" (p. 218).

According to Australian pioneers in music therapy research, Grocke and Wigram (2007) music influences all aspects of the person simultaneously, causing direct effects on their physical, psychological, cognitive, social, developmental, aesthetic, and spiritual domains. Therefore, listening to music can promote psychological insight, enhance relaxation, evoke imagery, structure movement, alter mood, summon memories, assist learning, facilitate transcendence, reduce heart rate and blood pressure, and foster creativity. Grocke and Wigram (2007) stated that "as our hearing is the most enduring and pervasive of the senses in our body, even a person who is not conscious about the music could also benefit from the music. Even those people who are impaired in hearing may also feel the vibrations created by music" (p.18).

Classical Music

Classical music, has been reported as an effective tool for relaxation and stress reduction, resulting in self-reported, behavioural, and physiological changes that are related to reduced stress (Hanser, 1985). Allen and Blaskovich (1994) found that listening to classical music was associated with reductions in autonomic activity and self-reported tension, resulting in the improvement of surgeons' performance. Similarly, McCraty, Barrios-Choplin, Atkinson, and Tomasino (1998) also reported that listening to classical music can reduce self-reported fatigue, sadness, and tension. According to Labbe, Schmidt, Babin, and Pharr (2007), listening to relaxing classical music after exposure to a stressor will result in significant reductions in the levels of arousal, anxiety, anger, negative emotional states, and instead lead to increased relaxation compared to those who sit in silence or listen to heavy metal music. The use of classical music in 13 weeks of guided imagery and music therapy reportedly led to a significant reduction in serum cortisol level (McKinney, Antoni, Kumar, Tims, & McCabe, 1997).

Although there has been some debate about whether the listener's preference of the music selection relates to experiences of physiological change, the conclusions are still unclear, with some studies reporting the degree of enjoyment of the music as positively related to the degree of relaxation that listeners' self-report (e.g., Stratton & Zalanowski, 1984; Allens & Blaskovich, 1994). Researchers mentioned that the presence or absence of choice over the use of classical music appears neither to facilitate nor to inhibit the degree of relaxation (Cassidy & Macdonald, 2009; Thaut & Davis, 1993; Scheufele, 2000;

Smolen, Topp, & Singer, 2002). Nevertheless, it was demonstrated that calm and soft classical music is a useful tool in alleviating pain and anxiety (Cooke, Chaboyer, & Hiratos, 2005; Hart, 2009). Classical music is a useful accompaniment to relaxation techniques, such as visual imagery in coping with anxiety and stress management (Cooke et al., 2005; Karagozoglu, Takyasar, & Yilmaz, 2013).

Music Used for Enhancing Sport Performance

Music is closely associated with sports, and has been proposed to have integral roles in many sports, including for motivation; entertainment purposes; eliciting patriotism and pride through national anthems; and enhancing the psychological state of athletes to participate in sports (Karageorghis & Terry, 1997; Karageorghis et al., 2009; 2012a). The benefits of music include lowered perceived effort, arousal control, improved affective states, and synchronization effects (Boutcher & Trenske, 1990; Copeland & Franks, 1991; Karageorghis & Terry, 1997). Researchers have also found that music affects mood (Karageorghis & Terry, 1997), self-esteem (Snyder, 1993), and confidence of exercisers (Becker et al., 1994; Lampl, 1996).

There are four distinctive effects that music has in enhancing the quality of exercise behaviour. These effects include distraction from the sensation of fatigue; increased levels of arousal; stimulation of motor coordination and synchronization; and increased relaxation (Copeland & Franks, 1991; Karageorghis, Jones, & Low, 2006; Thompson, Schellenberg, & Husain, 2001; Szabo & Hoban, 2004). Burns et al. (1999) studied the effects of different types of music on relaxation levels, skin temperature, and heart rate to show that classical and self-selected relaxating music can increase the perceptions of relaxation to a greater degree than listening to hard rock music. No differences were found, however, between the effects of different types of music on the physiological indicators of arousal. Although both kinds of music (classical and relaxing music) have shown facilitating effects on relaxation, these mechanisms are still not well understood. This creates a gap in the literature related to the appropriate music to promote particular effects on the performance of different sport tasks.

Researchers have shown equivocal results on the effects of different types of music on the performance of various sport tasks. Several studies show that fast-tempo music has an enhancing effect on performance, whereas slow tempo music facilitates relaxation, which is not beneficial to the performance of strength/power/endurance tasks (Beaver, 1976; Ferguson et al., 1994; Karageorghis et al., 1996). Becker et al. (1994) found that both up-tempo and slow-tempo music types are associated with improved performance when compared to white noise. Tenenbaum et al. (2004) claimed that music (rock, dance, inspirational) enhances physiological and psychological responses in running perseverance and coping with effort sensations. In contrast, Copeland and Franks (1991) found that loud and fast music did not enhance physiological and psychological responses in sub-maximal exercise, during an endurance task on a treadmill.

Despite the past conflicting findings, recent research has shown a strong positive correlation between musical tempo, mood, and sport performance

(Butler, 2009; Karageorghis et al., 1999; Karageorghis, Vencato, Chatzisarantis, & Carron, 2005; Shaulov & Lufi, 2009). Schneider, Askew, Abel, and Struder (2010) found a significant relationship between intrinsic and extrinsic oscillation patterns during exercise when using specific types of music. They suggested that when an approximately 3 Hz frequency is dominant in the EEG, the different physiological systems (heart rate and brain cortical activity) would trigger pleasurable mood by using participants' favourite musical pieces. This was in line with other research showing that an adequate choice of music during exercise enhances performance output and mood (Butler, 2009; Karageorghis et al., 1999; Schneider, Mierau, Diehl, Askew, & Struder, 2009).

Many factors other than tempo have also been associated with arousal related to music. Dorney et al. (1992) found that heart rate was significantly lowered during dart-throwing performance after listening to slow classical music. Fontaine and Schwalm (1979) found familiar music increased heart rate and vigilance performance (focusing task) when compared to unfamiliar music. In contrast, Crust (2004) found no significant difference between familiar music and unfamiliar music in incremental treadmill walking, although both music conditions showed significantly longer distances walked, in comparison to white noise.

The ergogenic effect of music on high intensity exercise also extends to elite sports persons. For example, elite runner, Haile Gebrselassie, used a high-tempo popular music song to synchronise his strides in order to optimise his pacing in winning a 5000m race in 2003 (Simpson & Karageorghis, 2006). Asynchronous music, defined as a situation in which there is no conscious effort to synchronise movements with music tempo, is also suggested to carry this performance-enhancing effect (Karageorghis & Priest, 2012b). In another unrelated study, in this case on music and video for recreational gym users, Barwood, Weston, Richard, and Page (2009) found a significantly greater improvement with the motivational music plus video group (MMV) than the control group. Results showed that the MMV group ran significantly further and had greater improvement in the tolerance of high intensity exercise in motivational music plus video group than the control group.

Studies on the differences between men's and women's responses to music experience have shown conflicting results. Some research conducted in sport studies (e.g., Crust & Clough, 2006; Elliott, Carr, & Orme, 2005; Karageorghis et al., 2006) showed that men and women differ in response to specific emotions, whereas others failed to find differences (e.g., Tenenbaum et al., 2004). Nater, Abbruzzese, Krebs, and Ehlert (2006) examined the different reactivity responses of 53 participants and found no differences in physiological variables (e.g., heart rate, electro-dermal activity, salivary cortisol, and salivary alpha-amylase) between male and female participants. However, a psychometric evaluation showed that women are more stress-reactive than men. This study might indicate that women are predisposed to react more sensitively to aversive emotional stimuli, such as unpleasant arousing music (Bradley et al., 2001a; 2001b; Kring & Gordon, 1998; Nater et al., 2006). In another unrelated study, Bradley et al. (2001), found that women are more defensively reactive to unpleasant pictures than men. Although there was no significant difference regarding the measures of electrodermal activity and galvanic skin responses, Bradley et al. observed a greater facial electromyographic reaction. Thus, with the equivocal results on the differences between men and women on the use of music, it is suggested that a great deal more work is needed to interpret the psycho-physiological mechanisms that underlie the emotional responses.

Using rating procedures, Karageorghis and colleagues have developed measures to assess the motivational qualities of music. The Brunel Music Rating Inventory (BMRI; Karageorghis et al., 1999) has been used with the intention to providing exercise leaders, sports coaches, and researchers with a standardised method to prescribe music intended to have motivational effects of improved emotion, reduced perceptions of exertion, and arousal control. Following these studies, the Brunel Music Rating Inventory-2 (BMRI-2; Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006) was employed with exercise instructors and sports and training participants. Karageorghis et al. (1999) suggested that using these inventories to select music for appropriately designed experimental investigation would provide more positive and consistent results, whilst also increasing the generalization of research findings in the areas of music and sports. More recently, an updated version of the inventory, BMRI-3 (Karageorghis, 2008), was published to allow researchers to specifically identify music tracks that induce a motivational impact upon athletes during sports performance. Motivational tracks are thought to include a high tempo beat (>120bpm), a strong rhythm, and to enhance energy and induce bodily action (Karageorghis et al., 2006). Further influential characteristics of music have been suggested to include the rhythm response, musicality, cultural impact, and association with the tracks (Karageorghis et al., 1999). Therefore music tracks that encompass all of these aspects can optimise moderate intensity exercise performance. For the past 10 years, over 30 studies have applied the BMRI to select music for experimental conditions, and its use has generally been encouraging. Motivational music appears to be associated with greater increases in 400-metre sprint performance, and distance travelled during sub-maximal exercise, than no-music control (Crust & Clough, 2006; Elliott et al., 2005; Simpson & Karageorghis, 2006). These results suggest that motivational music is subtle in nature and can contribute to increases in endurance and physical work.

Lane, Davis, and Devonport (2011) examined the effects of music interventions on emotional states and running performance in 65 volunteer participants. They reported increased pleasant emotions and decreased unpleasant emotions following music intervention. Significant performance improvements were also demonstrated among participants who reported a belief that emotional states relate to performance. This finding suggested that athletes and practitioners should consider using the BMRI-2 when selecting music for running.

Most recently, Karageorghis and Priest (2012a; 2012b) have published a review showing the development of the conceptual approaches and mechanism underlying the use of music on endurance type activities, self-selected, motivational, and stimulating music, which has been shown to enhance effort, reduce ratings of perceived exertion, improve energy efficiency and lead to increased work output. Some guidelines and recommendations for future research were also suggested (Karageorghis & Priest, 2012a; 2012b).

Music, Arousal and Sport Performance

The potential of music affecting listeners' arousal levels still contains much uncertainty and music research in the sporting arena indicates the relationship between arousal and performance is complex and dependent on the types of task and sport skills. More researchers have supported than opposed the hypothesis that musical structure affects physical responses, which will then elevate or depress the listeners' psycho-physiological states (Ritossa & Rickard, 2004). Music is also a highly potent stimulus, capable of inducing a variety of emotions. Studies have used music as a stimulus to facilitate a variety of emotional states (Gendolla & Kruesken, 2001; Gomez & Danuser, 2004; Khalfa et al., 2002). However, emotions that are enhanced by music can also be distinguished placing them at different locations on the orthogonal arousal–valence dimensions of mood (Krumhansl, 1997; Nyklicek, Thayer, & Van-Doomen, 1997). Music is also affected by other agents carrying an emotional tone. For example, high intensity (loud music) and fast tempo music can also lead to higher energy and arousal, which suggests that a high-arousal emotion may lead to higher excitement and enthusiasm, while slower or quiet music may lead to relaxation or calmness.

On the other hand, music that is commonly considered arousing, such as hip hop, techno music, and heavy metal, is known to exert arousal in physiological systems and does not commonly induce positive feelings (high arousal–low valence). For example, Gerra et al. (1998) showed that listening to techno music resulted in significant increases in heart rate, norepinephrine, cortisol, and adrenocorticotropic hormone, but did not induce positive feelings, such as satisfaction and happiness. However, at this time, only a small number of physiological parameters have been investigated - an approach that does not take into account the multi-faceted physiological reaction patterns that might be observed while listening to musical stimuli.

Bishop, Karageorghis, and Loizou (2007) conducted a study of music and performance that provided a rationale for the manipulation of emotional responses to music in junior tennis players. They suggested that the junior tennis players used music as a tool to “psych up” in preparation for performance (arousal regulation), shift attention focus (association/dissociation), boost self-efficacy, and encourage psychological skills use (mental imagery). Bishop showed that the use of appropriately selected music could induce an ergogenic effect (Bishop, Karageorghis, & Loizou, 2007).

Terry, Dinsdale, Karageorghis, and Lane (2006) examined the types of music that competitive athletes from a wide range of sports listened to, found that 24% of athletes preferred to listen to “fast up-beat” music, with 21% reporting a preference for “soft, slow” music. Lane (2008) found that endurance runners prefer to use music that associates with the emotional states they experienced during successful performance. Lane also found that an hour before competition, the runners often listened to slow sedative music when their goal was to feel calm before competition. Instead, runners usually increased the tempo and selected tracks with inspirational lyrics when they desired to feel invigorated before their competition. In addition, runners often selected musical tracks in accordance with their pacing strategy, which involved listening to songs with a moderate tempo at the start of the race as a reminder not to start too quickly, and then switching to higher tempo songs when the race began. Thus, Lane (2008) concluded that the "right" music is effective to help establish emotional states and pacing strategies required at different points of the competition.

The Use of Music in Imagery

According to music therapists, music forms a natural link with imagery (see Grocke & Wigram, 2007). In music therapy settings, the use of selected music has been demonstrated to have relaxing and sedative effects (Guzzetta, 1989; Rolvsjord, 2004). This leads to the possibility of imagery occurring when a person is in a relaxing condition. Thus, the musical stimulus will create an effect on the visualization or imagery (Rolvsjord, 2004).

Osborne (1981), who conducted two qualitative studies using content analyses on the response of music to mind mapping, characterised the data into thoughts, emotions, sensations, and images in response to music. He asked 43 participants to listen to synthesised music under relaxed conditions, and to write down their responses. He reported that the participants experienced more images (reported significantly more in the images category) when listening to music than they experienced thoughts, emotions, or sensations, and suggested that music could facilitate the production of imagery. Quittner and Glueckauf (1983) carried out a study exploring the facilitative effects of music on visual imagery. They found that participants reported more visual imagery on the Creative Imagination Scale (CIS) when listening to music than when in a relaxation control condition (using the shortened version of Jacobsen's [1938] progressive muscle relaxation technique). Quittner and Glueckauf's results were replicated to some extent by Tham (1994), who reported significantly higher movement imagery vividness for a music with imagery group, when compared to a no music control group. The three studies above, however, failed to mention the types of music, how the music was selected, the imagery instructions, or the types of imagery used in their studies. Strong evidence was shown that carefully selected music for imagery, played just before a performance, could facilitate the performance. According to Karageorghis, Smith, and Priest (2012c) music can be used as a medium to promote imagery.

Guided Imagery with Music

Guided Imagery with Music (GIM), also known as the Bonny Method of Guided Imagery and Music (Bonny, 1989), is a specialised music therapy method that has been systematically and specifically developed by Helen Bonny since the 1970s (Goldberg, 1994; Short, Gibb, Flides, & Holmes, 2012). In GIM, clients often experience a dynamic unfolding of images in response to a specific program, usually using classical music excerpts (Bruscia & Grocke, 2002). GIM has become a popular alternative especially in therapeutic settings and it has been shown to have effects on patients' behaviour and mood, as well as emotional, physiological, and cognitive state (Marr, 2001). For example, GIM reduces anxiety, alleviates pain, reduces drug dosages, promotes well-being, improves psychiatric patients' symptoms, alleviates depression, and promotes rehabilitation and recovery (Grocke & Wigram, 2007). The Bonny Method is a process focusing on the conscious use of imagery arising in response to a formalised program of relaxation and classical music. It had also been used successfully to reduce depression, fatigue, and to alleviate total mood disturbance, as identified by the POMS (McNair, Lorr, & Droppleman, 1971), and blood cortisol levels (McKinney et al., 1997). Burns (2001) explored the effectiveness of the Bonny Method in alleviating mood disturbance and improving quality of life in cancer patients. Eight volunteers with a cancer history were randomly assigned to either an experimental or a waiting list control group. Experimental participants took part in 10-weeks of GIM sessions. All participants completed the POMS (McNair et al., 1971) and Quality of Life-Cancer (QOL-CA; Padilla, Grant, & Ferrell, 1992) questionnaires pre-test, post-test, and at a 6-week follow-up. Individuals participating in GIM sessions displayed greater improvements in mood and quality of life scores at post-test than control participants. Additionally, mood and quality of life scores continued to improve in the experimental group, even after sessions were complete. Burns contended that GIM was effective in improving mood and quality of life in these cancer patients. Recently, Karagozoglu et al. (2013) reported that music therapy and guided imagery had not only been found to be effective in many health programs, the technique is also effective in decreasing patients’ state and trait anxiety levels significantly and reduced chemotherapy-induced nausea and vomiting significantly. They suggested that these approaches are beneficial for reducing anxiety problems, and recommended them as an effective treatment in the medicine and health care settings (Karagozoglu et al., 2013).

Music and Imagery in Sport-Related Task

There is much literature reporting on the effective use of imagery in applied research, but only few studies have been conducted on the use of imagery with music for enhancing sporting performance. There are, however, many sport practitioners who do incorporate music into imagery training, especially in the applied setting, however the music used is often not reported. For example, an imagery for peak performance CD by Thompson (1995), and a guided imagery to achieve peak performance CD, by Miller (1997) both incorporated soft music in the background together with the pre-recorded script.

According to Karageorghis et al. (2012c) more than 40 studies have been conducted on the effect of music in sports performance. However, most studies have been focused on the use of music for simulative or motivational qualities. I found no research that has examined the effect of music per se or the characteristics of music that reduce arousal for imagery training. In somewhat related research, Dorney et al. (1992) examined the effect of music in two studies. In the first study, they examined the effects of two types of music (slow and fast) on heart rate and dart throwing performance and found that music did not have an effect on dart throwing performance. In the second study, Dorney et al. examined the effect of imagery with music and a no music condition on a muscular endurance sit-up task, and found that performance in the task improved equally across both groups, regardless of the use or absence of music. In addition, the imagery with music group showed a significant increase in heart rate during preparation but heart rate was not related to task performance. Dorney et al. concluded that music might have affected arousal during imagery. Limitations of the studies by Dorney et al. are that they did not report on the key characteristics of the music and also the type of music used.

Blumenstein et al. (1995) randomly assigned 39 college students to three treatment groups (autogenic training plus imagery training; music plus imagery training; autogenic training, music, and imagery training), one placebo group, and a control group. Imagery was related to a 100m sprint. Treatment and control conditions each comprised 13 sessions of 20 min in duration. During the first seven sessions, participants in the treatment groups underwent 10 min of relaxation followed by 10 min of excitation. During the last six sessions, similar treatment was provided accompanied by frontalis EMG biofeedback. Heart rate, galvanic skin response, EMG, and breathing frequency were recorded at three points during each session. In addition, an athletic task (100m run) was examined at the outset, after seven sessions (no biofeedback), and after an additional six sessions (with biofeedback). Biofeedback was found to have a significant effect on physiological measures (HR, EMG, GSR, and breathing frequency) and athletic performance when accompanied by autogenic training, music, and imagery training. However, the study by Blumenstein et al. is rather convoluted with many interacting variables. This makes it difficult to draw specific conclusions about the effect of music during the imagery.

Karageorghis and Lee (2001) compared the effects of motivational music, imagery, and a combination of motivational music and imagery on an isometric muscular endurance task, requiring the participants to hold dumbbells in a cruciform position for as long as possible. They found that the combination of music and imagery yielded greater endurance than music alone, imagery alone, and a control condition. The imagery involved imagining holding dumbbells in the cruciform position for an extended period of time. However, it was unclear if the music and imagery interacted in some way to produce an ergogenic effect, or if the enhanced endurance effect was merely due to the summation of the motivational impact of the music and the motivational impact of the imagery. Nevertheless, Karageorghis and Lee stated that music may be a useful performance-enhancement strategy that can be integrated with imagery in a pre-performance preparation routine.

Almeida, Calomeni, Neto, Castro, and Silva (2008) investigated the effects of imagery associated with 10 sessions of music over three weeks in improving basketball free-throw shooting performance in two different age groups: 13 – 15 and 18 – 31 year-olds. The music used was the favourite musical rhythms selected by each participant. Participants performed 10 free throws before and after the imagery with music. The results from the inter-group analysis between the pre- and post-imagery intervention performance tests showed significant improvement in basketball free-throw performance ($p < 0.03$) for both age groups. Almeida et al. also found that the adult age group performed at a higher level in the shooting task and in their imagery ability measured by MIQ-R. However, a major limitation of this study was that Almeida et al. did not report key characteristics of the music. It was also surprising that they obtained significant differences for performance with as few as 10 trials at pre- and post-test.

In applied sport psychology work, Pain, Harwood, and Anderson (2011) examined pre-competition imagery with added music into the imagery script in facilitating flow state and performance. Five male soccer players participated in a single-subject multiple-baseline across individuals design with multiple treatments and without reversal. Pain et al. asked the soccer players to rate their subjective thoughts on their game, using a 5-point Likert-type rating scale. Pain et al. found that MG-M imagery combined with asynchronous music had a facilitative effect on flow and participants' perceived performance.

Recently, Karageorghis et al. (2012c) examined the effect of using voice enhancing technology (VET) and relaxing music during imagery among break-dancers, and found that the imagery intervention with VET and relaxing music improved the efficacy of relaxation and performance of the break-dancers compared to the control condition (without VET and relaxing music). They concluded that imagery with music seemed to have effects on sporting performance and this gives opportunity for future researchers to conduct research into this area.

The Present Thesis

Imagery is a PST technique that is widely used by athletes to enhance their performance. It has been studied intensively in sport for many years (e.g., Morris et al., 2005). More recently sport psychology researchers have developed research on the impact of music on sports performance (see Karageorghis et al., 2012a, 2012b). However, there is little research on the potential of music to enhance imagery, and its consequences in relation to performance. I found no published research examining the effect of relaxing or arousing music on imagery and performance, although several other lines of research suggest that music might have a facilitative effect on imagery, and the relaxing or arousing quality of music is considered to be an important variable. Further, I did not identify any research in the literature that has examined the effect of different types of music on imagery for performance of different types of sport tasks. This is noteworthy because it could be that different types of music, e.g., relaxing and arousing music, familiar and unfamiliar music, affect imagery for performance of different types of sport tasks, e.g., tasks usually performed most effectively with high levels of arousal and tasks usually performed most effectively with low levels of arousal, in different ways.

The use of music in preparation for competition in sport is not a new issue in the sport arena. This is usually based on the assumption that music has emotive and arousing qualities that can enhance performance. The imagery-enhancing qualities of different types of music may be more relevant. An important factor that should be considered is that studies on the effect of music on imagery and sports performance should be conducted away from the performance task. Most studies done on music and imagery (e.g., Almeida et al., 2008; Dorney et al., 1992) have measured performance straight after participants incorporated imagery with music, so the music could have affected the task directly, rather than the music influencing imagery, which then affected performance. To examine the effect of music during imagery on performance, without the risk of confounding effects of the music on performance, participants must undertake the music and imagery training away from performance, and performance should be measured separately at another time. In addition, it is important for studies examining the effect of music on imagery to conduct manipulation checks on the impact of the music. This can be done using physiological measures to monitor arousal level, if it is posited that the music affects arousal level, and by using psychological techniques, such as self-reports of the subjective experiences associated with performing imagery with music.

It is important to devise effective imagery interventions that stimulate vivid and controllable imagery. Many sport psychologists have argued that VMBR, which combines relaxation training and multi-sensory imagery training, shows the importance of relaxation for effective imagery (Perry & Morris, 1995). On the basis of the research of Lampl (1996) and Meyer (1994), the indication is that relaxing music could facilitate relaxation, thus, also facilitating the effectiveness of imagery training. Conversely, arousing music could also facilitate arousal, which could then be associated with the performance task. In this way arousing imagery could create positive effects in imagery training for tasks involving power or muscular strength for maximal power/speed sports (e.g., shot-putt, javelin, sprinting); however, it may be counterproductive for activities involving high levels of concentration or co-ordination (e.g., shooting, archery). Thus, the types of music chosen for optimum effects of imagery training may be influenced by the characteristics of the sport. There is a need for research to examine whether there is a relationship between the type of music and the type of sports task, when studying the effects of music on imagery training for sports tasks. Although, as proposed by Karageorghis et al. (1999, 2006), motivational music and familiar music have been demonstrated to influence selection of music, unfamiliar music, which is more obscure and not likely to be known by participants, should minimise the confounding effects of familiarity and past associations.

In this thesis, I aimed to examine the role of relaxing and arousing music during imagery for the enhancement of sport performance through three linked studies. I conducted Study 1 with the aim to identify unfamiliar classical music that was considered to be particularly relaxing or arousing based on a systematic process. First, expert musicians, sport psychologists, and sport science students were involved in a three-stage process to select and confirm appropriate excerpts. Then skilled shooters performed imagery with each type of music, and familiar arousing classical music. I monitored physiological and psychological aspects of the relaxing and arousing music during imagery to examine whether the music excerpts affected arousal level as expected. I predicted that the excerpts of relaxing music would lead to a reduction in level of arousal during imagery, whereas the arousing music excerpts would lead to an increase in level of arousal during imagery. I also predicted that there would be no significant difference between the level of arousal for unfamiliar arousing classical music and familiar arousing classical music.

In Study 2, I aimed to examine whether unfamiliar relaxing and arousing classical music during imagery affected performance of a fine-motor sport task. In this study, independent groups performed imagery based on the same imagery script accompanied by either unfamiliar relaxing classical music, unfamiliar arousing classical music, or no music. There were 12 sessions of imagery. I monitored physiological arousal throughout Session 1 and Session 12 and measured subjective perception of arousal using a measure of state anxiety. I tested performance before Session 1 and after Session 12. I predicted that relaxing music during imagery would lead to a reduction in physiological and psychological measures of level of arousal, whereas arousing music would lead to an increase in level of arousal. Based on the proposition that arousal during imagery would have the same effect on performance as arousal before or during actual performance, I predicted that relaxing music during imagery would lead to a significantly greater gain score for performance than arousing music in the fine-motor sport task.

Finally, in Study 3 of the thesis, I aimed to examine whether relaxing and arousing music during imagery would have different effects on level of arousal and performance, depending on the type of sport task, based on the same proposition that arousal during imagery would have the same effect as arousal level during actual performance of the task. Participants were highly skilled performers in a fine-motor sport task and an explosive power sport. Half the participants in each sport performed imagery accompanied by relaxing music and half performed imagery accompanied by arousing music. Again, I monitored physiological indicators of arousal during the whole of Session 1 and Session 12 of a 12-session imagery with music training program and psychological measures of arousal before Session 1 and after Session 12. I predicted that arousal level would be reduced when participants in either sport performed imagery with relaxing music, whereas arousal level would be increased when the athletes performed imagery with arousing music. Based on the proposition that subsequent performance is facilitated by levels of arousal during imagery that match the optimal level of arousal for actual performance of the task, I predicted that for the fine-motor task, there would be a significantly greater gain in performance with relaxing music than arousing music during imagery, whereas for the power sport, there would be a significantly greater gain in performance for imagery performed with arousing music than relaxing music.

CHAPTER 3

EXPLORATION OF THE AROUSING AND RELAXING PROPERTIES OF MUSIC DURING IMAGERY

Researchers have suggested that music can be carefully selected to match the requirements of activities and characteristics of both individuals and groups, in order to produce significant impacts on performance enhancement (Crust & Clough, 2006; Karageorghis et al., 1999; Priest, Karageorghis, & Sharp, 2004). Furthermore, music has been shown to have psychophysical effects of lowered perceived effort and arousal control, and improved affective states and synchronization effects (Boutcher & Trenske, 1990; Copeland & Franks, 1991; Karageorghis & Terry, 2011). There is increasing evidence to suggest that the "right" music, can lead to greater frequency, intensity, and duration of exercise behaviour (e.g., Atkinson, Wilson, & Eubank, 2004; Szabo, Small, & Leigh, 1999; Tenenbaum et al., 2004), which could then lead to enhanced sporting performance. Although there is also evidence that music can affect imagery (e.g., Dorney et al., 1992; Grocke & Wigram, 2007), no research examining the impact of relaxing and arousing characteristics of music on imagery has been identified. Before the impact of relaxing and arousing music on imagery for performance enhancement can be investigated, it is necessary to demonstrate that certain pieces of music are consistently arousing across occasions and between people, whereas other pieces are consistently relaxing. As a precursor to examining the effects of music on imagery, the purpose of this study was to examine the effects of music subjectively judged to be relaxing and arousing on the level of arousal measured by physiological indicators and subjective psychological perception of arousal during imagery of a shooting task in elite shooters.

Method

Stage 1: Preliminary Study to Select the Relaxing and Arousing Classical Music Excerpts

Ethics approval was obtained from the Victoria University Human Research Ethics Committee (VUHREC) for all procedures employed in this study, and all participants were required to provide written informed consent before the study commenced.

All the music used in this study was classical music, also known as traditional Western liturgical and secular music (Taruskin, 2005). Although there are a broad variety of forms, styles, genres, and historical periods, classical music tends to be written by composers and performed by musicians who are typically highly literate in understanding notation and the written quality of music, and it contains a higher level of complexity than other types of music, which includes modern music, such as folk, blues, and rock. Classical music can be classified into a number of types, including concertos, symphonies, sonatas, operas, dance music, suites, etudes, fugues, and symphonic poems. Thus, even though classical music can be highly arousing, that is, having a driving beat to increase the physiological and psychological states of anxiety, excitement, and emotion, the elements of music that stimulate the level of arousal will only be limited to structural notation. Classical music also has fewer changes in chord progression, unlike modern music which can include various forms of improvisation and rhythmic flexibility, unsyncopated as well as unstructured or dynamic unstructured forms that are less suitable for imagery purposes (Grocke & Wigram, 2007). Lowis (1998) found that listening to classical music, particularly fast or arousing music, can lead to reports of increased peak experiences, as described by Maslow (1964). According to Nercessian (2007), relaxing classical music has a slower beat, and tends to have smoother and longer melodic patterns that decrease the arousing emotions of people doing imagery. This creates a less tense, less formal, and less restrained environment. Nercessian stated that relaxing classical music creates physical relaxation and mental calmness and is suitable for enhancing cognitive responses and creativeness during imagery. Nercessian also proposed that arousing classical music is usually based on a powerful beat, and tends to have short melodic patterns that cause awakening and alertness, and that stimulate energetic responses in people when they are using imagery.

In this study, I selected unfamiliar classical music, that is, music that is not well-known by the general population. The reason for this was to minimise associations, which tend to lead to unpredictable effects on individual arousal levels. This obscurity of pre-selected music helped to minimise any confounding effects of familiarity and past associations. After this, familiar arousing classical music was added to the present study to examine the differences between familiar and unfamiliar arousing music. Familiar relaxing music was not used because it was not useful for the scope of this thesis as its familiarity and possible triggering of past experiences could confound the research.

The most suitable pieces of classical music used as exemplars for arousing and relaxing conditions in the present research were selected on the basis of a systematic process. To begin, for use in relation to the imagery training purposes in this study, I selected three unfamiliar relaxing classical music excerpts, three unfamiliar arousing classical music excerpts, and three familiar arousing classical music excerpts from 90 pieces of classical music recommended by the Australia Music Therapy Association (AMTA) lists, and based on criteria determined in previous research (Grocke & Wigram, 2007; Nercessian, 2007; Snyder, 1993; Tenenbaum et al., 2004). Three experienced music therapists who were also professional musicians – two violinists, and one flautist - with at least 10 years of musical experience, acted as expert judges (see Mason, 2002). I recruited these judges from a prestigious orchestra in Melbourne, Australia. Professional musicians / music therapists were selected because of their expertise in the musical field, and understanding of the structure, form, background, familiarity, arousing/relaxing properties, preference, and suitability of the classical music excerpts to be used with imagery.

I then independently presented each judge with 30 classical musical excerpts in a quiet room, on three visits, using a portable compact disc audio system with headphones attached. In this way, each judge considered all 90 pieces. All of the music was played at 55-70 decibels, which is within a pleasant hearing range for individuals with normal hearing (Job et al., 2004). The judges rated the music that they considered to be relaxing or arousing after listening to each piece for one minute. The overall session for each visit was approximately one hour. Through this expert judging process, 72 classical music excerpts were identified as appropriate for use as arousing and relaxing music during imagery among sports performers, and eighteen classical music excerpts were rated as "less appropriate" because they could cause confounding effects, due to factors, including cultural interpretation, social influences, or too many variations in the melodic structure. Each judge then independently organised the 72 music excerpts into categories representing "relaxing" and "arousing" music.

The "arousing" music excerpts were structured together into those considered as "familiar" or "unfamiliar" respectively. The judges also categorised the "relaxing" music excerpts as familiar or unfamiliar. They were informed to select both familiar and unfamiliar music according to the perceptions of the general population. Thus, the final clusters produced four groups of music excerpts: 33 familiar relaxing excerpts, 17 unfamiliar relaxing excerpts, 12 familiar arousing excerpts, and 10 unfamiliar arousing excerpts (see Appendix A). Then the judges were thanked for their contribution and time in helping the research.

When the independent classifications of the three judges were compared, I recruited three sport psychologists who had at least two years' experience of using imagery in the sport context to help pre-select the final three excerpts from the lists of unfamiliar and familiar arousing excerpts, as well as the unfamiliar relaxing excerpts category. Sport psychologists were used in the final stage of clustering because they were familiar with the use of music for imagery in the applied sporting context and had previous experience working with athletes, so they were able to judge which music excerpts was suitable for use in imagery in sports. The sport psychologists were not necessarily music experts, so they acted as a filter based on their familiarity with the excerpts. They were asked to list down three music excerpts that they considered the general population would perceive subjectively to be unfamiliar relaxing music, unfamiliar arousing music, and familiar arousing music in an ascending hierarchical order. All three judges selected the same three music excerpts they perceived to be familiar arousing music. However, for the unfamiliar arousing music and unfamiliar relaxing music, the judges were required to suggest an another additional two excerpts, in addition to the three they had previously selected. Only the three music excerpts that had the highest preferences of these panels were used for the final three music excerpts in both the unfamiliar relaxing music and unfamiliar arousing music categories. This session took approximately one hour, and all the judges were thanked for their contribution in helping to select the final nine excerpts in each category.

In the final stage, the nine music excerpts determined by consensus among the three sport psychologists were then pilot tested with five volunteer undergraduate sport science students. These students were recruited using a notice board at the College of Sport and Exercise Science, Victoria University. The students represented a convenient sample because they played sports and they had experience in their own sports, so they were able to relate the music to sporting contexts. They were briefed on the study objective and signed a consent form before the study began. Their subjective responses were measured to examine whether the nine music pieces influenced their arousal or relaxation level clearly and consistently as anticipated. To ensure that the six pieces of music identified as unfamiliar in previous stages were likely to be perceived to be unfamiliar to participants in the main study, each student was asked subjectively whether they had heard the music before. All five undergraduate students confirmed that they did not know any of the six pieces of music. In terms of subjective experience, they all reported that the familiar pieces intended to be arousing were actually arousing, and that all three unfamiliar pieces intended to be relaxing were so. One student reported that one of the unfamiliar arousing pieces was not arousing, but all the rest were perceived as arousing. The results showed that all the music was perceived as intended. Thus, it was concluded that the nine selected pieces of music were appropriate for use in this study of the physiological and psychological effects of relaxing and arousing music during imagery among elite shooters.

Stage 2: Study 1 to Examine the Effect of URM, UAM, and FAM on the Level of Arousal During Imagery among Elite Shooters

Participants

The Participants were 12 elite shooters (male = 8, female = 4), aged 22 to 41 years, recruited from the Melbourne International Shooting Club and Victorian Amateur Pistol Association (VAPA). In order to be called “skilled” athletes, all participants had at least two years of competitive experience at state level in air pistol shooting, and were listed as B-Grade shooters and above. I chose a shooting sport as a convenient sample, because I had access to the elite shooters due to previous associations with the shooting coaches. Also, shooting is a quiet and low arousal sport, which normally requires lower levels of arousal than high impact sports during performance. I considered that this would lead to less interference with physiological and psychological measures from arousal associated with performance than in high arousal sports. To be included in this study, participants were required to have normal hearing and they signed consent forms after reading information about the study procedures and risks and having all their questions answered. Additionally, to be included in the study shooters demonstrated moderate to high imagery ability on the Sport Imagery Ability Measure (SIAM). The sample size was calculated using a G*Power 3.1 analysis sample size calculation. With a significance level of .05, a moderate effect size of .50 based on previous research (Crust, 2004), and a power of .80, 14 participants were required (Faul, Erdfelder, Lang, & Buchner, 2009). Due to the limited number of eligible participants found during the study period, 12 participants were recruited and as the preliminary analysis showed satisfactory results, the collection of data was finalised.

Measures

To measure the impact of the nine different pre-selected music excerpts on the level of arousal of the skilled shooters, both physiological and psychological data were collected. Physiological signal data was collected using the ProComp+ system and BioGraph software version 5.0 from *Thought Technologies*™ (Montreal, Canada), which measured participants' galvanic skin response (GSR), peripheral temperature (PT), electromyogram (EMG), and heart rate (HR). Andreassi (2000) suggested that physiological measures (e.g., GSR, PT, EMG, HR) are good indicators for reflecting levels of autonomic nervous system activity. This gives researchers non-invasive, and reliable data sources, to objectively evaluate physiological arousal level. In order to seek the psychological perspectives of participants, they were instructed to rate their relaxation level, familiarity, and preferences for the music on a 100mm visual analogue scale. Participants' imagery ability was measured by SIAM.

Galvanic skin response (GSR). GSR is a measure of the skin's ability to conduct electricity, which is regarded as a "gold standard" in the measurement of arousal (e.g., Barry & Sokolov, 1993). To measure GSR, two sensors were placed on the participant's non-dominant hand, comprising Ag/AgCl electrodes on the medial phalanges of the second and forth digits. NaCl (.05 M) in an inert viscous ointment base was used as the electrolyte. GSR is considered to be a function of sweat gland activity and skin pore size, both of which are controlled by the sympathetic nervous system. GSR was used as an index for measuring arousal level because the sweat glands are activated when the sympathetic nervous system is aroused in response to increases in stress or anxiety and this leads to increases in GSR. Thus, GSR is a linear correlate to relaxation, and reflects emotional responses as well as cognitive activity (Lang, 1995). As sweat is produced, the skin's capacity to conduct an electric current is enhanced and measured conductance is increased. Thus, high scores reflecting increased conductivity, indicate high levels of arousal.

Peripheral temperature (PT). PT was measured with a thermistor placed on the ventral side of the non-dominant last or "smallest" finger (threshold = 0.0, scale – 0.25). PT is a measure of the temperature of the skin extremities, which varies according to the amount of blood perfusing to the skin. PT is dependent on the state of sympathetic arousal of the autonomic nervous system.

When individuals are sympathetically aroused, muscle contraction occurs. This causes vasoconstriction, which reduces blood flow to the skin, and results in a decrease in temperature (Kluger et al., 1985). At the same time, the arterioles, which supply blood to the tissues, are surrounded by smooth muscle fibres that are innervated by the sympathetic nervous system (SNS). Therefore, when a person experiences stress, arousal increases, their fingers tend to get colder and peripheral temperature decreases, whereas when they are relaxed blood flow increases and skin temperature increases. Thus, increases in PT of the finger reflect greater relaxation.

Electromyogram (EMG). Muscle activity was measured with silver-silver electrodes (threshold = 0.0, scale = 0.50) placed on the right frontalis muscle (just above the right eye). EMG measures the electrical energy (in microvolts) discharged by the motor nerve endings signalling a muscle to contract in order to evaluate and record the electrical activity produced. EMG can also be used to measure arousal. For example, the alpha rhythm on the occipital cortex can be used to measure arousal. Thus, greater muscle activity in various muscle groups, such as the corrugator muscles on the forehead, commonly referred to as the frontalis (forehead) EMG, is a reflection of higher arousal levels.

Heart rate (HR). HR was measured with a photoplethysmograph (threshold = 0.0, scale = .025) placed on the ventral side of the middle finger of the non-dominant hand. Photoplethysmography bounces infra-red light against a skin surface to measure the amount of reflected light against the skin surface.

This amount varies with the amount of blood present in the skin. At each heartbeat (pulse), there is more blood in the skin (blood reflects red light and absorbs other colours) meaning that more light is reflected from an infra-red light beam when there is more blood in that region of skin. Between pulses, the amount of blood decreases and more red light is absorbed. This is a good indication of vasomotor activity and sympathetic arousal. Since vasomotor activity is controlled by the Sympathetic Nervous System (SNS), HR measurements can display changes in sympathetic arousal. An increase in HR amplitude indicates decreased sympathetic arousal and greater blood flow to the peripheral vessels. Therefore, the photoplethysmograph was chosen over placing electrodes on the chest because it is less invasive and less uncomfortable for participants. However, it is important to note here that the photoplethysmograph is susceptible to motion artefact and may not detect blood flow changes in persons with cold hands, making it a less reliable indicator of heart rate than electrodes placed directly on the chest. To ensure reliability and accuracy of HR, participants were asked to sit on a comfortable chair and not to move the finger attached to the HR sensor while performing imagery with music.

Questionnaires.

Demographic form. Participants were asked to complete a short demographic form to collect information about the participants' gender, age, education, sports participation, and sports experiences (see Appendix B).

Sport Imagery Ability Measure (SIAM). The SIAM (Watt et al., 2004) assesses athletes' imagery ability in sport. Athletes imagine each of four generic sport scenes for 60 seconds. The four scenes refer to participants' imagery ability with regard to the home venue, a successful competition, a slow start, and a training session. Following the imagery of each scene, athletes respond to 12 items with reference to that particular scene. The 12 imagery ability items consist of five specific dimensions: control, vividness, ease, speed of generation, and duration, as well as six sensory modalities: kinaesthetic, tactile, visual, auditory, olfactory, and gustatory senses associated with the image. In addition, one item assesses imagery of emotion experienced during each scene. Participants make their response by placing a cross on a 100-mm analogue scale, anchored by opposing statements, for instance, "*no feeling*" and "*very clear feeling*" for the tactile modality of imagery. The analogue scale has no numerical markings. Thus, if a participant has a clear feeling of the image, they will place a cross near the right end of the analogue scale. The location of the cross on the line is measured in millimetres from the left end. Thus, the centre of the cross might convert to a score of 90 points on the scale, which ranges between 0 (*left end of the scale*) and 100 (*right end of the scale*). The 12 sub-scales appear in different orders for each scene to minimise order effects. The items comprising each dimension or modality are added up for each of the four scenes in the SIAM to create an overall score for each dimension or modality. The overall score for each dimension or modality varies between 0 and 400 points. Through the validation process, the SIAM revealed alpha values between .66 and .87. The SIAM has been used frequently during validation processes (Watt et al., 2004; 2001). In this study, the SIAM was administered to ensure that participants had sufficient imagery ability (at least moderate) to perform the imagery of shooting at their own pace. The SIAM is presented in Appendix C.

Relaxation rating scale. Following techniques used successfully by Burns et al. (2002), and Elliott, Polman, & Taylor. (2012), subjective relaxation was assessed using a 100mm visual analogue scale from 0 (*relaxing*) to 100 (*arousing*). Participants were asked to respond to their level of relaxation or arousal on the relaxation rating scale. Participants did this by placing a cross (X) on the line at the point that best described their level of relaxation or arousal. Using a millimetre ruler, a score was read off the line measuring in millimetres from the left end of the line, which produced a score between 0 and 100. Higher scores indicated that participants were more aroused (see Appendix D).

Familiarity rating scale. Participants were asked to complete a familiarity rating scale by rating their level of familiarity with the music on a 100mm visual analogue scale, 0 (*not familiar*) and 100 (*very familiar*). This was done by placing a cross (X) on the line at the point that best described their level of familiarity with the music. Using a millimetre ruler, a score was read off the line measuring in millimetres from the left end of the line, which produced a score between 0 and 100. Higher scores indicated that participants were relatively more familiar with that music excerpt (see Appendix D).

Preference rating scale. Participants were asked to complete a preference rating scale in order to rate their preferences for the music played on a 100mm visual analogue scale, from 0 (*dislike*) to 100 (*highly preferred*). This was done by placing a cross (X) on the line at the point that best described their level of preference for the music. Using a millimetre ruler, a score was read off the line measuring in millimetres from the left end of the line, which produced a score between 0 and 100. Higher scores indicated that participants had a relatively greater preference for that music excerpt (see Appendix D).

Music for Imagery

All nine pieces of classical music were trimmed into three-minute excerpts and digitised into the laptop computer at Sound Work Music Recording Studio, Brunswick, Australia. Then, the music excerpts were prerecorded into a Sony Walkman digital media player model (MP3) ZWZZ1050B at the range of 55-70 decibels, which is within a pleasant hearing range for individuals with normal hearing (Job et al., 2004). A certified music audiologist from the studio evaluated both the Sony player and the headphones (Sennheiser's HD 600 Avantgarde headphones) and fixed the sound at a moderate level and midrange on the volume dial so as not to cause discomfort or harm to the participants. This volume was chosen to ensure the clear sound of the music, without raising it to a volume that would have been arousing on its own. The tempo of the music excerpts used in this study was the original tempo from the recording studio. Although it could vary according to different orchestra or performer or different recording studio, all music excerpts were standardised to the original tempo without manipulating the tempo to make it more arousing or relaxing. The music excerpts are listed in Appendix E.

Instructions for Imagery

All nine classical music excerpts were randomly assigned to the participants on three different occasions prior to their normal training schedule in the testing room of the shooting club, where it is quiet and not affected by outside noise. In order to allow maximum comfort, the temperature of the room was checked and kept between 20 - 24 degrees Celsius. Only three pieces of music were played during each training session. Participants were not informed about the pre-selection of the music as either relaxing or arousing. They were advised that prior to coming for testing they should not do any arousing activities, such as running, cycling, or swimming. This was to avoid any residual effects of a high level of arousal due to physical activity before data collection that might confound the data. To ensure that standardization of instructions to participants was maintained, the following script was used:

> Today you will be listening to three different types of music for three minutes; you will need to sit in silence for approximately 10 minutes, with some electrodes placed on your non-dominant hand, and one electrode at your right frontalis muscle, with the headphone attached. To avoid inaccurate measurement, try not to move your non-dominant hand while performing the imagery. The music will then be played when your baseline of measures is achieved. When you hear the music sound in the background, you will slowly start to imagine your preparation routine during training, while listening to the music. As you get a picture of yourself performing normally the skill in practice, try to complete an entire training session successfully. Three minutes after the music

finishes you will need to complete some questions. In between each session, you will have 10 minutes before the next music excerpt starts. Do you have any questions before we begin?

Because imagery was not the variable under study, but a part of the conditions under which the level of arousal associated with music excerpts was tested, no further efforts were made to influence the quality of participants' imagery. A check was made after each trial to ensure that participants did perform imagery during the presentation of music excerpts.

Procedure

Necessary permission and consent were obtained prior to the study using standard consent procedures (see Appendix F and Appendix G). All participants were informed that all results would be confidential and they could withdraw from the study at any time. The study was conducted inside a quiet testing room provided by the shooting club, where no pistol shooting sound could be heard and where there were no other distractions from the surrounding environment. The participant sat in a comfortable chair, and the GSR, PT, and HR devices were fixed on the non-dominant hand, and EMG electrodes were fixed on the corrugator muscles of the forehead. The participant was then instructed to sit in silence for 10 minutes in order to obtain baseline resting physiological readings of GSR, PT, EMG, and HR (t_0) prior to starting the imagery sessions, with different types of music for each session. Monitoring of the level of arousal during imagery with each type of music was randomly assigned across the three types of classical music excerpt: unfamiliar relaxing music (URM), unfamiliar arousing music (UAM), and familiar arousing music (FAM). Participants performed imagery at three sessions during each of which they experienced three different music excerpts. At the end of each of three randomly selected pieces of music, participants were asked to record their subjective psychological ratings on the imagery in relation to the music. The total duration of each session was approximately 60-80 minutes, depending on the duration for measuring the baseline of each participant, time to prepare the participant, and time to return to baseline after each music excerpt. Finally, all participants were debriefed and thanked for their participation.

Analysis

Statistical analysis was conducted using SPSS 17.0. The descriptive information on imagery ability was reported. I then pre-screened data for missing data and outliers, and normality of distribution. The mean and standard deviation (SD) of each time point across the 12 shooters was taken to examine changes in the trend on GSR, PT, EMG, and HR from resting at 0 seconds (t_0) to end of trial at 170 seconds (t_{170}). A line-graph of each music condition was plotted to observe the trend and changes for GSR, PT, EMG, and HR from t_0 to t_{170}. Readings at t_{170} were used as opposed to t_{180} (three minutes) because of the possibility of artefacts due to termination of the music at 180 seconds. The values at t_{170} were considered to be an accurate reflection of the level of arousal at the end of each music excerpt. One-way Analysis of Variance (ANOVA) was used to identify the difference between the three music conditions in each baseline (t_0) for GSR, PT, EMG, and HR. The difference between end of trial (t_{170}) and resting (t_0) was identified as the gain score ($t_{170} - t_0$). ANOVA was used to identify the differences between music conditions in gain score for GSR, PT, EMG, and HR. The differences between each pair of mean gain scores were then determined using Post-hoc Tukey tests. Descriptive statistics were reported on the subjective ratings of perceptions on the relaxation level, familiarity of, and preference for different types of music.

Results

The aim of this study was to examine whether selected excerpts of classical music would affect arousal level, in terms of changes in level of arousal from the physiological and psychological indicators, while sports performers imagined performance in their sport. To monitor sympathetic physiological responses to selected music, galvanic skin response (GSR), peripheral temperature (PT), electromyogram (EMG), and heart rate (HR) were measured during imagery with music. The physiological indicators were used to measure levels of arousal associated with each of the nine selected music excerpts, three chosen to be unfamiliar relaxing music, three chosen to be unfamiliar arousing music, and three chosen to be familiar arousing music, during imagery of their shooting routine by skilled shooters. To gain greater insight into participants' psychological responses to music, participants' subjective ratings of perceptions on their relaxation level, familiarity with, and preference for the nine preselected classical music excerpts were also measured.

I present the results in three subsections. In the first subsection, I describe the participants' imagery ability. In the second subsection, I present the physiological indicators for GSR, PT, EMG, and HR in terms of levels of arousal with different types of music excerpts. For each indicator, results involve a mean for the three pieces of music designated as unfamiliar relaxing music, unfamiliar arousing music, or familiar arousing music. Results reflect changes from starting time (t_0) to post-test (t_{170}), that is, the 170-second duration of each piece of music during imagery. Finally, in the third subsection, I present the psychological ratings of relaxation, familiarity with, and preference for different types of classical music excerpts.

Imagery ability

Participants completed a subjective measure of imagery ability, the SIAM, a multimodal-multidimensional measure of imagery ability. Table 3.1 shows the participants' scores on imagery ability. All participants reported moderate to high scores on almost all subscales, scoring particularly high on potentially important imagery ability characteristics, such as vividness, control, ease of generation, speed of generation, duration of the image, the visual sense, and the emotion associated with imagery. Summarising the imagery ability scores, the means for all participants were above 260 points, except for the olfactory and gustatory subscales. These subscales appear to be less important, as smell and taste play a minor role in shooting tasks. The results provided evidence that the participants possessed the imagery ability to effectively employ imagery as part of their training program.

Table 3.1

Sport Imagery Ability Measure (SIAM) Subscale Means and SDs for 12 participants

SIAM	*Mean*	*SD*
Vividness	346.37	25.83
Control	329.31	44.79
Ease of Generation	344.91	51.51
Speed of Generation	338.79	34.89
Duration of the image	331.11	42.73
Visual	337.84	33.72
Auditory	269.13	46.46
Kinaesthetic	286.77	52.91
Olfactory	69.16	34.56
Gustatory	123.62	86.75
Tactile	287.79	46.09
Emotion	314.51	26.68
Total Score	3349.29	323.40

Physiological Measures of Levels of Arousal

Results reflect changes from starting time (t_0) to end of trial (t_{170}), that is, the 170-second duration of each piece of music during imagery. The resting time was not presented because no meaningful trends were observed in the nine pre-selected classical music excerpts. The patterns of level of arousal from the physiological indicators (GSR, PT, EMG, and HR) were very similar on the three chosen music excerpts in each category: unfamiliar relaxing music (URM), unfamiliar arousing music (UAM), and familiar arousing music (FAM), and these data showed consistency across excerpts chosen to reflect a particular category. Thus, the average of the three classical music excerpts in each category was used in the analysis.

Galvanic Skin Response (GSR). The line-graph of GSR is presented in Figure 3.1 for the URM, UAM, and FAM classical music conditions. All music conditions showed a decrease in GSR from t_0 to t_{170} during imagery. URM showed the largest decrease in GSR level from t_0 to t_{170}, whereas UAM and FAM showed shallow decreases from t_0 to t_{170}.

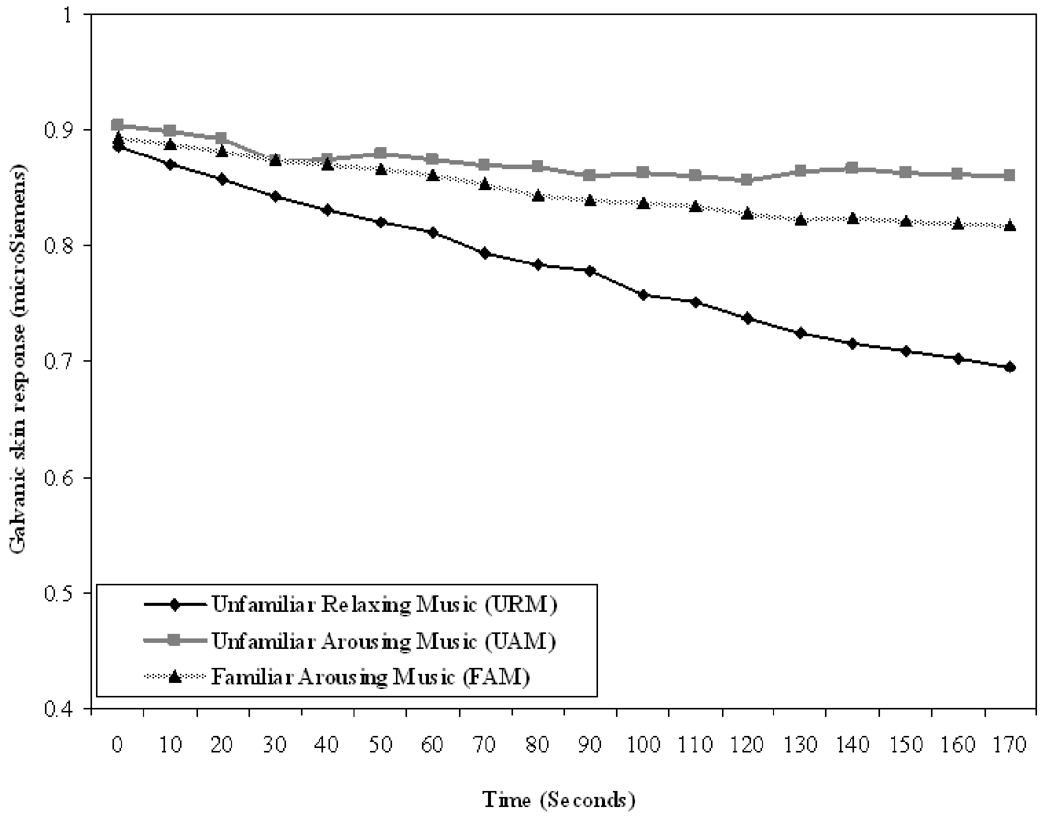


Figure 3.1 Galvanic skin response (GSR) for URM, UAM, and FAM

Analysis, using one-way ANOVA, indicated that there was no significant difference at baseline (resting time) among the three music conditions, F (2,107) = .025, p = .97, eta^2 < .001, with small effect size. One-way ANOVA on gain scores indicates that there was a significant difference between music conditions, F (2, 107) = 9.26, p < .001, eta^2 = .15, with medium effect size. Further analysis using the Tukey test indicated that URM and UAM were significantly different in gain scores (p < .001). There was also a significant difference between URM and FAM in gain scores (p = .005). However, there was no significant difference between UAM and FAM in gain scores (p = .66). URM showed the highest negative gain score (M = -.19, SD = .16) when compared to both UAM (M = -.04, SD = .14) and FAM (M = -.07, SD = .14). This indicates that URM was associated with a significantly greater decrease in GSR compared to arousing classical music, which indicates that it was more relaxing than both types of arousing classical music. The small decreases in GSR for both arousing classical music conditions indicate that the level of arousal declined a little even when arousing classical music was played.

Peripheral Temperature (PT). A line-graph of PT is presented in Figure 3.2 for the URM, UAM, and FAM classical music conditions. Here, URM and UAM showed an increase in peripheral temperature. URM appears to be more relaxing (highest in PT level) than the two arousing classical music conditions. FAM showed a decrement in PT from the start to the end of the music presentation.

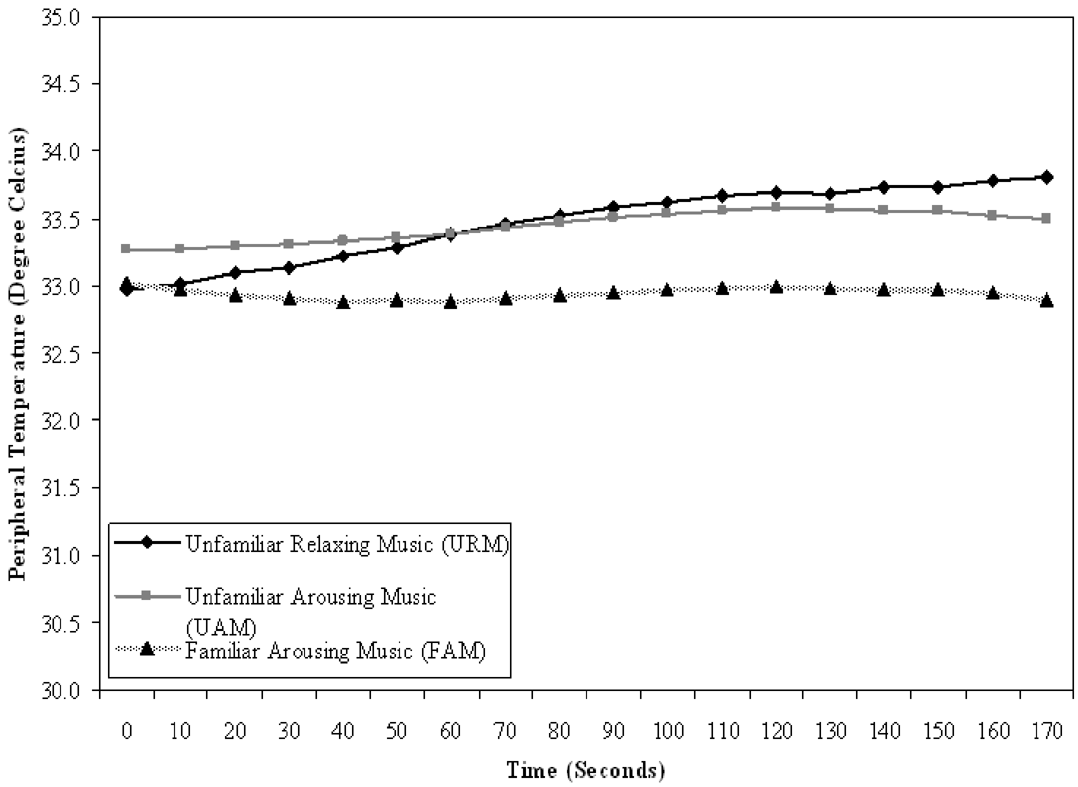


Figure 3.2 Peripheral temperatures (PT) for URM, UAM and FAM

Analysis using one-way ANOVA indicated that there was no significant difference at baseline among the three music conditions, $F(2,107) = .52$, $p = .60$, $eta^2 = .01$, with small effect size. One-way ANOVA on gain scores indicated that there was a significant difference between music conditions, $F(2, 107) = 7.39$, $p = .001$, $eta^2 = .12$, with medium effect size. Further analysis using the Tukey test indicated that URM and FAM were significantly different in gain scores ($p = .001$). However, there were no significant differences in the gain score of URM and UAM ($p = .18$), and UAM and FAM ($p = .11$). URM had a higher gain score ($M = .83$, $SD = 1.21$) than UAM ($M = .38$, $SD = 1.01$). This indicates that although URM and UAM both showed an increment in PT, temperature for URM increased more. Also, FAM decreased in temperature from t_0 to t_{170} with a small, negative gain score ($M = -.11$, $SD = .86$).

Electromyogram (EMG). The line-graph of EMG is presented in Figure 3.3 for the URM, UAM, and FAM classical music conditions. URM showed the largest decrease in EMG level from t_0 to t_{170}, whereas UAM and FAM showed slight increases from t_0 to t_{170}.

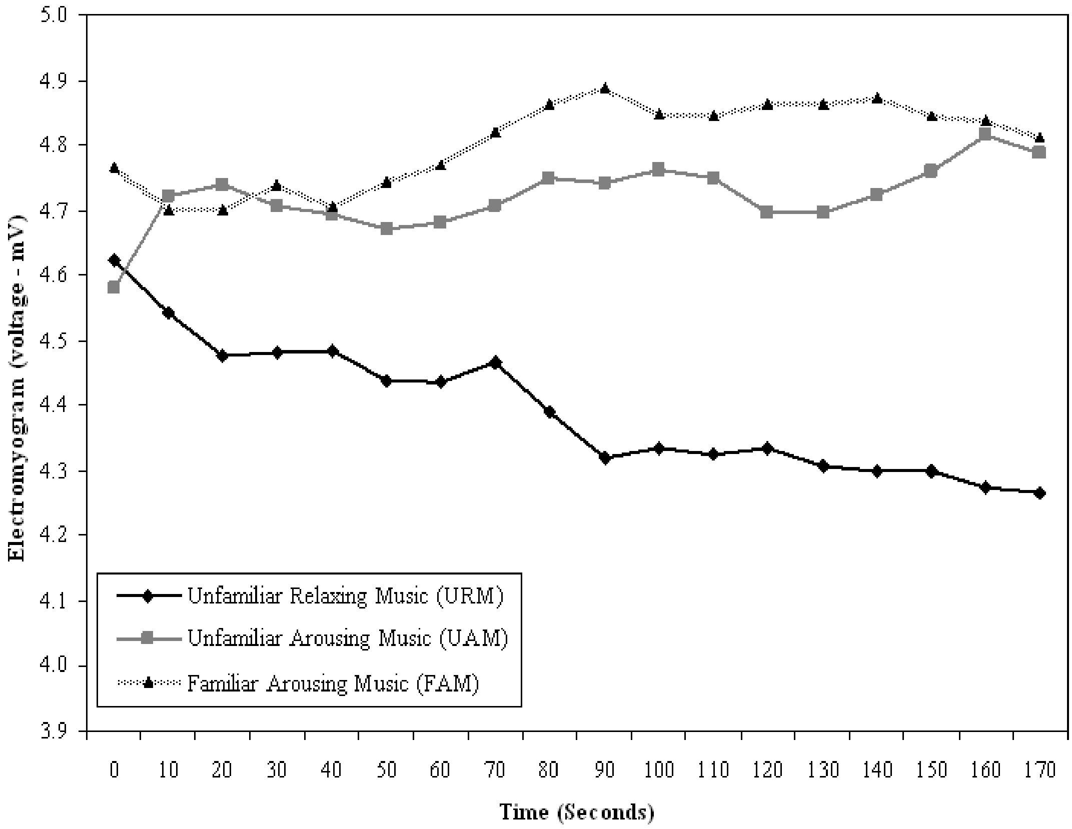


Figure 3.3 Electromyogram (EMG) for URM, UAM and FAM

Analysis using one-way ANOVA indicated that there was no significant difference at baseline among the three music conditions, $F(2,107) = 1.02$, $p = .37$, eta^2 = .02, with small effect size. One-way ANOVA on gain scores indicated that there was a significant difference in music conditions, $F(2,107) = 9.21$, $p < .001$, eta^2 = .15, with medium effect size. Further analysis using Tukey post hoc tests indicated that there were significant differences between URM and UAM ($p < .001$), and URM and FAM ($p = .005$). However, UAM was not significantly different from FAM in affecting HR during imagery ($p = .69$). URM had a higher negative gain score in EMG from t_0 to t_{170} ($M = -.35$, $SD = .71$), indicating that URM decreases in EMG from t_0 to t_{170}, and was, thus, more relaxing at the end of imagery. UAM showed increases from t_0 to t_{170} with positive gain scores (*M* = .22, *SD* = .56), followed by FAM with lower gain scores (*M* = .10, *SD* = .52). This indicates that UAM was more arousing and more incremental in EMG than FAM.

Heart rate (HR). The line-graph of heart rate (HR) is presented in Figure 3.4 for the URM, UAM, and FAM classical music conditions. From Figure 3.4, the first 10 seconds were not considered to reflect accurate readings because the participants' HR could have been artificially low due to the baseline resting periods. This might explain the large increases from 0 to 10 seconds, which were evident in all three conditions. The variations could also be due to finger movements by the participants, which could have been detected by the photoplethysmography, when the music and imagery were started. This graph shows that URM was associated with the lowest HR (more relaxing), and UAM produced the highest HR (more arousing). URM showed the lowest HR level when compared with UAM and FAM, from t_0 to t_{170}.

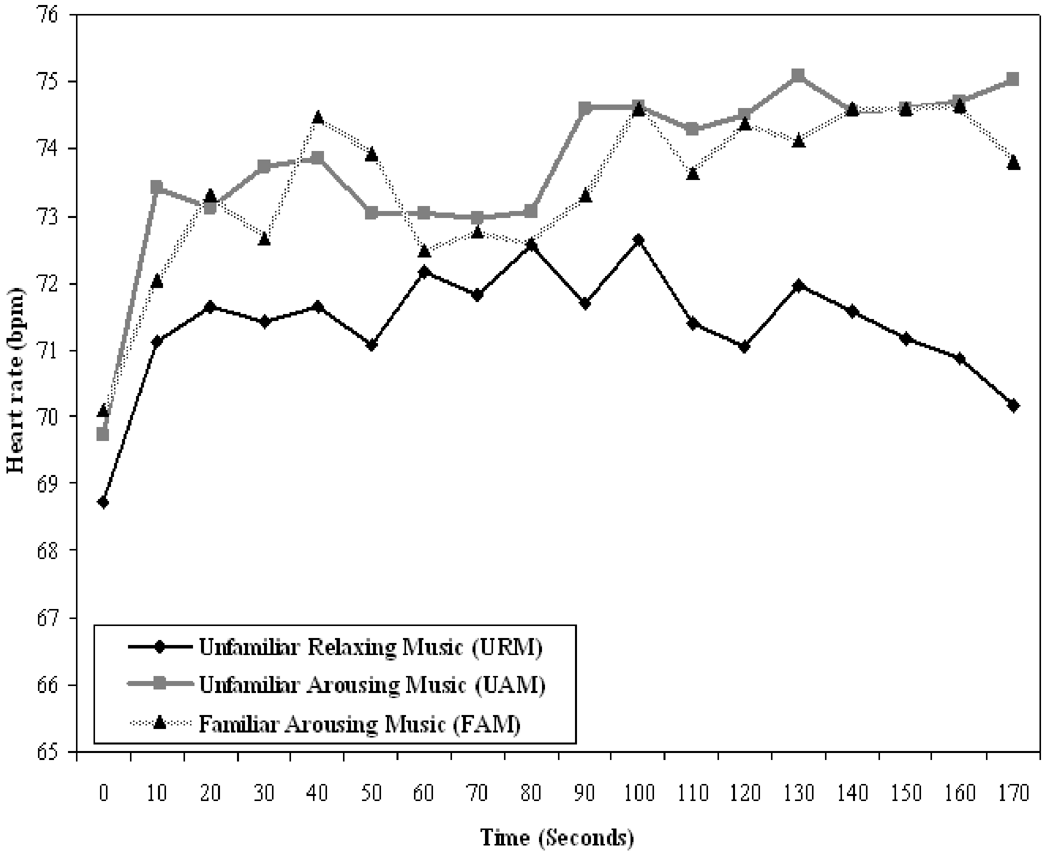


Figure 3.4 Heart rate for URM, UAM and FAM music

One-way ANOVA indicates that there was no significant difference at baseline among the three music conditions, $F(2,107) = .18$, $p = .84$, $eta^2 = .003$, with small effect size. One-way ANOVA on gain scores indicates that there was a significant difference in music conditions, $F(2,107) = 6.63$, $p = .002$, $eta^2 = .11$, with medium effect size. Further analysis using Tukey post hoc tests indicates that there were significant differences between URM and UAM ($p = .002$), and URM and FAM ($p = .04$). However, UAM and FAM were not significantly different in gain score ($p = .56$). UAM had higher gain scores in heart rate from t_0 to t_{170} ($M = 5.33$, $SD = 5.69$), followed by FAM ($M = 4.10$, $SD = 5.44$). URM showed the lowest increment in heart rate from t_0 to t_{170} (M = 1.07, SD = 4.00). This indicates that UAM is more arousing than other music, while URM is more relaxing.

Summary of patterns of arousal for physiological measures. In summary, although there was no significant difference in arousal level between the three music conditions at baseline (resting time), a significant difference was observed after three minutes of imagery, where URM showed significantly higher negative gain scores than UAM and FAM for GSR and HR, and significantly higher positive gain scores for PT. Although EMG did show higher negative gain scores for URM compared to UAM and FAM, they were not significantly different. This indicates that URM is associated with a greater decrease in GSR and HR, and a greater increase in PT than arousing classical music (UAM and FAM), with URM shown to be physiologically more relaxing than both types of arousing classical music after three minutes of imagery.

Subjective Perceptions of Relaxation, Familiarity, and Preference

In Table 3.2, the subjective ratings of relaxation, familiarity with, and preference for the three types of musical excerpts, namely unfamiliar relaxing music (URM), unfamiliar arousing music (UAM), and familiar arousing music (FAM), are presented on 0-100 scales for comparison purposes. URM showed the lowest ratings on the relaxation rating scale and UAM showed the highest ratings. URM was rated toward the low arousal end of the rating scale, whereas UAM and FAM were both rated toward the high end of the arousal rating scale. FAM showed the highest rating for familiarity, being rated toward the high familiarity end of the scale, whereas URM and UAM were both rated toward the unfamiliar end of the rating scale. URM was given a high preference rating by participants considering its use during imagery, whereas both UAM and FAM were given moderate ratings.

Table 3.2

Means and Standard Deviations by Music

Variables	**URM**	**UAM**	**FAM**
	Mean (SD)	***Mean (SD)***	***Mean (SD)***
Relaxation ratings	19.92 (13.02)	73.94 (13.55)	72.73 (13.72)
Familiarity ratings	24.51 (19.43)	24.26 (18.82)	74.33 (21.15)
Preference ratings	71.33 (15.16)	59.53 (21.12)	47.63 (27.24)

Summary of the psychological measures. The subjective ratings of relaxation, familiarity, and preference are consistent with the intended characteristics of the different categories of music presented to the participants during the imagery of their shooting performance. The participants' ratings were as predicted. Overall, the ratings of relaxation confirmed that URM was most relaxing compared to the UAM and FAM. Participants did not find any of the unfamiliar classical music excerpts familiar, or familiar classical music excerpts unfamiliar. The results confirmed the unfamiliarity and familiarity of the music. Therefore, the results from this study confirmed findings from the preliminary study in which musicologists and sport psychologists classified the excerpts as either relaxing or arousing, and familiar or unfamiliar. Thus, music rated as familiar by experts was more familiar among the general population. The preference ratings were an indication of which music the participants preferred. Interestingly, participants (shooters) rated URM as their highest preference when performing imagery, followed by UAM and FAM in that order. This showed that the participants (shooters) preferred having relaxing music out of the three choices of classical music categories. This result might be due to the task of imagery as some shooters used relaxing music to decrease their arousal level before they shot at the shooting range. The results for subjective perceptions provide support for examination of the physiological impact of arousing and relaxing music.

Summary of the Physiological and Psychological Measures

In summary, unfamiliar relaxing music (URM) was associated with a decrease in level of arousal for all physiological measures from t_0 to t_{170}. URM was also associated with lower levels of arousal than both types of arousing music (UAM and FAM) for all physiological measures. Both familiar and unfamiliar arousing classical music (UAM and FAM) were associated with small increases or no change in the level of arousal for different measures with significant differences observed using GSR and HR on both UAM and FAM compared to URM. URM also showed the lowest level of arousal in the ratings of relaxation level, lowest unfamiliarity, but highest preference among the elite shooters. Using the physiological and psychological measures, the results showed that classification of the nine pre-selected music excerpts was successful and consistent with predictions about their effects on level of arousal.

Discussion

Music has been shown to have the capacity to alter arousal levels, with some music being relaxing and other music being arousing (Burns, Labbe, Williams, & McCall, 1999; Miluk-Kolasa & Matejek, 1996). Furthermore, many researchers have proposed that relaxation is important for promoting imagery in sport performance (Suinn, 1986; Weinberg, Gould, & Jackson, 1980). Evidence shows that arousing music at the time of performance can facilitate performance in both power and endurance tasks (Copeland & Franks, 1991). It is also possible that matching arousal levels during imagery with desired arousal levels during performance will facilitate later performance. To test the impact of relaxing and arousing music during imagery on the later performance of sports skills, it is first necessary to demonstrate that certain pieces of music are consistently perceived to be relaxing or arousing, in concurrence with objective physiological and psychological indicators of level of arousal. In order to provide the basis for subsequent studies aiming to test the proposition that the selection and application of appropriate music can be an effective way of enhancing imagery, in the present study, I examined whether selected excerpts of classical music affected the level of arousal as predicted, based on physiological indicators and participants' subjective ratings of the perception on their relaxation level, familiarity with, and preference for the nine pre-selected classical music excerpts.

In Stage 1, the preliminary study, appropriate music excerpts were examined with the involvement of professional musicians, sport psychologists, and sport science students to select three unfamiliar relaxing music (URM) excerpts, three unfamiliar arousing music (UAM) excerpts, and three familiar arousing music (FAM) excerpts from 90 pre-selected classical music excerpts generated in an initial search for use with imagery. In Stage 2, which constituted the first main study, the nine pre-selected classical music excerpts (URM, UAM, FAM) were examined with 12 pistol shooters doing imagery of their pistol-shooting task. Both of these stages confirmed that the music excerpts chosen were consistent with the intended physiological level of arousal and the proposed characteristics of familiarity and preference.

Theory and Research

Physiological indicators and subjective ratings confirmed the prediction that skilled pistol shooters perceived URM to be more relaxing than either UAM or FAM classical music excerpts. Graphs plotting GSR, PT, and HR across the 3-minute excerpts, averaged within type of music, consistently showed greater reduction in arousal level for URM. Subjective ratings showed these results are similar to those of Burns et al. (2002), who used the classical music “Serenata Notturna”, KV239 by Wolfgang Amadeus Mozart, and found it to be more relaxing in as evidenced by the physiological responses of participants in skin temperature, muscle tension, and heart rate, compared to the arousing hard rock music of “So Close” by the rock band Alice in Chains. However, I found no research in the literature comparing the physiological and psychological responses of relaxing or arousing music using solely classical music. I also found no research that has examined the physiological and psychological responses of sports performers to music played during imagery. In addition, I found no research comparing either URM with UAM, URM with FAM, or UAM with FAM.

Although in this study, I found no significant difference between level of arousal measured by GSR, PT, EMG, or HR for URM, UAM, and FAM at baseline (resting time), a significant difference was observed after three minutes of imagery. URM showed significantly higher negative gain scores than UAM and FAM for GSR and HR, and significantly higher positive gain scores for PT. Although EMG did show higher negative gain scores for URM compared to UAM and FAM, the means for the conditions were not significantly different. This indicates that URM was associated with a greater decrease in GSR and HR, and a greater increase in PT than arousing music (UAM, FAM), when the music was played while shooters were using imagery.

All measures, in this study, showed consistent interpretations of the arousal levels of shooters, while they were doing imagery of a shooting task with different types of music excerpts. When GSR decreased, PT increased, EMG decreased, and HR decreased. This showed a trend of calming down and signs of relaxation (Blumenstein et al., 1995). The results of this study supported other research that has indicated that listening to relaxing music during a task, such as performing surgery (Allen & Blascovich, 1994), helps decrease individuals' physiological arousal. The results also support the study by Miluk-Kolasa and Matejek (1996), who showed that listening to relaxing classical music helped return pre-surgical patients to a less physiologically-aroused state after learning about the surgical procedure they were to experience. In addition, all measures showed consistent promising interpretations on the level of arousal of the elite shooters, while they were doing imagery of a shooting task with UAM and FAM. The results of this study supported other research that has indicated that listening to arousing music during a task can lead to increases in individuals' physiological arousal, which has been shown to be beneficial to an athlete's performance when competing in arousing power sports (Priest & Karageorghis, 2008). An interesting pattern was observed in GSR where a small decrease in level of arousal was noted during both conditions involving arousing music, rather than the expected increase in arousal levels. This indicates that arousal levels can decline a little, even when arousing music is played during imagery. One explanation for this could be that the task of imagery itself is associated with an automatic relaxation effect. If this is the case, athletes performing imagery automatically relax when they become absorbed in their internal thoughts.

An interesting secondary result from the subjective responses was that participants rated their psychological perceived levels of arousal to be higher for UAM than for FAM and URM. The URM was least arousing, as predicted. Although FAM included some of the most famous arousing classical excerpts, including "Ride of the Valkyries" by Richard Wagner, "Carmina Burana – O Fortuna" by Carl Orff and "1812 Overture" by Pyotr Ilyich Tchaikovsky, they were certainly not perceived to be more arousing than UAM classical excerpts. I found no research in the literature comparing subjective responses to UAM and FAM classical music, either before or during a sports task or while athletes performed imagery.

In this study, it seemed that URM helped shooters to relax more than when they listened to either UAM or FAM. This indicates that when used appropriately, URM can enhance the relaxation levels of athletes in fine motor skill sport tasks and help them to concentrate more on their imagery. Greater focus during imagery has the potential to create positive experiences and positive outcomes that increase sports performance (Weinberg, 2008). Results also showed that UAM can create higher arousal levels than FAM, confirming that the UAM selections used in this study were particularly arousing without having previous associations, given that participants reported low familiarity with those excerpts.

As predicted, participants rated familiarity for FAM to be higher than either URM or UAM. This result confirms findings in the preliminary selection of the music stage of this study in which musicologists and sport psychologists classified excerpts as either familiar or unfamiliar. Thus, classical music selected to be familiar was rated as more familiar among elite pistol shooters. Interestingly participants rated URM as their highest preference when performing imagery, followed by UAM and FAM, in that order.

Although this study was conducted with elite shooters, it could also be applied to other sport performers, such as 100m sprinters, hockey players, or weightlifters. Heart rate (HR), galvanic skin response (GSR), electromyogram (EMG), and peripheral temperature (PT) were shown to be reliable physiological measures of arousal. A combination of HR, GSR, EMG, and PT are sound physiological measures of level of arousal of athletes for peak performance enhancement. This in turn can facilitate research to develop a clear and comprehensive understanding of the importance of using music with imagery for performance enhancement.

Methodological Issues

In this study, I compared excerpts of three types of music played during imagery among elite pistol shooters. Literature searches showed that this is the first study to examine physiological and psychological indicators of level of arousal with different types of music during imagery. Dorney et al. (1992) examined the effect of imagery plus music on performance of a muscular endurance task, but did not measure physiological and psychological indicators of level of arousal. Blumenstein et al. (1995) used psychological measures to monitor the level of arousal while relaxing music was played during imagery, but they added 10 minutes of a specific relaxation technique before the imagery, which might have confounded the outcome of this study. The present study produced some interesting results and used a number of research techniques effectively, but there were also a number of limitations.

One of the limitations of this study was involvement of skilled performers from the sport of shooting in the measurement of levels of arousal. Shooters are typically located at the very low end of the arousal continuum during their performance. In this study, I selected shooters because they do very little physical movement during performance. Physical movement affects level of arousal, so it could confound the measurements of physiological level of arousal that were caused by the different types of music. Therefore, it is not possible to transfer the results of this study to sporting tasks that are typically performed with high levels of arousal, such as sprint racing in athletics, cycling, and swimming, combat sports, team ball games, or weightlifting.

In this study, there was no examination of, or attempt to control, the quality or content of participants' imagery. This is because the sample in this study comprised skilled shooters. These skilled shooters were instructed to use imagery of performing their shooting skill as they usually used it, because they were high-level performers who used imagery of pistol shooting in their normal training and competition routines. The focus of this study was to examine whether the excerpts of music, especially the URM and UAM excerpts, had the predicted impact on physiological and psychological indicators of arousal level during imagery. The examination of arousal level confirmed predictions and the shooters confirmed informally that they had used imagery during the sessions.

In this study, I chose to employ four physiological measures, GSR, PT, EMG, and HR because the *ProComp+* equipment is portable, measures all four indicators, and has shown strong reliability for monitoring arousal level in previous research (Burns et al., 1999; Miluk-Kolasa & Matejek, 1996). Thus, I was able to perform testing in a quiet room at the shooting club, which minimised the travel time for participants and ensured that they were not distracted by an unfamiliar environment. In addition, using several physiological indicators allowed for comparisons of patterns between measures to check that the data was reliable. However, results from this study showed no significant difference in EMG, whereas GSR, PT, and HR all showed significant differences between music with imagery conditions. This suggests that EMG might be a less sensitive measure of general arousal than GSR, PT, or HR. In addition, the procedure of sticking an electrode on the forehead of the participants might cause the participants to become aroused or give them a feeling of anxiety. Furthermore, I was advised by the shooting coaches to remove the EMG measures, which might cause discomfort to the participants. In the present context, which was similar to the design of Studies 2 and 3, GSR, PT, and HR appeared to be reliable indicators. Thus, it was decided to use those three physiological indicators and not to use EMG in Studies 2 and 3.

In this study, I compared excerpts of three types of music played during imagery among elite pistol shooters. One methodological limitation of the present study relates to the technique used to measure heart rate. The use of the photoplethysmograph to measure HR can be problematic. This is because the photoplethysmograph is susceptible to motion artefact, which might have caused a sudden increase in HR readings, which was observed during the first 30 seconds due to small movements in the participants' finger on which the sensor was placed when the music was started. Although participants were asked to sit on a comfortable chair and not to move the finger attached to the HR sensor, while performing imagery with music, it is hard to prevent slight finger movements. In future, researchers might employ a simpler, reliable, but less sensitive alternative, such as the Polar HR monitor, or it is possible to use the EKG receiver with a Polar transmitter belt developed by Thought Technology, which measures HR more accurately.

Future Research

This is the first study I have identified that has looked at both physiological measurements and subjective psychological assessments to monitor arousal levels in relation to different pieces of music played during imagery. In addition, no studies found in the literature have classified music through the kind of extensive, systematic process employed here. Using that process, the physiological measures and the subjective psychological measures, gave consistent results, indicating that particular music excerpts were relaxing or arousing during imagery. Furthermore, this is the first study I have found in the literature that compared unfamiliar relaxing classical excerpts with unfamiliar arousing classical excerpts. Familiar arousing classical excerpts were added to test for any difference between UAM and FAM. In extensive literature searches, I observed that most researchers who have studied music in sport employed familiar music for their studies (e.g., Burns et al., 2002; D. Evans, 2002; Staum & Brotons, 2000). In this study, I used unfamiliar music, so that I could examine the arousing and relaxing properties of the music without confounding effects of familiarity and prior associations, or established preferences. The finding that arousal levels for UAM and FAM were similar indicated that FAM was not more arousing than UAM because of prior associations, although FAM was clearly rated as more familiar. These results support the use of the UAM excerpts in Studies 2 and 3 and in future research. Although this study supported the use of unfamiliar relaxing and arousing music to achieve the aims of the present thesis, future research using this kind of systematic approach is encouraged to further clarify the effects of familiar and unfamiliar music on arousal levels in general and specifically during imagery. Studies should carefully compare selected pieces of unfamiliar relaxing music with unfamiliar arousing music, unfamiliar arousing music with familiar arousing music, and familiar relaxing music with unfamiliar relaxing music to give more insight into the effects of different kinds of music on arousal level during imagery.

The current study utilised each music excerpt for only three minutes. It is possible that the music potentially created a short-term effect on arousal. Although the aim of this study was to measure the physiological and psychological impact of URM and UAM, it is possible that this short timeframe is not sufficient to allow the participants' to fully benefit from the music excerpts. There are some studies that suggest that listening to music only had obvious effects on physiological arousal after 6-8 minutes of musical exposure (e.g., Burns et al., 2002). In this study, the results from the physiological measures showed an obvious effect on the level of arousal. It is possible that a longer duration of the music may also cause a "ceiling effect" to the level of arousal due to over-stimulation to the music, however, we do not know. Thus, it might be useful to examine the impact of arousing and relaxing music over a longer duration, to determine whether there is an increasing effect on the level of arousal with a longer duration or whether the effect reaches a plateau or even starts to decline with a longer duration.

The participants in this study were skilled shooters, thus, they were competent at performing imagery. According to Blair et al. (1993), skilled performers develop a stronger internal representation of their sporting skills, allowing them to generate a clearer, more accurate image of their task. Participants in this study also had moderate to high levels of imagery ability measured by the SIAM. However, the current study did not examine the impact of music during imagery on novice or less-skilled athletes, or athletes with lower imagery ability. Thus, it is not possible to generalise the effects of URM, UAM, or FAM beyond skilled athletes. Because imagery has been shown to be effective in facilitation learning and performance in novices and developing performers, it would be valuable to examine the impact of music during imagery in that population. Thus, in future, researchers should examine how novice athletes respond in terms of physiological level of arousal and psychological perceptions of arousal to different types of music played during imagery, using methods similar to those used in the present study. In addition, researchers should compare arousal levels during imagery in participants with low imagery ability and high imagery ability. Such research has the potential to increase the understanding of the complex interactions between music, arousal, skill level, and imagery.

In this study, I did not guide participants' imagery by use of a standardised imagery script. As noted earlier, this was because the participants were skilled shooters and the focus of the study was not on the content or quality of imagery. Thus, I concentrated on the effect of different types of music on level of physiological arousal and psychological perception of arousal. However, in order to effectively measure the effect of relaxing and arousing music during imagery in the presence of variables like learning, performance, or modification of psychological variables, it is important to standardise the imagery script so that all participants perform imagery in a similar way and not according to idiosyncratic preferences. Thus, I suggest that researchers compare the effect of different types of music using the same imagery script for all participants, to examine the effect of different types of music during imagery on a range of outcome variables.

Conclusion

This study demonstrated that carefully selected excerpts of familiar and unfamiliar classical music were perceived to be relatively arousing and showed corresponding physiological and subjective psychological changes in arousal level, whereas excerpts of unfamiliar classical music produced greater relaxation. The careful selection of music to be used in research to examine the effect of music during imagery on later performance is important. GSR, PT, and HR showed promising results for use in identifying and differentiating physiological arousal. The pieces of arousing and relaxing unfamiliar classical music examined in this study were shown to be suitable for use in studies to examine the effects of arousing and relaxing music during imagery on later performance among sports performers.

CHAPTER 4

THE EFFECT OF RELAXING AND AROUSING MUSIC DURING IMAGERY TRAINING ON PERFORMANCE OF A FINE MOTOR SKILL SPORT TASK

In investigating whether relaxing and arousing music affects performance in sport tasks, strong evidence supports the conclusion that carefully selected music played just before or during performance can help improve performance (e.g., Karageorghis et al., 2009; 2010; Ward & Dunaway, 1995). However, no studies have been identified that examine the effect of music played during imagery training on subsequent performance of sport skills. Furthermore, although imagery training is a psychological skill training technique widely used by athletes to enhance performance, little research on the potential of music to enhance imagery has been found, particularly in the context of sport.

It is important for the development of optimal imagery training programs that researchers examine the impact of different types of music on sport performance, when imagery training is conducted away from that performance. This contrasts with the few studies involving music and imagery (e.g., Dorney et al., 1992; Osborne, 1981) in which performance was measured directly after undertaking imagery with music, rather than allowing the music to influence imagery for the enhancement of later performance. In the present research, I propose that in order to examine the effect of music on imagery delivered as it would be in imagery training in sport, participants need to experience music with imagery training on a number of occasions. Then performance is measured at a later time. In the present study, this is operationalised in terms of an intervention involving 12 sessions of imagery training over a 4-week period. This allows the music to influence the imagery intervention for the enhancement of later performance. The purpose of this study is to examine the effect of different types of music, relaxing or arousing, in facilitating imagery training of dart-throwing performance. No music was added as a control condition.

Method

Participants

Participants were 63 sport science students (45 males, and 18 females) aged between 18 and 25 years (*M* = 20.21, *SD* = 3.20), who were studying either undergraduate sport and exercise science, or physical education at the School of Sport and Exercise Science, Victoria University. Participants had at least one year of sports experience in a primary activity, including Australian football, basketball, cricket, soccer, handball, netball, swimming, softball, tennis, taekwondo, track running, or volleyball. All female participants were requested to take part in the study during their late luteal phase (e.g., around the 25th day of the menstrual cycle) in order to minimise the psycho-physiological variations induced by hormonal changes. Additionally, all participants reported their hearing as “normal”. The sample size was calculated using a G*Power 3.1 analysis sample size calculation. With a significance level of .05 to achieve a moderate effect size of .50 and power of 80 per cent, a total of 63 participants were required, that is, 21 participants in each condition (Faul et al., 2009). Participants were informed that they were free to withdraw from the study at any time and signed consent forms if they wished to volunteer. All participants were volunteers and no payment or other incentive was offered.

Design

This study employed a pre-test – intervention – post-test design. Participants were randomly allocated into three imagery training research conditions: Unfamiliar relaxing music during imagery (URMI), unfamiliar arousing music during imagery (UAMI), or no music during imagery (NMI) as a control condition. In this study, unfamiliar arousing music was used because it creates at least as high arousal levels as familiar arousing music, as found in Chapter 3 (Study 1), but minimises any confounding effects of familiarity and past associations, which tend to lead to unpredictable effects on individual arousal level. Participants completed a demographic information questionnaire, and completed assessments of imagery ability using the SIAM questionnaire. Only participants who rated themselves as intermediate-to-high in imagery ability on key dimensions, vividness and controllability, speed of generation, duration of image, visual sense, and the kinaesthesis sense were included in the study. Then, participants' somatic state anxiety, cognitive state anxiety and self-confidence were assessed using CSAI-2R (Cox, Martens, & Russell, 2003). After completing this initial assessment, the pre-test was conducted using 40 trials of dart throwing at a concentric circles dart board. Then participants undertook the intervention imagery training, following administration of CSAI-2R. During the imagery training, participants' physiological arousal was measured using galvanic skin response (GSR), peripheral temperature (PT) and heart rate (HR) on Session 1 and Session 12 of the intervention. After 12 sessions of imagery training over four weeks, I re-administered the CSAI-2R and a performance post-test, followed by another re-administration of CSAI-2R after the performance post-test. After post-testing, six participants (two in each condition) were randomly selected to further explore their subjective experiences of URMI, UAMI, or NMI on their imagery training, using a short interview.

Measures

Demographic information. The demographic form contained items designed to ascertain the participants' age, gender, sports participation, years of sporting experience, years of competitive experience, experience in dart throwing, competitive level in dart throwing, hearing ability, and experiences of using imagery in sports. The demographic information is presented in Appendix H.

Physiological measures. In this study, GSR, PT, and HR were measured on Session 1 and Session 12 of the imagery training.

***Galvanic skin response* (*GSR*).** As described in Study 1 (Chapter 3).

Peripheral temperature (PT). As described in Study 1 (Chapter 3).

Heart rate (HR). HR was measured with the EKG receiver together with a Polar HR transmitter, rather than using the photoplethysmography from the BVP sensor as described in Chapter 3. The EKG receiver designed by Thought Technology detects the HR of the participants from the Polar HR transmitter belt that the participant wears around the chest. The advantage of using the EKG receiver is that it is more stable compared to the photoplethysmopragh method. Also, it is less prone to movement artefacts. In addition, it uses wireless transmission from the transmitter to the EKG receiver, thus, the participant only needs to wear the belt on the chest position and no separate electrodes are needed.

Psychological measures. In this study, two measures were used, namely the Sport Imagery Ability Measure (SIAM) and the Revised Competitive State Anxiety Inventory – 2 (CSAI-2R).

Sport Imagery Ability Measure (SIAM). As described in Chapter 3. In this study, the SIAM was administered to ensure that participants had sufficient imagery ability (at least moderate) to perform the imagery task in the script, which is the dart throwing. In this study, I asked the participants to imagine their primary sports, because most participants might not have had sufficient experience of darts to imagine the dart-throwing task in a way that would make completion of the SIAM meaningful.

Revised Competitive State Anxiety Inventory – 2 (CSAI-2R). The CSAI-2R (Cox et al., 2003) was used to assess somatic state anxiety (5 items), cognitive state anxiety (7 items), and self-confidence (5 items) in competitive settings. Respondents rate their feelings before competition on the 17-item instrument (e.g., *I feel jittery*, *I am concerned about losing*) using a 4-point Likert scale from 1 (*not at all)*, through 2 (*somewhat)*, and 3 (*moderately so)*, to 4 (*very much so*). Subscale scores are calculated by summing items in each subscale, dividing by the number of items, and multiplying by 10. Score range is 10 – 40 for each subscale. The factorial validity of the CSAI-2R was previously established by Cox et al. (2003), using confirmatory factor analysis (CFA) on data from 331 athletes, which showed a good fit of the hypothesised measurement model to the data (CFI = .95, NNFI = .94, RMSEA = .05) and Cronbach alpha coefficients for each subscale of the CSAI-2R showed sound internal consistency (somatic anxiety = .88, cognitive anxiety = .83, self-confidence = .85). In this study, CSAI-2R was used because it gives a subjective measure of the perceived level of anxiety. The CSAI-2R is presented in Appendix I.

Short interview. On completion of the simulated post-test performance for dart throwing, six participants (two from each condition) were asked to participate in a short interview to describe their subjective experience of the imagery training. The questions included asking the participants to share their overall imagery training experiences, the outcome of the participants' experience of music during imagery, the challenges (if any) they faced during the imagery training, and some recommendations or suggestions from the participants for the use of music with imagery in future mental training. Questions related to music were not addressed to the two NMI condition interviewees. The short interview is presented in Appendix J.

Dart-throwing Performance

In this study, dart throwing was selected to evaluate performance because it is a closed skill sport involving a fine motor skill. Also, the dart-throwing task is self-paced, so participants throw whenever they are ready. In a fine motor skill like this, arousal level is not affected much by the physical aspects of the task, as the level of physical exertion is limited. This is helpful in detecting the influence of external factors, such as music. The equipment consisted of a modified Harrows' competition dart board and five Harrows' combat precision steel tip darts. The dart board consisted of 10 concentric circles with diameters of 2 cm, 4 cm, 6 cm, 8 cm, 10 cm, 12 cm, 14 cm, 16 cm, 18 cm, and 20 cm, respectively, as shown in Figure 4.1. In this study, concentric circles, rather than competition scoring were used to minimise the effects of strategy. Participants scored 10 points for hitting the centre circle, nine points for the next circle, eight points for the next, then seven points, down to one point for the outermost circle, and 0 if the dart went outside the outer circle or missed the board. Participants were instructed to be as accurate as possible by aiming their darts at the centre bullseye of the dart board. Pre-test and post-test performances were measured using 40 trials of throwing darts at a concentric circles dart board, from a distance of 237 cm - the distance between the dart board and the participants. Electrical tape was placed on the floor to mark the distance. The dart board was hung so that the central bullseye was 173 cm from the floor. For scoring, 40 trials produced total scores between 0 and 400 points. Participants were instructed to stand behind the throwing line and aim for the bullseye, and to throw the darts whenever they were ready. They were given five practice trials prior to each performance test of 40 trials.

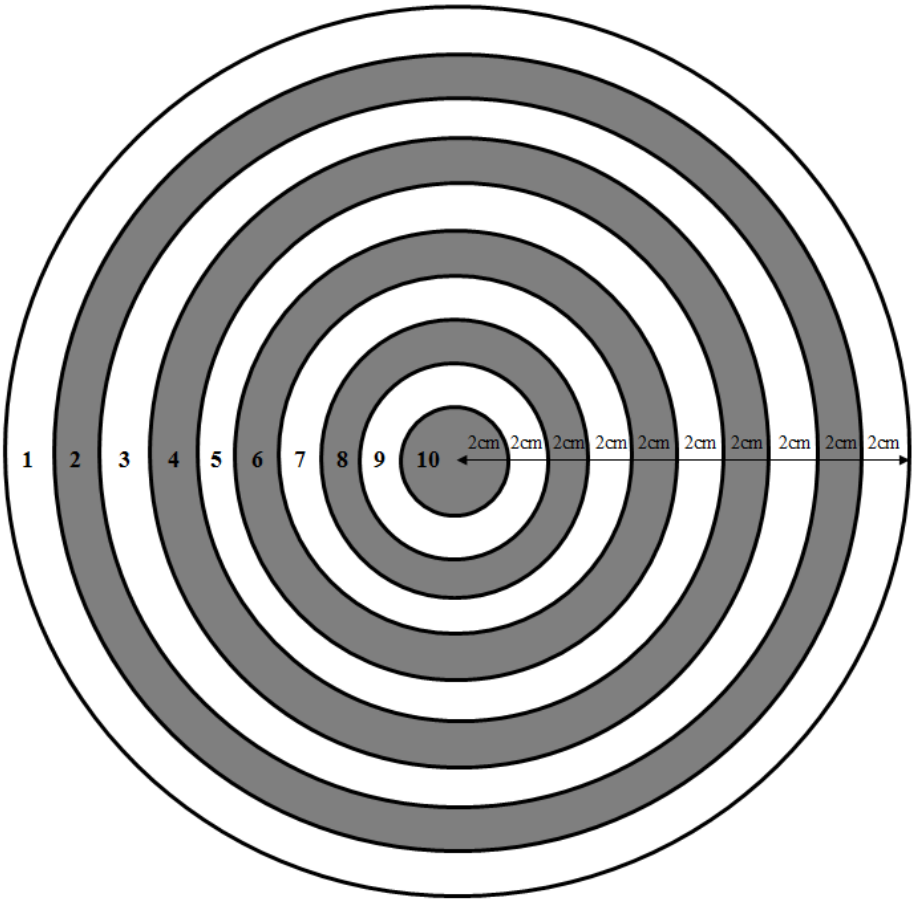


Figure 4.1 The dart-board scoring system using the concentric circles.

Imagery Script

A pre-recorded dart-throwing imagery script that was developed for the imagery sessions is presented in Appendix K. A pre-test of this script was presented in a pilot phase of the study to check for suitability. The script was then checked by two semi-professional dart players, who had played recreational darts competitions once per week for two years prior to the study. Minor changes were made as suggested by the dart players. The dart-throwing imagery script focused on executing the sport task of throwing darts at a concentric circles target with the aim to hit the bull's eye, including feeling the weight of the dart, gripping the dart, looking at the bull's eye of the dart board, imaging the distance between the dart board and the standing mark on the floor from which darts were to be thrown, the height of the dart board from the floor, and throwing the dart towards the target accurately when ready. The participants were also regularly reminded about the way their arm muscles should feel, as well as the sensation of movement of the arm as they were throwing the dart and the need to keep their body still and stable as they threw. In addition to imagery of skill production, the participants were instructed in the imagery script to picture a successful performance, which has been found to build confidence, leading to enhanced performance (Morris et al., 2005). Participants were instructed to imagine their darts hitting close to the centre of the target. The imagery training consisted of 12 sessions, with approximately 9 minutes for each session. There was no instruction about how many times the act of throwing a dart at the target was to be imagined, so all participants paced their own imagery.

Log of Imagery Sessions

An adherence log was handed out to participants to keep track of the day, time, and duration of each session, and add comments about their experiences during the imagery session, such as how well they were able to concentrate and how they felt (emotions) [see Appendix H]. This provided an opportunity for the participants to note any changes in their experience and comment on their imagery in regard to how strongly and vividly they experienced the music, the imagery, and the dart-throwing training. The adherence log was also used to check that participants had completed their imagery sessions. Participants with an uncompleted log or who had missed more than two sessions were excluded from the main analysis. The adherence log is presented in Appendix L.

Imagery Research Conditions

In this study, imagery training was undertaken in three research conditions. In all three conditions the same dart-throwing imagery script was given to participants, so the only component of the training environment that varied was the presence of music (relaxing, arousing) or no music. Participants performed imagery training under one of three research conditions, namely URMI, UAMI, or NMI (control).

Unfamiliar relaxing music during imagery (URMI). The relaxing music was one of the three music excerpts that were identified and used in Study 1 (see Chapter 3). The music excerpt was taken from Frederick Delius's Florida Suite: III Sunset "Near the Plantation".

Unfamiliar arousing music during imagery (UAMI). The arousing music used in this condition was one of the three music excerpts of unfamiliar arousing music used in Study 1 (see Chapter 3). The music selected for this study was Edmond De Luca's Conquerors of the Ages "Attila the Hun".

No music during imagery (NMI). This imagery condition without any music was the control condition in which no music was played during the imagery sessions. The imagery content was the same as in the other two research conditions (URMI, UAMI).

Procedure

Victoria University Human Research Ethics Committee (VUHREC) approved this research. I recruited participants from undergraduate students from sport and exercise science and physical education classes, using an electronic advertisement placed on the students' email noticeboards, and noticeboards of the School of Sport and Exercise Science at Victoria University. Following standard consent procedures, I informed participants of the purpose and procedures of the study (Appendix M and Appendix N). They were also informed that the results would be confidential and they could withdraw from the study at any time. I encouraged potential participants to ask any questions they had about the study aims, procedures, and risks. Those willing to participate as volunteers signed the consent form prior to testing (Appendix O and Appendix P).

The procedures in this study were carried out individually, and participants were encouraged to ask questions both immediately after hearing and reading instructions, and at any time during the test sessions. After completing the consent form, I asked students to fill in a demographic form, the SIAM, and the CSAI-2R. Participants were then given five practice throws to familiarise themselves with the darts, followed by a pre-performance test of 40 throws in which I reminded participants that the aim of the study was to hit as many bull's eyes on the dart board as possible. After these throws, I gave participants approximately 20 minutes of rest prior to undertaking Session 1 of the imagery training for dart-throwing intervention. During this time, I randomly assigned participants to one of the three research conditions – URMI, UAMI, or NMI. I then gave instructions to participants on how to work through the imagery script, including imagining themselves completing the dart-throwing task. Participants were then expected to listen to the imagery script while concentrating on their imagery. This script was used for all three-research conditions. In two imagery sessions, I conducted the session for each participant. These were Session 1, following the dart-throwing performance pre-test, and Session 12, before the dart-throwing performance post-test. Participants in the URMI and UAMI conditions performed their imagery with music playing throughout the whole of the session (Sessions 1 to 12). Participants in the NMI condition performed all 12 imagery sessions without music. For the manipulation check on the level of arousal, I measured physiological indicators of GSR, PT, and HR throughout Sessions 1 and 12, starting five minutes before imagery commenced and terminating five minutes after imagery ended. After the imagery training in Sessions 1 and 12 when their physiological measurements were taken, I conducted a post-test on CSAI-2R. For the 10 imagery sessions without guidance, I instructed participants in all three conditions to listen to the recorded imagery script using a Sony MP3 player on alternate days. For each session, they were instructed to follow the script on the MP3 player in a relaxed position while listening to the music and imagining the scene in sessions that took place. I encouraged participants not to conduct the imagery training during the night time or when they felt tired. During their 10 sessions without guidance, personal follow up emails and telephone calls were conducted to seek participants' accountability in performing their imagery tasks. In these sessions, I briefly discussed their imagery outcomes. In addition, by completing the logbook after every session, participants provided a record of the imagery they conducted together with any noteworthy features they experienced. Approximately four weeks later, after participants had completed the 12th imagery intervention session, they performed a post-test of 40 trials of dart throwing under the same conditions as their pre-test. Table 4.1 shows the 4-week cycle of three imagery sessions on the Monday, Wednesday, and Friday of each week, which together comprised 12 imagery sessions.

Table 4.1.

Example of the Pattern of 12 Imagery Sessions over Four Weeks

	Monday Pre-test (session 1)	Tuesday Rest	Wednesday Self (session 2)	Thursday Rest	Friday Self (session 3)	Saturday Rest
Sunday Rest	Monday Self (session 4)	Tuesday Rest	Wednesday Self (session 5)	Thursday Rest	Friday Self (session 6)	Saturday Rest
Sunday Rest	Monday Self (session 7)	Tuesday Rest	Wednesday Self (session 8)	Thursday Rest	Friday Self (session 9)	Saturday Rest
Sunday Rest	Monday Self (session 10)	Tuesday Rest	Wednesday Self (session 11)	Thursday Rest	Friday Post-test (session 12)	

After the post-test, I randomly selected six of the participants (2 in each condition) to further explore their subjective experience of URMI, UAMI or NMI during the imagery training intervention, using a short interview. Following completion of all aspects of the study, I debriefed participants and thanked them for volunteering for and contributing to this study.

Data Analyses

All data were averaged and I calculated descriptive statistics (means and standard deviations) to describe the study variables (SIAM, GSR, PT, HR, CSAI-2R, and dart-throwing performance). I then pre-screened data for missing dataoutliers, and normality of distribution, using SPSS analysis procedures. No missing data or outliers were observed. I examined differences between the baseline data for the study variables using one-way analysis of variance (ANOVA).

Because the statistical analysis of physiological measures was important to examine whether the three research conditions, URMI, UAMI, and NMI, had the intended impact on participants' arousal levels during imagery training, I monitored physiological measures during Session 1 (t_0 to t_{540}) and Session 12 (t_0 to t_{540}). In this study, I only report the time during which participants performed the imagery training because the pre-imagery and post-imagery data did not show any meaningful information. In order to determine the impact of the research conditions on the physiological measures, GSR, PT, and HR, the changes in arousal from t_0 to t_{540} were plotted on a line graph and the trends were described. I conducted one-way ANOVA to determine whether there was any difference between research conditions at the end of imagery training during Session 1 and Session 12. In the case of significant differences between the three research conditions, I conducted further analysis using post hoc Tukey tests to determine which of the three research conditions were significantly different from others. In addition, I conducted two-way mixed design ANOVAs to examine whether there was a main effect of research conditions, occasion, and interactions between research conditions and occasion from baseline of Session 1, t_0 to baseline of Session 12, t_0, and from the end of Session 1, t_{540} to the end of Session 12, t_{540}. In the case of significant differences, further analysis using post hoc Tukey tests was conducted to determine which of the conditions were significantly different from others.

In examining whether the subjective perceptions of different types of research conditions (URMI, UAMI) compared with no music (NMI) impacted on changes in the psychological measures (somatic anxiety, cognitive anxiety, self-confidence) from Session 1 (pre and post) to Session 12 (pre and post), I used paired-samples *t*-tests. Here, results of both pre- and post-tests in each session were recorded. Paired-samples *t*-tests were used to test for significant changes from before Session 1 (Session 1 pre-test) to the end of Session 12 (Session 12 post-test) for each research condition (URMI, UAMI, NMI).

Next, I examined the impact of arousing and relaxing music and imagery training on the performance of dart throwing, which is the objective of this study. I used one-way independent groups ANOVA to determine the differences in research conditions at baseline for dart-throwing performance scores. Then, I calculated gain scores for each condition and illustrated this in a bar graph. I conducted one-way independent groups ANOVA to identify whether there was a difference in dart-throwing performance gain scores between the three research conditions. I conducted post hoc Tukey tests to determine the location of differences in pairs of research conditions.

Finally, I analysed the short interview using inductive content analysis. Content analysis refers to investigators searching text for recurring words and themes or analysing text, rather than observation-based field notes (Patton, 2002). This procedure allows researchers to organise raw data (e.g., direct quotations from participants) into interpretable and meaningful themes and categories as the inquirers come to understand patterns that exist (Hanton & Jones, 1999). I only employed inductive content analysis during this study because the purpose of the short interview was to explore the experience of the participants during imagery with music or no music. Inductive content analysis has been widely used by sport psychology researchers (e.g., Gould, Eklund, & Jackson, 1992a, 1992b) and has also been used for sport psychology case study research (e.g., Jackson & Baker, 2001).

Results

The study results are presented in five subsections. In the first subsection, I present descriptive information related to participants' imagery ability, and usage of the adherence log. In the next subsection, I present physiological arousal for the three research conditions, UAMI, URMI, and NMI, during imagery of dart throwing, in terms of GSR, PT, and HR. In the following subsection, I report subjective, self-report psychological indicators of arousal (cognitive anxiety, somatic anxiety, self-confidence) in relation to the three research conditions. The effect of the three research conditions on dart-throwing performance is presented in the next subsection, which is the main objective of this study. In the final subsection, participants' experiences are explained, regarding their use of imagery and the perceived effects on performance of the three research conditions.

Imagery Ability

Participants completed a self-report measure of imagery ability, the SIAM, a multimodal, multidimensional measure of imagery ability. All participants reported moderate to high scores on almost all subscales, scoring particularly high on potentially important imagery ability characteristics, such as vividness, control, ease of generation, speed of generation, duration of the image, the visual sense, auditory sense, kinaesthetic sense, tactile sense, and emotion (see Table 4.2). Summarising the imagery ability scores, the means for all participants were in the top third of the scale (above 260), with scores generally above 230 points out of a maximum of 400, except for the olfactory and gustatory subscales. Both of these subscales appeared to be less important, as smell and taste play a minor role in dart-throwing performance. Analysis using one-way ANOVA showed no significant differences between pre-intervention imagery ability for URMI, UAMI, and NMI on any of the subscales of the SIAM. This indicates that the participants in the three research conditions did not differ significantly in imagery ability at the start of the study. The pre-intervention results of this study provide evidence that all participants were able to equally effectively employ imagery as part of their intervention program. Overall, participants' scores were lower compared to Study 1 (Chapter 3) as the present participants were novices, whereas Study 1 participants were elite sports performers.

Table 4.2

Sport Imagery Ability Measure (SIAM) Subscale Means and SDs for URM, UAMI, and NMI.

SIAM	URMI		UAMI		NMI		$F_{(2,62)}$	*p*-value
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*		
Vividness	289.86	47.34	291.24	41.39	293.43	45.85	0.03	.97
Control	287.24	51.58	279.67	42.31	282.62	50.52	0.13	.88
Ease Generation	274.91	59.99	283.47	49.25	289.33	54.46	0.37	.69
Speed Generation	280.57	53.71	285.47	42.63	288.62	47.41	0.15	.86
Duration	274.14	58.92	276.24	49.36	282.47	59.07	0.13	.88
Visual	292.38	46.22	291.81	37.60	294.95	49.41	0.03	.97
Auditory	230.33	71.83	246.81	63.64	235.38	68.90	0.39	.68
Kinaesthetic	252.57	53.42	235.28	53.78	253.76	53.92	0.78	.46
Olfactory	168.33	74.16	121.38	60.64	144.00	61.53	2.68	.08
Gustatory	156.24	85.44	114.86	69.53	133.09	71.32	1.57	.22
Tactile	236.67	65.68	235.71	58.09	245.09	55.03	0.16	.86
Emotion	247.05	61.46	261.95	47.99	247.95	52.39	0.43	.66
Total Score	2988.29	624.62	2923.90	494.78	3000.71	572.00	0.11	.89

Adherence Log

Using the adherence log, all participants confirmed they had frequently practised imagery during the intervention period and indicated that they had completed all imagery sessions as instructed. However, the time between sessions varied between two and three days, due to the participants' university-related commitments. Times recorded in their logbooks showed that participants did their imagery between 10am and 7pm, with no participants undertaking imagery training sessions late at night. Based on the high levels of adherence, all participants were included in the subsequent analyses.

Physiological Changes

Mean GSR, PT, and HR were monitored in Sessions 1 and 12. Patterns of these physiological indicators that reflected the level of arousal are illustrated in line graphs in the figures in this section.

Galvanic skin response (GSR). Figure 4.1 shows the mean for GSR from time-0 to time-540 in seconds for each of the three research conditions, UAMI, URMI, and NMI, across Sessions 1 and 12. The line graphs for the three research conditions in Figure 4.1 indicate that URMI was the most relaxing, with GSR decreasing monotonically over time from the start at t_0 to the end of the session, at t_{540} for Session 1 and for Session 12. GSR for the NMI condition also decreased for Sessions 1 and 12, but the extent and the rate of decrease were less than for URMI. GSR for the UAMI condition showed the highest values for level of arousal for Session 1 and 12 compared with URMI and NMI, but even the arousing condition (UAMI) did show a decrease from the start to end of each session, especially in Session 12. It is also noteworthy that the starting levels of GSR in Session 12 were much lower than the starting levels in Session 1.

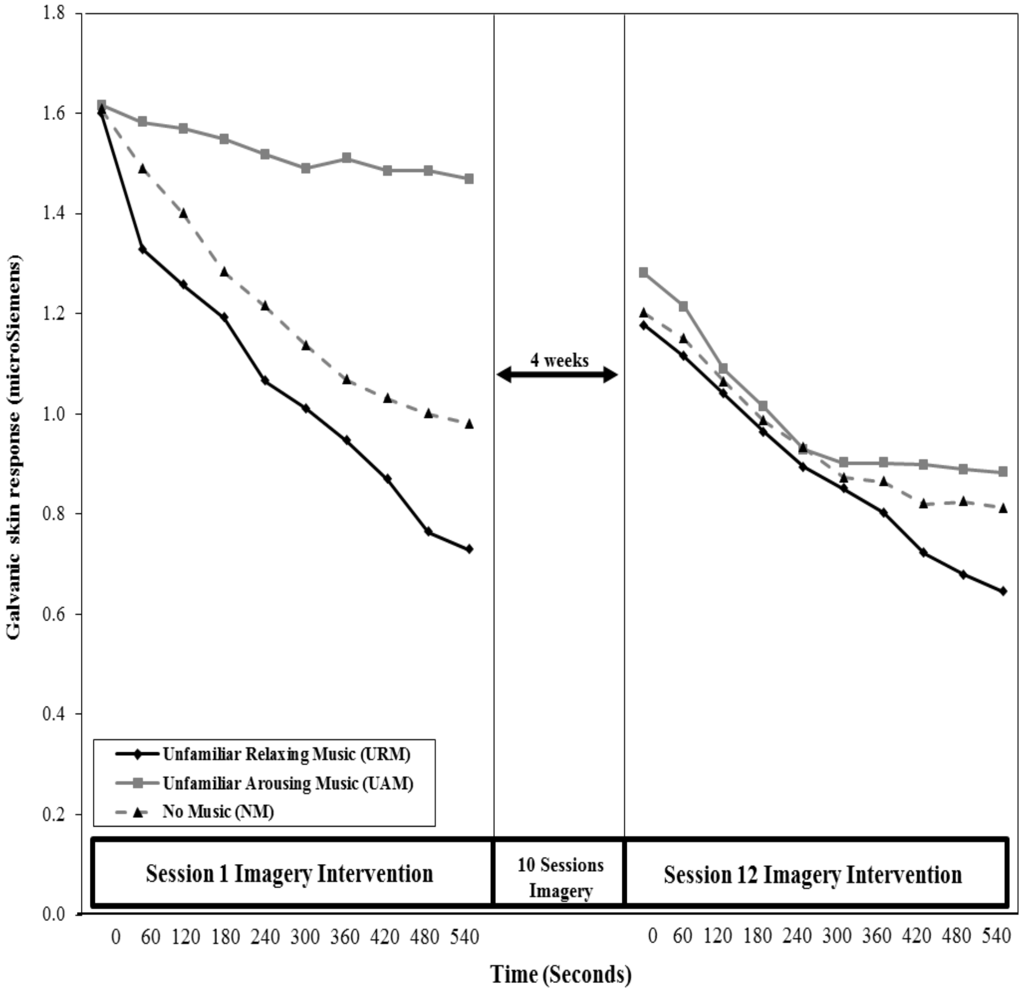


Figure 4.2. Mean galvanic skin response (GSR) from t_0 to t_{540} across Sessions 1 and 12

Comparison at baseline of Session 1 and baseline of Session 12. One-way, independent groups ANOVA revealed that there were no significant differences between research conditions for GSR at baseline, t_0 in Session 1, $F(2, 62) = .002$; $p = .99$, $eta^2 < .001$, with a very small effect size, and Session 12, $F(2, 62) = .13$; $p = .88$, $eta^2 = .004$, with very small effect size.

Comparison at end of Session 1 and end of Session 12. One-way, independent groups ANOVA was employed to identify whether there was a difference between research conditions at the end of each session. Results show that there was a significant difference between research conditions for GSR at the end of Session 1, t_{540}, $F(2, 62) = 7.81$; $p = .001$, eta$^2 = .21$, with a moderate effect size. Further analysis, using post-hoc Tukey tests, showed that at the end of Session 1, GSR was significantly lower in the URMI condition than UAMI ($p = .001$) and NMI ($p = .03$), indicating that URMI was more relaxing compared to UAMI and NMI. At the end of Session 12, $t_{540,}$ there was no significant difference between the three research conditions for GSR, $F(2, 62) = 1.03$; $p = .36$, eta$^2 = .03$, with a small effect size.

Comparison from baseline of Session 1 to baseline of Session 12. Further analysis was conducted on GSR to determine whether there was a main effect of research conditions, occasion, or interaction between research conditions and occasion from baseline of Session 1, t_0 to baseline of Session 12, t_0. Two-way mixed design ANOVA with one independent groups factor, condition, with three levels, URMI, UAMI, NMI, and one repeated measures factor, occasion, with two levels, Session 1 baseline and Session 12 baseline, revealed that there was no significant main effect of research conditions on GSR, $F(2, 60) = 0.05$, $p = .95$, eta$^2 = .002$ with a very small effect size. However, results showed that there was a significant main effect of occasion on GSR from baseline of Session 1, t_0 to baseline of Session 12, $t_{0,}$ $F(1, 60) = 6.17$, $p = .02$, eta$^2 = .09$ with a moderate effect size. This indicates that across all conditions GSR was lower at the start of Session 12 than at the start of Session 1. The results showed that there was no significant interaction between occasion and research conditions on GSR from baseline of Session 1, $t_{0,}$ to baseline of Session 12, $t_{0,}$ $F(2, 60) = .049$, $p = .95$, eta^2 = .002, with a very small effect size.

Comparison from end of Session 1 to end of Session 12. Two-way mixed design ANOVA with one independent groups factor, condition, with three levels, URMI, UAMI, NMI, and one repeated measures factor, occasion, with two levels, end of Session 1 and end of Session 12, revealed that there was a significant main effect of research conditions on GSR, $F(2, 60) = 4.68$, $p = .013$, eta^2 = .14, with a moderate effect size. Further analysis using post hoc Tukey tests, indicated that there was a significant difference between URMI and UAMI ($p = .01$), but there was no significant difference between URMI and NMI (p = .39), or between UAMI and NMI ($p = .20$). Results also showed that there was a significant main effect of occasion on GSR from end of Session 1, t_{540} to end of Session 12, t_{540}, $F(1, 60) = 10.05$, $p = .002$, eta^2 = .14, with a moderate effect size. This indicates that across all conditions GSR was lower at the end of Session 12 than at the end of Session 1. The results also showed that for GSR there was a significant interaction between occasion and research conditions from end of Session 1, t_{540} to end of Session 12, $t_{540,}$ $F(2, 60) = 4.31$, $p = .02$, eta^2 = .13, with a moderate effect size. These results revealed that GSR for UAMI condition reduced dramatically from end of Session 1 to end of Session 12, whereas GSR for URMI and NMI slightly reduced from end of Session 1 to end of Session 12 (see Figure 4.1).

Peripheral temperature (PT). Figure 4.2 shows the means for PT from t_0 to t_{540} for the three research conditions across Sessions 1 and 12. From the line graphs, although there were no differences between UAMI, URMI, and NMI at the start of Session 1, URMI showed a higher level of PT than UAMI and NMI as the session progressed, which corresponds to the lowest level of arousal. For Session 12, there was no difference between URMI and NMI at the start, but UAMI showed lower PT at that point. During Session 12, PT increased more for URMI than NMI, and URMI retained a higher level than UAMI. PT increased over time from the start to the end of Session 1 and 12 for all three-research conditions. Thus, as for GSR, the main trend was for level of arousal to decrease in UAMI, URMI, and NMI across both sessions. The highest PT representing the lowest level of arousal was observed for URMI.

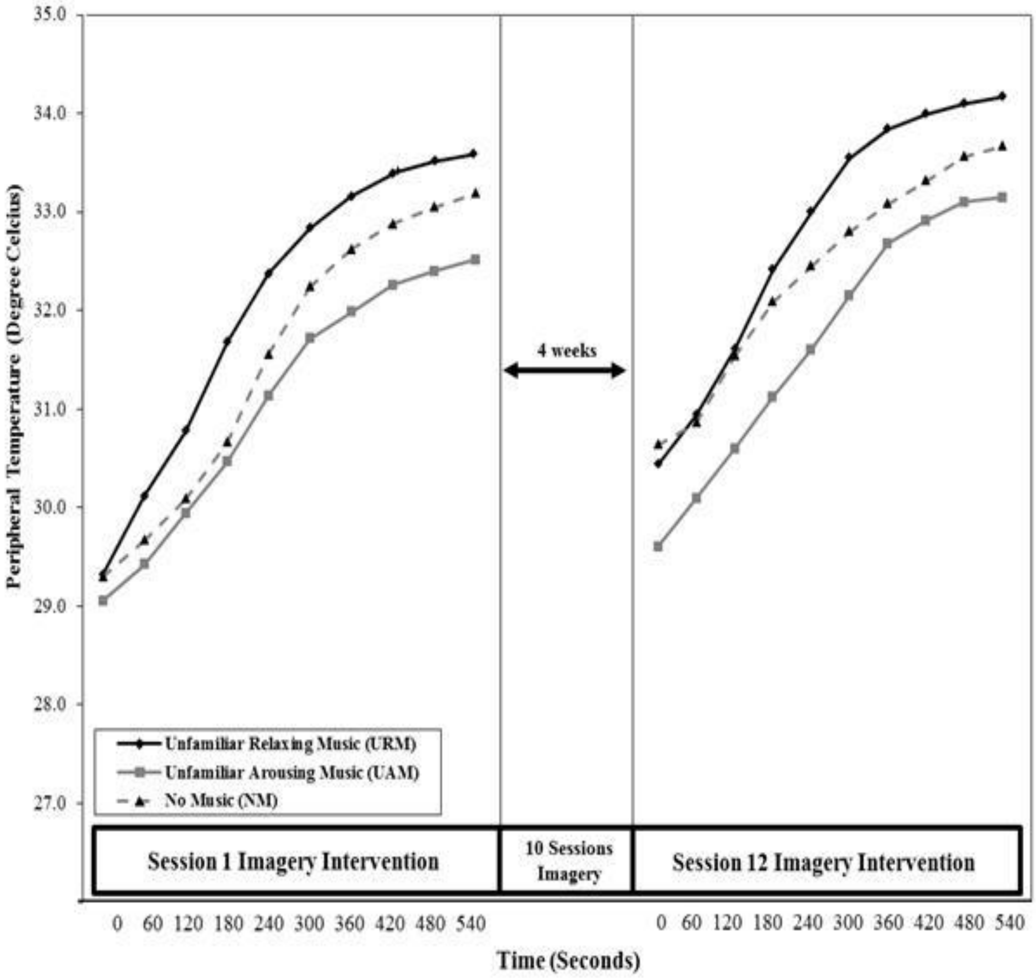


Figure 4.3. Mean peripheral temperature (PT) from t_0 to t_{540} across Sessions 1 and 12

Comparison at baseline of Session 1 and baseline of Session 12. Results of one-way, independent groups ANOVA revealed that there were no significant differences between research conditions for PT at baseline, t_0 in Session 1, $F(2, 62) = .03$, $p = .97$, eta^2 < .001, with a very small effect size, and at the start of Session 12, $F(2, 62) = .38$; $p = .68$, eta^2 = .01, with a small effect size.

Comparison at end of Session 1 and end of Session 12. Results of one-way, independent groups ANOVA showed that there were no significant differences between research conditions for PT at the end of Session 1, t_{540}, $F(2, 62) = 1.33$; $p = .27$, eta^2 = .04, with a small effect size, and at the end of Session 12, t_{540}, $F(2, 62) = .64$; $p = .53$, eta^2 = .02, with a small effect size.

Comparison from baseline of Session 1 to baseline of Session 12. Further analysis was conducted to determine whether for PT there was a main effect of research conditions, occasion, or any interaction between research conditions and occasion from baseline Session 1, t_0 to baseline of Session 12, t_0. Two-way mixed design ANOVA with one independent groups factor, research condition, with three levels, URMI, UAMI, NMI, and one repeated measures factor, occasion, with two levels, Session 1 baseline and Session 12 baseline, revealed that there was no significant main effect of research conditions on PT, $F(2, 60) = 0.21$, $p = .81$, eta^2 = .01, with a small effect size. Results also showed that there was no significant main effect of occasion on PT from baseline of Session 1, t_0 to baseline of Session 12, t_0, $F(1, 60) = 2.38$, $p = .13$, eta^2 = .04, with a small effect size. The results showed that there was no significant interaction between occasion and research conditions on PT from baseline of Session 1, t_0 to baseline of Session 12, t_0, $F(2, 60) = .19$, $p = .83$, eta^2 = .01, with a small effect size.

Comparison from end of Session 1 to end of Session 12. Two-way mixed design ANOVA with one independent groups factor, research condition, with three levels, URMI, UAMI, NMI, and one repeated measures factor, occasion, with two levels, end of Session 1 and end of Session 12, revealed that there was no significant main effect of research conditions on PT, $F(2, 60) = 1.32$, $p = .28$, eta^2 = .04, with a small effect size. Results also showed that there was no significant main effect of occasion on PT from end of Session 1, t_{540} to end of Session 12, t_{540}, $F(1, 60) = 0.08$, $p = .77$, eta^2 = .001, with a small effect size. The results also showed that there was no significant interaction for PT between occasion and research conditions from the end of Session 1, t_{540} to the end of Session 12, t_{540}, $F(2, 60) = 0.16$, $p = .85$, eta^2 = .01, with a small effect size.

These results indicate that there were no significant changes of PT among participants from the three research conditions, from baseline of Session 1, t_0 to baseline of Session 12, t_0, and the end of Session 1, t_{540} to the end of Session 12, t_{540}. There were also no interactions between occasion and research conditions between baseline of Session 1, t_0 and baseline of Session 12, t_0, or between the end of Session 1, t_{540} and the end of Session 12, t_{540}.

Heart rate (HR). Figure 4.3 shows the means for HR from t_0 to t_{540} in seconds across Sessions 1 and 12. From this line graph, URMI reflects the largest reduction in level of arousal across Sessions 1 and 12, with HR decreasing monotonically from the start to the end of both sessions. NMI also shows a decrease in HR, but the slope of the graph is less steep, indicating that the rate of decrease was less than that for URMI. UAMI decreased the least compared to URMI and NMI. Again, after a brief and minimal increase, UAMI showed a small reduction in level of arousal over the course of nine minutes of imagery, during which arousing music was played continuously across Sessions 1, and during Session 12 UAMI showed a noteworthy decrease in arousal level.

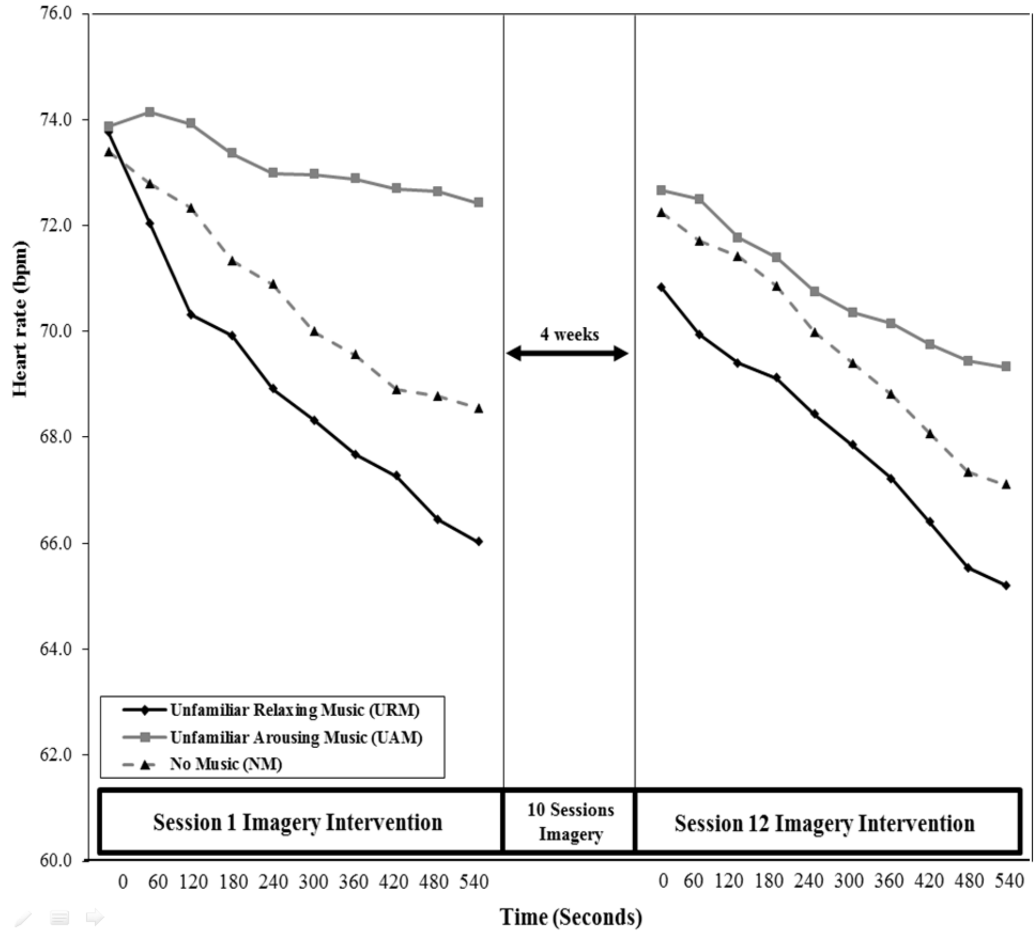


Figure 4.4. Mean heart rate (HR) from t_0 to t_{540} across Sessions 1 and 12

Comparison at baseline of Session 1 and baseline of Session 12. One-way, independent groups ANOVA revealed that there were no significant differences between research conditions for HR at baseline, t_0 in Session 1, $F(2, 62) = .02$; $p = .98$, $\text{eta}^2 < .001$, with a very small effect size, and Session 12, $F(2, 62) = .61$; $p = .55$, $\text{eta}^2 = .02$, with a small effect size.

Comparison at end of Session 1 and end of Session 12. One-way, independent groups ANOVA showed that there was a significant difference between research conditions for HR at the end of Session 1, t_{540}, $F(2, 62) = 3.21$; $p = .047$, $\text{eta}^2 = .10$, with a moderate effect size. Further analysis using post-hoc

Tukey tests revealed that there was a significant difference between URMI and UAMI (p = .04). This indicated that at the end of Session 1, HR was significantly lower for URMI than UAMI. However, there was no significant difference between UAMI and NMI (p = . 29), or between URMI and NMI (p = . 59) at the end of Session 1. At the end of Session 12, there was no significant difference between research conditions for HR, F(2, 62) = 1.73; p = .19, eta^2 = .05, with a small effect size.

Comparison from baseline of Session 1 to baseline of Session 12. Further analysis was conducted on HR to determine whether there was a main effect of occasion, research conditions, or any interaction between occasion and research conditions from baseline of Session 1, t_0 to baseline of Session 12, t_0. Two-way mixed design ANOVA with one independent groups factor, research condition, with three levels, URMI, UAMI, NMI, and one repeated measures factor, occasion, with two levels, Session 1 baseline and Session 12 baseline, revealed that there was no significant main effect of research conditions on HR, F(2, 60) = 0.22, p = .80, eta^2 = .01, with a small effect size. Results also showed that there was no significant main effect of occasion on HR from baseline of Session 1, $t_{0,}$ to baseline of Session 12, $t_{0,}$ F(1, 60) = 0.82, p = .37, eta^2 = .01, with a small effect size. The results showed that there was no significant interaction between occasion and research condition on HR from baseline of Session 1, t_0 to baseline of Session 12, $t_{0,}$ F(2, 60) = .27, p = .77, eta^2 = .01, with a small effect size.

Comparison from end of Session 1 to end of Session 12. Two-way mixed design ANOVA with one independent groups factor, research condition, with three levels, URMI, UAMI, NMI, and one repeated measures factor, occasion, with two levels, end of Session 1 and end of Session 12, revealed that there was a significant main effect of research conditions on HR from end of Session 1, t_0 to end of Session 12, $F(2, 60) = 4.28$, $p = .02$, eta^2 = .13, with a moderate effect size. Further analysis using post hoc Tukey tests indicated that there was a significant difference between URMI and UAMI ($p = .01$), but no significant differences were found for URMI and NMI ($p = .44$), or UAMI and NMI ($p = .22$). This analysis revealed that level of arousal was reduced more for UAMI than for URMI from the end of Session 1 to the end of Session 12. However, results showed that there was no significant main effect of occasion on HR from end of Session 1, t_{540} to end of Session 12, t_{540}, $F(1, 60) = 1.94$, $p = .17$, eta^2 = .03, with a small effect size. The results also showed that there was no significant interaction between occasion and research conditions on HR from end of Session 1, t_{540} to end of Session 12, $t_{540,}$ $F(2, 60) = 0.20$, $p = .82$, eta^2 = .01, with a small effect size.

Psychological Measures

In this subsection, I present the results for psychological variables including somatic anxiety, cognitive anxiety, and self-confidence.

Somatic state anxiety. Means and standard deviations of somatic state anxiety for UAMI, URMI, and NMI during Session 1 and Session 12 are presented in Table 4.3. This table also shows the results of paired-samples *t*-tests comparing the changes between Session 1 pre-test and Session 12 post-test in somatic state anxiety in the three research conditions (URMI, UAMI, and NMI).

Table 4.3

Means and Standard Deviations for Somatic State Anxiety in Session 1 and Session 12

Research conditions		Session 1 Pre-test	Session 1 Post-test	Session 12 Pre-test	Session 12 Post-test	Paired samples *t*-test (*df* =20)	*p*-value	*Cohen's d*
URMI	*Mean*	16.38	12.52	14.86	12.67	5.06	<.001	1.10
	SD	3.53	3.09	4.05	2.76			
UAMI	*Mean*	16.05	13.14	15.10	14.38	2.34	.03	0.51
	SD	5.14	4.05	5.13	4.49			
NMI	*Mean*	16.14	13.48	15.00	14.43	2.00	.06	0.44
	SD	4.93	4.24	4.29	4.49			

One-way ANOVA showed that there was no significant difference between the three research conditions at baseline for somatic anxiety, $F(2, 62) = .03$, $p = .97$, $\text{eta}^2 < .001$, with a very small effect size. Paired-samples *t*-test analysis comparing Session 1 pre-test and Session 12 post-test revealed that there were significant reductions in URMI ($p < .001$), with a very large effect size, and UAMI ($p = .03$), with a medium effect size, for somatic state anxiety. However, no significant difference was observed in NMI for somatic state anxiety ($p = .06$), although the effect size was also medium. This indicates that somatic state anxiety was significantly reduced among participants in the URMI and UAMI research conditions from the start of Session 1 to the end of Session 12.

Cognitive state anxiety. Means and standard deviations of cognitive state anxiety for UAMI, URMI, and NMI during Session 1 and Session 12 are presented in Table 4.4. This table also shows the results of paired-samples *t*-tests comparing the changes from the start of Session 1 to the end of Session 12 in cognitive state anxiety in the three research conditions (URMI, UAMI, NMI).

Table 4.4

Mean, Standard Deviations for Cognitive State Anxiety in Session 1 and Session 12

Research conditions		Session 1		Session 12		Paired samples *t*-test (df =20)	*p*-value	*Cohen's d*
		Pre-test	Post-test	Pre-test	Post-test			
URMI	*Mean*	20.10	15.43	18.67	13.62	5.09	<.001	1.11
	SD	5.78	5.87	5.27	4.63			
UAMI	*Mean*	20.86	19.24	18.95	17.90	2.05	.06	0.45
	SD	8.31	6.74	7.63	6.24			
NMI	*Mean*	19.52	17.05	17.14	17.05	3.23	.004	0.70
	SD	6.13	4.67	6.94	6.68			

One-way ANOVA showed that there was no significant difference between the three research conditions at baseline for cognitive state anxiety, $F(2, 62) = .20$, $p = .82$, eta$^2 = .01$, with a small effect size. Paired-samples *t*-test analysis comparing the start of Session 1 and the end of Session 12 revealed that there were significant decreases in URMI ($p < .001$), with a very large effect size, and NMI ($p = .004$), with a large effect size, for cognitive state anxiety. However, there was no significant difference in UAMI for cognitive state anxiety ($p = .06$), but the effect size was medium. This indicates that cognitive state anxiety was significantly reduced in the URMI and NMI research conditions from the start of Session 1 to the end of Session 12.

Self-confidence. Means and standard deviations of self-confidence for UAMI, URMI, and NMI during Session 1 and Session 12 are presented in Table 4.5. This table also shows the results of paired-samples *t*-tests comparing the changes from the start of Session 1 to the end of Session 12 in self-confidence in the three research conditions.

Table 4.5

Mean, Standard Deviations for Self-Confidence in Session 1 and Session 12

Research conditions		Session 1 Pre-test	Session 1 Post-test	Session 12 Pre-test	Session 12 Post-test	Paired samples *t*-test (*df* =20)	*p*-value	*Cohen's d*
URMI	*Mean*	26.29	31.52	27.71	33.33	6.97	<.001	1.52
	SD	3.70	3.16	3.91	3.60			
UAMI	*Mean*	28.57	29.62	28.19	29.05	0.45	.66	0.10
	SD	5.63	6.25	5.72	7.23			
NMI	*Mean*	28.86	31.52	29.05	30.76	2.12	.06	0.46
	SD	5.00	5.44	4.88	4.62			

One-way ANOVA showed that there was no significant difference between the three research conditions at baseline for self-confidence, $F(2, 62) = 1.78$, $p = .18$, $eta^2 = .06$, but the effect size was medium. Paired-samples *t*-test analysis comparing the start of Session 1 with the end of Session 12 revealed that there was a significant increase in URMI ($p < .001$). There was no significant difference in self-confidence for NMI ($p = .06$), but the effect size was medium. Here was no significant difference in UAMI for self-confidence ($p = .66$), with a small effect size.

Summary of results from physiological and psychological measures. Statistical analysis indicated that there were significant differences between research conditions at the end of Session 1 for GSR and HR. In addition, observation of the trends of all physiological measures (GSR, PT, and HR) in terms of line graphs showed that URMI had a larger decrease in GSR and HR than UAMI, and had the largest increase in PT. The results showed a consistent trend for URMI to be associated with the largest reductions in level of arousal, indicating the largest effect on relaxation, NMI to be associated with a moderate relaxation effect, and UAMI to be associated with the smallest relaxation effect. It is noteworthy that both URMI and UAMI music, as well as NMI, were linked with reduced arousal levels during imagery of dart throwing.

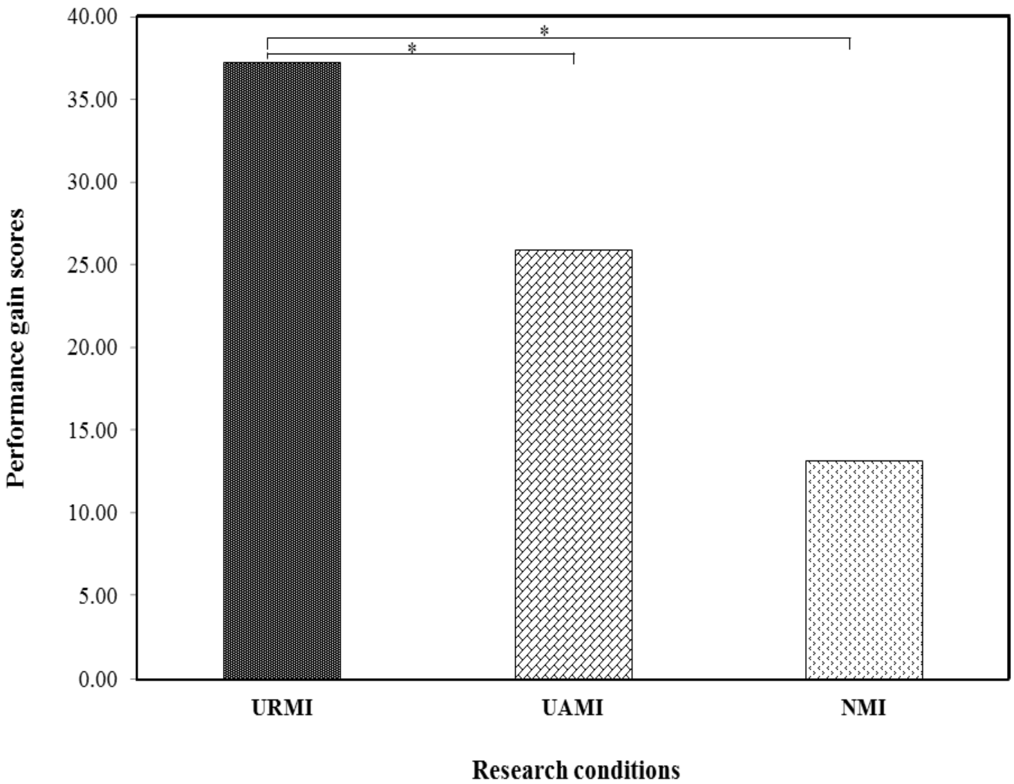
For the psychological measures, somatic state anxiety was significantly reduced from the start of Session 1 to the end of Session 12 for URMI and UAMI. Cognitive state anxiety was significantly reduced from the start of Session 1 to the end of Session 12 for URMI and NMI, and for self-confidence, significant increases were only observed for URMI from the start of Session 1 to the end of Session 12, but not for UAMI and NMI.

In summary, these results indicate that although UAMI, URMI, and NMI all showed trends of increasing physiological relaxation and reducing psychological anxiety (somatic and cognitive) for Sessions 1 and 12, URMI was associated with larger reductions in physiological and psychological indicators of level of arousal than either NMI or UAMI. Given that these differences in the relaxing effects in the three research conditions were consistent in relative terms with predictions, the manipulation check supports consideration of the effect of music during imagery on dart-throwing performance. Thus, I go on to examine the impact of URMI, UAMI, and NMI during imagery training on dart-throwing performance in the following sub-section.

Dart-Throwing Performance

The dart-throwing performance mean scores at pre-test for the three research conditions, URMI, UAMI, and NMI, were 167.10 ± 37.97, 182.95 ± 49.46, and 186.05 ± 41.95 respectively. One-way ANOVA revealed no significant difference between the three research conditions at pre-test for dart-throwing performance, $F(2, 62) = 1.15$, $p = .32$, $\text{eta}^2 = .04$, with a small effect size.

The overall mean gain scores for dart-throwing performance from pre-test, before imagery training, to post-test, after 12 sessions of imagery training, are shown in Figure 4.4. Mean gain scores indicate that participants in the three research conditions improved performance on the post-test compared to the pre-test. URMI showed the greatest improvement (highest mean gain score) in dart-throwing performance, followed by UAMI, and then NMI.



Note. Independent sample *t*-test significance. * = $p < .05$

Figure 4.5. Dart-throwing performance gain scores for the three music imagery conditions.

One-way ANOVA of gain scores revealed that there was a significant difference between the three research conditions in terms of gain scores for performance, $F(2,62) = 5.03$, $p = .01$, $\text{eta}^2 = .14$, with a very large effect size. Gain scores for URMI, UAMI, and NMI were 37.24 ± 25.94, 17.57 ± 24.30, and 13.19 ± 28.15 respectively. Post hoc Tukey tests indicated that there was a significant difference in gain scores on dart-throwing performance between URMI and UAMI ($p = .04$), and between URMI and NMI ($p = .01$). In both cases, the gain score for URMI was significantly larger than that for the comparison conditions. There was no significant difference between UAMI and NMI (p = .85).

Short Interview

On completion of the dart-throwing task, six participants (two from each condition) were asked to describe their subjective experience of the imagery training. Content analysis of the responses revealed that all participants indicated that they had completed all 12 sessions of imagery training. Firstly, I asked about outcomes of the overall imagery training experiences, and then, the outcomes for participants' experience of music during imagery (four participants – not including NMI group). Finally, I asked participants to list the challenges (if any) they faced during imagery training and their recommendations for future imagery training sessions. Pseudonyms have been used to ensure participants' anonymity. The participants, with corresponding research condition, were Christian (URMI), Anna (URMI), Andrew (UAMI), Jackson (UAMI), Matthew (NMI), and Johnna (NMI).

All participants indicated that, during the intervention phase (imagery training), they had made a sustained effort throughout the trials. Further, five out of six participants indicated that the intervention had improved their performance. Participants also felt more relaxed, positive, confident, and they perceived that they experienced greater flow when compared to pre-performance dart throwing. For example, Christian indicated that during the intervention phase, he had felt more relaxed and confident, and that his dart-throwing performance had improved:

> The imagery showed some effects on the dart throwing, I felt confident and great… it not only had helped my capacity to hold more images in my head, but it also affected my mood and the positive outcome... my body had less tension… I was able to imagine more flow state within the imagery…I felt in control of my task knowing what to react to and able to concentrate on my task.

Anna said, “After the imagery, I was relaxed… I felt my body was not tensed… I have more confidence to throw the darts on target and to improve my score… I am surprised this imagery could make a difference in my skills.”

Additionally, Andrew indicated he had experienced reduced anxiety and less concern about his performance: “I improved in my scoring… I felt less nervous compared to the initial competition… I was not worried… my confidence increased...” Matthew also indicated that, during the intervention phase, he had felt more relaxed, but it was after the third imagery training that he began to note significant changes; “I was able to visualise the dart throwing more efficiently after the third attempt… I began to feel relaxed… my body was not tense as before… I began to feel more focused and had more concentration… I felt good.” Similar responses were provided by Johnna: “Imagery works…my body was relaxed… I had complete concentration and focus… I was not worried about the scoring… I was not concerned about performing poorly.”

On the impact of music for imagery training, all four participants (two from URMI, two from UAMI) expressed the feeling that they enjoyed having music as a facilitator to imagery training. They felt it created a more fun, motivational, exciting, and positive mood. For example, Anna expressed the view that during the imagery training, she felt more excitement and motivation, and the music had prompted her to remember the imagery: “I like the music (relaxing music)… the rhythm was good… I am in a relaxing mood… it makes the imagery a more interesting, motivating and exciting experience… it helped me to remember the imagery during the post-performance.” Andrew also expressed excitement and motivation: “I found it an interesting and rather exciting experience… I experienced a motivating experience visualizing with high beat music… slowly I got used to the music and began to visualise my throwing more efficient.” Surprisingly, Jackson used the music to energise his imagery, “I used the music to ‘pump me up’ and make me perform better… it makes me more excited, want to do it better, getting more aroused, but then ‘turn them off’ to focusing on throwing the dart… I think it is a fun experience.”

As for the challenges participants faced, only two participants indicated that they faced some challenges, which included difficulties trying to concentrate, occasionally feeling tired, and having problems with time management, that is, finding suitable times to do imagery sessions. For example, Matthew expressed the following thoughts:

> I nearly missed one or two sessions due to tiredness... I have assignments and a lecture in the morning.... it was rather hard to concentrate if I was tired... However, the follow up on contacting me and completion of the logbook did help me to remember to do my training.

Johnna also experienced similar concerns: “I was distracted twice... waking up too early made me de-motivated and tired... it was hard to manage my time for the imagery.”

Finally, participants suggested some recommendations, including longer periods of imagery (Christian, Matthew), a shorter period of imagery (Andrew), making a weekly follow up (Matthew), having a performance test in between imagery sessions (Anna), measuring HR in every session (Matthew), adding a breathing exercise before imagery (Johnna), using their own earphones (Jackson), and increasing the frequency of imagery sessions (Anna, Matthew). Surprisingly, Matthew said, “I think it should be more, as 12 sessions is not enough for me. I suggest 20 sessions will be ideal...”

Discussion

The purpose of the current study was to investigate the effects of relaxing and arousing music played during imagery training on later performance of the fine-motor skills task of darts throwing. In order to achieve this, I used unfamiliar relaxing and arousing classical music chosen on the basis of testing in Study 1 (Chapter 3), and no music during imagery as a control condition. Given the stated purpose, it was important to undertake a manipulation check to determine whether the relaxing or arousing music excerpts were experienced as relaxing and arousing respectively by the participants in the present study. Physiological measurements of GSR, PT, and HR, and subjective psychological measures of somatic state anxiety, cognitive state anxiety, and self-confidence were used in this study to examine differences in level of arousal and changes in arousal between the research conditions. I used both physiological and subjective psychological measures because physiological measures give an objective indication of the level of arousal, but they do not reflect the subjectively perceived state associated with the psychological arousal level. Thus, a high level of arousal could be associated with anxiety or excitement, whereas a low level of arousal could reflect relaxation or boredom. Self-report subjective psychological measures can add insight into the subjective experience. Thus, the manipulation checks were included to ensure that the music designated as relaxing and arousing, based on its examination in Study 1, was experienced as intended. It was anticipated that when no music was played level of arousal would be between the relatively low level associated with relaxing music and the relatively high level associated with the arousing music.

Firstly, based on research in which music was studied prior to or during actual performance (e.g., Elliott et al., 2012), it was expected that unfamiliar relaxing music (URMI) would lead to reductions in the physiological and subjective psychological measures of GSR, HR, somatic state anxiety and cognitive state anxiety, as well as increases in the PT and self-confidence, all of which reflect a decrease in level of arousal. It was hypothesised that this would enhance performance of dart throwing. Secondly, based on that research on music played before performance, it was expected that unfamiliar arousing music (UAMI) would increase level of arousal as indicated by both physiological and subjective psychological measures. It was proposed that this would lead to a decrease in performance of dart throwing. Finally, no music (NMI; control condition) was expected to have no effect on level of arousal, which would remain in the mid-range of both physiological and subjective psychological measures between the higher arousal level associated with UAMI and the lower level of arousal associated with URMI. It was predicted that this would not enhance or decrease performance of dart throwing.

The discussion of the results is divided into five sections. First, I discuss the participants' imagery abilities and the adherence check with the participants. Second, I discuss the manipulation checks using the physiological and psychological measures from the imagery training. The third section consists of the discussion on the effects of different types of music during imagery training on performance. Fourth, I consider the qualitative results from the short interviews on the subjective experience of six participants, and, finally, I discuss methodological issues and future research.

Participants' Imagery Abilities and Adherence Check

Preliminary testing in the current study showed that all participants had acceptable imagery ability measured by the SIAM, on which all participants scored generally above 230 points out of a maximum of 400, except for the olfactory and gustatory subscales. Comparison of the results for the three research conditions, URMI, UAMI, and NMI, indicated that the participants in the three research conditions did not differ significantly in their imagery ability at the start of the study. The results from Table 4.2 showed that all participants were able to equally effectively employ imagery as part of their intervention program. According to Morris et al. (2005), it is important for researchers to measure participants' imagery ability in order to pre-screen participants to ensure that they have imagery ability that is adequate for experiments and field-based interventions. Athletes who display poor imagery ability should be excluded from studies or applied use of imagery or should be given adequate imagery training exercises to enhance their imagery ability (Williams et al., 2010).

The results from the adherence log confirmed that all participants completed all 10 sessions of imagery training that they were asked to do on their own during the 4-week study period, although the timing of sessions varied between two and three days, due to the participants' university-related commitments. Furthermore, the time recorded in the adherence log showed that participants did not perform their imagery training sessions after 7pm, or even late at night. This is important because some participants might experience tiredness or even loss of concentration when performing the imagery training in the late evening, which can influence their capacity to fully focus on the imagery script together with the music during the 10 sessions of imagery intervention by themselves. Thus, based on the results from the adherence log, which showed that all participants had good adherence to the imagery training requirements of this study, participants' data were included in the subsequent manipulation check analyses.

Manipulation Check

Physiological measures. The results from the manipulation check indicated that consistent changes in GSR, PT, and HR reflected lower levels of arousal for URMI than UAMI, or NMI that were significant for GSR and HR, and higher levels of arousal for PT, which did not reach significance, but which showed a medium effect size, suggesting that the differences were meaningful. Visual inspection of Figures 4.1, 4.2, and 4.3 suggests that in Session 1 the levels of arousal reduced, which is consistent with the relaxing effect of URMI. The level of arousal decreased during the 9-minute imagery session with music to a greater extent than was observed for UAMI or NMI. This was consistent with the research prediction. At the same time, level of arousal decreased across Session 1 for all three research conditions, although the decreases were shallow for UAMI on the GSR and HR measures. This difference was significant at the end of Session 1 between URMI and UAMI on the GSR and HR measures, further supporting the prediction about the relaxing effects of URMI. Two trends are prominent in Figures 4.1, 4.2, and 4.3 for GSR, PT, and HR during Session 12. First, in all the physiological measures, for all three research conditions, level of arousal is lower at the start of Session 12 than at the baseline of Session 1. This trend is greatest for GSR, however, it is not significant, and it is least evident for PT, where it is also not significant. For HR, it is also not significant, but a medium effect size suggests a meaningful effect.

Second, the trends across the 9-minute imagery session in Session 12 reflect that arousal level, which again decreased for all three research conditions across the session, differed less between the conditions than in Session 1, suggesting that level of arousal for NMI and UAMI decreased more than that for URMI across the 10 self-managed imagery sessions, but those sessions were not monitored for physiological change in this study. In particular, visual inspection suggests that the decrease in arousal level for UAMI during Session 12 is more substantial than in Session 1. This is supported by the statistical results, which indicate that significant differences between URMI and UAMI at the end of Session 1 are no longer present at the end of Session 12. These trends are not consistent with predictions. It was expected that NMI would show little or no relaxing effect and UAMI would be associated with increases in arousal. Both NMI and UAMI showed clear and consistent reductions in level of arousal within each session and between Session 1 and Session 12. One other clear trend across all three physiological measures for both sessions is that the graphs for NMI are all between the graphs for URMI and UAMI, as predicted.

Comparing the end of Session 1 to the end of Session 12, significant main effects were observed on occasion, research conditions, and interaction between occasion and research conditions for GSR and only a significant main effect on research conditions was observed in HR. The results showed that URMI is significantly different to UAMI, but there was no such difference between URMI and NMI. Furthermore, Figure 4.1 and Figure 4.3 showed that UAMI reduced dramatically whereas URMI and NMI slightly reduced from Session 1 to end of Session 12. An interesting finding is that GSR for the UAMI condition reduced a lot from Session 1 to Session 12, whereas GSR for URMI and NMI showed minimal change. This could represent further evidence of the relaxing effect of the cognitive process involved in performing imagery, which was suggested from the results of Study 1. Thus, it is possible that such a relaxing effect of doing imagery damped down the arousing effect of UAMI. It is also possible that the pattern of reduced arousal observed for UAMI, where arousing unfamiliar classical music was expected to increase level of arousal is associated with a habituation effect. Over 12 sessions of imagery with UAMI, unfamiliar music could have become familiar to the participants. Support for a relaxing effect of doing imagery comes from the results for NMI, however. It was expected that there would be no effect on level of arousal in the NMI condition because there was no music to manipulate arousal level. Once again, however, level of arousal reduced substantially in both Session 1 and Session 12 where the physiological indicators were employed. It is possible that for the music conditions a combination of increasing familiarity and a relaxing effect of imagery operated. However for NMI there was no music so changes in arousal level must be due to other processes and a relaxing effect of becoming immersed in imagery is one possibility. It is interesting that arousal level for URMI did not reduce as much as that for UAMI in Session 12, although at the end of Session 12, level of arousal for the URMI condition is still the lowest level of any condition at any time in the study. It is possible that the decrease in the rate of arousal reduction for URMI could reflect a "floor effect" condition. It is also possible that this reduction of arousal level is a consequence of increasing familiarity with the relaxing music reducing its impact.

Psychological measures. Self-report psychological measurement showed mixed results, with significant decreases in somatic state anxiety observed in URMI and UAMI, but not in NMI, although there was a practical meaningful reduction in somatic state anxiety with medium effect sizes. This indicates that somatic state anxiety was significantly reduced among participants in the URMI and UAMI research conditions from the start of Session 1 to the end of Session 12. In contrast, for cognitive state anxiety, significant decreases were observed in URMI and NMI, but not in UAMI, although there was a practically meaningful reduction with medium effect sizes. For self-confidence, corresponding increases were observed for URMI, but not for UAMI and NMI, even though NMI showed medium effect sizes. Although NMI only acted as a control condition, the NMI condition did show a significant effect on cognitive state anxiety, while effect sizes for somatic state anxiety and self-confidence were medium. The self-report measures of somatic and cognitive anxiety, and self-confidence were included in this study to facilitate interpretation of the changes in level of arousal observed among the physiological measures. These results provide support for the proposition that the reductions in level of arousal observed in those physiological measures were associated with relaxation, rather than boredom or drowsiness.

In an unpublished thesis, Chiu (2008) conducted a study on the application of relaxing classical music as an intervention on 12 female Chinese University basketball players before a tournament. Results from the Chinese language version of the CSAI-2 showed significant reductions in cognitive and somatic state anxiety, with an increase in self-confidence, which is similar to the findings from this study. However, the study was written in the Chinese language, which prohibited full interpretation of the detailed design of the study. Moreover, the thesis did not report any physiological measures that could have provided indicators of the level of arousal associated with the use of relaxing classical music prior to a basketball tournament.

It is possible that both the imagery process and the music contributed to the changes observed in state anxiety and self-confidence. According to Morris et al. (2005), numerous studies in sport have shown that imagery training decreases anxiety levels and increases self-confidence, resulting in enhanced performance. Hanrahan and Vergeer (2001) also provided support for the proposition that imagery interventions can facilitate athletes establishing clearer goals, enhancing confidence, and focusing attention on the task. Their study showed that an imagery intervention had an effect on participants' state anxiety and self-confidence. Nonetheless, most imagery studies that have monitored state anxiety and confidence, have done so because their imagery interventions were designed to reduce anxiety or enhance confidence. This was not the focus of the present study, although participants were encouraged to imagine successful outcomes that have been shown to enhance self-confidence (e.g., Morris et al., 2005). With the presence of relaxing music during imagery (URMI) in the present study, it is possible that this played a part in the reduction of state anxiety. However, the results exhibited significant effects on both state anxiety and self-confidence, with very large effect sizes, and it is not clear how relaxing music would enhance self-confidence, unless it is an outcome of reducing state anxiety. A study by Elliott et al. (2012) also provides support for the application of relaxing music for competitive state anxiety with medium effect sizes, even though the result was not significant. In addition, many studies have also suggested that music can be used to reduce anxiety in individuals (e.g., Seaward, 2002; Sorenson, Czech, Gonzales, Klein, & Lachowetz, 2008). Seaward (2002) stated that by listening to calming music (relaxing music) an hour every day, individuals could significantly reduce their anxiety level.

Researchers have often reported that increases in self-confidence accompany reductions in state anxiety (Woodman & Hardy, 2003). The results from the current study supported the proposal that the use of relaxing music during imagery is effective to decrease competitive state anxiety and to increase self-confidence for fine-motor skills sport performance. On the other hand, the results from this study showed that arousing music (UAMI) had a significant effect in reducing somatic state anxiety, but not cognitive state anxiety or self-confidence level, although cognitive state anxiety showed a very large effect size. The no music condition (NMI) showed a significant effect in reducing cognitive state anxiety, but not for somatic state anxiety or self–confidence, although self-confidence showed a very large effect size. The results for UAMI and NMI are not easy to explain based on the music manipulations in these conditions. It seems more likely that aspects of imagery underpinned those changes in state anxiety and self-confidence.

Arousal is most closely related to somatic anxiety, because it reflects individuals' perception and interpretation of their bodily sensations, so it would be expected that when participants experienced lowering in their levels of physiological arousal, they would also report reductions in somatic state anxiety, but it is not clear why changes in physiological arousal would be associated with cognitive anxiety or self-confidence. One explanation could be that imagining successful performance helped participants to feel less worried and more assured, which was reflected in reductions in their reports of cognitive state anxiety and increases in self-confidence on the CSAI-2R. Hall and Erickson (1995) examined the use of stimulating music (arousing music), namely the "Rocky theme", compared to a control condition. They found that the stimulating music was associated with increased levels of somatic state anxiety, rather than the cognitive dimension of anxiety.

Effect of Music or No Music during Imagery Training on Sport Performance

In terms of performance, it was hypothesised that, because of its relaxing quality, reducing level of arousal, URMI would produce significantly larger gains in performance than UAMI and NMI. This hypothesis was supported. This indicates that playing unfamiliar relaxing music during 12 sessions of imagery training had the most beneficial effects on later performance of dart-throwing performance compared to UAMI and NMI. Although UAMI produced the least relaxing conditions during imagery, UAMI still produced a larger improvement in performance than NMI, although the difference was not significant. Dorney et al. (1992) suggested that music does not enhance the effectiveness of imagery. However, in a triangulation interview study on seven NCAA Division 1 collegiate athletes, Sorenson et al. (2008) revealed the opposite and suggested that music is important as a facilitator of imagery. They found that music in essence became part of the athletes' imagery routine, as they would first put on their headphones before engaging in imagery. In addition, the athletes also reported that the music enabled them to focus on their imagery routine, as well as blocking out any other distractions that were occurring around them. Sorenson et al. stated that music is important in facilitating the reduction of somatic and cognitive anxiety, which enables athletes to focus on a specific routine and to perform the imagery routine correctly.

In this study, I found that URMI was associated with a significantly larger performance gain score than UAMI or NMI, suggesting that URMI facilitated imagery and dart-throwing performance. In his work on visuomotor behavior rehearsal (VMBR), Suinn (1976) concluded that when imagery rehearsal was preceded by a relaxation exercise there were more beneficial effects than when imagery was rehearsed alone. The results from the present study provide additional information to Suinn's work because I monitored arousal level using physiological measures, which showed that URMI reduced physiological level of arousal to a lower level than UAMI or NMI and this was associated with greater performance gain. This appears to support Suinn's general argument that relaxation (lower arousal) facilitates imagery training, at least in a fine-motor skill.

In the literature review, relaxing classical music and imagery had showed beneficial effects for concentration tasks, and therapeutic settings using the Bonny method of guided imagery and music (Bruscia & Groke, 2002; Goldberg, 1994; Grocke & Wigram, 2007). Recently, Karageorghis et al. (2012c) examined the effect of using voice enhancing technology (VET) and relaxing music on the imagery of break-dancers. They found that the imagery intervention with VET and relaxing music improved relaxation and performance of the break-dancers compared to the control condition (without VET and relaxing music). Imagery with music seems to have effects on performance activities, however, there is still no research examining the effect of relaxing music or arousing music on arousal level during imagery training, and the impact that has on sport performance.

Qualitative Results from Interviews

The subjective experiences derived from the interviews at the end of the study with six participants, two from each research condition, also provided some interesting findings. All six participants reported that they had benefited from imagery regardless of research condition. This was the case despite two participants having experienced imagery with URMI, two with UAMI, and two with no music (NMI). The qualitative responses in the present study suggested that the imagery used here was associated not only with improvement in performance, but also enhanced relaxation. In addition, five of the six participants interviewed stated that the imagery sessions (with or without music) helped them to relax. They also reported that they experienced a more positive state and even claimed that they entered flow on some occasions. This suggests that the participants experienced the relaxing effect that would be expected to occur as a result of the reductions in level of arousal that we measured using physiological indicators and that was associated with positive psychological states. In addition, all four participants (with music) stated that they had enjoyed the music during imagery training. The participants also reported that the music created more motivation, fun, and excitement, which motivated them to perform the imagery training.

Methodological Issues

Variations between research conditions in levels of adherence could affect subsequent performance. In this study, the participants' adherence was uniformly high in all research conditions. One reason could be because of the study design, which encouraged strong accountability between the participants and the researcher. In this study, I personally conducted the imagery Session 1 with participants, then, participants were given a portable MP3 device to do another 10 sessions of imagery. Also, the participants were given an adherence log. In addition, personal follow-up emails and telephone calls were made during the four weeks of imagery, in order to ensure adherence of participants to the imagery intervention program. It is also possible that the use of MP3 players supported adherence, as recently reported in studies with portable devices for delivering imagery interventions by Azizuddin Khan (Azizuddin Khan, Morris, & Marchant, 2011; Azizuddin Khan, Morris, & Marchant, 2012).

A possible limitation in this study is that participants in the three-research conditions used imagery in different ways. I used the same imagery scripts across all three-research conditions – URMI, UAMI, and NMI. The imagery scripts were recorded into the portable MP3 player and only the music and no music conditions changed. The participants in all three conditions were given the same instructions on the use of the imagery training and I checked verbally with the participants that they had followed the instructions correctly after Session 1 of the imagery training. The specific details of individual participants' imagery would inevitably vary, but the general content and sequence of imagery was reported by participants to follow the script. Based on the instructions given and the verbal checks conducted with participants, no systematic differences in the conduct of imagery were observed between the three conditions. Thus, the effect of the imagery intervention on dart-throwing performance depended on the interaction between the music conditions and the imagery content. This means that any difference between conditions was related to the interaction of the music condition with imagery to influence subsequent performance.

Another limitation of this study was that no instruction was given about how many times the act of throwing a dart at the target was to be imagined during one imagery session. Participants were left to pace their own imagery. Thus, some participants might have imagined 40 shots whereas other participants might only have managed to imagine 10 shots during the imagery intervention with or without music. Therefore, the differences in the numbers of imagery rehearsals of the task during a session could also influence the performance. However, I found no studies comparing the differences between the numbers of times during imagery training.

In this study, the number of successful throws (positive imagery) could be a possible limitation. Elite golfer, Nicklaus & Bowden (1974) emphasised the importance of positive mental imagery in helping to achieve good consistent performance. Woolfolk et al. (1985), who investigated the effect of positive and negative imagery on golf putting, found that participants who imagined a successful putting stroke with the golf ball going into the cup (target) showed significant improvement on their performance compared to participants who imagined the golf ball narrowly missing the cup. Beilcock, Afremow, Rabe, and Carr (2001) emphasised the type of imagined image (positive or negative) will subsequent affect the execution of the task. Taylor and Shaw (2002) found that negative outcome imagery (missing a putt) was detrimental to golf putting performance. Therefore, it is also important that the participants in this study imagine successful throws of the darts towards the target.

A concern in Study 1 was that the method of measuring HR using a plethysmograph was associated with some artefact due to movement of the finger that was being monitored. This appeared to be especially evident at the start of data collection in all conditions. In this study, the technique of using the EKG receiver together with the Polar transmitter belt to measure HR worked successfully. HR results showed more reliable consistence trends, less sensitive to finger movement, and less fluctuation compared to Study 1, particularly at the start of the sessions recorded in each research condition. Therefore, I recommend the use of the EKG receiver together with the Polar transmitter belt for measuring HR.

Another concern in this study relates to the extent of increase in peripheral temperature (PT). From Figure 4.2, the results from the mean PT from Session 1 (t_0 to t_{540}) and Session 12 (t_0 to t_{540}) showed that PT increased approximately 3.5 degrees Celsius from the start of the session to the end for all three conditions. These were huge increases in PT, however, we do not know why this occurred. However, I found no studies comparing PT indicators on the music and imagery for comparison. Because this is a huge increase, I advise that the PT measures should be interpreted with caution.

In this study, the participants were sport science students with a variety of different sport backgrounds. This is a limitation in terms of generalisation to elite sports performance. The benefits of using students include the fact that it is more convenient for them and less stressful for data collection, because the students are already at the university to attend their classes, thus they do not need to travel for the testing sessions. In addition, they are interested to participating in the study because they can also learn from the experience of imagery training in research settings. A related limitation of student participants was that, although all participants completed all imagery sessions as instructed, the adherence logs showed the time between the imagery sessions varied between two and three days because of the students' needs to attend classes and to complete assignments. The results of this study indicated that imagery of dart-throwing enhanced performance in all three conditions among novices imagining and then performing this fine-motor skill, but that URMI produced the largest improvement in performance within this sample. Nonetheless, studies should be conducted with elite performers in their own sports to test the generalisation of these findings.

One benefit of examining the impact of imagery on novices is that such participants have more opportunity for improvement. Some researchers have reported that novices benefit more than elite athletes from the use of music in sporting performance (e.g., Brownley, McMurray, & Hackney, 1995; Karageorghis & Priest, 2012a; Muhammadzedeh, Tartibiya, & Ahmadi, 2008). The music in those studies was directly associated with sporting performance and, thus, music might not work in the same way when it is associated with imagery because imagery has been argued to be more effective with skilled performers (Blair et al., 1993; Morris et al., 2005).

According to Karageorghis and Priest (2012a), failure to standardise important aspects of experimental protocol, such as playing music at a consistent volume, is likely to cause inconsistencies in research findings. In this study, the volume was adjusted and a sticker was used to lock the volume, so that the participants could not change the volume of the MP3. This is because changing the volume changes the decibel level of the music and loudness can affect the arousing properties of music. Although in this study, I informed the participants not to change the volume, in future, researchers could also consider using an MP3 player that can lock the volume at the desirable level, so that participants cannot change the volume. Informal checks in this study suggested that participants did not change the volume of the music during the study.

During the period of training and testing in this study, in order to minimise the possibility of interaction with other participants, both from the same and from the other conditions, participants were asked not to talk to others about the study until their involvement in the study was over. This is important because such interaction could have confounded the study. In this study, although various measures were taken to minimise interaction among the participants, it is still possible that participants discussed their involvement in the research among themselves. One reason for this is that the study took four weeks to complete, and during the study period, participants came to the university to attend lectures, tutorials, and other class activities, providing the opportunity for such interaction to occur. Thus, although appropriate steps were taken to avoid interactions among the participants, it is possible that some participants could have interacted during the study period.

In this study, although the short interview was a tool to collect secondary data to seek participants' subjective experience of the imagery training, only six participants were chosen at random for the short interview. Coincidentally, I found that all six interview participants improved in their post-test performance on dart throwing. It would be interesting if researchers, who conduct similar studies in future, recruit participants purposefully to ensure there is a mixture of participants with strong and weak post-test performance results. This will give more opportunity to identify differences in experiences between those who find an imagery training intervention beneficial and those who do not gain so much benefit. Increasing the number of participants involved in post-study interviews is one way to increase the probability of sampling participants with diverse outcomes. This should give more insight into the participants' experiences during the imagery training interventions.

Future Research

The results of the present study raised a number of issues that warrant further research. In this study, physiological measurements from GSR, PT, and HR showed changes between Session 1 and Session 12, especially for the UAMI condition. In all research conditions the level of arousal observed at the start of Session 12 was lower than that at the start of Session 1, but it is not possible to identify when changes in arousal level at the start of sessions changed because there was no physiological monitoring in Sessions 2 to 11. For example, it might be that the starting level of arousal fell gradually across Sessions 2 to 11, indicating a progressive adaptation associated with the music and imagery. Alternatively, it could be that there were one or more discrete points at which a reduction in the starting level of arousal occurred, which would suggest a different process. Measuring the physiological indicators of every participant in every session is very time consuming and expensive, and was not feasible in the present PhD context. A suggested compromise strategy in future is for researchers to monitor physiological measures periodically, such as every third session, to track patterns and trends in the level of arousal during imagery if the level of arousal during imagery intervention is a key question in a study.

The results of this study indicated that the arousing music in UAMI, did not increase the level of arousal of participants as strongly in Session 12 as it did in Session 1. It is possible that this was because the unfamiliar arousing music used in the study became less stimulating with repeated presentation during Sessions 2 to 11. This could be because the unfamiliar music became more familiar when repeated a number of times. However, I have found no research that has examined this question. An alternative explanation is that performing imagery triggered a relaxation response, which counteracted the arousing effect of the music in UAMI. In future, researchers could examine the possible relaxing properties of imagery by monitoring physiological indicators during imagery. It would be interesting to examine the effects of imagery of different activities. The task imagined in the present study was a fine-motor skill. It is possible that imagining tasks that are associated with low levels of arousal, such as darts, shooting, or golf putting, has a relaxing effect, whereas imagining tasks that are associated with high arousal levels, such as sprinting, shot putt, or weightlifting, does not. Research could also be conducted to examine whether there is an increasing effect on level of arousal as individuals become skilled in the use of imagery to imagine sports skills through continued practice.

Terry (2004) provided examples of many athletes using music within a pre-competition routine to regulate mood and arousal. He reported that music was particularly helpful in maintaining pre-competition focus, positive mood, and appropriate arousal level. Many researchers have proposed that the benefits of music for performance in sport are confined to its use as a component of pre-competition routines (Karageorghis & Priest, 2012a; Sorenson et al., 2012). However, in literature searches, I found no studies that have examined the effect of music presented in contexts removed from performance on performance on a later occasion, as has been done in the present study by examining the impact of music played during imagery sessions not directly associated with performance on performance after 12 sessions of imagery with music. This is an important area to explore because many sports competitions, such as shooting, archery, and weightlifting, prohibit athletes from using any sort of music player during the competition, preparation for the competition, or even in the competition venue. Thus, athletes are not allowed to use music as part of their pre-competition routines during events. In this study, the participants used MP3 players with music playing while they worked on imagery scripts to improve dart-throwing performance. If the positive findings of this research are replicated with skilled athletes, it is possible that athletes will not need to listen to music immediately before or during competitions to obtain its benefits. As the participants in this study completed 12 sessions of imagery training with music, the participants should have remembered the scripts, the music, and the arousal level associated with it, during their subsequent performance. Thus, during actual competition, it is possible that athletes could recall music with which they conducted imagery training, prompting them to relax, experience less arousal, and hopefully to perform well. Methods and techniques similar to those employed in the present study should be used in research with skilled athletes.

Conclusion

In conclusion, results in this study provided strong support for the potential of using URMI imagery training to enhance sport performance of a fine-motor sport skill. URMI did produce superior performance compared to UAMI and NMI, however I could not distinguish whether this was because the experience of imagining performance with a low level of arousal transferred to actual performance or whether low arousal during imagery enhanced the effect of imagery on performance of the dart-throwing skill, which then transferred to physical performance. The reduction of level of arousal could be partly due to the effect of imagery alone, or because arousal declines on subsequent use of music over continuous sessions. However, the observation that UAMI was associated with reducing level of arousal over sessions, while arousal level did not reduce as much for URMI in Session 12 compared to Session 1 could be due to increasing familiarity with the music. It was noted that arousal level also declined for NMI during imagery when there was no music to influence arousal level. Further examination of the effects of relaxing and arousing music in which power-tasks are compared to fine-motor skills has the potential to throw light on some of the questions raised in the present study.

CHAPTER 5

THE EFFECT OF RELAXING AND AROUSING MUSIC DURING IMAGERY TRAINING ON PERFORMANCE OF POWER AND FINE MOTOR SPORTS SKILLS

Research has shown equivocal results on the effect of different types of music on the performance of various sport tasks. Several studies have shown that fast tempo music can enhance sports performance, whereas slow tempo music can be detrimental because it facilitates relaxation, which is not beneficial to performance of strength / power / endurance tasks (Beaver, 1976; Ferguson et al., 1994; Karageorghis et al., 1996). Dorney et al. (1992) found that heart rate was significantly lowered after listening to slow classical music and Fontaine and Schwalm (1979) found that familiar music increased heart rate and performance as compared to unfamiliar music.

Researchers have shown that imagery can enhance sport performance, but the conditions that facilitate the imagery process are still not clearly understood. One such issue related to imagery processes is whether imagery should be conducted in a relaxing environment in order to have an optimal effect. Some researchers have argued that relaxation facilitates imagery (Suinn, 1994; Weinberg, Seabourne, & Jackson, 1981), whereas other researchers have proposed that relaxation has not been demonstrated to enhance the impact of imagery on subsequent performance (Braun, Beurskens, Kleynen, Schols, & Wade, 2011; Murphy, Woolfolk, & Budney, 1988; Woolfolk et al., 1985).

Some types of music have been shown to have relaxing effects during imagery, whereas others have been shown to be arousing (Ferguson et al., 1994). Research on the effects of music just before or during performance, and research and practice related to imagery lead to two alternative propositions. The first proposition, which has been the main theme of the present thesis, is that if music is played at the time athletes are performing imagery, it may be associated with the sports task that is being imagined. Thus, if that task requires high arousal for power or endurance, arousing music may have a greater facilitating effect than relaxing music on subsequent performance. For example, Hanton, Jones, and Mullen (2000) compared the effect of arousing music on an explosive sport (rugby league) and a fine neuromuscular control sport (target rifle shooting). Their results suggested that rugby players interpreted greater facilitative effects for both cognitive and somatic anxiety than rifle shooters. On the other hand, if the sports task involves fine motor skills, relaxing music might be more facilitative of subsequent performance, as demonstrated in the previous chapter with the fine motor skill of dart throwing. The second proposition is that if imagery is enhanced by relaxation, relaxing music may have a facilitating effect on imagery for all types of sports tasks. The results of Study 2 in this thesis do not differentiate between these two propositions. Both propositions predict the superiority of relaxing music for enhancing the impact of imagery on performance in fine motor skills like dart throwing.

In thorough literature searches, I found no research that has been carried out to examine the effects of music during imagery training on later competition or actual performance of sports skills. More specifically, I did not identify any research comparing the effects of relaxing and arousing music during imagery of low-arousal fine-motor skills and high-arousal power sports tasks. Further, I found no examination of these issues in relation to imagery and performance among elite athletes. Thus, in this study, the aim was to investigate the effects of relaxing and arousing music during imagery training on the subsequent performance of a low-arousal fine-motor sports skill and a high-arousal power sports skill among elite athletes. Based on the first proposition presented here, it was predicted that performance of a fine motor skill, measured by pre- to post-test gain scores, would be facilitated more by relaxing music during imagery training than by arousing music, whereas performance of a high-arousal power task would be facilitated more by arousing music during imagery training than by relaxing music. To confirm that the unfamiliar classical music excerpts labelled relaxing and arousing did have these effects, I also predicted that unfamiliar relaxing classical music would lead to reductions in physiological and psychological indicators of level of arousal, whereas unfamiliar arousing classical music would lead to increases in level of arousal.

Method

Participants

Participants were 26 skilled shooters (18 males, and 8 females) and 26 skilled weightlifters (19 males, 7 females), aged between 20 and 40 years (Shooters, M = 29.38, SD = 6.06; Weightlifters, M = 25.76, SD = 4.81). The shooters were recruited from Pistol Australia (PA) and the Victorian Amateur

Pistol Association (VAPA); weightlifters were recruited from the Australian Weightlifting Federation (AWF) and the Victorian Weightlifting Association (VWA). As all participants had at least 2 years of competitive experience at state level in their respective sports, they qualified as “skilled” athletes. All participants were required to have normal hearing. All female participants were requested to take part in the study during their late luteal phase (e.g., around the 25th day of the menstrual cycle) in order to minimise psycho-physiological variations induced by hormonal changes. The sample size was calculated using G*Power 3.1 analysis sample size calculation. With a significance level of .05, in order to achieve a moderate effect size of 0.5 and power of 80 percent, a total of 52 participants was required, that is, 13 participants in each condition (Faul et al., 2009). Participants were informed that they were free to withdraw from the study at any time, they were encouraged to ask questions to ensure that they understood what they were asked to do in the study, and they signed consent forms if they wished to volunteer. In this study, one participant from the weightlifting group was excluded from the study because he did not complete a minimum of 10 out of the 12 sessions of imagery training due to tight competition schedules as recorded in his logbook. Even though personal follow-ups and telephone calls were conducted, the participant still missed three sessions of the imagery training. Thus, that participant’s data was deleted from the records.

Design

In this study, I used a pre-test – intervention – post-test design. In the pre-test, participants firstly completed a demographic questionnaire and the SIAM to ensure that they were competent in the major areas of imagery ability employed in the imagery scripts. Next, they completed the Revised Competitive State Anxiety Inventory – 2 (CSAI-2R; Cox, Martens, & Russell, 2003) before and after competing in a simulated shooting or weightlifting competition as appropriate. I then randomly assigned participants from shooting to relaxing - “matched” (*n*=13) or arousing - “mismatched” (*n*=13) unfamiliar classical music research conditions. Similarly, I randomly assigned participants from weightlifting to an arousing - “matched” (*n*=12) or relaxing - “mismatched” (*n*=13) unfamiliar classical music research condition. Participants then undertook 12 sessions of imagery training over four weeks, while relaxing music or arousing music was played throughout all sessions. Following the four weeks of imagery training, I conducted a post-test in a simulated competition under equivalent conditions to the pre-test. Participants completed the anxiety self-report measure, CSAI-2R, before and after the simulated competition. I monitored physiological indicators of galvanic skin response (GSR), peripheral temperature (PT), and heart rate (HR) during Session 1 and Session 12 of the imagery training. After post-testing, I randomly selected 12 participants (three in each condition) to further explore subjective experiences of the relaxing and arousing music on their imagery training using a short interview.

Measures

Demographic information. Questions ascertained participants' age, gender, years of sporting experience, years of competitive experience, experience in shooting or weightlifting, competitive level in the sport, hearing ability, and experience of using imagery in sports. This demographic information is presented in Appendix G (shooting) and Appendix H (weightlifting).

Physiological measures.

***Galvanic skin response* (*GSR*).** As described in Chapter 3.

Peripheral temperature (PT). As described in Chapter 3.

Heart rate (HR). As described in Chapter 4.

Psychological measures. In this study, two measures were used including the Sport Imagery Ability Measure (SIAM) and the Revised Competitive State Anxiety Inventory – 2 (CSAI-2R).

Sport Imagery Ability Measure (SIAM; Watt et al., 2004). As described in Chapter 3. The SIAM was administered to ensure that participants (shooters and weightlifters) had sufficient imagery ability (at least moderate) to perform the imagery tasks in the script, which was either shooting or weightlifting.

Revised Competitive State Anxiety Inventory – 2 (CSAI-2R; Cox et al., 2003). As described in Chapter 4.

Log of Imagery Sessions. I developed an adherence log to keep track of the day, time, and duration of each session. In addition to filling in these details each time they used the MP3 player to perform an imagery session, participants made comments about their experiences during the imagery session, such as how well they were able to concentrate and how they felt (emotions). This provided an opportunity for the participants to note any changes in their experience and comment on their imagery with reference to how strongly and vividly they experienced the music, the imagery, and the sport task (shooting or weightlifting). The adherence logs also provided the opportunity to check how many imagery sessions participants completed. I excluded participants who had missed more than two sessions from the main analysis. The adherence log is presented in Appendix K.

Short Interview. On completion of the simulated competition post-test for shooters and weightlifters, I invited 12 participants (three from each condition) to participate in a short interview (15 – 20 minutes) to describe their subjective experience of the imagery training. The questions included asking the participants to share their overall imagery training experiences, the outcome of the participants' experience of music during imagery, the challenges (if any) they faced during the imagery training, and some recommendations or suggestions from the participants for any future imagery training. The sample questions of the short interview are presented in Appendix H.

Shooting Performance

Shooting performance was based on the score from shooting at a standard 10-metre air-pistol competition target, which is an Olympic shooting event governed by the International Shooting Sport Federation (ISSF). Two simulated competitions were conducted among the shooters, one at pre-test before the imagery training, and one at post-test after the imagery training. Pre-test and post-test performance scores were measured using standard Olympic shooting scoring, which is 60 shots within 105 minutes for male shooters. With agreement from coaches and participants, female shooters also performed 60 shots (instead of the normal 40 shots for women) during the simulated pistol competition for analysis purposes, but with 20 minutes extra time compared to the males, that is 125 minutes. In the simulated competition, there were some restrictions on pistol participants in accordance with the standards set by ISSF in which shooters can only operate with one hand from a standing, unsupported position. The shooters were given enough time to complete a simulated competition in which they could decide their own tempo, as long as the maximum time allowed according to gender, was not exceeded. The simulated competition for air-pistol shooters was conducted indoors with specified minimum requirements of artificial lighting, compliant with ISSF standards. Each participant was given a table with a 1-metre firing point width, and allowed a 10-metre distance between the firing line and the target line. This target, 17 cm by 17 cm, is traditionally made of light-coloured cardboard upon which scoring lines and a black aiming mark, consisting of the score zones 7 through to 10, are printed. Although there is also an inner 10 ring, the number of these is only used in tie-breaking situations. Individual shooters handle changes of targets by means of electronic devices. In this competition, only five shots were fired at each target. With scores varying between 7 and 10 for each of 60 shots the minimum score was 420 (7 x 60) and the maximum score was 600 (10 x 60). The simulated competitions were conducted in the presence of other athletes, coaches, and an audience, which facilitated the conditions of the simulation.

Weightlifting Performance

Weightlifting performance in this study was based on weight lifted in the "clean and jerk", a two-stage action, which is a standard Olympic event governed by the International Weightlifting Federation (IWF). In testing, two simulated competitions were conducted, one at pre-test before the imagery training, and one at post-test after the imagery training. During the simulated weightlifting competition, each participant was given three attempts, with the best valid attempt on each lift counting as the total of the successful lift used to determine the overall result within a bodyweight category. In this study, only the best lifts (from the 3^{rd} attempt) were used for analysis. Thus, the score at pre-test and post-test in weightlifting was heaviest weight lifted in kilograms. At the level of competition of the participants in this study, bearing in mind that weight lifted depends on body weight, scoring typically ranged between 80 and 250 kg. During the competition, two side judges and one head referee, all of whom were qualified Australian Weightlifting Federation (AWF) and International Weightlifting Federation (IWF) officials, provided a "successful" or "failed" result for each attempt, based on their observation of the lift within the governing body's rules and regulations. The judges' and referee's results were registered via a lighting system with a white light indicating a "successful" lift and a red light indicating a "failed" lift. This was done for the benefit of all in attendance, including athletes, coaches, and audience, which facilitated the conditions of the simulation.

Imagery Training

The pre-recorded imagery training sessions were of approximately 9 minutes duration (540 seconds). There were separate shooting and weightlifting imagery scripts, each of which contained content that related directly to the task that was performed at pre-test and post-test. I wrote the scripts from an internal perspective because both tasks, shooting and weightlifting, were predominantly closed skills, where internal imagery has been shown to be more effective (Morris & Spittle, 2012). I then recorded the scripts onto MP3 players, which I gave to the participants for the duration of imagery training.

Imagery script for shooters. I recorded the previously recorded imagery script with relaxing music or arousing music separately for the imagery sessions of shooters. Two shooting state coaches and two elite shooters gave advice during the development and pre-testing of the script in the pilot phase of the study to ensure its suitability. The head coach verified the final version of the script before it was recorded onto the MP3 player. The script focused on executing the sport task, including imagining the weight of the air-pistol, gripping the air-pistol, looking at the target, imagining the distance between the target and the standing podium, checking the hand position, and shooting to the target accurately when ready, using their usual technique and routine for shooting, the outcome of the shooting performance, and successfully performing the shooting at the target during the competition. I reminded participants regularly in the recorded script to be aware of the way their muscles felt, as well as their posture and movement, such as pulling the trigger. The text of the shooting imagery script is presented in Appendix I.

Imagery script for weightlifters. Similar to the shooting imagery script, I recorded the previously recorded imagery script with relaxing music or arousing music separately for the weightlifters in this study. Two weightlifting state coaches and two elite weightlifters provided assistance in the development and pre-testing of the script in the pilot phase of the study to ensure its suitability. The head coach verified the final version of the script before it was recorded onto the MP3 player. The script focused on imagining execution of the sport task, namely clean and jerk, including imagining the weight being lifted, gripping on the weight-bar, positioning for the lifting, executing the clean aspect of the task, lifting the weight to the shoulders, good balance on jerking the weight, using their usual technique and routine on lifting the bar, and successful outcome of the performance. I reminded participants regularly to be aware of the way their muscles felt, as well as the movement of the body, such as the feeling of the squat and the body posture. The text of the weightlifting imagery script is presented in Appendix J.

Research Conditions

In this study, imagery training was undertaken with unfamiliar relaxing music during imagery (URMI) or unfamiliar arousing music during imagery (UAMI). The URMI and UAMI excerpts used were the ones tested in Study 1 (Chapter 3) and used successfully in Study 2 (Chapter 4). The music was pre-recorded and edited onto a standardised Sony Walkman 4GB MP3 player

(Model: NWZ-A865BLK) together with the imagery script, according to the tasks (shooting, weightlifting) and the headphones used is Senheiser HD 600 Avantarde noise-cancelling headphones. Thus, participants imagining shooting or weightlifting in the URMI conditions experienced the same relaxing music and both shooters and weightlifters in the UAMI conditions experienced the same arousing music. The music was controlled at 55-70 decibels, which is the pleasant hearing range for participants with normal hearing (Job et al., 2004). All music was recorded with the help of a qualified sound engineer in a professional recording studio at the Brunswick Music Studio, Melbourne, Australia, specifically set up for recording for this study to eliminate unwanted noise and to control the decibel level. I conducted a pilot study to ensure that the recordings were clear and audible before the actual study began with the participants and checked all MP3 players for volume before use. I used a sticker to lock the volume so that participants were not able to change the volume. Also, I instructed the participants not to change the settings of the MP3 player, including the volume on the MP3 player.

Unfamiliar Relaxing Music Imagery (URMI). As described in Study 2 (Chapter 4).

Unfamiliar Arousing Music Imagery (UAMI). As described in Study 2 (Chapter 4).

Matching of Relaxing and Arousing Music in Shooting and Weightlifting

In this study, I selected weightlifting because it is a power task, which involves high arousal to perform the task (clean and jerk) for maximum performance (Knotts, 2000). Thus, based on the proposition that music during imagery is associated with the task, so it facilitates actual performance to the extent that it matches the arousal level at which the task is performed most effectively, I proposed that arousing music would be a matched condition and relaxing music would be a mismatched condition for imagery of the weightlifting clean and jerk task. I selected shooting because it is a fine-motor skill, in which concentration, minimal muscle tremor, and low heart rate, characteristics associated with relaxation, have been associated with performance success (Haywood, 2007). Thus, based on the same proposition, I proposed that relaxing music would be a matched condition and arousing music would be a mismatched condition for imagery of the shooting task. The study, thus, consisted of four research conditions, two in each of two different sports, weightlifting and shooting. Participants from each sport were randomly assigned into an URMI or UAMI condition to produce the four conditions, which were:

- Shooters – URMI (matched)
- Shooters – UAMI (mismatched)
- Weightlifters – URMI (mismatched)
- Weightlifters – UAMI (matched)

Procedure

Victoria University Human Research Ethics Committee (VUHREC) approved this research. Following standard consent procedures, I informed participants of the purpose and procedures of the study. I encouraged participants to ask questions to ensure they understood what participation involved. I also informed them that results would be confidential and they could withdraw from the study at any time. Those willing to participate as volunteers signed the consent form before any testing occurred. I conducted the procedures in this study individually, and encouraged participants to ask questions both immediately after hearing and reading instructions, and at any time during the test sessions. After they completed a consent form, I asked participants to fill in a demographic information form, followed by the SIAM and CSAI-2R. Participants then undertook their pre-test performance on the task appropriate to their sport, 10-metres air-pistol shooting for the shooters or clean and jerk for the weightlifters. This performance was conducted in a simulated competition environment with coaches, other athletes and audiences present. After the pre-test on performance, I gave participants approximately 20 minutes of rest prior to undertaking Session 1 of imagery for their sport task. I gave instructions on the use of the imagery script on the MP3 player, which was designed for the shooting or weightlifting task as appropriate, with randomly assigned music conditions, URMI or UAMI. I then guided participants to listen to the imagery script while concentrating solely on their imagery. Throughout Session 1 and 12, I monitored physiological indicators of GSR, PT, and HR, starting five minutes before imagery commenced and terminating five minutes after imagery ended. During these two sessions, participants completed the self-report measure, CSAI-2R, before the imagery started and after the imagery session was completed. After Session 1, I gave each participant a Sony MP3 player and I instructed the participants to listen to the recorded imagery script during 10 separate sessions without further guidance. For each session, they followed the script on the MP3 player, while listening to the music and imagining the scene. I also instructed participants how to complete the logbook and asked them to complete it after every session of imagery. This provided a record of the imagery they conducted together with any noteworthy features they experienced. I encouraged participants not to conduct the imagery training during the night or when they felt tired. During the 10 sessions without guidance, I sent personal follow-up emails and made telephone calls to each participant to seek participants' accountability in performing their imagery task. In these communications, I briefly discussed their imagery outcomes. In addition, by completing the logbook after every session, participants provided a record of the imagery they conducted together with any noteworthy features they experienced. Approximately four weeks later, after participants had completed the 12th imagery intervention session, I asked them to perform a post-test simulated competition under the same conditions as their pre-test. I recommended the same 4-week cycle of three imagery sessions on the Monday, Wednesday, and Friday of each week, as shown in Table 4.1 in Chapter 4, which together comprised 12 imagery sessions. Following the post-test, I re-measured participants' subjective experience, using CSAI-2R. Then I randomly selected 12 participants (3 from each condition) to further explore their subjective experience of the URMI and UAMI during imagery training using a short interview with prior agreement from those individuals. Following completion of all aspects of the study, I debriefed and thanked participants for volunteering for and contributing to this study.

Data Analyses

As in Study 2 (Chapter 4), I averaged all data and calculated descriptive statistics (means and standard deviations) to describe the study variables (SIAM, GSR, PT, HR, CSAI-2R, and shooting or weightlifting performance). Then I pre-screened data for missing data, outliers, and normality of distribution using SPSS analysis procedures. In this study, I analyzed the sports (shooting and weightlifting) separately because of the difference in the tasks and scoring procedures.

In order to conduct the manipulation check on the relaxing or arousing music on the four research conditions, namely shooters URMI and UAMI, and weightlifters URMI and UAMI,, I illustrated the changes of GSR, PT, and HR for each condition from t_0 to t_{540} in Session 1 and Session 12 in a line graph and described the trends for each condition. I conducted independent samples *t*-tests at baseline for GSR, PT, and HR to determine whether there was a difference among the research conditions (URMI, UAMI) in each sport (shooting and weightlifting) at the starting point. Then, I conducted independent samples *t*-tests to determine whether there were any differences between research conditions at the end of imagery training at Session 1 and Session 12 in each sport.

I conducted two-way mixed design ANOVAs to examine whether there was a main effect of occasion or research conditions, and whether there were interactions between occasion and research conditions from baseline of Session 1, t_0 to baseline of Session 12, t_0, and at the end of Session 1, t_{540} to the end of Session 12, t_{540}. These analyses were conducted separately for shooters and weightlifters. Thus, in each analysis there were two factors: research condition, with two levels, URMI and UAMI, and occasion, with two levels, Session 1 and Session 12 for baseline or end of session.

In examining whether the subjective perceptions of different types of music impacted on changes in the psychological measures (somatic anxiety, cognitive anxiety, self-confidence) from Session 1 (pre, post) to Session 12 (pre, post), I conducted independent samples *t*-tests and paired-samples *t*-tests. First, I conducted an independent samples *t*-test to examine whether there was a difference between the research conditions on the psychological measures at pre-test for Session 1. Then I calculated paired-samples *t*-tests to identify significant changes from Session 1 pre-test to the end of Session 12 (Session 12 post-test) on the psychological measures for the four research conditions URMI and UAMI, for shooters and weightlifters separately.

For analyses that involved using independent samples *t*-tests and paired samples *t*-tests, I calculated effect sizes using Cohen's *d*. Effect sizes .80, .50, and .20 can be considered as large, moderate, or small in size, respectively (Cohen, 1988). For analyses that involved using one-way independent groups ANOVA and two-way mixed design ANOVA, I calculated effect sizes using eta squared (eta^2). Effect sizes .25, .09, .01 can be considered as large, moderate, or small in size, respectively (Cohen, 1988).

After the manipulation checks based on the physiological and psychological arousal analyses, I examined the impact of imagery training on performance of the simulated competitions before and after imagery training of shooters and weightlifters, which is the main objective of this study. I conducted independent samples *t*-tests to determine whether there were differences in music conditions at baseline for performance scores in each sport. Then, I calculated gain scores for each condition by subtracting score at pre-test from score at post-test, and illustrated the mean gain scores for each condition in a bar graph. Finally, I conducted independent samples *t*-tests to identify whether there was a difference in sport performance gain scores between seperate conditions in each sport.

Results

Results of Study 3 are presented in five subsections. In the first subsection, descriptive information of participants' demographics, imagery ability, and use of the adherence log are presented. In the second subsection, I present physiological level of arousal for different research conditions (URMI and UAMI) for shooters and weightlifters in terms of GSR, PT, and HR. In the third subsection, I report subjective, self-report psychological indicators of arousal, namely somatic state anxiety, cognitive state anxiety, and self-confidence. In the fourth subsection, I present the effects of the imagery with relaxing or arousing music interventions on gain scores in performance for participants from the two sports, that is, shooters URMI and UAMI, and weightlifters URMI and UAMI. In the final subsection, participants' subjective experiences from the short interview are described, regarding their use of imagery and the perceived effects on performance of the imagery intervention accompanied by music in different research conditions.

Imagery Ability

Participants completed a self-report measure of imagery ability, the SIAM (Watt, Morris, & Andersen, 2004), a multimodal, multidimensional measure of imagery ability. All participants reported moderate to high scores on almost all subscales, scoring particularly high on potentially important imagery ability characteristics, such as vividness, control, ease of generation, speed of generation, duration of the image, and the visual and kinaesthetic senses (see Table 5.1). Summarising the imagery ability scores, the means for all participants were in the top third of the scale, with scores generally above 250 points out of a maximum of 400, except for the olfactory and gustatory subscales. Both of these subscales appeared to be less important, as both characteristics play a minor role in shooting and weightlifting performance. Analysis using one-way independent groups ANOVA showed no significant differences between imagery ability on any of the subscales of the SIAM between the research conditions, involving imagery with URMI and UAMI for both shooters and weightlifters. This indicates that the participants doing shooting and weightlifting imagery with both music conditions (URMI and UAMI) did not differ significantly in their imagery ability. The pre-intervention results of this study provide evidence that all participants were able to equally effectively employ imagery as part of their intervention program

Table 5.1

Sport Imagery Ability Measure (SIAM) Subscale Means and SDs for Shooters' and Weightlifters' URMI and UAMI

SIAM	Shooters - URMI *Mean* *(SD)*	Shooters - UAMI *Mean* *(SD)*	Weightlifters - URMI *Mean* *(SD)*	Weightlifters - UAMI *Mean* *(SD)*	$F_{(3,50)}$	*p*-value
Vividness	306.08 (51.89)	303.31 (43.61)	292.62 (45.21)	295.83 (48.28)	0.23	.88
Control	295.46 (51.69)	293.69 (48.97)	289.15 (47.38)	290.08 (50.06)	0.05	.99
Ease Generation	309.62 (48.42)	297.77 (56.44)	295.62 (52.76)	297.33 (46.71)	0.20	.89
Speed Generation	304.62 (48.94)	297.46 (50.30)	289.77 (44.85)	290.67 (47.73)	0.26	.85
Duration	293.38 (59.01)	291.15 (52.35)	276.23 (61.26)	277.17 (45.72)	0.34	.79
Visual	299.77 (55.45)	303.07 (50.86)	296.31 (49.26)	291.42 (56.91)	0.11	.95
Auditory	260.92 (49.90)	261.62 (53.29)	262.08 (51.77)	265.42 (49.67)	0.02	.99
Kinaesthetic	258.08 (50.34)	260.92 (46.53)	251.54 (54.11)	254.58 (47.81)	0.09	.96
Olfactory	171.08 (70.97)	173.07 (61.59)	142.77 (65.32)	152.08 (62.22)	0.66	.58

Gustatory	157.77	154.69	131.77	138.17	0.44	.73
	(78.81)	(54.94)	(68.39)	(69.19)		
Tactile	265.38	253.54	257.23	266.33	0.27	.85
	(40.32)	(47.86)	(43.16)	(38.64)		
Emotion	283.62	278.08	255.92	280.17	0.66	.58
	(50.23)	(55.51)	(64.36)	(50.83)		
Total Score	3205.77	3168.39	3041.03	3099.25	0.28	.84
	(655.97)	(622.28)	(647.85)	(613.77)		

Adherence Log

Using the adherence log, all shooters and all but one of the weightlifters confirmed that they had frequently practised imagery during the intervention period and indicated that they had completed all imagery sessions as instructed. One weightlifter was excluded from the study because he did not complete a minimum of 10 out of 12 sessions of imagery training due to tight competition schedules. The participant's data was excluded for subsequent analyses. The time between sessions varied on some occasions by one day due to the participants' training-related commitments. Times recorded in the logbook showed that participants did their imagery between 7am and 5pm, with no participants undertaking imagery training sessions late at night, as instructed. The adherence log did not identify any systematic imagery practice beyond what was reported in this study.

Physiological Changes

Means of the GSR, PT, and HR were monitored in Session 1 and Session 12 as a manipulation check for level and change in physiological arousal in the four research conditions. Patterns of these physiological indicators reflecting level of arousal for shooters and weightlifters in URMI and UAMI conditions are illustrated in line graphs in the figures in this section.

Galvanic skin response (GSR). Figure 5.1 shows the means for GSR from t_0 to t_{540}, that is, the 9-minute imagery session in seconds, for the research conditions, shooters URMI and UAMI, and weightlifters URMI and UAMI, across Session 1 and Session 12. The line graphs indicated that URMI conditions for shooters and weightlifters were associated with lower levels of arousal than the corresponding UAMI conditions, and that changes across each session reflected GSR decreasing monotonically over time from the start, at $t_{0,}$ to the end of the session, at $t_{540,}$ for Session 1 and for Session 12. Although all conditions showed the pattern of reducing arousal levels, except for UAMI for weightlifters in Session 1, the extent of reduction was greater for each URMI condition than for the UAMI condition in the same sport. Nonetheless, the change scores for GSRs for the UAMI (shooters and weightlifters) conditions showed a decrease during imagery training for Session 1 and for Session 12.

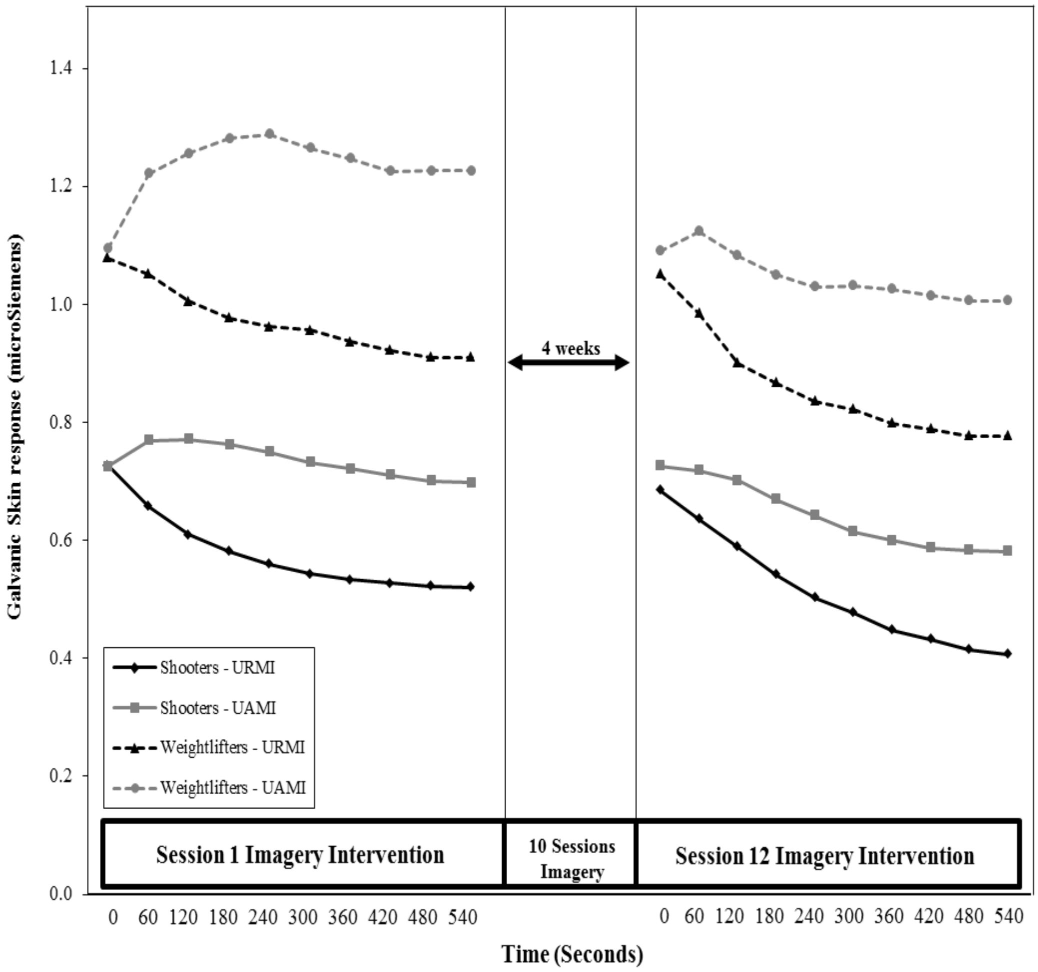


Figure 5.1. Shooters and weightlifters' mean galvanic skin response (GSR) from t_0 to t_{540} across Sessions 1 and 12

Comparison at baseline of Session 1 and baseline of Session 12. For shooters, independent samples *t*-tests revealed that there were no significant differences between research conditions for GSR at the start of Sessions 1 and 12, t_0 at Session 1, $t(24) = .02$, $p = .99$, Cohen's $d = 0.06$, with a small effect size, and at Session 12, $t(24) = 0.28$, $p = .78$, Cohen's $d = 0.11$, with a small effect size.

For weightlifters, independent samples *t*-tests revealed that there were no significant differences between research conditions for GSR at the start of

Sessions 1 and 12, t_0 at Session 1, *t*(23) = .13, *p* = .90, Cohen's *d* = 0.05, with a small effect size, and at Session 12, *t*(23) = 0.17, *p* = .86, Cohen's *d* = 0.007, with a very small effect size.

Comparison at end of Session 1 and end of Session 12. For shooters, I conducted independent samples *t*-tests to identify whether there was a difference between research conditions at the end of each session. Results showed that there was no significant difference between research conditions for GSR at the end of each session, at t_{540} for Session 1, *t*(24) = 1.47, *p* = .16, Cohen's *d* = 0.58, with a moderate effect size, and Session 12, *t*(24) = 1.63, *p* = .12, Cohen's *d* = 0.64, with a moderate effect size. Although there was no significant difference at the end of Session 1 or Session 12, GSR for the URMI conditions was consistently lower than GSR for UAMI for shooters, indicating that URMI reduced level of arousal more than UAMI. Results from both Session 1 and Session 12 showed moderate effect sizes, which suggested a meaningful difference between the music conditions at the end of Session 1 and Session 12.

For weightlifters, results from independent samples *t*-tests showed that there was a significant difference between research conditions for GSR at the end of Session 1, at t_{540} for Session 1, *t*(23) = 2.14, *p* = .04, Cohen's *d* = 0.85, with a large effect size, but no significant difference was found between research conditions at the end of Session 12, *t*(23) = 1.19, *p* = .25, Cohen's *d* = 0.47, with a small to moderate effect size. Similar to the results observed for shooters, weightlifters in the URMI condition showed lower GSR than weightlifters in the UAMI condition at the end of the monitored imagery sessions (Session 1 and Session 12), indicating that URMI was more relaxing than UAMI.

Comparison at baseline of Session 1 to baseline of Session 12. For shooters, further analysis were conducted to determine whether there was a main effect of occasions, research conditions, or an interaction between occasion and research conditions from start of Session 1, t_0 to start of Session 12, t_0 on GSR among the shooters. Two-way mixed design ANOVA revealed that there was no significant main effect of occasions for GSR from the start of Session 1, $t_{0,}$ to the start of Session 12, $t_{0,}$ $F(1, 24) = .32$, $p = .58$, eta^2 = .01, with a small effect size. The results showed that there was no significant main effect of research conditions for GSR from start of Session 1, $t_{0,}$ to start of Session 12, $t_{0,}$ $F(1, 24) = .02$, $p = .89$, eta^2 = .001, with a very small effect size. The results also showed that there was no significant interaction between occasions and research conditions on GSR from the start of Session 1, t_0 to the start of Session 12, $t_{0,}$ $F(1, 24) = .16$, $p = .69$, eta^2 = .007, with a very small effect size.

For weightlifters, further analysis was conducted to determine whether there was a main effect of occasion, research conditions, or the interaction between occasion and research condition from start of Session 1, t_0 to start of Session 12, t_0 on GSR among the weightlifters. Two-way mixed design ANOVA revealed that there was no significant main effect of occasions on GSR from start of Session 1, t_0 to start of Session 12, $t_{0,}$ $F(1, 23) = .84$, $p = .37$, eta^2 = .04, with a small effect size. The results also showed no significant main effect of research condition on GSR from start of Session 1, t_0 to start of Session 12, $t_{0,}$ $F(1, 23) = .03$, $p = .86$, eta^2 = .001, with a very small effect size. The results also showed that there was no significant interaction between occasion and research conditions for GSR from start of Session 1, t_0 to start of Session 12, $t_{0,}$ $F(1, 23) = .01$, $p = .92$, eta^2 < .001, with a very small effect size.

Comparison at end of Session 1 to end of Session 12. For shooters, two-way mixed design ANOVA was also conducted between the end of Session 1, $t_{540,}$ and the end of Session 12, t_{540}. Results showed that there was no significant main effect of occasions on GSR, $F(1, 24) = 3.12$, $p = .09$, eta^2 = .12, with a moderate effect size. The results showed no significant main effect of research conditions on GSR, $F(1, 24) = 2.92$, $p = .10$, eta^2 = .11, with a moderate effect size. The results also showed that there was no significant interaction between occasions and research conditions on GSR from the end of Session 1, $t_{540,}$ to the end of Session 12, $t_{540,}$ $F(1, 24) = .09$, $p = .77$, eta^2 = .004, with a very small effect size.

For weightlifters, two-way mixed design ANOVA was also conducted between the end of Session 1, t_{540} and the end of Session 12, t_{540}. Result showed that there was a significant main effect of occasions on GSR, $F(1, 23) = 5.01$, $p = .04$, eta^2 = .18, with a moderate to large effect size. The results showed no significant main effect of research conditions on GSR, but the p value approached significance, $F(1, 23) = 4.22$, $p = .06$, eta^2 = .15, with a moderate effect size. The results also showed that there was no significant interaction between occasions and research conditions on GSR from the end of Session 1, t_{540} to the end of Session 12, $t_{540,}$ $F(1, 23) = .43$, $p = .52$, eta^2 = .02, with a small effect size.

Peripheral temperature (PT). Figure 5.2 shows the means for PT from time-0 to time-540 for each of the conditions, shooters URMI and UAMI, and weightlifters URMI and UAMI, across Session 1 and Session 12. The line graphs indicated that URMI of shooters and weightlifters showed greater reductions in level of arousal than UAMI, and the changes reflected PT increasing monotonically over time from the start at t_0 to the end of the session, at $t_{540,}$ for Session 1 and for Session 12. These increases in PT were larger for the two URMI conditions than the two UAMI conditions. PT for both UAMI conditions (shooters and weightlifters) showed higher levels of arousal with the lowest value of PT for Session 1 and Session 12 compared with both shooters and weightlifters in the URMI conditions. The change scores for PTs for the UAMI (shooters and weightlifters) conditions showed decreases during imagery training for Session 1, indicating that shooters and weightlifters in the UAMI conditions became marginally more aroused. For Session 12, a different trend was observed, where shooters' and weightlifters' PT for UAMI began to increase rather than decrease, indicating that their arousal levels decreased marginally.

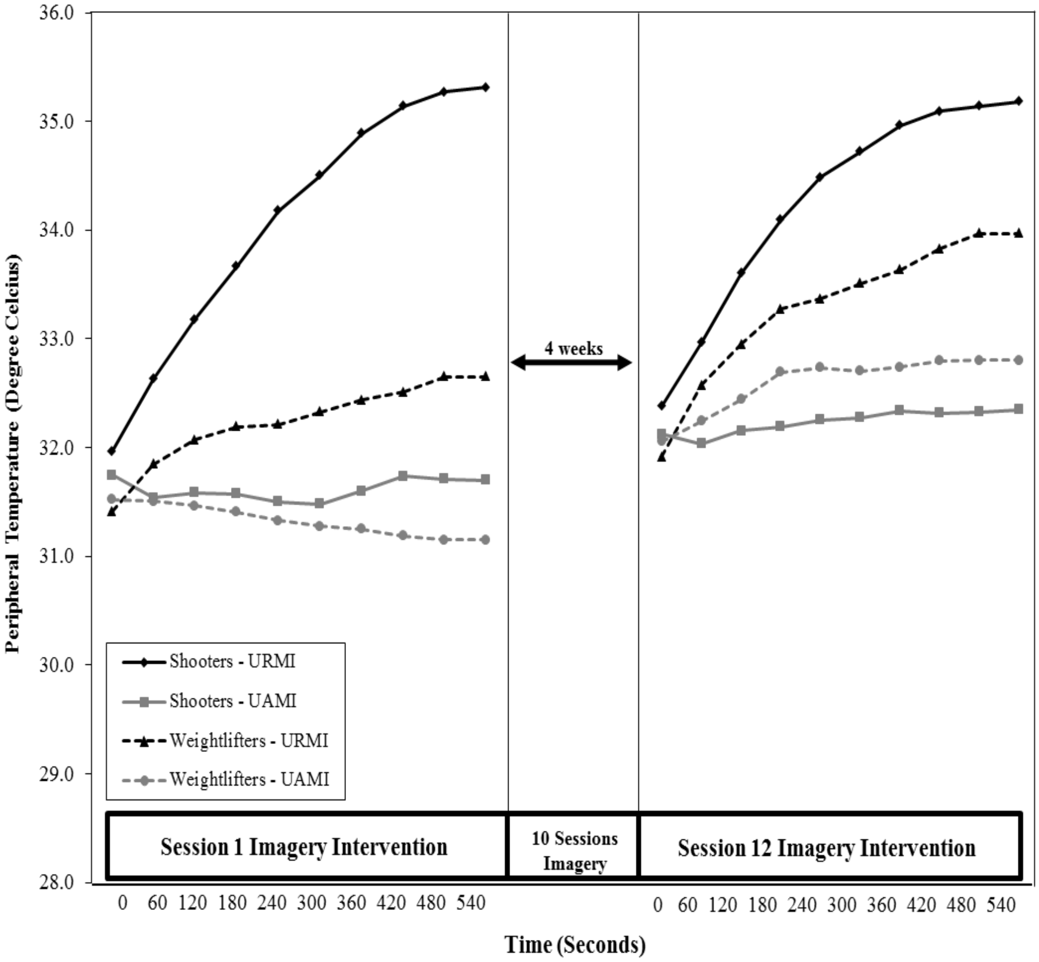


Figure 5.2. Shooters and weightlifters' mean peripheral temperature (PT) from t_0 to t_{540} across Sessions 1 and 12

Comparison at baseline of Session 1 and baseline of Session 12. For shooters, independent samples *t*-tests revealed that there were no significant differences between research conditions for PT at the start of the sessions, t_0 at Session 1, $t(24) = .23$, $p = .82$, Cohen's $d = 0.09$, with a small effect size, and at Session 12, $t(24) = 0.25$, $p = .81$, Cohen's $d = 0.10$, with a small effect size.

For weightlifters, independent samples *t*-tests revealed that there were no significant differences between research conditions for PT at the start of the sessions, t_0 at Session 1, $t(23) = .22$, $p = .83$, Cohen's $d = 0.09$, with a small effect size, and at Session 12, $t(23) = 0.21$, $p = .83$, Cohen's $d = 0.09$, with a small effect size.

Comparison at end of Session 1 and end of Session 12. For shooters, independent samples *t*-tests were employed to identify whether there was a difference between research conditions at the end of each session. Results showed that there was a significant difference between research conditions for PT at the end of sessions, at $t_{540,}$ for Session 1, $t(24) = 3.06$, $p = .01$, Cohen's d = 1.20, with a very large effect size, and Session 12, $t(24) = 3.19$, $p = .004$, Cohen's $d = 1.25$, with a very large effect size. This indicated that at the end of Sessions 1 and 12, shooters in the URMI condition had significantly higher PT (less aroused) compared to those in the UAMI condition, indicating that URMI was more relaxing compared to UAMI, given that there was no difference at baseline for either session.

For weightlifters, independent samples *t*-tests were employed to identify whether there was a difference between research conditions at the end of each session. Results showed that there was a significant difference between research conditions for PT at the end of the session, at $t_{540,}$ for Session 1, $t(23) = 2.64$, p = .02, Cohen's $d = 1.05$, with a very large effect size, but no significant difference was found between research conditions for PT at the end of Session 12, $t(23)$ = 1.88, $p = .07$, Cohen's $d = 0.74$, with a moderate effect size. Similar to the results observed for shooters, weightlifters in the URMI condition showed higher PT than weightlifters in the UAMI condition at the end of the imagery session

(Session 1 and Session 12), which indicated that URMI was more relaxing than UAMI.

Comparison at baseline of Session 1 to baseline of Session 12. For shooters, two-way mixed design ANOVA revealed no significant main effect of occasion for PT from the start of Session 1, $t_{0,}$ to the start of Session 12, $t_{0,}$ $F(1, 24) = 3.78$, $p = .06$, $\text{eta}^2 = .14$, with a moderate effect size. The results also showed no significant main effect of research conditions for PT from start of Session 1, $t_{0,}$ to start of Session 12, $t_{0,}$ $F(1, 24) = 0.07$, $p = .80$, $\text{eta}^2 = .003$, with a very small effect size. The results also showed that there was no significant interaction between occasion and research conditions on PT from the start of Session 1, t_0 to the start of Session 12, $t_{0,}$ $F(1, 24) = .001$, $p = .99$, $\text{eta}^2 < .001$, with a very small effect size.

For weightlifters, two-way mixed design ANOVA revealed that there was a significant main effect of occasion on PT from Session 1, t_0 to Session 12, $t_{0,}$ $F(1, 23) = 7.13$, $p = .01$, $\text{eta}^2 = .24$, with a moderate to large effect size. However, there was no significant main effect of research conditions on PT from start of Session 1, t_0 to start of Session 12, $t_{0,}$ $F(1, 23) = 0.06$, $p = .80$, $\text{eta}^2 = .003$, with a very small effect size. The results showed that there was no significant interaction between occasion and research conditions on PT from start of Session 1, t_0 to start of Session 12, $t_{0,}$ $F(1, 23) = .001$, $p = .98$, $\text{eta}^2 < .001$, with a very small effect size.

Comparison at end of Session 1 to end of Session 12. For shooters, two-way mixed design ANOVA was also conducted between the end of Session 1,

t_{540} and the end of Session 12, t_{540}. Results showed that there was no significant main effect of occasion on PT, $F(1, 24) = .57$, $p = .46$, $eta^2 = .02$, with a small effect size. However, the results showed that there was a significant main effect of research conditions on PT, $F(1, 24) = 11.35$, $p = .003$, $eta^2 = .32$, with a large effect size. The results showed that there was no significant interaction between occasions and research conditions on PT from the end of Session 1, t_{540} to the end of Session 12, $t_{540,}$ $F(1, 24) = .1.60$, $p = .22$, $eta^2 = .06$, with a small effect size.

For weightlifters, two-way mixed design ANOVA was also conducted between the end of Session 1, t_{540} and the end of Session 12, t_{540}. The results showed that there was a significant main effect of occasion on PT, $F(1, 23) = 26.68$, $p < .001$, $eta^2 = .54$, with a very large effect size. The results also showed that there was a significant main effect of research conditions on PT, $F(1, 23) = 7.36$, $p = .01$, $eta^2 = .24$, with a moderate effect size. However, the results showed that there was no significant interaction between occasion and music conditions on PT from Session 1, t_{540} to Session 12, $t_{540,}$ $F(1, 23) = .56$, $p = .46$, $eta^2 = .02$, with a small effect size.

Heart rate (HR). Figure 5.3 shows the means for shooters' and weightlifters' HR from time-0 to time-540 for each of the conditions, shooters URMI and UAMI, and weightlifters URMI and UAMI, across Session 1 and Session 12. The line graphs indicated that URMI reduced level of arousal more for shooters and weightlifters than UAMI, and that changes reflected HR decreasing monotonically over time from the start at t_0 to the end of the session, at t_{540}, for Session 1 and for Session 12 for the two URMI conditions, but increased a small amount for the UAMI conditions for shooters and weightlifters during the first four minutes of Session 1. During Session 12, HR decreased for the UAMI conditions for shooters and weightlifters.

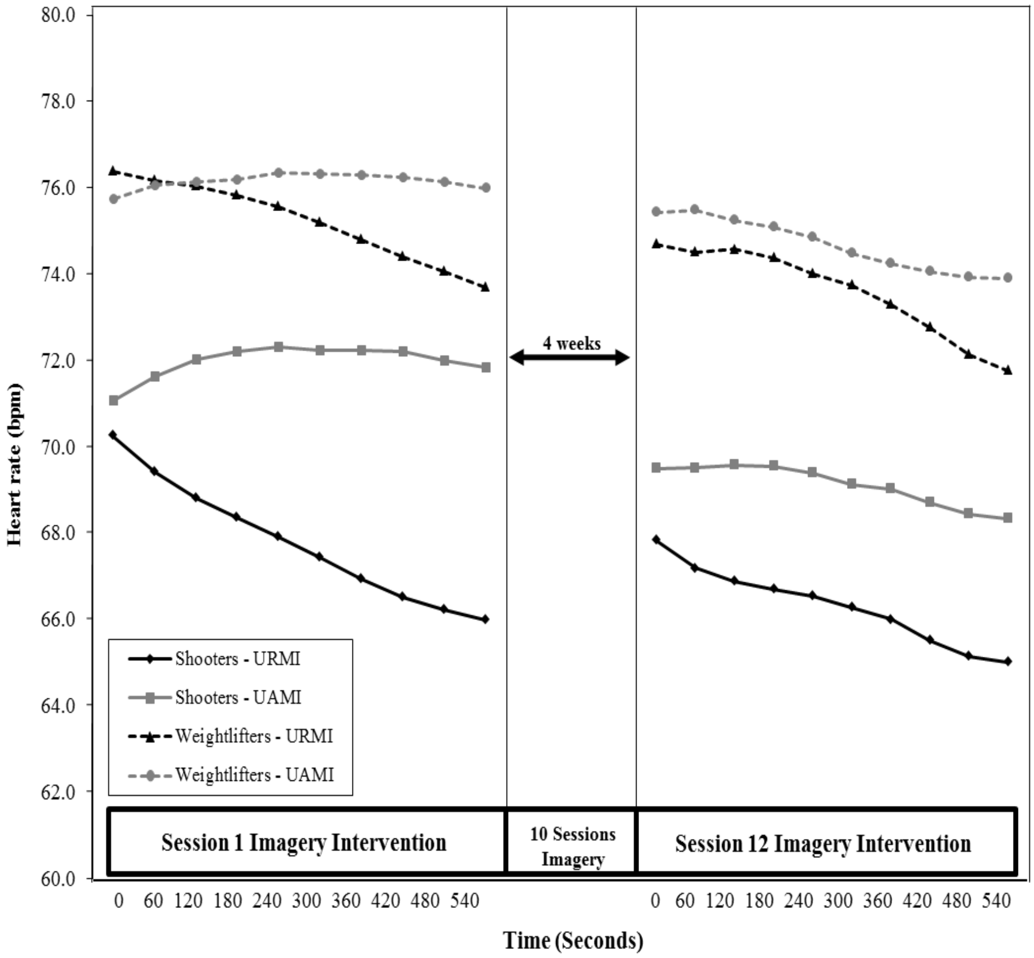


Figure 5.3. Shooters and weightlifters' mean heart rate (HR) from t_0 to t_{540} across Sessions 1 and 12

Comparison at baseline of Session 1 and baseline of Session 12. For shooters, independent samples *t*-tests revealed that there were no significant differences between research conditions for HR at the start of the sessions, $t_{0,}$ at Session 1, $t(24) = .27$, $p = .79$, Cohen's $d = 0.11$, with a small effect size, and at Session 12, $t(24) = 0.72$, $p = .48$, Cohen's $d = 0.28$, with a small effect size.

For weightlifters, independent samples *t*-tests revealed that there were no significant differences between research conditions for HR at the start of the sessions, $t_{0,}$ at Session 1, *t*(23) = .17, *p* = .86, Cohen's *d* = 0.07, with a small effect size, and at Session 12, *t*(23) = 0.19, *p* = .85, Cohen's *d* = 0.08, with a small effect size.

Comparison at end of Session 1 and end of Session 12. For shooters, independent samples *t*-tests were employed to identify whether there was a difference between research conditions at the end of each session. Results showed that there was no significant difference between research conditions for HR at the end of each session, at $t_{540,}$ for Session 1, *t*(24) = 1.87, *p* = .074, Cohen's *d* = 0.73, with a moderate effect size, and Session 12, *t*(24) = 1.39, *p* = .18, Cohen's *d* = 0.55, with a moderate effect size. Although there was no significant difference at the end session of Session 1 or Session 12, HR for the URMI condition was consistently lower than that for the UAMI condition for shooters, indicating that URMI was more relaxing compared to UAMI. Moderate effect sizes suggested that these differences were meaningful. Further analyses were conducted to determine whether there was a main effect of music conditions and interaction between time and music conditions from Session 1, t_0 and Session 12, t_0 on HR among the shooters.

For weightlifters, results from independent samples *t*-tests showed that there was no significant difference between research conditions for HR at the end of the sessions, at $t_{540,}$ for Session 1, *t*(23) = 0.68, *p* = .50, Cohen's *d* = 0.27, with a small effect size, and Session 12, *t*(23) = 0.56, *p* = .58, Cohen's *d* = 0.22, with a small effect size. Similar to the results observed for shooters, weightlifters in the

URMI condition showed lower HR than weightlifters in the UAMI condition at the end of Session 1 and Session 12, indicating that URMI was more relaxing than UAMI.

Comparison at baseline of Session 1 to baseline of Session 12. For shooters, two-way mixed design ANOVA revealed that there was no significant main effect of occasions on HR from the start of Session 1, t_0 to the start of Session 12, $t_{0,}$ $F(1, 24) = 1.58$, $p = .22$, eta$^2 = .06$, with a small effect size.. The results also showed that there was no significant main effect of research conditions on HR from the start of Session 1, t_0 to the start of Session 12, $t_{0,}$ $F(1, 24) = 0.30$, $p = .59$, eta$^2 = .01$, with a small effect size. The results also showed that there was no significant interaction between occasions and research conditions on HR from the start of Session 1, t_0 to the start of Session 12, $t_{0,}$ $F(1, 24) = .08$, $p = .79$, eta$^2 = .003$, with a very small effect size.

For weightlifters, further analysis was conducted to determine whether there was a main effect of occasions, research conditions, and the interaction between occasions and research conditions for HR from the start of Session 1, t_0 to the start of Session 12, t_0 . Two-way mixed design ANOVA revealed that there was no significant main effect of occasion on HR from Session 1, $t_{0,}$ to Session 12, $t_{0,}$ $F(1, 23) = .31$, $p = .59$, eta$^2 = .01$, with a small effect size. There was also no significant main effect of research conditions on HR from the start of Session 1, t_0 to the start of Session 12, $t_{0,}$ $F(1, 23) = .001$, $p = .99$, eta$^2 < .001$, with a small effect size. The results also showed that there was no significant interaction between occasion and research conditions for HR from Session 1, t_0 to Session 12, $t_{0,}$ $F(1, 23) = .17$, $p = .69$, eta$^2 = .01$, with a small effect size.

Comparison at end of Session 1 to end of Session 12. For shooters, a two-way mixed design ANOVA was also conducted between the end of Session 1, t_{540} and the end of Session 12, t_{540}. Results showed that there was no significant main effect of occasion on HR, $F(1, 24) = 1.61$, $p = .22$, $eta^2 = .06$, with a small effect size. The results showed that there was no significant main effect of research conditions on HR, $F(1, 24) = 3.98$, $p = .06$, $eta^2 = .14$, with a moderate effect size. The results also showed that there was no significant interaction between occasion and research conditions on HR from the end of Session 1, t_{540} to the end of Session 12, $t_{540,}$ $F(1, 24) = .72$, $p = .40$, $eta^2 = .03$, with a small effect size.

For weightlifters, two-way mixed design ANOVA was also conducted between the end of Session 1, t_{540} and the end of Session 12, t_{540}. Results showed that there was no significant main effect of occasion on HR, $F(1, 23) = 0.81$, $p = .38$, $eta^2 = .03$, with a small effect size. Results showed that there was no significant main effect of research conditions on HR, $F(1, 23) = 0.57$, $p = .46$, $eta^2 = .02$, with a small effect size. The results also showed that there was no significant interaction between occasions and research conditions on HR from the end of Session 1, t_{540} to the end of Session 12, $t_{540,}$ $F(1, 23) = .0.002$, $p = .97$, $eta^2 < .001$, with a very small effect size.

From the patterns of physiological results, URMI was shown to be more relaxing compared to UAMI, thus, the manipulation check in this section supported the planned manipulations, namely that URMI would produce a greater reduction in level of arousal than UAMI. The observed patterns were not significant on some occasions. The expected increases in arousal level in the

UAMI research conditions were only observed in some physiological measures, they were small and only arose in the first part of Session 1, whereas by Session 12 the physiological indicators depicted reductions in level of arousal for UAMI in shooters and weightlifters.

Psychological Measures

In this subsection, the results for psychological variables are presented. This includes somatic state anxiety, cognitive state anxiety, and self-confidence for both shooters and weightlifters. The results before the imagery with music interventions are reported first in each section to determine whether there were any differences between conditions in each sport before introduction of the interventions. This is followed by analysis comparing these variables at the start of Session 1 to the end of Session 12 of the imagery intervention in each sport.

Somatic state anxiety. Table 5.2 shows the means and standard deviations for somatic state anxiety for each of the research conditions, shooters URMI and UAMI, and weightlifters URMI and UAMI, during Session 1 and Session 12. Table 5.2 also displays the results of *t*-test comparisons of the changes between Session 1 pre-test and Session 12 post-test in somatic state anxiety for shooters and weightlifters in the two research conditions (URMI and UAMI) in terms of the *t*-values, *p* values, and effect sizes (Cohen’s *d*).

Table 5.2

Means, Standard Deviations, paired sample t-tests, p-values and Effect Sizes for Somatic State Anxiety in Session 1 and Session 12

Research conditions		Session 1		Session 12		Paired samples *t*-test (df =12[a]; 11[b])	*p*-value	*Cohen's d*
		Pre-test	Post-test	Pre-test	Post-test			
Shooters								
URMI	*Mean*	16.08	11.69	12.54	10.85	6.22	<.001	1.73
	SD	3.64	2.87	2.07	1.06			
UAMI	*Mean*	15.92	13.08	14.15	13.46	2.24	.046	0.61
	SD	4.27	5.45	3.36	3.50			
Weightlifters								
URMI	*Mean*	15.69	12.23	14.23	11.38	5.47	<.001	1.49
	SD	2.84	2.45	2.28	1.56			
UAMI	*Mean*	16.92	15.42	15.58	15.75	.72	.49	0.21
	SD	3.50	3.70	3.85	5.19			

Note. a = *df* for shooter participants, b = *df* for weightlifter participants

Independent samples *t*-tests showed that there were no significant differences between the research conditions for shooters and weightlifters at baseline for somatic state anxiety, $t(24) = .10$, $p = .92$, Cohen's $d = 0.04$ and $t(23) = .96$, $p = .35$, Cohen's $d = 0.38$, respectively, with small effect sizes.

For shooters, paired-samples *t*-tests comparing Session 1 pre-test and Session 12 post-test revealed that there were significant reductions in URMI ($p < .001$) and UAMI ($p = .046$) for somatic state anxiety. This indicates that somatic state anxiety was significantly reduced among shooters in the URMI and UAMI research conditions from the start of Session 1 to the end of Session 12, although URMI reduced more than UAMI.

For weightlifters, paired-samples *t*-tests comparing Session 1 pre-test and Session 12 post-test revealed that there were significant reductions in URMI ($p < .001$), but not in UAMI ($p = .49$) for somatic state anxiety. This indicated that somatic state anxiety was significantly reduced among weightlifters in the URMI condition from the start of Session 1 to the end of Session 12, but not in the UAMI research condition.

Cognitive state anxiety. Table 5.3 shows the means and standard deviations for cognitive state anxiety for each of the research conditions, shooters URMI and UAMI, and weightlifters URMI and UAMI,, during Session 1 and Session 12. Table 5.3 also shows the results of paired-samples *t*-tests comparing the changes at Session 1 pre-test and Session 12 post-test in cognitive state anxiety for shooters and weightlifters in the two research conditions (URMI, UAMI), in terms of *t*-value, *p* value, and effect size (Cohen's *d*).

Table 5.3

Means, Standard Deviations, t-tests, p-values and Effect Sizes for Cognitive State Anxiety in Session 1 and Session 12

Research conditions		Session 1		Session 12		Paired samples *t*-test (df =12[a]; 11[b])	*p*-value	*Cohen's d*
		Pre-test	Post-test	Pre-test	Post-test			
Shooters								
URMI	*Mean*	17.85	13.08	15.08	12.92	6.12	<.001	1.70
	SD	3.78	3.23	2.53	2.25			
UAMI	*Mean*	17.38	14.92	15.23	14.30	3.24	.007	0.95
	SD	3.78	6.14	1.30	2.29			
Weightlifters								
URMI	*Mean*	20.00	15.69	16.38	12.77	5.08	<.001	1.41
	SD	5.29	3.45	3.50	1.54			
UAMI	*Mean*	19.42	15.25	17.75	15.00	3.53	.005	1.08
	SD	5.30	4.07	5.24	4.07			

Note. a = *df* for shooter participants, b = *df* for weightlifter participants

Independent samples *t*-tests showed that there were no significant differences between the research conditions for shooters and weightlifters at baseline for cognitive state anxiety, $t(24) = .31$, $p = .76$, Cohen's $d = 0.12$ and $t(23) = .28$, $p = .79$, Cohen's $d = 0.11$, respectively, with small effect sizes.

For shooters, paired-samples *t*-test analysis comparing Session 1 pre-test and Session 12 post-test revealed that there were significant reductions in URMI ($p < .001$) and UAMI ($p = .007$) for cognitive state anxiety. The results indicated that cognitive state anxiety was significantly reduced among the shooters in the URMI and UAMI research conditions from the start of Session 1 to the end of Session 12, although URMI reduced more than UAMI.

For weightlifters, paired-samples *t*-test analysis comparing Session 1 pre-test and Session 12 post-test revealed that there were significant reductions in URMI ($p < .001$) and UAMI ($p = .005$) for cognitive state anxiety. The results indicated that cognitive state anxiety was significantly reduced among weightlifters in both the URMI and UAMI research conditions from the start of Session 1 to the end of Session 12. Again, the reduction for URMI was greater than that for UAMI.

Self-confidence. Table 5.4 shows the means and standard deviations for self-confidence for each of the research conditions, shooters URMI and UAMI, and weightlifters URMI and UAMI, during Session 1 and Session 12. The table also shows paired-samples *t*-test comparisons of the changes between Session 1 pre-test and Session 12 post-test in self-confidence for shooters and weightlifters in the two research conditions (URMI, UAMI).

Table 5.4

Means, Standard Deviations, t-tests, p-values and Effect Sizes for self-confidence in Session 1 and Session 12

Research conditions		Session 1		Session 12		Paired samples *t*-test (df =12[a]; 11[b])	*p*-value	*Cohen's d*
		Pre-test	Post-test	Pre-test	Post-test			
Shooters								
URMI	*Mean*	24.00	31.23	31.08	34.00	6.12	<.001	1.70
	SD	4.76	4.13	3.79	4.24			
UAMI	*Mean*	25.85	32.00	30.15	29.08	1.72	.11	0.48
	SD	5.38	2.71	5.51	5.81			
Weightlifters								
URMI	*Mean*	25.38	30.46	28.00	35.54	9.07	<.001	2.51
	SD	4.72	5.78	4.47	3.76			
UAMI	*Mean*	25.50	29.17	28.00	29.00	2.96	.01	0.85
	SD	4.27	5.56	4.35	4.39			

Note. a = *df* for shooter participants, b = *df* for weightlifter participants

Independent samples *t*-tests showed that there were no significant differences between the research conditions for shooters and weightlifters at baseline for self-confidence, $t(24) = .93$, $p = .36$, Cohen's $d = 0.36$ and $t(23) = .06$, $p = .95$, Cohen's $d = 0.03$, respectively, with small effect sizes.

For shooters, paired-samples *t*-test analysis comparing Session 1 pre-test and Session 12 post-test revealed that there was a significant difference for URMI ($p < .001$), but not for UAMI ($p = .11$) for self-confidence. The results indicated that self-confidence was significantly increased among the shooters in the URMI condition from the start of Session 1 to the end of session 12, but there was no significant change for the UAMI research condition.

For weightlifters, paired-samples *t*-test analysis comparing Session 1 pre-test and Session 12 post-test revealed that there were significant increases in URMI ($p < .001$) and in UAMI ($p = .01$) for self-confidence. The results indicated that self-confidence was significantly increased among the weightlifters in the URMI and UAMI conditions from the start of Session 1 to the end of Session 12.

Summary of results from physiological and psychological measures. Statistical analysis indicated that there were significant differences between URMI and UAMI research conditions at the end of Session 1 for PT of shooters and weightlifters, and GSR of weightlifters. Significant differences were also observed at the end of Session 12 for PT of shooters. In addition, observation of the trends of the physiological measures (GSR, PT, HR) in terms of line graphs showed that shooters and weightlifters in the URMI conditions had a larger decrease in GSR and HR than those in the UAMI conditions, and the URMI conditions showed larger increases in PT for Session 1 and Session 12. The results showed a consistent trend for URMI to be associated with the largest relaxation effects and UAMI to be associated with the smallest relaxation effects. In Session 1, the UAMI conditions showed some tendency for initial small increases in level of arousal that showed a plateau later in the session. Both arousing and relaxing music were linked with reduced arousal levels during imagery of shooting and weightlifting in Session 12.

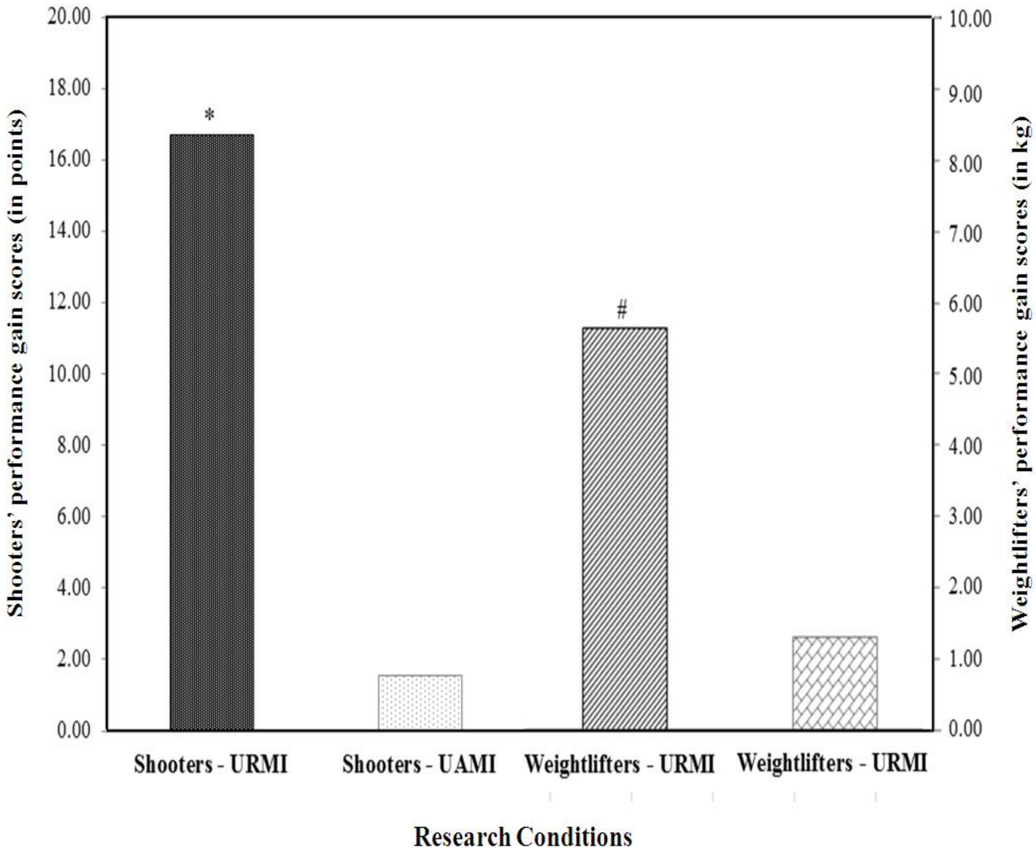
For the psychological measures, somatic state anxiety was significantly reduced from the start of Session 1 to the end of Session 12 for shooters in the URMI condition, shooters in the UAMI research condition, and weightlifters in the URMI condition. Cognitive state anxiety was significantly reduced from the start of Session 1 to the end of Session 12 for both shooters and weightlifters in the URMI and UAMI research conditions. However, a different pattern was observed for self-confidence, where significant increases were observed only for URMI for both shooters and weightlifters but not for UAMI conditions from the start of Session 1 to the end of Session 12.

In summary, these results indicate that although URMI and UAMI showed trends of increasing relaxation for Session 12, URMI was associated with larger reductions in arousal level than UAMI. These results of the manipulation check for URMI and UAMI in the shooters and weightlifters, indicate that the manipulations appear to reflect what was planned, at least in relative terms. Thus, the impact of URMI and UAMI during imagery training on performance of shooting and weightlifting can be examined and is reported in the following subsection.

Shooters' and Weightlifters' Performance

The overall gain scores for simulated competition performance of the participants during pre-test and post-test for shooting and weightlifting are shown in Figure 5.4. Results showed that all intervention groups experienced improvement at post-test compared to pre-test with positive gain scores for shooters' and weightlifters' simulated competitive performance.

Further analysis on gain scores using independent samples *t*-tests reveals that there were significant differences in gain scores of shooting performance between URMI and UAMI $t(24) = 2.71$, $p = .01$, Cohen's $d = 1.06$), with a large effect size. For shooters, gain score for URMI (Mean = 16.69) was significantly higher than gain score for UAMI (Mean = 1.54). There was also a significant difference in gain scores of weightlifting simulated competition performance between URMI and UAMI research conditions $t(23) = 5.63$, $p < .001$, Cohen's $d = 2.26$), with a very large effect size. Similar to the shooters' simulated competition performance, gain scores of weightlifting performance for URMI (Mean = 5.77) were higher compared to gain scores of UAMI (Mean = 1.33). These simulated competition performance gain scores are based on raw performance scores. Because shooters' raw performance score range is much larger than that for weightlifters, it appears that shooters improved more than weightlifters, yet the t-test result for weightlifters has a higher *p* value. When gain scores were converted to a percentage of scores at pre-test, shooters with URMI showed 3.19% improvement in gain scores, and shooters with UAMI showed 0.29% improvement in gain scores, whereas, weightlifters with URMI showed 5.27% improvement in gain scores, and weightlifters with UAMI showed 1.24% improvement in gain scores. Thus, the percentage gain for weightlifters was greater than that for shooters. Nonetheless, a raw score improvement of 16 points for elite shooters is of great practical value. Similarly, for weightlifters, an improvement of 6 kg is important in practice.



Note. Independent sample *t*-test significance. * = $p < .01$; # = $p < .001$

Figure 5.4 Simulated competition performances on gain-score for shooters and weightlifters.

Overall, the URMI research condition showed a higher gain score for shooters' and weightlifters' simulated competition performance compared to the UAMI condition in each sport. Although both conditions (URMI, UAMI) showed positive effects on performance, URMI showed greater benefits for the effect of imagery training on performance than UAMI for shooters and weightlifters.

Short Interview

On completion of the post imagery intervention simulated competitions for shooters and weightlifters, 12 participants (three from each condition selected at random) were asked to describe their subjective experience of the imagery training in writing. Content analysis of the written responses revealed that all participants indicated that they had completed all 12 sessions of imagery training. Pseudonyms have been used to ensure participants' anonymity. The participants' pseudonyms include Chris, Gary, Joy (Shooters - URMI); Annette, John, Mark (Shooters - UAMI); Daniel, Kate, Paolo (Weightlifters – URMI), and Belinda, Lester, Joshua (Weightlifters – UAMI). For icebreaker and familiarisation during the interview, I asked participants about their sporting history, including the highest competition in which they had participated in their sport. Then, I asked them to share their overall imagery training experiences, and then, the outcomes for participants' experience of music during imagery. Finally, I asked participants to list the challenges (if any) they faced during imagery training and their recommendations for future imagery-training sessions. I report the interview results for shooters first, followed by the weightlifters.

For shooters, all shooters had been shooting for more than 6 years in Regional to Inter-State air-pistol shooting competitions, and three of the shooters indicated that their best experience has been competing at the 2010 World Championship in Munich. All shooters indicated that, during the intervention phase (imagery training with music), they had made a sustained effort throughout the trials. Further, all shooters felt that the intervention had improved their performance and they enjoyed it. They also felt more relaxed, more focused, confident, calm, removed from stress, positive, and motivated. For example, Gary indicated that during the intervention phase, he had felt more relaxed and confident, calm and motivated and that he wanted to go shooting after every imagery session:

> Initially, I felt a little bit out of my comfort zone, which was what I wanted. But when I started my second imagery session, I saw some improvement in my shooting skills, I felt more relaxed, confident, calmer, motivated and I enjoyed the energy flow... I felt the imagery became more vivid and powerful... It improved my performance and it helped me focus better... I want to go shooting straight away after the imagery session.

Chris commented:

> The imagery training has enhanced my awareness on every shot I made... I felt more motivated after every imagery session... I do feel more a little more confident, shooting at my own rhythm… having more knowledge that can assist me in my shooting... I felt that my concentration improved... It was a pleasing and worthwhile experience... I am calm and relaxed...Some of my shots were more consistent throughout the 60 shots...The shooting scores were slightly improved.

Annette also expressed a similar thought. She said:

> The imagery made me feel more positive throughout shooting... The imagery training was positive and motivated... I feel more positive flow coming from my routine and I am more focussed, I was in my own zone, into my own shooting rhythm. Of course, my performance increased from pre-test to the post-test... Overall, a great experience.

Interestingly, Chris and Annette used some terms such as “shooting at own rhythm”, “positive flow”, “in my own zone”, and “automaticity”, which Jackson and Csikszentmihayli (1999) described as being characteristic of “flow” experience, meaning that both shooters were concentrating on the task on hand, which made them lose self-consciousness during their post-test shooting competition. It appeared that the imagery intervention helped both shooters to get into a flow state.

Further, Joy indicated she had experienced less stress (somatic anxiety) during the simulated competition after her imagery training. She explained:

> I always stress before a competition, thus my initial scoring is not consistent... Initially at the pre-test, I was worried as I just wanted to do the best I could. I felt like [I was] competing in an International Open, although it was just a stimulated competition with my team mates. I had a bit of pressure just to perform my best. This is normally my high self-expectation, however, during the post-competition, I did a consistent scoring, which amazed me. I think it might be the imagery training I did with you (the researcher)... I felt less stress and I enjoyed the post-competition more...This made me worry less and increased my confidence and I was able to concentrate on my shooting…When I made a missed score on shot number 10, I did not feel the pressure, I told myself like ‘ok, that’s alright, I can just forget about this score and I will get the next one on target, I can do this’. This made me feel really positive on my shooting.

For the outcomes of music for imagery training, all three participants from the URMI condition, and one from UAMI expressed the feeling that they enjoyed having music as a facilitator to imagery training. However, two participants (UAMI) found it too powerful and expressed the thought that it might cause some distraction to the imagery. For example, Mark commented:

> I think it was helpful; the music was empowering and made me feel very pumped up... Occasionally I felt invincible, which might, on the other hand, cause distraction from my shooting in the imagery.

John also expressed a similar issue, he said:

> The music could be a bit distracting as I was too focused on the music, which made me more aroused, rather than imagining my shooting. I knew I should be more relaxed and calm in order to shoot a good score... I got used to it after the second session and I was able to begin to focus on the mental training. Then, my shooting visualization improved.

Regarding the positive uses of music, Gary explained:

> The music is good... it cuts out all "other" sounds... letting you concentrate on the script fully... I am 100% focused... it is not distracting, but is easier to imagine my shooting performance... the music makes the imagery more vivid... In my post-shooting competition, when I was anxious, I can still remember the music, which then prompted me to remember my shooting routine... I found it hilarious; unusual, but it works very well for me. Great experience.

Joy said that the music was an excellent choice and relaxing. She said:

> The music was an excellent choice as it was non-intrusive, but relaxing and I could remember the music for such a long time... The music was able to cover most background noise, allowing me to concentrate and focus on the voice [giving imagery instructions on the recording]... I enjoyed this experience... it allows me to continuously experience absorption in the visualization of the shot...

Similarly, Chris also commented:

> I felt that the music helps bring me into the imagery world... Music is soft and relaxing... I felt less stress...I am inside my own zone... I felt the music was suitable and can help me in my training and competition... However, the music was unfamiliar to me... Advantage - it is fresh and new, easy to remember...It is able to relate to a certain aspect of an event, so they can be recalled easily. Disadvantage – not sure what to expect, so I am focusing on two things at a time, the imagery and music. But, overall I prefer having the music.

As for the challenges faced by the participants who were shooters, no participants expressed that they faced any major challenges. However, one participant, Gary, commented:

> I have no challenges...but, finding a quiet moment might be a challenge. Everyone is busy these days... so to find a place, which is calm and focused to do the imagery might be also a challenge... Because of this, I

> visualised mainly in the morning when I was calm, where I could focus, no distraction and I felt good.

Finally, participants suggested some recommendations, including longer periods of imagery. Annette said: “Why is it 12 sessions, I think it should be more?”, Mark suggested: “not sure if it is suitable, if we use personal choice of music?” John said: “I compete in 6 events, and I would like to develop a specific imagery session for each event” and Joy suggested “it will be more effective, if we are able to conduct every imagery session with you (the researcher).”

For weightlifters, all interviewed participants stated that they had been weightlifting for at least seven years in Inter-State to National open championship in weightlifting, and among them, two weightlifters observed that their best experience in weightlifting was performance in the 2010 Commonwealth Games in Delhi, two at the Oceania Open in 2009, one at the 2008 Commonwealth Youth Games, and another at the Australian Weightlifting Open in 2010. All weightlifters indicated that, during the imagery training, they had made a sustained effort throughout the trials. Further, five participants felt that the intervention had improved their performance. One participant also felt it might be useful, but did not impact to his weightlifting, he stated:

> The training might be effective but hasn’t shown any significant effect as yet… although the post-competition scoring seemed a slight improvement… but I am expecting more after 4 weeks of training.

Similar to the response from shooters, the weightlifters felt more relaxed, more focused, confident, calm, positive, and motivated. For example, Daniel indicated that during the intervention phase, he had felt relaxed, focused, confident, and stronger. He commented:

> I was relaxed and focused… the training showed much improvement… at the post-test, I was more focused on my technique from the script, I did not worry about what people were talking, I was into my own mental state. Most importantly, I felt more confident, stronger and I felt I could lift 2kgs more than my PB (personal best), even before the competition began.

Paolo, Kate, Belinda, Lester and Joshua also expressed similar responses on their imagery experiences. Paolo commented:

I feel very confident… I am calm, relaxed, confident, and focused… my coach said my technique improved… and my core body lift was straight (this a technique used by weightlifters in clean and jerk during lifting)…

Kate mentioned:

> The training helped me to relax and believe in myself… it helped me to achieve my PB (personal best) in the competition…I felt more focused…it helped me gain confidence and believe in myself again…my results were better this time.

Further, Belinda said, "During the post-test, I was very concentrated… I was relaxed… my confidence level feels slightly better… I did some improvement…" and Lester commented, "I felt more focused on my goals with each session, I was very focused but relaxed at the same time… I am refreshed although music was pumped… I believe it is better in my post-performance.” Finally, Joshua mentioned:

> I was rather tense with the music for the first 2 sessions, only after the third session I able to fully concentrate on the person talking and then I was ready to lift the weights compared to the first one... I felt more focused and energised inside...

For the outcomes of music for imagery training, all participants from the URMI condition reported that the music was good and appropriate, but two participants from the UAMI condition felt it might be a distraction to the task (weightlifting). Lester said:

> I think the music is good but it can be distracting as well… the high beat of the music keeps my mind of the pressure during competition… I think it was rather arousing but it might be ok to pump me up before the competition… but occasionally I got distracted and forgot to focus on my task (imagery).

Belinda commented:

> The music made me quite pumped up and ready to explode… however, I often get pumped up to lift the bar at the inappropriate time…I knew I needed to focus on the imagery to get a correct technique, rather to getting too pumped up… Although my overall performance improved, I felt I am thinking of two things during my lift simultaneously… one on the exploding music… and another on the weightlifting skill I imagined… It

> makes my confidence level increase and sometimes decrease. Kind of mixed feeling… but I am interested in using it much more.

Daniel said:

The music is pleasant… it is appropriate and helpful in queuing the task and my technique as the script reaches the actual lifting… It is good at invoking the necessary reaction from the mind…I was relaxed, focused and confident… I felt like I was the only one in the competition… I felt my whole body was energised.

Kate mentioned:

> The advantage of using music is that it helps me in my focus… It has the relaxing and calming effect…I believe this is a good strategy… It helped me to focus and I was inside the zone… At the post-test, I felt rather tense during the warm up…I remembered the music and I suddenly became less tense and had self-confidence. The music then reminds me of the routine in the MP3. Thus, I followed it and I did my PB… my coach is very satisfied.

Paolo explained:

The music is relaxing but impactful… I was focusing on the script and it just made me calm, relaxed and fully focused… The music helps me to refocus on my task, and reminded me on how my body should prepare subconsciously in order to perform well in weightlifting… This is excellent for me.

Joshua said:

> At first tired and switched off, but after a few sessions… I got used to it and began to concentrate on the task when it played…I was subconsciously switched on and off… it was like doing meditation… but I could consciously think about my task... Subconsciously, I became energised and felt confident on my lift.

As for the challenge faced by the participants who were weightlifters, none of the participants stated that they faced any major challenges.

Finally, participants suggested some recommendations. For example, two participants recommended that the music should be familiar to them. They believed that if the researcher could use familiar music, it might be more beneficial. …Belinda said: "I am not familiar with the music, thus, it is harder for me to concentrate on the imagery and the music." Lester said:

> I was a bit tense because I was not familiar with the music… It might be better if the music is what I knew… but after the second or third session, I began to become familiar with the music and then I was more calm and relaxed.

Another suggestion is that it would be helpful to change the recording periodically. According to Daniel:

> Possibly changing the recording… by the end of the 12 weeks, the script got predictable, however, I found it useful as I could remember my task and it makes me feel more confident during competition…

To summarise, the shooters and weightlifters who were interviewed gave positive evaluations of the imagery with music intervention, regardless of whether they experienced relaxing or arousing music. They reported positive changes in a range of important subjective variables, including motivation, confidence, and calmness. A noteworthy difference between experience of the relaxing and arousing music was that two shooters and two weightlifters indicated that the arousing music was distracting. Two interviewees expressed the view that imagery with music might be even more effective if the music was familiar to them. In the present study, music was selected to ensure it was unfamiliar to participants, so the question of whether familiar or even self-selected music would be more beneficial remains to be examined. In many ways, the comments made in the interviews were consistent with the quantitative results, but the shooters and weightlifters who were interviewed gave interesting additional insights.

Discussion

The primary purpose of the current study was to examine the effect of relaxing and arousing music during imagery training on performance of fine motor and power sports skills. This study examined two propositions. The first proposition is that if music is played at the time athletes are performing imagery, it may be associated with the sports task that is being imagined. Then when the task is physically performed that association will have a similar effect to the effect when music is actually played during or immediately before performance, which has been demonstrated in substantial research (e.g., Anshel & Marisi, 1978; Dorney et al., 1992; Karegeorghis et al., 1996; Waterhouse, Hudson, &

Edwards, 2010). In that case, arousing music may have a greater facilitating effect for tasks that require high arousal for optimal performance, such as power or endurance tasks, for example, skiing, track sprinting, weightlifting, sprint swimming, wrestling, or sprint cycle racing (Birnbaum, Boone, & Huschle, 2009; Karageorghis & Priest, 2012a; North & Hargreaves, 1996). On the other hand, relaxing music might be more facilitative to subsequent performance for tasks that require low arousal, including fine motor skills, for example, archery, bowling, golf putting, or shooting (e.g., Elliott et al., 2012; North & Hargreaves, 2008). The second, and alternative, proposition is that if relaxation enhances imagery, relaxing music may have a facilitative effect on imagery for all types of sports tasks regardless of whether they are power or endurance tasks or fine-motor skill sports. In this study, when highly skilled shooters, who perform a fine motor skill, and highly skilled weightlifters, who perform a power task, performed imagery with unfamiliar relaxing music (URMI) they showed significantly greater improvement in performance than similarly skilled athletes from those sports, who performed imagery with unfamiliar arousing music (UAMI). The results provide support for the second proposition that relaxing music has a facilitative effect on imagery for sports tasks regardless of whether they involve fine-motor or high-arousal power skill tasks.

The discussion of the results is divided into five sections. First, I discuss both the shooters' and weightlifters' imagery ability and the adherence check. Second, I consider results of manipulation checks using physiological and psychological measures during imagery training. Third, I address the impact of relaxing and arousing music or performance in pistol shooting and weightlifting.

Specifically, I discuss the results based on the propositions of this study. Fourth, I examine the relationship between the subjective experiences of shooters and weightlifters reported in short interviews conducted after the post-test and the results of quantitative monitoring of level or arousal and testing of performance. Finally, to thoroughly evaluate the effectiveness of the imagery intervention using relaxing or arousing music, I reflect on strategies and intervention elements that participants reported as useful and discuss methodological issues and future research.

Participants' Imagery Ability and Adherence Check

Results from the SIAM showed that all participants (shooters and weightlifters) reported strong imagery ability. They are elite athletes, with at least 2 years of competitive experience at state level. This was expected because research indicates that highly skilled athletes generally report high levels of imagery ability (Morris et al., 2005). There were no systematic differences between imagery ability across the four conditions. Thus, the results provide evidence that participants in all conditions were able to equally effectively employ imagery as part of their intervention program.

Using the adherence log, all shooters and weightlifters confirmed that they completed all 12 sessions of imagery training during the 4-week study period as instructed, except for one weightlifter. This participant was excluded from the study, as he did not complete a minimum of 10 out of 12 sessions of imagery training due to tight competition schedules. All other participants reported very high levels of adherence, so they were included in the subsequent analyses.

Manipulation check

Physiological measures. The results from the manipulation check indicated that consistent changes in GSR, PT, and HR reflected lower levels of arousal for URMI compared to UAMI for both shooters and weightlifters. Visual inspection of Figures 5.1, 5.2, and 5.3 suggested that in Session 1 level of physiological arousal decreased for URMI during the 9-minute imagery session with music, more than was observed for UAMI. This was consistent with expectations, based on the use of relaxing and arousing music that was selected because of its effectiveness in Study 1, and further evidence supporting its effects in the manipulation check in Study 2. At the same time, the physiological indicators showed small levels of arousal increases across the early part of Session 1 for UAMI research conditions for shooters and weightlifters. Those small increases were followed by gradual decreases in level of arousal. These results were reflected in there being notably lower arousal at the end of Session 1 in the URMI conditions than the UAMI conditions on the GSR and HR measures, which did not differ at the start of Session 1. This provided further support for the relaxing effects of URMI.

In this study, an important observation from Figure 5.1 and 5.3 was that shooters' level of arousal was distinctly lower than that of weightlifters. This was consistent throughout the physiological measures on GSR and HR from the start of Session 1 to the end of Session 1, and from the start of Session 12 to the end of Session 12. These results were consistent with previous research and understanding within the sports that weightlifting is a high-arousal task, whereas shooting is a low-arousal task. Thus, participants' level of arousal was different. However, the distinction was not as clear for PT from Figure 5.2.

Two trends are prominent in Figures 5.1, 5.2, and 5.3 for GSR, PT, and HR during Session 12. First, considering the physiological measures for all four conditions, level of arousal was lower at the start of Session 12 than at the start of Session 1. This trend was greatest for GSR and HR, but it was not significant. It was least evident for PT, where it was also not significant. Second, the trends across the 9-minute imagery session in Session 12 reflect that arousal level decreased for all four conditions across the session, as in Session 1, but differed less between the conditions than in Session 1. This suggests that level of arousal for UAMI shooters and weightlifters decreased more than that for URMI across the 10 imagery sessions not monitored for physiological arousal. Visual inspection suggests that the decrease in arousal level for the UAMI condition for shooters and weightlifters during Session 12 was more substantial than in Session 1. This is supported by the statistical results, which indicate that significant differences between URMI and UAMI observed at the end of Session 1 were no longer present at the end of Session 12. These trends are not consistent with predictions. UAMI showed a reduction in level of arousal within each session and between corresponding times in Session 1 and Session 12.

Comparing the end of Session 1 to the end of Session 12, significant main effects were observed on occasion, research conditions, and interaction between occasion and research conditions for GSR. A significant main effect on research conditions was also observed for HR. These results indicated that arousal levels for the URMI conditions for shooters and weightlifters were significantly lower than arousal for the UAMI shooters and weightlifters. Furthermore, Figure 5.1 and Figure 5.3 showed that arousal levels for UAMI conditions for shooters and weightlifters reduced dramatically from the end of Session 1 to the end of Session 12, whereas URMIs for both sports showed little further reduction.

For shooters, as predicted by proposition 1 and proposition 2, physiological measurements of GSR, PT, and HR showed greater reductions in arousal level, when they were exposed to relaxing music during the imagery intervention, than with arousing music during imagery. For URMI, GSR and HR demonstrated clearer decreases in arousal and PT showed a clearer increase than UAMI for Session 1. In Session 12, arousal level in the UAMI condition seemed to reduce more than that in the URMI condition, but the recorded levels of arousal were still lower in the URMI condition than in UAMI. The continued reduction of arousal in UAMI compared to slower reduction in URMI might reflect that participants in URMI were approaching a minimum level, that is, a floor effect came into operation.

For weightlifters, the results supported the second proposition. Physiological measurements of GSR, PT, and HR showed reduced levels of arousal when weightlifters were exposed to URMI even though they were imagining a high-arousal weightlifting task. GSR decreased, PT increased, and HR decreased for Session 1 and substantially for Session 12. This was surprising because the expectation was that level of arousal should have increased to some extent when weightlifters were imagining a high-arousal task even though they were listening to relaxing music.

It was even more surprising to find that weightlifters in the UAMI condition, after a minimal increase for the first two minutes for Session 1 in GSR and HR, showed a decrease in level of arousal on the physiological measures, which was substantial during Session 12. Burns et al. (2002) and Blumenstein et al. (1995) reported that arousing music was associated with an increase in physiological level of arousal, when it was played prior to performance. Thus, it was expected that UAMI would be associated with an increase in the level of arousal for weightlifting because weightlifting is a high-arousal task. However, in this study, even with arousing music and the high-arousal task, level of arousal did not increase physiologically for weightlifters, as was predicted in the first proposition. The decrease in level of arousal for weightlifters in the UAMI condition was contrary to expectations. This is difficult to account for in terms of the effect of arousing music played during imagery of the high-arousal sports task. Similar results were found when arousing music was played during imagery for two fine motor sports tasks, shooting and dart-throwing performance, but those were predicted by both propositions.

The results from examining the effect on physiological measures of level of arousal of arousing music during imagery in three sport tasks (dart-throwing, shooting, weightlifting) are difficult to explain based on previous research that has found arousing music to be experienced as arousing, based on self-reports and physiological indicators (Burns et al., 2002; Rickard, 2004). Two explanations appear to be possible. First, given that imagery was practised with the same piece of arousing music for 12 sessions, it is possible that the arousing music became familiar or habituated. The second explanation is that doing the imagery training triggered the reduction of the arousal level, contrary to the high-arousal classification of the sport task of weightlifting and the arousing character of the music in the UAMI condition. This would suggest that imagery, at least when individuals who are skilled at performing it, as high-level shooters and weightlifters would be expected to be, is automatically relaxing when imagers become absorbed in imagining performance of their sport skills. This is supported by the observation that physiological indicators of arousal level showed reductions in arousal during imagery for participants in the NMI condition in Study 2, in which there was no music to influence arousal level.

Another anomalous observation relates to the results for shooters in the UAMI condition, who produced lower PT, that is, they were more aroused, than weightlifters in the UAMI condition in Session 12, even though shooters in the UAMI condition were imagining a low-arousal shooting task and weightlifters in the UAMI condition were imagining a high-arousal task. Given that PT was the least reliable of the physiological indicators, I consider that the PT measures should be interpreted with caution. The second explanation is that the shooting task, which is a fine-motor skill sport, is a mismatch condition for arousing music. This might cause further distractions or discomfort, making the shooters even more aroused compared to the weightlifters.

Overall, the present results reveal that, even in the presence of arousing music played during imagery of a high-arousal task, namely weightlifting, physiological indicators still showed decreases in level of arousal. This was shown in the manipulation check using GSR and HR in Session 1 and was even more striking in Session 12 of the imagery intervention. Results for PT were ambiguous. The patterns of decreasing arousal level for the UAMI conditions for shooters and weightlifters were particularly evident by Session 12.

Psychological measures. The level of somatic state anxiety of shooters in the URMI condition, shooters in the UAMI condition, and weightlifters in the URMI condition, showed significant reductions from the beginning of Session 1 to the end of intervention Session 12. Although this was predicted for shooters in the URMI condition because relaxing music was previously shown to be effective for the reduction of somatic state anxiety in a similar fine-motor skill, dart throwing (Study 2), it was interesting that a similar significant reduction in level of somatic state anxiety was also experienced by the shooters in the UAMI condition, dart players in the UAMI condition (Study 2), and weightlifters in the URMI condition.

However, no significant reduction was found for weightlifters in the UAMI condition. The finding for somatic state anxiety of shooters in the URMI condition is accordance with the matching hypothesis proposed by Davidson and Schwartz (1976) and applied to sport by Martens et al. (1990), that relaxing music, being a somatic technique, is effective for reduction of somatic state anxiety for fine-motor skill sports. In the present study, however, it was found that URMI was also effective for reducing the level of somatic state anxiety for a high-arousal power sport, weightlifting, which was not expected.

The level of cognitive state anxiety of shooters in the URMI condition, shooters in the UAMI condition, weightlifters in the URMI condition, and weightlifters in the UAMI condition showed significant reductions from the beginning of Session 1 to the end of intervention Session 12. This showed that shooters' and weightlifters' cognitive anxiety were significantly reduced regardless of the music used. Many studies conducted in the area of imagery training have shown that imagery interventions reduced cognitive state anxiety (e.g., Cumming et al., 2006; Morris et al., 2005), but in all those studies the content of the imagery intervention was designed to reduce anxiety. In the present study, the content of the imagery script was designed to enhance performance; there was no intention to reduce cognitive state anxiety. I have found no studies examining the effect of imagery that aimed to enhance performance accompanied by arousing music or relaxing music that have examined the impact of this combination on cognitive state anxiety for comparison.

In terms of self-confidence, results from CSAI-2R showed that shooters' and weightlifters' self-confidence level significantly increased after 12 sessions (4 weeks) of the imagery intervention with relaxing music (URMI). However, only weightlifters in the UAMI condition increased in self-confidence. The self-confidence of shooters in the UAMI condition did not change. For weightlifters, although both URMI and UAMI conditions showed a significant increment in self-confidence level, the URMI condition showed a higher level of significance ($p<.001$) compared to the UAMI condition ($p=.01$). Many researchers have found that imagery training in which the content of the imagery was designed to enhance self-confidence did enhance self-confidence (e.g., Cumming et al., 2006; Hall et al., 1992; Vadocz et al., 1997). However, I have found no studies examining the effect of imagery designed to enhance performance, accompanied by arousing music or relaxing music, that have examined the impact of this combination on self-confidence level for comparison.

One possible explanation for the effects of the research conditions in this study on somatic and cognitive anxiety and self-confidence is that although the content of the imagery was not designed to reduce anxiety or to increase self-confidence, that content did have those effects. One way to enhance self-confidence using imagery is to imagine a successful outcome of performance. That was one instruction in the imagery for shooters and for weightlifters, along with substantial imagery instructions associated with imagining the correct process of performance. The instruction to imagine a successful outcome could have increased self-confidence and the well-researched relationship between self-confidence and anxiety, especially cognitive anxiety, would suggest that an increase in self-confidence as a result of imagining successful performance, could have led to a reduction in cognitive anxiety, and possibly also somatic anxiety (e.g., Martens et al., 1990). This possibility could be examined in future studies by carefully designing imagery scripts to avoid imagery of successful outcomes.

The Effect of Music during Imagery Training on Sport Performance

In terms of performance, all four research conditions showed improvement on the post-test compared to pre-test with positive gain scores for shooters' and weightlifters' simulated competitive performance. However, the URMI condition showed a significantly higher gain score compared to the UAMI condition for both shooters and weightlifters. This suggests that URMI provided an imagery environment that was more facilitative for enhancement of performance than UAMI.

For shooters, I predicted that the URMI condition would show a significantly greater performance gain than the UAMI condition in post-test simulated competitive performance. This is because shooting is a fine-motor skills sport, in which low arousal facilitates performance, based on a stable body position, steady pistol arm, and smooth trigger squeeze. In addition, doing imagery with music that is relaxing and reduces level of arousal should help shooters to imagine the calm, controlled state associated with successful performance. Thus, the inclusion of relaxing music should be more facilitative to subsequent performance than accompaniment by arousing music. This was also demonstrated in Study 2 with the fine-motor skill of dart throwing.

However, for weightlifters I did not predict that gain score in performance would be significantly greater in the URMI condition than the UAMI condition. This is because weightlifting is a high-arousal power sport. Thus, I proposed that music during imagery of performance would be most effective when it reflected arousal level during actual performance, so arousing music should produce a greater facilitative effect than relaxing music on subsequent performance. The results from this study showed that the use of relaxing music for shooters and weightlifters was associated with a larger gain score than accompanying imagery with arousing music. These results contradict the first proposition and provide support for the alternative proposition that relaxing music has a facilitative effect on imagery for all types of sports tasks, regardless of whether they are power, speed, strength, endurance, combination tasks (such as team ball sports) that require power, speed and skill, or fine-motor skill sports. However, I found no research that has examined the effect of arousing music or relaxing music during imagery on competitive performance using a similar approach to the research conducted in the present study.

I found results that were similar to those reported for shooters in the present study for the fine-motor skill of throwing dart at a concentric circles target in Study 2. Thus, both studies provide support to the proposal of Suinn (1986) and Weinberg et al. (1981) that relaxation facilitates imagery processes. The strongest support for this comes from the results for the high-arousal power task of weightlifting. However, the evidence derived from the reductions in level of physiological and psychological arousal found for arousing music in both shooting and weightlifting, suggests that one factor contributing to those reductions could be the imagery process. It is difficult to explain how arousing music can lead to reductions in level of arousal. The proposition that becoming absorbed in imagery triggers a reduction in level of arousal is further supported by the reductions in arousal level noted for the NMI condition in Study 2. Although they might appear paradoxical, the present results also provide support for the sport psychology researchers and practitioners, who have claimed that a formal relaxation technique is not needed to facilitate effective imagery (Braun et al., 2011; Murphy et al., 1988; Weinberg et al., 1981; Woolfolk et al., 1985). It is possible that applied sport psychologists who have observed expert athletes using imagery effectively without prior relaxation, using techniques like PMR or autogenic training, as well as those researchers who found no difference in performance between an imagery condition accompanied by relaxation and an imagery alone condition, observed effects associated with the automatic triggering of relaxation, which I suggest were demonstrated in this study. In other studies that found imagery plus relaxation to be associated with superior performance than imagery alone, it is possible that the samples had less ability to become absorbed, so addition of a relaxation technique was facilitative. These proposals should be tested in future research in which capacity for absorption is measured (See Qualls & Sheehan, 1981). Further, it is important that changes in level of arousal are monitored during such studies. Researchers who have addressed this question have often failed to measure level of arousal using physiological indicators, simply assuming that participants in the condition given a formal relaxation technique in their intervention should be more relaxed (have lower arousal level) than those performing imagery without relaxation.

Results from the Interviews

The subjective experiences derived from the interviews at the end of the study with 12 participants, three from each research condition, provided some interesting findings. All participants reported that they had made a sustained effort throughout the sessions and they felt that the imagery intervention had improved their tests of performance during training throughout the sessions (The test of performance during training is a report of the shooters' or weightlifters' weekly individual performance submitted to their coaches and was used by the coaches to evaluate and plan the athletes' training regimen every two months. The test of performance report was not monitored in this study.). Some participants reported that the imagery intervention also improved their actual competition performance. For the shooters, qualitative responses suggested that the music and imagery intervention used in this study was associated with enhanced relaxation, confidence level, and calmness.

In addition, the shooters from the URMI condition expressed the view that the relaxing music enhanced their concentration and increased their motivation to continue with the imagery sessions. All shooters mentioned that the music enhanced flow of their shooting routine, regardless of whether they were in the URMI or UAMI condition. This could imply that imagery with music enhanced flow regardless of which type of music shooters experienced in their imagery intervention. This could be because imagery facilitates the experience of flow among shooters. In that case, perhaps the experience of music was just associated with a pleasant experience generated by imagery of the correct performance process and a successful outcome. However, I found no studies in the literature examining the effect of a combination of music and imagery on flow state. Considering imagery alone, in an unpublished thesis, Jeong (2012) examined flow experience and imagery use in professional dancers. She found that imagery training did enhance the experience of flow, leading to positive experiences of dance performance. Interestingly, in that study a general relaxation imagery intervention was as effective as an intervention developed on the basis of a questionnaire study in which imagery functions on the SIQ were correlated with flow dimensions and interviews about imagery and flow among dancers. Thus, it is possible that the reduction in arousal level experienced by shooters in the present study was enough to noticeably increase the experience of flow. Hamilton (1998) discussed strategies to create optimal performance and flow experience, and proposed that imagery training could enhance the effectiveness of flow experience and performance, leading to enhanced self-awareness, enhanced motivation, focused attention, increased self-confidence, reduced anxiety, and greater acquisition of skills.

For the weightlifters, the qualitative responses suggested that the music and imagery intervention that they experienced in this study was associated with increases in relaxation, focus, confidence level, calmness, positivity, and motivation. Contrary to expectations, the weightlifters in the UAMI (matched) condition reported that the arousing music was distracting, rather than facilitating to their performance. They expressed the view that the music was “exploding”, “invoking” and “energizing”, but they needed to focus on the imagery in order to perform the imagery process effectively to experience successful performance. This could be a noteworthy finding that supports the proposition that imagery is enhanced by relaxation. Thus, relaxing music may be more facilitative to imagery even in sports that are performed effectively with high arousal. One reason for this could be that the weightlifters were already more highly aroused than the shooters, so the addition of arousing music during imagery might have been disruptive, whereas the introduction of relaxing music helped the weightlifters in the URMI condition to focus more effectively on their imagery task. The observations made by the weightlifters in the UAMI condition could also be consistent with the proposition that when people become absorbed in an imagery task, this triggers reductions in arousal, experienced as relaxation. In this case, the experience of the weightlifters in the UAMI condition could reflect a process whereby the arousing music added to an already aroused state was experienced as distracting, making it difficult for those participants to become absorbed in the imagery task. If a minimal level of absorption is necessary for imagery to trigger reduced arousal, weightlifters in the UAMI condition might have found it difficult to perform the imagery effectively with a consequent effect of reduced benefits for performance compared to the weightlifters in the URMI condition. Further, the physiological data for the UAMI condition with weightlifters showed an initial small increase in level of arousal in Session 1, followed by a stabilisation and then a gradual decrease, leading to reduction in level of arousal for participants in that condition by Session 12. This pattern could reflect that these skilled weightlifters were able to overcome the distracting effect of arousing music as imagery sessions progressed, so they did achieve the level of absorption that is postulated here to be facilitative of performance, but not until later in the 12 imagery sessions than participants in other research conditions. These competing interpretations open up an interesting new research direction.

Methodological Issues

A limitation of this study is that only one power sport, weightlifting, and one fine motor skill sport, shooting, were studied. Even though there was a significantly greater gain in sporting performance of shooters and weightlifters in the URMI condition, the difference could be related to specific tasks and not to the categories of sports in which different levels of arousal are proposed to facilitate performance. Thus, it is not possible to conclude that the same effect will occur for other power or explosive sporting tasks, such as sprinting, wrestling, cycle sprint racing, or sprint rowing. Similarly, I could not conclude that the same effect would occur for other fine-motor sport skills, such as archery, golf putting, or lawn bowls. Thus, the present research should be replicated in a range of power, strength, speed, and other explosive sports, as well as in a number of fine motor skill sports. It would also be interesting to examine sports that would be categorised between the highly explosive and the low arousal activities, such as team ball games and individual ball sports, to see whether these would show effects between the extreme categories for the effects of different kinds of music during imagery on level of arousal and subsequent performance. Assuming the effect of music during imagery on arousal and performance is established more generally, it would then be a priority to examine the mechanism underlying the benefits of relaxing music during imagery.

The inclusion of elite level shooters and weightlifters in the present study is a strong point of the research in terms of the potential for application of the findings to the application of music during imagery in elite sport. At the same time, it does limit the conclusions that can be drawn to elite performers. Thus, it is not possible to consider whether particular music would enhance the efficacy of imagery for performance enhancement among developing performers or novices based on the results of this study. For fine motor skills, the results of Study 2 do address that question for individuals starting to learn a sports skill. The findings are consistent with the results for elite shooters in this study. Novices' arousal level declined in both URMI and UAMI conditions and their performance was enhanced most in the URMI condition. These results were also evident with shooters in the present study. Thus, for fine-motor sports there is evidence that relaxing music facilitated imagery for novices learning a task and elite athletes aiming to perform their highly attuned skills at an optimal level. Further study should be conducted that examines elite athletes and beginners in the same task to minimise any effects of differences between the tasks, but the similarity of the results from Study 2 and the present study together seem to carry some conviction.

For power tasks, there is not the same extent of evidence related to skill level. Only elite performers have been examined in this thesis. In the present study, the results for weightlifters show a substantial level of agreement with those for shooters in terms of the direction of changes in arousal level and relative performance gains. This suggests that the facilitative effect of relaxing music might apply to performance enhancement regardless of the type of task. Nonetheless, the results are limited in relation to skill level, so it would be valuable to examine not only novices, but also experienced, but not elite performers.

A concern that should be acknowledged with the choice of elite samples of shooters and weightlifters is that there could have been ceiling effects associated with performance among these very high performing athletes. Given the high levels of performance at pre-test in the simulated competitions, it is noteworthy that performance gains were observed in all the research conditions and they were quite large and meaningful in practice in the URMI conditions in particular. Nonetheless, it might be that developing performers would show larger gains. This is another reason for replicating the present study with moderately skilled, but not elite, performers in a range of sports.

A possible methodological issue of the current study was that the simulated competitions used to measure performance in shooting and weightlifting, were not real events. This could be argued to have limited ecological validity. However, a wide range of actions was taken working closely with the shooters' and weightlifters' coaches to make the competition as similar as possible to actual competition. Measures such as using the same competition scoring and a competition monitor screen and competition administrators in shooting, and using 3 judges to evaluate the competition of weightlifting, all gave the competition a sense of realism. In addition, the presence of spectators, as well as other athletes, increased the evaluative element. In addition, the attitude of the coaches in both sports who treated this as a very serious event would certainly have sent a message to the participants. Some participants who were interviewed at the end of the study did provide unsolicited comments indicating that they experienced the simulated competitions as if they were real events. However, it is unlikely that participants experienced the same pressure that they do in major competitions, so their arousal level might not have been the same as in those competitions that represent the culmination of years of training and preparation. If studies could be conducted between two real competitions perhaps differences in performance in those competitions could provide some indication of the impact of imagery training accompanied by music on actual competition performance

With reference to the imagery script, this study used a standardised imagery script for all shooters and weightlifters. The imagery scripts for shooting and weightlifting were developed and pre-tested with the assistance of 2 coaches and 2 elite performers from each sport. I standardised the imagery scripts so that all participants in each sport were instructed to do the same imagery training. Further, I ensured that characteristics of the content were equivalent between sports, varying only in the specifics of the skills in each sport. In addition, participants were instructed to listen to the instructions on the MP3 player as they were doing the imagery. However, these elite athletes used imagery in their preparation, so they might previously have developed different imagery strategies compared to other competitors. It is possible that the participants might have modified the instructions in the imagery script slightly in order to suit their usual imagery routine or their own imagery strategies. It is not possible to determine how precisely participants followed the imagery scripts, together with the music, during every imagery training session. Participants reported informally that the initial instructions were clear for the imagery sessions, and I regularly reminded participants to follow the imagery scripts. However, I did not measure the extent of the participants' use of the imagery scripts in each imagery session. Monitoring of the extent to which actual imagery deviates from experimental scripts could be included in future studies by asking participants to rate the extent to which they followed the script, but such self-report measures of unobservable events are open to manipulation.

Future Research

In this study, I produced some encouraging results related to the effects of using unfamiliar relaxing music during imagery on subsequent performance of fine-motor and high-arousal power sport tasks. Generally, the effects and underlying mechanisms of how and why the use of relaxing music is effective in increasing both fine motor and high-arousal power sport tasks warrant further investigation. In this study, I found that unfamiliar relaxing music was superior for shooting, which is a fine motor skill sport, compared to unfamiliar arousing music. Similar effects were also demonstrated in dart throwing, another fine motor skill sport, in Study 2. In addition, I also found that unfamiliar relaxing music was superior for weightlifters, which is a high-arousal power skill sport, compared to unfamiliar arousing music. This is the only study I have identified in the literature that has examined the effect of unfamiliar relaxing music or unfamiliar arousing music during imagery on performance of a high-arousal power sport task, the clean and jerk in weightlifting. Thus, in future, researchers should replicate this part of the study, using the similar unfamiliar relaxing music and unfamiliar arousing music for other high-arousal power sport tasks, for example, power or snatch weightlifting, shot putt and discus, and sprint swimming, rowing, running, and cycling. Studies should also be conducted to replicate the present research, using similar music for high arousal endurance sport tasks, such as skiing, or longer distance swimming, running, and cycle racing.

In this study, I observed a reduction in physiological levels of arousal for both fine-motor skill and high-arousal power sport tasks with unfamiliar arousing music in Session 1 and Session 12 during the imagery training, although a minimal increase for the first two minutes was observed for GSR and HR in Session 1 of the imagery training for weightlifters. The reduction in physiological levels of arousal for a fine motor skill sport was also found in Study 2 on dart throwing with unfamiliar arousing music. However, the reduction in the levels of arousal for a high-arousal power sport task is contrary to expectations, which were that levels of arousal should increase when weightlifters were imaging a high-arousal weightlifting task, while they listened to unfamiliar arousing music. One explanation is that the arousing music became familiar or habituated. This could be because use of the same piece of unfamiliar arousing music throughout the imagery intervention phase of the study led to familiarity with the music, which in turn made it less arousing over the course of the 12 sessions. I have found no research that has examined changes in the impact of music over a number of repeated presentations. In future, researchers should explore the impact of repeated presentation of unfamiliar music over a number of sessions of imagery to examine whether the effect on level of arousal of initially arousing music, like that in the UAMI condition, is reduced as participants become familiar with the music across sessions. To do this it would be important for researchers to monitor physiological indicators of arousal ideally in every session, or at least every three or four sessions, to determine whether a pattern or trend of changes in level of arousal during imagery emerges. Further it would be valuable to study the effect on level of arousal of changing the piece of arousing music periodically, for example, every three sessions, in order to examine whether reduced impact on arousal level of playing the same piece of music over a substantial number of imagery sessions is due to familiarity. In such research, physiological indicators should be monitored in every session. If familiarity is the cause of reductions in arousal level, then physiological arousal would reduce more in the condition where the same excerpt is played across many sessions than in the condition where new pieces of arousing music are introduced every few sessions.

An alternative explanation for the reduction in level of arousal is that when individuals become absorbed in performing imagery training this triggers an automatic relaxation effect, which is reflected in the reduction of arousal level measured by physiological indicators. This suggests that doing imagery training is automatically relaxing, at least when individuals are skilled at performing the imagery task, so that they become absorbed in their imagery of the task. This is supported by the observation of reductions in levels of arousal on the physiological indicators in the imagery with no music condition in Study 2, which cannot be explained by effects of music, whether relaxing or arousing. It is not clear from the three conditions in Study 2 whether the reduction in arousal levels observed might be due to the low arousal characteristics of the sport skill that is being imagined or whether reductions in level of arousal relate to a process that links absorbing cognitive tasks such as imagery to the autonomic nervous system. Observation of a similar reduction in level of arousal, especially in Session 12, in the high-arousal power task in Study 3 cannot be explained by the effect of the imagined task on level of arousal. Thus, the operation of a process through which absorption in imagery triggers arousal reduction through the autonomic nervous system is a proposition that should be examined further. To examine this proposition, studies should be conducted in high-arousal tasks, where imagery of the task is accompanied by arousing music. In addition to monitoring peripheral, physiological indicators of level of arousal, such as GSR and HR, studies of this kind should include monitoring of central processes in the brain to determine whether regions of the brain that are responsible for the process of imagery and those that are responsible for the control of autonomic nervous system function show concomitant patterns of change during imagery. Further, it would be important to examine whether these changes corresponded with reductions in level of arousal reflected in the physiological measures of peripheral indicators of arousal level.

In addition, in the qualitative interviews, weightlifters in the UAMI condition reported that the arousing music was distracting, which made it difficult for the weightlifters to concentrate on the imagery task. This suggests that when an arousing external stimulus, such as arousing music, was added to the highly-arousing weightlifting task, weightlifters might have found it difficult to get absorbed in the imagery process. On the other hand, accompaniment of imagery of the high-arousal weightlifting task by relaxing music could have facilitated participants' absorption into performing the imagery training. Although no music during imagery of the arousing task condition was not included in the present study, in future, researchers should also examine the effect of imagery of arousing tasks with no music to examine whether imagery has a similar effect on the reduction of level of arousal of high-arousal tasks. In addition to the measurement of physiological indicators, examination of brain function in this context would be valuable.

To further examine the proposition that when individuals become absorbed in the imagery process this triggers a reduction in level of arousal, associated with a relaxing experience, it would be interesting to study the effect on level of arousal when sports performers become absorbed in imagery that is unrelated to sport. Researchers should examine the effect on level of arousal, measured using physiological indicators, when skilled athletes perform imagery related to their sport and imagery of an unrelated task, such as imagining their favourite scene from a movie or imagining a fitness activity in a gym, each accompanied by music, preferably unfamiliar arousing music. If becoming absorbed in imagery that is not related to their sport produces similar reductions in level of arousal to that associated with imagery of their sport, this would provide support for the claim that absorption in imagery triggers reduction in level of arousal regardless of the task being imagined, whereas greater reduction in level of arousal when imagining the sport task would suggest that the effect on level of arousal is related, at least in part, to content of the specific task.

In the present study, I selected shooting as an example of a low-arousal fine-motor sport and weightlifting as an example of a high-arousal power sport. Because the skills, techniques, movements, and strategies required for shooters are very different to those of weightlifters and the scoring methods also differ, it was necessary to compare the effects of relaxing and arousing music during imagery of the high- and low-arousal sports separately. This means some effects of the interaction between the arousal level of the sport and the arousing properties of the music could not be examined. To examine the effects of arousing and relaxing music during imagery, the arousal level associated with the performance of the activity, and their interaction together, it would be necessary to identify sports with similar skills, techniques, and movements, and similar scoring methods, but which are performed at very different levels of arousal. It is no easy task to identify such activities. For example, it would be possible to compare imagery with music of explosive sprint events and endurance events in racing sports, such as 100 metre anaerobic power running, swimming (50 metre), cycling, or rowing versus 5000m aerobic endurance events in running, swimming (1500 metre), cycling, or rowing. All of these could be transferred to their ergometer-based analogues in the physiology laboratory to further increase control, but with an associated reduction in ecological validity. Identifying true low arousal activities that correspond to high arousal activities would be more challenging, but may provide interesting avenues for future study.

Conclusion

In conclusion, the results of this study showed that URMI imagery training was more effective in enhancing sports performance for fine-motor skill and power sports than UAMI. URMI produced a lower level of arousal measured by physiological measures, GSR, PT, and HR, and URMI was associated with lower subjective perception of arousal on psychological measures, including somatic state anxiety and cognitive state anxiety, as well as increased self-confidence level. Although URMI and UAMI showed positive effects on performance for shooters and weightlifters, URMI showed significantly greater gain scores for shooters and weightlifters in simulated competition performance compared to the corresponding UAMI conditions. This is the first study that I have been able to identify to systematically examine the effect on level of arousal of different types of music during imagery training related to fine-motor skill and high-arousal power sports. The study raised the question of what caused the decrease in level of arousal during imagery with arousing music in the high-arousal power sport. The finding that performance increased more with relaxing than arousing music in the high-arousal power sport of weightlifting was contrary to expectations. It suggests that with low-arousal and high-arousal sports imagery is more effective when athletes are more relaxed. I suggest that this study may serve as a stimulus for future research to investigate a variety of psychological interventions using different types of music for enhancing sporting performance.

CHAPTER 6

GENERAL DISCUSSION

Introduction

The present thesis comprises three studies investigating the effects of relaxing and arousing music during imagery on sports performance. A central aspect of this research was testing the effect of relaxing and arousing music during imagery training on subsequent performance of sports skills. I also examined the effects of imagery with relaxing or arousing music on levels of arousal, using physiological indicators and self-report measures of psychological arousal. In this General Discussion chapter, first, I summarise the conclusions from the three studies and consider how they relate to theory and research. Next, I present directions for future research that are based on the findings from all three studies in the thesis. Following this, I examine implications for practice based on the understanding gleaned from the three studies. Finally, I make concluding remarks about the research reported in this thesis.

Summary

In this research, in order to ensure that all participants in Study 1, Study 2, and Study 3 were able to equally effectively employ imagery as part of their interventions, I screened participants for imagery ability. All participants reported moderate to high scores on almost all subscales of the SIAM, scoring particularly high on potentially important imagery ability characteristics, such as vividness, control, ease of generation, speed of generation, duration of the image, and the visual and kinaesthetic senses. All participants demonstrated strong imagery abilities to perform imagery training, and they were all included in the study for which they had been recruited. According to Hall (2001), athletes who have the ability to generate quality images on criteria including vividness, controllability, and ease of generating images, visual and kinesthetic sense modalities, emotional experience, and effectiveness in imagery, typically show superior performance on a variety of movement tasks. In an unpublished thesis, Koehn (2007) measured imagery ability of youth tennis players, using the SIAM. He then examined the effect of imagery on flow and tennis performance based on a 12-session imagery intervention. Koehn found that the participants reported moderate to high imagery ability and this lead to significant improvements in tennis performance.

It is also important to ensure that all participants demonstrate adequate adherence to the imagery training intervention in research on the impact of imagery on sporting performance. In Study 1, where each participant undertook three imagery sessions with music, I conducted all imagery sessions with the participants, so adherence was 100 percent. In Study 2 and Study 3, the adherence was 100 percent and 98 percent respectively. In Studies 2 and 3, I conducted two sessions (Session 1 and Session 12) with the participants, and the participants completed another 10 sessions of imagery training by themselves, recording their adherence in logbooks. In addition, personal follow-up emails were sent and telephone calls were made to encourage participants to perform the imagery training as instructed. In the 10 imagery sessions in Studies 2 and 3, where participants were instructed to practice on their own, adherence was still very high, with only one participant from Study 3 not completing all sessions. All participants, except one weightlifter in Study 3, were included in subsequent analyses. In similar studies using adherence logs, researchers also reported high levels of adherence to the imagery intervention program (e.g., Callow & Waters, 2005; Munroe-Chandler, Hall, Fishburne, Murphy, & Hall, 2012; Post et al., 2012). According to Vealey and Greenleaf (2001), it is recommended that athletes keep a log of their imagery experience in order to monitor imagery practice and improvements. Shambrook and Bull (1996) stated that the use of a log or diary encourages and promotes adherence to the imagery. In this research, in part, the high level of adherence might be because of personal follow-up emails and telephone calls that were conducted in Study 2 and Study 3 and the use of adherence logs, which increases participants' motivation to do the imagery training. Another possible explanation for the high adherence is that I used a portable device, the Sony MP3 player, to deliver the music combined with imagery training in Studies 2 and 3. Recent imagery studies have shown strong adherence using portable devices in imagery training (e.g., Almeida et al., 2008; Azzizuddin Khan et al., 2011; 2012). Azizuddin Khan et al. (2011) examined the impact of imagery supported by video modeling on netball shooting performance and self-efficacy. The study included three conditions, of which two conditions used a portable device, the iPod touch. In one condition, instructions for viewing the modelling and then performing imagery while the iPod screen was blank were given before each example of modeling and imagery practice in the session. In the other condition, the instructions were given only at the start of the session. These two iPod delivery conditions were compared with a stationary modeling condition in which participants were given the same modeling and imagery material on a DVD disc to play on their desktop computer. Azizuddin Khan et al.

(2011; 2012) found that participants who used the portable iPod touch showed 50 percent higher adherence compared to those who used the stationary device, and there was no difference between initial instructions and repeated instructions in terms of adherence. That study demonstrated that the use of portable devices, such as iPods, can lead to higher adherence among participants for imagery training. A limitation of the study by Azizuddin Khan et al. (2011; 2012) is that, whereas they used automatic electronic recording on the device in the iPod touch conditions to check adherence to the imagery sessions during the 7-day intervention, for the stationary device a self-report adherence log was used. Not only does it appear that portable devices are effective for promoting adherence to imagery training, but also they offer the increased reliability of electronic recording of use of the device for imagery training. This option was not available on the MP3 players employed in the present research, so self-report adherence logs were used here.

Research that depends on the manipulations of variables, such as arousal level, requires manipulation checks to determine whether the intended manipulations actually occurred. To begin with, in the first study, physiological and psychological measures of arousal level were dependent variables, monitored to determine whether the selected music was relatively relaxing or arousing. In Study 1, I established that the excerpts of music selected to be either relaxing (URM) or arousing (UAM) did have the predicted effects on level of arousal for the physiological measures and subjectively perceived arousal during imagery of a sporting task. In this thesis, I selected unfamiliar classical music to minimise associations, which can lead to unpredictable effects on individual arousal level.

The results indicated that use of unfamiliar music helped to minimise any confounding effect of familiarity and past associations. Familiar arousing music (FAM) was added in Study 1 to examine differences between the effects of familiar and unfamiliar arousing music on level of arousal. While 12 skilled pistol shooters performed their usual imagery routine and the music was played, the shooters' level of arousal was monitored. After each piece of music, the shooters rated their arousal levels subjectively. Physiological and psychological measures indicated that arousal levels reduced more with URM than with UAM or FAM, indicating that the three excerpts of URM and UAM were suitable for use in studies of the effects of relaxing and arousing music during imagery on subsequent performance. Comparisons between UAM and FAM revealed that they only differed a little. Thus, there was no advantage in using familiar music for its possible additional arousing effect due to the associations with well-known stirring pieces, because such additional arousal did not emerge. Thus, the excerpts of unfamiliar arousing music were considered to be suitable for use in further studies. However, I found no research on the use of music during imagery that compared unfamiliar relaxing music with unfamiliar arousing music, unfamiliar relaxing music with familiar arousing music, or unfamiliar arousing music and familiar arousing music. On an exercise endurance task, Crust (2004) examined the use of familiar music and unfamiliar music, with white noise. The results showed that 15 female students were able to walk significantly longer while listening to familiar and unfamiliar music compared to white noise, but no significant differences were found between the two music conditions, which is similar to the results of Study 1 in this thesis. I have found no research in the literature that used familiar or unfamiliar music during imagery.

Study 2 was designed to test whether 12 sessions of imagery training accompanied by three variations of music, unfamiliar relaxing music during imagery (URMI), unfamiliar arousing music during imagery (UAMI), or no music during imagery (NMI), had an effect on performance of dart throwing among novices. Thus, the type of music played during imagery was the manipulation in this study. Participants were 63 sport science students. Physiological and psychological measures of arousal were monitored as a manipulation check for changes in level of arousal during music combined with imagery training. URMI produced the greatest reduction and UAMI produced the least reduction in level of arousal, with NMI producing arousal levels and changes in arousal level across sessions that were between URMI and UAMI. Thus, the manipulation check showed that the three research conditions manipulated level of arousal as intended.

In Study 3, I employed a match-and-mismatch approach to examine the impact of 12 sessions of imagery training accompanied by unfamiliar relaxing music during imagery (URMI) or unfamiliar arousing music during imagery (UAMI) on performance of the fine motor skill of pistol shooting and the power sport skill of weightlifting with elite performers from each sport as participants. The research conditions were considered to match each task when the arousing properties of the music accompanying imagery corresponded to the level of arousal shown to enhance performance when athletes are actually performing the task. Thirteen shooters (matched) and 13 weightlifters (mismatched) imagined their skill with relaxing music (URMI), while another 13 shooters (mismatched) and 12 weightlifters (matched) performed imagery with arousing music (UAMI). The type of music played during imagery was the manipulation in this study. Physiological and psychological measures monitored during the first and last sessions indicated that participants in the URMI conditions showed lower levels of arousal than those in the UAMI conditions within the same sport, indicating that the manipulations of arousal level were successful. Interestingly, participants in both weightlifting conditions showed much higher arousal levels than shooters in either research condition, especially in the first session. This is consistent with previous research and understanding within the sports that weightlifting is a high-arousal task (Hoffman et al., 2004; Knotts, 2000; Meltzer, 1994; Storey & Smith, 2012), whereas shooting is a low-arousal task (Bortoli, Bertollo, Hanin, & Robazza, 2012; Haywood, 2007; Kim, Lee, Kim, Woo, 2013; Loze, Collins, & Holmes, 2001; Wang & Hung, 2006).

Table 6.1

Summary of Main Findings from Studies 1, 2, and 3

Type of Task	**Type of Music**	**Study**	**Outcome**	
			Arousal	**Performance**
1. Low Arousal	Low Arousing	1, 2, 3	Decreased	Enhanced (Not tested in Study 1)
2. Low Arousal	High Arousing	1, 2, 3	Decreased (Small increase in Study 1, and small increase in Session 1 for Study 3)	Enhanced less than low arousing (Not tested in Study 1)
3. Low Arousal	No Music	2	Decreased	Enhanced less than low arousing music
4. High Arousal	Low Arousing	3	Decreased	Enhanced
5. High Arousal	High Arousing	3	Decreased (Small increase in Session 1 for Study 3).	Enhanced less than low arousing music

The primary purpose of this thesis was to examine the effect of relaxing and arousing music during imagery on subsequent performance of sport skills. The results for Studies 1, 2, and 3 are summarised in Table 6.1. Results in Study 2 showed that the URMI condition was associated with the largest gain in fine-motor skills task performance of novices in dart-throwing. This is consistent with the prediction that relaxing music is suited to fine motor skills, such as darts performance, because such skills are performed best when level of arousal is low. Thus, it was predicted that URMI would promote low arousal levels during imagery and this would create an association that would be transferred to actual performance after the 12 imagery sessions. Researchers have argued that certain pieces of classical music reduce level of arousal, so they are considered to be relaxing, because they have regular pulsation and repetitive tonal patterns based on a limited number of pitch levels (Karageoghis et al., 2012b). Karageoghis et al. (2012b) stated that regularity and repetition in music reduces levels of arousal, which is experienced as relaxing. The results in Study 2 showed that relaxing music during imagery was superior to arousing music or no music for enhancing darts performance, as predicted on the basis of the proposition that an association of darts performance with low levels of arousal occurs during imagery with relaxing music, which is consistent with the optimal conditions for darts performance. This study does not provide a test of this explanation, however. An alternative explanation is that relaxing music during imagery promotes a lower level of arousal, which is consistent with the optimal conditions for performing imagery (e.g., Suinn, 1976; 84). This proposition focuses on imagery as the basis for enhanced performance and URMI as a facilitator of relaxation, which is conducive to effective imagery. Study 2 did not provide information that distinguishes between these two propositions because the relaxing music condition matches the low arousal required for actual performance and it also creates preferred conditions for performing imagery. Comparison of the effects of relaxing and arousing music in a high-arousal task, involving power, strength, or explosive speed, is needed to differentiate between the predictions associated with the two propositions.

In Study 3, performance in both URMI conditions showed larger gains than performance in the corresponding UAMI conditions for the fine motor skill of shooting and the power task skill of weightlifting among elite performers. Using a match and mismatch approach, unfamiliar relaxing music produced a greater gain in performance than unfamiliar arousing music for the fine motor sport task of shooting, which was predicted. However, unfamiliar relaxing music also produced superior performance for the power sport task of weightlifting, which was not predicted on the basis of the proposition that arousal level during imagery should match arousal level during performance. Thus, the results of this study, which is the first that I have seen in which both arousing and relaxing music accompanied imagery in both a fine-motor skill and a power sport, are not consistent with the research done on the effect of arousing music on power tasks when music was played before performance (e.g., Hayakawa, Miki, Takada, & Tanaka, 2000; Simpson & Karageorghis, 2006; Terry, Karageorghis, Saha, & D'Auria, 2012). In the present research, the results from Study 3 suggested that the use of unfamiliar relaxing music can cause a reduction in the level of arousal that is beneficial for imagery, and superior imagery produces greater positive effects on subsequent performance. Thus, Study 3 supported the second proposition that imagery is more effective under relaxing conditions, such as those provided by unfamiliar relaxing music. However, more research is needed with different types of music during imagery and performance of different types of sporting tasks, such in explosive speed and strength sports, endurance events, or open or closed skill tasks, to replicate and expand on the findings of the current study. Although the results for the fine motor skill of shooting do replicate the findings of Study 2, but with highly skilled athletes, it is still possible that some benefit was shown in terms of the transfer to subsequent performance of the low arousal level attained during imagery by participants in the URMI condition.

In Study 2 and Study 3, the manipulation checks, using physiological and psychological indicators to monitor relaxing and arousing music during imagery, showed that relaxing music produced greater reductions in level of arousal from the start to the end of the imagery sessions (Session 1 and Session 12) as predicted. Arousing music showed a small increase in arousal during the early part of Session 1 for Study 3, but otherwise, arousing music also showed reductions in levels of arousal, especially in Session 12, which was not predicted in this research. I found no studies that examined changes in level of arousal for different types of music during imagery training for comparison with the present results. Most previous research involved music that was presented before or during performance (e.g., Crust, 2004; Crust & Clough, 2006; Elliott, Carr, & Savage, 2004; Simpson & Karageorghis, 2006; Terry et al., 2012), and did not use imagery as part of the intervention, which is different from the current research examining the effect of different types of music during imagery training on subsequent performance.

In this research, the decrease in level of arousal (rather than increase) associated with arousing music in both studies (Study 2 and Study 3) could be due to the imagery intervention. It is possible that the process of performing imagery is associated with reduction in arousal level, that is, when athletes become absorbed in performing imagery of a task their arousal levels decrease, so they become more relaxed. This statement is supported by the results from Study 2, in which the no music during imagery (NMI) condition also showed signs of relaxation with physiological and psychological indicators depicting decreases in level of arousal. Suinn (1984) compared the use of VMBR with relaxation during imagery, imagery training without relaxation, relaxation training alone, and placebo conditions, and found that VMBR with relaxation during imagery had greater effects on performance than the other conditions. The focus in that study was on the comparison between the impact on performance of imagery with and without a relaxation technique. Suinn did not examine the effect of the different interventions on level of arousal, using physiological indicators. Thus, it is possible that level of arousal decreased in the imagery alone condition, but not as much as in the condition in which a relaxation technique was used, and that there was an improvement in performance in the imagery alone condition, but it was not as large as that in the imagery with relaxation condition. Other researchers have found no significant difference between imagery with relaxation and imagery alone conditions (Murphy et al., 1988; Weinberg et al., 1981), but all these studies varied considerably in many aspects of their design. I found no studies in the literature examining the use of imagery and its association with reductions in arousal level, in particular where level of arousal was monitored using physiological indicators.

An alternative explanation for the reduction in the levels of arousal for unfamiliar arousing music during imagery observed in Studies 2 and 3 is that the continued use of the same excerpts of music during imagery increased familiarity with the initially unfamiliar arousing music during imagery, which in turn reduced its arousing impact. However, I did not measure level of arousal during the imagery training in Sessions 2 to 11. Thus, it is not possible to draw conclusions about whether reduction of the level of arousal in the unfamiliar arousing music conditions is solely due to the unfamiliar arousing music losing some of its potential to arouse as sessions progressed due to increasing familiarity. It is also possible that the effect can be explained by an inherent arousal reduction effect of becoming engrossed in imagery. Based on the observation that there were lower levels of arousal at the start of Session 12 compared to the start of Session 1 in all conditions in Study 2 and Study 3, it is suggested that the music with imagery continued to have an effect in Sessions 2 to 11. To examine this further, physiological indicators of arousal could be used in some or all sessions between Sessions 1 and 12 in studies with similar design to Study 2 or Study 3. However, this would not determine whether the reductions observed are due to increased familiarity with the music or a relaxing effect of performing imagery. The results of the studies in this thesis add to knowledge about the role that music might play in sport, and the impact of imagery training on performance. The studies also raise a range of questions that should be addressed in further research.

Future Research

Some important implications for future research have emerged from the three studies in this thesis in terms of music, imagery, and sport performance. A number of topics are examined separately in this subsection.

Music, Imagery Training, and Sport Performance

The research reported in the present thesis produced encouraging results related to the use of music during imagery on subsequent performance of fine-motor and power sport tasks. Generally, the effects and underlying mechanisms of how and why the use of relaxing music is effective in increasing both fine motor and power sport tasks warrant further investigation. In this thesis, I found that unfamiliar relaxing music was superior to unfamiliar arousing music for enhancing performance in fine motor skill sports. This was demonstrated for novices in dart throwing in Study 2 and was replicated with elite pistol shooters in Study 3. These results match the prediction that relaxing music is superior for fine-motor sports. In addition, I found that unfamiliar relaxing music was superior for enhancing performance of elite athletes in the high-arousal power sport of weightlifting (Study 3). I predicted that unfamiliar relaxing music would be a mismatched condition based on the proposition that the arousing characteristics of the music accompanying imagery should match the arousal level at which the sport is actually performed effectively. Similarly, I predicted that unfamiliar arousing music would be a matched condition for enhancing performance in the high-arousal power sport of weightlifting, but I found that it was less effective than unfamiliar relaxing music, which was contrary to the prediction (Study 3). The no music condition was the least effective condition compared to unfamiliar relaxing music and unfamiliar arousing music for the fine-motor sport of dart throwing (Study 2). I predicted this for unfamiliar relaxing music, but not for unfamiliar arousing music. However, only one study was conducted in which no music was employed and the performance difference with unfamiliar arousing music was not large. It was also the case that I only examined the effect of music during imagery on performance of a power sport with one sport in one study. Thus, the results should be replicated using similar music for other power sport tasks, for example, power lifting, snatch for weightlifters, shot putt, discus, or 50m ergometer sprinting, as well as other high-arousal sports, involving explosive speed or physical contact, such as sprint running, cycling, or swimming, rugby, football, boxing, or wrestling. Similarly, researchers should include a no music condition to compare the effects of imagery on level of arousal and performance of fine-motor skill sports and high-arousal power skill sports.

In Study 2 and Study 3 of this thesis, I found that unfamiliar arousing music during imagery was less effective for subsequent performance compared to unfamiliar relaxing music. However, this is contradictory to the studies done on the use of arousing motivational music before performance (e.g., Elliott et al., 2005; Koc & Curtseit, 2009; Rendi, Szabo, & Szabo, 2008; Simpson & Karageorghis, 2006). In extensive literature searches, I found no studies examining the effect of unfamiliar relaxing music or unfamiliar arousing music, and no studies measuring the physiological and psychological level of arousal associated with the music used, during imagery that examined subsequent performance. Some studies have examined the effects of imagery on performance, that have included music (familiar music / preferred music) as part of the intervention, but they did not measure the level of arousal physiologically or psychologically, and they did not compare different types of music (e.g., Almeida et al., 2008; Dorney et al., 1992). The benefit of using unfamiliar music is because it is not well known by the general population, which should minimise associations, which could lead to different participants evoking a variety of emotions based on different past experiences associated with that music, creating unpredictable effects on individuals' arousal level. It will be interesting for researchers to replicate the research in the present thesis, using unfamiliar relaxing music and unfamiliar arousing music during imagery, rather than using familiar or participant-preferred music. Such studies should then examine the effect of those types of music during imagery on subsequent performance of different sport tasks. Such research might provide deeper understanding of the effect of using kinds of music that will be more suitable during imagery intervention programs because unfamiliar music has predictable effects due to the absence of diverse previous associations.

The present research provides evidence on the effect of using relaxing music during imagery training on subsequent performance of fine-motor skill sports and a power sport skill. In relation to the examination of the impact of music on imagery training interventions, I found no research that has examined the effect of music per se or the characteristics of music that reduce arousal. According to Karageorghis and Priest (2012a), the characteristics that underpin the effects of music are still poorly understood. They suggested that this is because insufficient attention has been paid to the mechanism underlying the effects of music on performance, although the effects of music on performance have been extensively demonstrated. Dorney et al. (1992) examined the effects of music during imagery on performance of a muscular endurance sit-up task, but they did not measure physiological and psychological levels of arousal during imagery with music. Dorney et al. found that both conditions in their study, namely imagery only and imagery with music, equally enhanced sit-up performance. Whilst imagery plus music increased performance more than imagery alone, the difference was not significant. However, Dorney et al. did not report key characteristics of the music, including whether the music was relaxing or arousing, and whether the music used was familiar or unfamiliar to the participants.

In another study, Almeida et al. (2008) examined the effects of imagery associated with 10 sessions of music over three weeks in improving basketball free-throw shooting performance in two different age groups: 13 – 15 and 18 – 31 year-olds. The music used was the favourite musical rhythms selected by each participant. Each participant performed 10 free throws before and after the imagery with music. The results from the inter-group analysis between the pre- and post-imagery intervention performance tests showed significant improvement in basketball throwing performance ($p < 0.03$) for both age groups. Almeida et al. also found that the adult age group performed at a higher level in the shooting task and reported higher imagery ability measured by the MIQ-R. A major limitation of this study was similar to the study by Dorney et al. (1992), namely that Almeida et al. did not report key characteristics of the music. Selection of participants' favourite music indicates that it was familiar to the participants, but there is no indication of whether the music was intended to be relaxing or arousing, and it is possible that it varied from participant to participant on this characteristic.

Although there have been mixed results on the effects of music during imagery interventions on arousal level and performance of sports tasks, the mechanism underlying the effect of using music during imagery on subsequent performance is unknown. A step-by-step approach, similar to the research in this thesis, including measurement of level of arousal, and controlling other factors, such as associations, emotions, and motivational effects, will provide valuable information that can increase understanding of the characteristics involved in the process by which music during imagery has an effect on subsequent performance. It is also important that researchers examine a diverse range of sports skills that includes sports that require levels of arousal between high arousal explosive sports and low arousal fine motor skill sports. These include a range of individual and team ball sports. It would be especially interesting for researchers to examine the effect of music during imagery on subsequent performance of sports that involve both high- and low-arousal aspects. A prime example of this kind of sport is biathlon, in which competitors must ski as fast as they can over considerable distances (high arousal) and then shoot at targets with a rifle they carry throughout the event (low arousal).

Given that the participants in the studies in this thesis were young adults, I decided that a potential source of unfamiliar relaxing and arousing music was classical pieces, excluding some of the most famous pieces that are part of popular culture. The evidence from participants' subjective reports indicated that the musical excerpts that were selected through a careful process in Study 1 were unfamiliar to the participants across all three studies. This led to the desired outcome that participants responded in a consistent way to the unfamiliar classical excerpts presented, showing greater reductions on the physiological and psychological indicators of levels of arousal for the unfamiliar musical excerpts selected to be relaxing than they did for the unfamiliar arousing excerpts. In future, researchers should replicate the approach of the studies in this thesis to manipulation of music and physiological and psychological monitoring of its effects on arousal to examine further the effect of unfamiliar relaxing and arousing music on different sports tasks.

In this research, I conducted two similar studies on fine motor task sports examining the effects of relaxing and arousing music on imagery and performance. In Study 2, novices participated in research in which I examined the effect of music during imagery on darts performance, whereas in Study 3, expert shooters participated in research in which I examined the effect of music during imagery on shooting performance. Results for both studies showed that unfamiliar relaxing music during imagery training lead to significantly greater gains in performance than unfamiliar arousing music. Although the evidence is compelling with similar outcomes for novices and experts, in future, researchers should conduct similar studies on samples from different fine-motor skill sports and different skill levels. It would be particularly informative to compare novices, developing performers, and experts on the same task.

In this thesis, I only examined one sport task that requires high levels of arousal for effective performance. In Study 3, the weightlifters were highly-skilled performers. The results in Study 3 showed that unfamiliar relaxing music was also superior to arousing music in enhancing the performance of elite weightlifters. However, other high arousal sports skills, such as rugby, sprinting, wrestling, or sprint cycle racing, should be examined in order to test further the proposition that unfamiliar arousing music is less effective than unfamiliar relaxing music during imagery for enhancing subsequent performance. Such research should also examine the effect of unfamiliar relaxing and arousing music during imagery on performers of different skill levels performing the same high-arousal sports task. In addition, research examining the effects of imagery with music on sports tasks that researchers would classify as most effectively performed at a moderate level of arousal would provide a more complete picture of performance effects.

In the present thesis, I used a generic imagery script for Study 2 and Study 3 (dart throwing, shooting, weightlifting), whereas participants generated their own imagery in Study 1. In recent research, Wilson, Smith, Burden, and Holmes (2010) reported that the use of participant-generated imagery scripts produced greater EMG activity of the right bicep, and higher imagery ability ratings than experimenter-generated imagery scripts in lifting weights. However, Wilson et al. did not measure performance. According to Lang's (1979, 1985) bioinformational theory, personalizing imagery interventions produces more vivid imagery, accompanied by task-specific physiological responses. Future studies of the effects of relaxing and arousing music during imagery on performance should examine whether participant-generated imagery scripts or customised scripts, developed in consultation with the athlete and their coach, would be more effective than generic imagery scripts that are the same for all participants.

In the current research, I focused on the impact of different types of music for enhancing sporting performance. However, it would also be interesting to use a similar research design involving different types of music in association with different imagery purposes, such as reducing anxiety, increasing motivation, enhancing self-confidence, changing mood, or facilitating rehabilitation from injury among sports performers. Karageorghis and Lee (2001) compared the effects of motivational music, imagery, and a combination of motivational music and imagery on performance of an isometric muscular endurance task, requiring the participants to hold dumbbells in a cruciform position for as long as possible. They found that the combination of music and imagery yielded greater endurance than music alone, imagery alone, and a control condition. However, it was unclear if the music and imagery interacted in some way to produce an ergogenic effect, or if this effect was merely an addition of the motivational impact of the music to the imagery. Karageorghis and Lee did not mention the type of music or the characteristics of the music used. Also, they did not include a measure to test for differences in motivation. I encourage researchers to use the same relaxing and arousing music, which has been carefully selected through a process like that involved in Study 1 of the present thesis, for application in the examination of different imagery purposes to see whether relaxing music has a greater effect on outcomes for other imagery purposes, such as modifying psychological variables or facilitating recovery from injury or heavy training. This would reduce the degree of variability currently evident in this field, where the characteristics of music employed in research are diverse.

In this research, I screened all the participants to ensure they had at least moderate imagery ability. However, the results could be different for participants with low imagery ability. According to Martin et al. (1999), it is important to consider imagery ability in research or applied work on the utilization of imagery. Most research, such as the study conducted by Murphy (1994), has excluded athletes who have low imagery ability in order to examine the effect of an imagery intervention on performance. The rationale for doing this is that if low imagery ability individuals are included in a study and the outcome is not significant, it is not possible to conclude whether the intervention was ineffective or the participants did not have sufficient imagery ability to make use of the imagery provided. I have not identified any research comparing the effect of relaxing and arousing music during imagery on performance among low imagery ability athletes and high imagery ability athletes. Thus, in future, researchers could consider comparing the effect of using relaxing or arousing music for high and low imagery participants, to examine whether similar effects occur for low imagery athletes. Such research might provide deeper understanding of the differences between high and low imagery ability participants, which should help sport psychologists to implement different intervention strategies in applied work with low and high imagery ability individuals, if they respond differently in research on the effect of music during imagery.

Cook (2000) stated that his experience of working with clients in a therapeutic setting was that his clients often responded more positively to relatively unfamiliar music compared to familiar music. In this thesis, I selected unfamiliar music because of the possible confounding effect of familiarity with the selected music on level of arousal. In particular, familiarity with arousing music can produce variable reactions. Although I did not find any significant difference between unfamiliar arousing music and familiar arousing music in Study 1, it is possible that the use of familiar music, such as comparing the effect of familiar arousing music and familiar relaxing music with unfamiliar arousing music and unfamiliar relaxing music during imagery could produce unpredictable results in relation to levels of arousal during imagery interventions, as well as in terms of subsequent performance. For example, comparing the effects of four research conditions, familiar relaxing music, familiar arousing music, unfamiliar relaxing music and unfamiliar arousing music, within the same sports during imagery training could increase understanding regarding the differences between familiar and unfamiliar music for imagery interventions and with reference to which types of music actually produce greater relaxation, leading to greater performance enhancement.

Cassidy and Macdonald (2009) conducted a study comparing the effect of self-selected and experimenter-selected music on performance of a driving video game using five research conditions: (1) silence, (2) car sounds alone, (3) familiar moderate-arousal self-selected music, (4) unfamiliar high-arousal experimenter-selected music, and (5) unfamiliar low-arousal experimenter-selected music. The participants judged both high- and low-arousal music, using the arousal and liking questionnaire. Cassidy and Macdonald found that participants exposed to familiar moderate-arousal self-selected music performed most efficiently in the driving video game, perceived lower distraction, higher enjoyment, liking, and appropriateness, and experienced a reduction in tension-anxiety. Interestingly, participants' experiences were poorest when they were exposed to high-arousal experimenter-selected music, among the three types of music. This suggests that if the music selected by the experimenter is not perceived to be suitable by the participants during the performance of the specific task, this might lead to frustration, distraction, and anxiety, as was reported in the interviews in Study 3 in the present thesis by weightlifting participants who performed imagery with unfamiliar arousing music. It should be emphasised that Cassidy and Macdonald examined performance of the task while music was playing and did not include imagery in their study, so comparisons to the present research should be made with caution.

According to Karageorghis and Priest (2012b), self-selected music is especially efficacious in an applied context. However, researchers should also be aware of the inherent difficulties pertaining to self-selection; there is a greater likelihood of the emergence of Hawthorne effects and experimental effects (Lucaccini & Kriet, 1972; Priest & Karageorghis, 2008). Although in the present research, the music was preselected through a systematic process that involved expert musicians, sport psychologists, and sport science students, it might not have had the same effect for participants as self-selected music. Familiarity could also trigger past experiences and confound the research, for example, if self-selected arousing music has a positive valence for the individual who selects it. I found no studies in the literature comparing the effects of experimenter-selected music and participant-selected music played during imagery on level of arousal and subsequent performance. To examine whether self-selected music is superior to researcher-selected (or sport psychologist-selected) music, researchers should investigate the differences between the use of self-selected and experimenter-selected music during imagery training. For example, it would be interesting to compare the effect on arousal level and subsequent performance of playing music during imagery training when a sample of participants from one sport self-selects the music and a matched sample from the same sport is presented with the same music by the researchers. In this way there would be no confounding of the music and the source of selection. Both samples would do imagery training with the same music, so the only variable that changes is the source of selection.

Since music was used in mental training by Eastern European sport psychologists several decades ago, many studies of the impact of music on sports performance have focused on factors, such as familiarity, motivation, popularity, preferences, and synchronization, with the aim to identify the factors leading to selection of optimal music to enhance performance in sport (Karageorghis & Priest, 2012a; 2012b). However, most studies have not measured the effects on physiological level of arousal of the music used. In this thesis, I found that music that was intended to be arousing, based on the process of selection in Study 1, did not significantly increase level of arousal during imagery. Thus, by using music that was "perceived" to be arousing or motivational by research participants or researchers, all that researchers can draw conclusions about is perception and preference. The majority of previous research examining the effects of music on performance has used factors, such as the perceived motivational character of the music (Barwood et al., 2009; Brooks, & Brooks, 2010; Michal, Ehud, Alon, Dan, & Yoav, 2012) or the popularity of the music defined in various ways (Waterhouse et al., 2010) to identify the character of the music. In these kinds of research, the aspects of familiarity with and motivational characteristics of the specific music employed have often been considered, for example, by the creation and use of measures of the motivational qualities of music, such as the Brunel Music Rating Inventory (BMRI; Karageorghis et al., 1999; BMRI-2; Karageorghis, Priest et al., 2006; BMRI-3; Karageorghis, 2008). Researchers have also examined different genres of music, including classical music (Dorney et al., 1992; Elliott et al., 2004; Grocke & Wigram, 2007; Potteiger, Schroeder, & Goff, 2000; Szabo et al., 1999), hard rock music (Anshel & Marisi, 1978; Karageorghis et al., 2006; 2009; Pujol & Langenfeld, 1999), and pop music (Karageorghis et al., 2009; Pujol & Langenfeld, 1999). Other characteristics of music have also been examined, including whether the music is synchronous (Hayakawa et al., 2000; Karageorghis et al., 2010; Simpson & Karageorghis, 2006; Terry et al., 2012) or asynchronous (Crust, 2004; Crust, & Clough, 2006; Elliot et al., 2004; Geisler, & Leith, 2001; Pates, Karageorghis, Fryer, Maynard, 2003; Szabo et al., 1999). The body of research on music in sport, which has reflected an interest in the characteristics of music, has greatly enhanced understanding of the types of music that can affect behaviour in sport and the conditions under which those effects are observed. However, in the present thesis, the emphasis was on the impact of one characteristic of music, its relaxing or arousing properties, when music is played during imagery to enhance subsequent sports performance. I decided that the issues of familiarity and preference were best controlled by using unfamiliar music. I intentionally chose unfamiliar music so that the motivational aspects of the music did not confound the arousing effects of the music, which was the basis for selection. Thus, familiarity, preferences, or association factors were controlled. Although it was not within the scope of the current study, in future, researchers should also explore the different characteristics of music, such as familiar versus unfamiliar music, the motivational versus demotivational character of music, motivational versus oudeterous music (neither motivating nor demotivating), popular music versus music that is not popular, synchronous versus asynchronous music, and music that has associations for the listener versus music that has no associations. Considering these issues in music and imagery research is necessary to fully understand the different aspects of music played during imagery that influence the effect of imagery on sporting performance. Studies will vary in terms of conceptual framework related to the music used with imagery. Thus, these characteristics should be examined separately in accordance with specific research objectives. For example, the examination of the effect of familiar arousing music compared to familiar relaxing music during imagery using different sporting tasks, should control for factors, such as association and previous experience, which unintentionally might provoke emotions.

Effect of Music on Physiological Arousal during Imagery

Examining physiological indicators of level of arousal during imagery showed consistent results across all three studies in this thesis. All the studies showed greater reductions in levels of arousal during imagery training with unfamiliar relaxing music than for unfamiliar arousing music. The findings were broadly consistent for the three physiological indicators and the psychological measures. In particular, for the URMI conditions, GSR and HR decreased monotonically over time from the start of the imagery to the end of the imagery in Sessions 1 and Sessions 12 (Study 2 and Study 3). Both measures showed the largest decrease in arousal for unfamiliar relaxing music, compared to unfamiliar arousing music (Study 1, 2, and 3), familiar arousing music (Study 1), and no music (Study 2). This showed that unfamiliar relaxing music facilitated relaxation among the participants more effectively than the other research conditions. In addition, using the matched and mismatched conditions among shooters and weightlifters in Study 3, unfamiliar relaxing music was also associated with decreases in levels of arousal measured by GSR and HR, with elite performers in both a fine-motor skill sport and a power sport. It is noteworthy that when weightlifters were imagining performing a task that requires a high level of arousal, their arousal levels declined in the relaxing music (mismatched) condition. This is the first study I have identified in the literature that compared both physiological and psychological indicators of level of arousal using different types of relaxing and arousing music during imagery training. The physiological measures reflected change in key autonomic functions associated with arousal level during performance of imagery while listening to music, whereas the self-report psychological measures depicted reductions in subjectively-experienced anxiety. Thus, the physiological measures indicated that there was a reduction in arousal level and the psychological measures supported the proposal that those bodily changes were associated with relaxation, rather than other low arousal states. Based on the conclusions that can be drawn from using physiological and psychological measures in the present thesis, in further research into the use of music and imagery, I suggest that researchers should examine the physiological and psychological levels of arousal of the music used, in order to understand whether the music reduces level of arousal and whether changes observed reflect relaxation.

In Study 3, music was shown to be associated with reductions in level of arousal during imagery for shooters and weightlifters, regardless of whether the music was intended to be relaxing or arousing and whether the task was a low-arousal sport or a high-arousal sport, with just a minimal increase shown for unfamiliar arousing music during the first two minutes of Session 1 for weightlifters. The use of unfamiliar relaxing music during imagery corresponded with the greatest reductions in level of arousal during imagery, but unfamiliar arousing music showed a substantial decrease in level of arousal across Session 12, even for the high-arousal sport. In Study 2, with novices performing imagery of the fine motor skill of darts, level of arousal decreased in the no music condition as well as in both relaxing and arousing music conditions. This provided additional support for the proposal that when individuals become absorbed in imagery this triggers a reduction in arousal level because there was no music to explain the reduction in arousal observed. In Study 3, however, I did not employ the no music with imagery condition because the focus was on the match-mismatch design and it was challenging to recruit the required number of elite level participants. Thus, it was not possible to determine whether the pattern of arousal reduction with no music would occur with elite performers in a low-arousal task, pistol shooting, or elite performers in a high-arousal task, weightlifting. Researchers should examine the effect of imagery with no music for elite performers performing fine-motor and power tasks, as well as other high-, moderate-, and low-arousal tasks to clarify whether the reduction in arousal level during imagery without music is similar for elite athletes and for high arousal sports to that observed with novices in the fine motor skill of dart throwing in Study 2. This would provide further evidence related to the proposition that when individuals become absorbed in imagery their arousal level is reduced.

All physiological indicators used in this thesis, namely GSR, PT, EMG, and HR, showed reductions in levels of arousal with unfamiliar relaxing music as predicted, but for arousing music, I found small decreases, rather than the expected increases, in the levels of arousal in all three studies, with small and temporary increases in two cases followed by decreases that became large by Session 12. Decreases in level of arousal with arousing music were not expected. It was clearly the case that arousing music was associated with smaller decreases in arousal level than relaxing music on all comparisons. In addition, participants' responses to the self-report psychological measures in Studies 2 and 3 indicated that the arousing music was not perceived to be as relaxing as the designated relaxing music. Nonetheless, it was expected that the most stirring and arousing piece of unfamiliar classical music, which was found to be at least as arousing as well-known stirring pieces in the familiar condition in Study 1, would be associated with increases in level of arousal reflected in both physiological and psychological indicators. One possible explanation proposed for the reductions or at most early, minimal increases in arousal level observed for arousing music in the studies in this thesis is that the task of imagery itself is associated with a relaxation effect, which reduces the participants' levels of arousal. Perry and Morris (1995) stated that the role of relaxation as a basis for imagery is still empirically under-studied. Certainly, the literature appears to include very little examination of physiological indicators of level of arousal during imagery, with or without music or other arousal manipulation techniques. An alternative explanation for the brief, minimal increase in arousal level with unfamiliar arousing music in Session 1, followed by a gradual decrease and then the large decrease from a lower starting level in Session 12 is that performing 12 sessions of imagery with the same piece of music is associated with a familiarity or habituation effect that leads to reduction in the arousing properties of the music after several sessions. I could not find any published research investigating the effects on physiological arousal level of unfamiliar arousing music or relaxing music during imagery training presented over a number of sessions of imagery. Thus, there is no evidence elsewhere of arousing music leading to reductions in physiological indicators of arousal level, which means that there also appears to be no literature in which researchers in sport psychology have discussed the reasons why such an effect might occur. Thus, research similar to that in this thesis should be conducted, so that a sound comparison can be made of the alternative explanations based on imagery-triggered arousal and familiarity with a piece of arousing music leading to habituation. Researchers should explore the impact of repeated presentation of unfamiliar music, especially music that is initially identified as arousing, over a number of sessions of imagery to examine whether the effect of initially arousing music, like that in the UAMI conditions in Study 2 and Study 3, is reduced as participants become familiar with the music across sessions. Arousal level should be monitored using physiological indicators, such as GSR and HR, in each session or alternate sessions, to examine how the effect of the music changes within each session and from session to session. Further, it would be valuable to examine the effect on level of arousal of changing the arousing music periodically, for example every three imagery sessions, if it is established that there is reduced impact on arousal level of playing the same piece of music over a substantial number of imagery sessions. Examination of the data recorded by the physiological indicators of arousal should identify trends within each session and between sessions, which should clarify whether there is a familiarity factor that moderates the impact of repeating arousing music. Repetition of the same piece of music over multiple sessions should be associated with a regular pattern of reduction of arousal level, whereas changing the arousing music every three sessions should produce a fluctuating pattern of arousal in which gradual decline over each three-session block with the same music is interrupted by an increase in level of arousal each time a new piece of music is introduced. If the patterns for a single piece of arousing music and multiple pieces of arousing music are found to be similar, this would suggest that familiarity plays a minimal role and support further examination of the imagery-triggered arousal reduction proposition.

In this thesis, unfamiliar relaxing music was shown to be associated with a greater effect in reducing level of arousal and larger gains in performance, than unfamiliar arousing music, when they were played during imagery training in novices imagining dart throwing in Study 2, and in skilled performers imagining shooting or weightlifting in Study 3. This showed that certain levels of arousal might facilitate the effects of imagery on later performance more than others. However, other relaxation methods and low-intensity activities, such as progressive relaxation, yoga, breathing control exercises, meditation, autogenic training, and pilates exercises, might also have effects on level of arousal during imagery and subsequent performance. North and Hargreaves (1996) compared the use of five different types of popular music excerpts with very low, low, moderate, high, and very high complexity structures in two different activities, yoga and aerobics. They found that yoga participants preferred very low complexity music and aerobic exercise participants preferred very high complexity music excerpts. Further analyses indicated that yoga and aerobic exercise participants differed significantly in terms of psychological ratings scales of arousal and preferences. Based on the research in the present thesis, I concluded that unfamiliar relaxing music is most suitable for imagery, regardless of the tasks or the sports involved. If the effect of relaxing music is replicated for imagery of a range of tasks, it will be interesting to compare the effect of relaxing music during imagery with other relaxation techniques. Such research should employ similar physiological indicators and self-report psychological measures to those used in the present thesis, so that levels of arousal can be compared directly. This should provide insight into the different levels of arousal associated with a wide variety of relaxing adjuncts to imagery. To do this, I suggest that, in the future, researchers should examine different types of low-intensity activity exercise, as well as relaxation and meditation techniques, with relaxing music during imagery to quantify the relative relaxation associated with each type of activity for their use with imagery. It should also be interesting to observe whether there is a point in the most relaxing activities, at which level of arousal drops so low that the impact of imagery training starts to deteriorate, perhaps due to reduced capacity to attend to the task to be imagined.

Effect of Music on Psychological Arousal during Imagery

Results of the subjective psychological measures, using the CSAI-2R inventory in Study 2 and Study 3, indicated that URMI significantly lowered somatic state anxiety during imagery of dart throwing among novices, and shooting and weightlifting among skilled performers. UAMI significantly lowered somatic state anxiety of novices imagining dart throwing and skilled shooters imagining pistol shooting. URMI significant lowered cognitive state anxiety for novices imagining dart throwing, and for skilled shooters and weightlifters, and UAMI significantly lowered cognitive state anxiety during imagery for shooters and weightlifters. In Study 2, NMI significantly lowered cognitive state anxiety during imagery of dart throwing. In a study examining the effect of experimenter-selected relaxing classical music and pop music on competitive anxiety, Elliott et al. (2012) found that relaxing classical music significantly reduced somatic and cognitive state anxiety from the pre- to post-music intervention. Elliott et al. concluded that relaxing classical music was effective for reducing competitive state anxiety, while also increasing perceptions of relaxation. However, Elliott et al. did not examine the effect of relaxing music on anxiety during imagery and their results relate only to perceptions of anxiety because they did not monitor physiological indicators of level of arousal. Despite the issues surrounding the impact of music on competitive anxiety and arousal during imagery, I found no research that has examined the effect of use of music during imagery on competitive anxiety. Results of the present thesis do address this issue to some extent. Nonetheless, the current research should be replicated in a variety of contexts. For example, the URMI and UAMI conditions should be studied in other high-arousal power sport tasks, explosive tasks, combat, and endurance activities, and the NMI condition should be included in studies of low-moderate- and high-arousal sports.

In the present thesis, the CSAI-2R was used primarily as a manipulation check for the subjective experience of arousal. In Studies 2 and 3, I did not intend to use imagery as an intervention to increase or reduce the level of competitive anxiety. Thus, the imagery script was not designed to reduce competitive anxiety. I focused content of the script on the process of performing the sports skill, with an instruction to imagine a successful outcome. However, I found some significant effects on competitive anxiety associated with the use of relaxing and arousing music during imagery training. According to Elliott et al. (2012), listening to either non-relaxing (chilled-pop) music or relaxing classical music for anxiety control could provide anxiolytic benefits. However, I found no research in the literature that has examined the effect of music during imagery on competitive anxiety. Thus, although it was not the purpose of this thesis, the effects of the music in Studies 2 and 3 on state anxiety and self-confidence suggest that, in future, researchers could specifically examine the effect of using different types of music during imagery with the purpose of the intervention being to reduce or increase competitive anxiety, leading to effects on performance of different types of sports task or to provide an environment in which athletes can learn to cope with inappropriate anxiety during performance.

In the current thesis, the sports selected were all individual sports (dart throwing, shooting, weightlifting). The type of sport could also influence the effects of music on subsequent performance. For example, Martens et al. (1990) suggested that athletes competing in individual sports, subjectively judged sports, or contact sports, would report greater intensities of cognitive anxiety and less self-confidence than performers in team sports, objectively judged sports, and non-contact sports. Martens et al. (1990) added that somatic anxiety would reflect the specific activation and arousal requirements of sport-specific demands. This is interesting as the findings from Study 3 indicated that both relaxing and arousing music during imagery reduced the cognitive state anxiety of athletes in individual sports, regardless of the large differences in levels of arousal usually associated with performance of those sports (shooters performing in a particularly low-arousal sport, and weightlifters in a very high-arousal sport). In addition, relaxing music during imagery reduced somatic state anxiety significantly in both shooters and weightlifters, but arousing music did not. Thus, further research into the use of music during imagery in which researchers monitor level of arousal and measure performance, using different types of music and different types of sporting tasks, should lead to deeper understanding of the music-arousal-performance relationship during imagery in different sports. For example, researchers should examine the effects of music during imagery on high arousal sports, such as extreme or explosive sports, compared with fine-motor sports, such as archery, lawn bowls, and golf, as well as other low-to-moderate arousal activities, such as badminton, volleyball, and golf.

In this thesis, a novel research question was the focus of study. This relates to the impact of music associated with different levels of physiological arousal played during imagery on the performance of sports that have different characteristics in terms of the optimal level of arousal required for actual performance. This research has raised a number of issues that warrant further examination. First, in the present research, relaxing music during imagery was associated with greater performance gains than arousing music regardless of the sports task. Those gains were meaningful in the context of highly-skilled performers, who would be expected to be performing close to their ceiling, as well as with novices. Second, music selected because it was perceived to be arousing was associated with reductions in level of arousal in a high-arousal sport task, as well as in low-arousal-tasks. Third, level of arousal was reduced in a condition in which no music accompanied imagery, which is difficult to explain by reference to any factor other than the imagery. These findings appear to offer potential for research that can help to refine understanding of the conditions under which imagery most effectively influences performance and how imagery is related to level of arousal. Sport psychologists should glean valuable information from such research about the effective use of imagery in practice.

Implications for Practice

The findings in this thesis also highlight some positive strategies that could help sport psychologists and coaches to use imagery training effectively with athletes. Athletes would benefit by increasing the content of their imagery training, leading to more effective outcomes in terms of performance enhancement and personal well-being. The development of the music to be used in the imagery intervention program was based on the systematic process described in Study 1, whereas the development of the imagery scripts was based on the advice of expert coaches and athletes in Study 2 and Study 3. The main practical implications for the practice of imagery can be derived from Study 2 and Study 3. Many coaches and sport psychologists are not aware of the value of music for imagery. Music, selected to match the requirements of imagery rehearsal, can create a positive psychological state, leading to a decreased level of arousal during imagery, which the studies in this thesis suggest will enhance the benefit of imagery training for their sporting performance. The present research provides support for the use of music in sports that lie towards the low and high extremes of the arousal continuum for performance, that is, fine motor skills and power task sports, respectively. Although further research is required to confirm this, the results suggest that relaxing music that reduces level of arousal should facilitate imagery of sports for which appropriate arousal levels for performance lie between these extremes. According to Karageorghis et al. (1999) the use of the “right” music is important in order to get full benefits of the music for applied use. The results in Studies 2 and 3 showed that unfamiliar relaxing classical music is more beneficial than unfamiliar arousing classical music for enhancing sporting performance for fine-motor skills sports and also for power skill sports.

The finding is of great value to practicing sport psychologists, who can advise athletes to use unfamiliar relaxing classical music to lower level of physiological arousal during imagery training sessions. Such relaxing music should also be associated with a decrease in the level of somatic state anxiety and cognitive state anxiety, and an increase in the level of self-confidence, which are often desirable outcomes associated with enhanced performance. The evidence from the studies in this thesis is that such changes in physiological and psychological aspects of arousal and anxiety are likely to be associated with an increase in sporting performance. Thus, by understanding the research on the effect of use of unfamiliar relaxing music, sport psychology practitioners should aim for more effective interventions, based on the use of music during imagery training that is appropriate to the specific task or sporting event, together with consideration of the situational characteristics, to implement strategic intervention packages for diverse sports.

The full potential of the imagery intervention may depend on athletes' imagery ability, as well as athletes' adherence to the imagery program. A secondary finding from this research was that athletes with moderate to high imagery ability skills were able to use a combination of music and imagery successfully, although the music was new to them, so this effect of relaxing music can operate even when the music is not initially familiar to them. The present results suggest that athletes with at least moderate imagery ability can enhance their sporting performance by the use of this combination of relaxing music and imagery. Based on an initial assessment of imagery ability and under professional guidance, athletes should be encouraged, to more frequently engage in a systematic process of using imagery accompanied by relaxing music to increase performance in sport.

The use of adherence logs in the present thesis might have helped to increase participants' adherence to the imagery intervention. Responses to the adherence logs also provided the opportunity for me to determine how many sessions the participants had completed of their imagery interventions. Further, this gave me the opportunity to see the pattern of the development of imagery, the time of day when participants conducted their imagery training, and the participants' reactions to the imagery session from the comments presented by the participants. My experience of the information I gleaned from the adherence logs leads me to conclude that they could be valuable to sport psychology practitioners, who are working in more flexible conditions where they can use feedback from the logs to modify any problematic aspects of imagery training programs quickly and focus athletes on what appears to be effective in their experience of doing imagery.

In this thesis, I found that both novice and elite athletes benefitted from the imagery intervention using unfamiliar relaxing music. This statement is based on the results from Study 2 and Study 3, in which I employed the same music during imagery in the darts task with novices and in the shooting task with elite performers. Some researchers have argued that imagery is most effective when used with novice performers (Wrisberg & Ragsdale, 1979), whereas others have suggested that it is most effective when applied with elite athletes (Noel, 1980;

Suinn, 1983). Based on the results reported in this thesis, I suggest that imagery can be employed effectively with novices and skilled performers provided that the content of the imagery scripts is tailored to the needs of the performers who will use them.

In this research, imagery scripts were first developed on the basis of discussion with experts and then they were written down. Next, expert coaches and athletes not involved in the studies checked the written scripts to confirm that they were appropriate for the purpose. Once final editing confirmed that the scripts satisfied expert scrutiny, they were orally recorded into portable MP3 players with relaxing or arousing music, depending on the research condition. According to previous research, the use of systematically developed scripts that are orally delivered to athletes has been the most popular technique for administering imagery interventions (Perry & Morris, 1995). In this study, the qualitative interviews with participants in Study 2 and Study 3 showed that all participants enjoyed the imagery experience and found the scripts and their delivery to be effective. Further, analyses of adherence indicated that delivery by a portable device was associated with very high levels of adherence. Thus, I suggest that to promote imagery, sport psychology practitioners should oversee the systematic development of the content of imagery scripts to suit the specific athletes who will use them, and record the scripts onto portable devices, such as MP3 players, along with appropriate relaxing music to enhance the effectiveness of the delivery of imagery training and to optimise athletes’ experience of the use of imagery intervention programs. The benefits of using a systematic approach in the development of imagery scripts as well as their delivery will be judged by the extent of positive outcomes of use of such imagery interventions.

Many sport psychology practitioners have used music for imagery on an intuitive basis (Pain et al., 2011), and some have not used music at all in their applied imagery training work with athletes. However, this research showed that unfamiliar relaxing music is superior to unfamiliar arousing music for fine-motor sports and power task sports, although I could not conclude that relaxing music is suitable for use with imagery of all sport tasks. Thus, understanding of the use of unfamiliar music for use in imagery interventions will give athletes an extra edge in their preparation, which should also enhance their confidence that they have prepared thoroughly.

The findings in this thesis can be used to assist in the development of programs that use different types of music for imagery training, according to the specific task. From a practical perspective, this research could enhance athletes' use of music during imagery rehearsal, which may facilitate imagery training, so that imagery interventions are more effective. Knowledge gained from this work should assist coaches and sport psychologists in the development and delivery of effective imagery training to athletes. If this finding is replicated for the use of music with imagery across other strength and power tasks that are usually enhanced by music prior to or during actual performance (Karageorghis et al., 2009; Simpson & Karageorghis, 2006), it has important implications for the use of particular types of music with imagery, and supports the proposition that imagery is more effective when conducted with athletes who are relaxed or who become relaxed.

Concluding Remarks

Imagery has been widely studied, and music has been shown to enhance sporting performance, but little research has shown the effect of music on imagery, and the consequent impact of this combination on sport performance. The present thesis was designed to extend imagery research by examining the impact of using relaxing and arousing music during imagery. The thesis provides important insights into the effect of music on imagery training of different sport tasks, in particular indicating that relatively low levels of arousal are beneficial for imagery. By examining the effect of relaxing and arousing music during imagery on subsequent performance in this thesis, I have raised a range of questions about the relaxing and arousing effects of music during imagery, the effects of imagery on arousal level, and the effects of imagery with music on performance of sports skills, which I hope will stimulate other researchers to undertake further research on this topic to lead to greater understanding of the effects of music for imagery training.

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Appendix A

A table of the selected classical music excerpts for familiar relaxing music, unfamiliar relaxing music, familiar arousing music, and unfamiliar arousing music excerpts.

Familiar relaxing music

	Composer	**Name**	**Time**
1	Albinoni	Adagio in G Minor	11.32
2	Bach	Air of G string	5.2
3	Bach	Concerto for two violins: Largo	7.02
4	Beethoven	Violin Sonata No. 5 in F Major, Spring - Adagio molto espressivo	5.42
5	Beethoven	Piano Concerto no. 5: Adagio un poco mosso	8.04
6	Butterworth	The Banks of Green Willow	6.25
7	Boccherini	Cello Concerto in B-Flat Major: Adagio non troppo	6.55
8	Brahms	Piano Concerto No. 2: Andante piu Adagio	13.51
9	Brahms	Violin Concerto in D, Op. 77: Adagio	9.41
10	Brahms	Violin and Cello Concerto in A Minor, Op. 102: Andante	7.29
11	Chopin	Prelude in D flat, Op. 28 "Raindrop"	6.36
12	Chopin	Prelude in E Minor, Op 28	2.06
13	Faure	Pavane (Ochestra only)	7.44
14	Gluck	Orpheus and Eurydice: Dance of the Blessed Spirits	2.13
15	Gounod	Faust Ballet Music: II Adagio	4.26
16	Grieg	Concerto for Piano and Orchestra in A Minor, Op, 16: II Adagio	6.05
17	Grieg	Morning from Peer Gynt Suite	3.38
18	Liadov	The Enchanged Lake	7.55
19	Mahler	Symphony No. 5 In C Sharp Minor: IV Adagietto	4.09
20	Mascagni	Cavalleria rusticana - Intermezo	3.33
21	Mozart	Lodron Night Music No.1, Adagio, K.247	7.52
22	Mozart	Clarinet Concerto in A Major, Adagio, K. 622	7.31
23	Pachelbel	Canon in D	7.04
24	Puccini	Madame Butterfly: Humming Chorus	2.5
25	Rodrigo	Concierto de Aranjuez: Adagio	12.01

26	Saint-Saens	Carnivals of the Animals: VII Aquarium	2.03
27	Saint-Saens	Carnivals of the Animals: XIII The Swan	2.58
28	Satie	Gymnopedie No. 1	2.56
29	Satie	Gymnopedie No. 2	3.35
30	Satie	Gymnopedie No. 3	2.37
31	Vaughan Williams	Fantasia On Greensleeves	4.15
32	Vaughan Williams	Prelude on Rhosymedre	3.47
33	Vivaldi	12 Concertos, Op.3, No. 11 "L'estro armonico"	2.23

Unfamiliar Relaxing Music

	Composer	**Name**	**Time**
1	Borodin	Symphony No. 2 in B Minor: Andante	10.26
2	Beethoven	Symphony No. 9 in D Minor, Op. 125: Adagio Molto e Cantabile	15.01
3	Brahms	Symphony No. 4 in E Minor, Op. 98: Andante moderato	11.28
4	Copland	Appalachian Spring: Ballet for Martha	26.34
5	Delius	Florida Suite: III Sunset - Near the Plantation	10.10
6	Dvorak	Czeska Suita in D Minor, Op. 39: Romanze	4.15
7	Glazunov	The Seasons: Autumn: Adagio	3.47
8	Glazunov	Vesna (Spring), Op. 34	13.49
9	Holst	The Planets Suite: Venus	7.58
10	Massenet	Orchestra Suite No. 7, Scenes alsaciennes: Sous les tilleuls	4.58
11	Rachmaninoff	Symphony No. 2 in E Minor, Op. 27: III Adagio	17.11
12	Respighi	The Pines of Rome: Gianicolo	6.41
13	Respighi	The Birds: The Dove	4.27
14	Respighi	The Birds: The Nightingale	4.43
15	Respighi	Fountains of Rome: I. The Valle Medici Fountain	5.55
16	Wagner	Lohengrin: Prelude to Act 1	9.50
17	Vaughan Williams	Symphony No. 5 in D Major: III Romanza	12.37

Familiar Arousing Music			
	Composer	**Name**	**Time**
1	Elgar	March of the Mogul Emperors	3.50
2	Gliere	Russian Sailors' Dance	4.00
3	Holst	The Planets, Op. 32: I. Mars, the Bringer of Wars	6.36
4	Khachaturian	Waltz from Maskarade	3.26
5	Orff	Carmina Burana: O Fortuna (orchestra only)	2.4
6	Rossini	William Tell Overture-Finale	3.11
7	Saint-Saens	Symphony No. 3 in C Minor, Op. 78	7.57
8	Sibelius	Finlandia, Op. 26	8.31
9	Tchaikovsky	1812 Overture: Grand Finale	3.41
10	Verdi	Aida: Triumphal March and Chorus - Finale	5.49
11	Wagner	Die Walkure: The Ride of the Valkyries	3.08
12	Wagner	Lohengrin Prelude to Act III	3.07

Unfamiliar Arousing Music			
	Composer	**Name**	**Time**
1	Bruckner	Symphony No. 9 in D Minor, II Scherzo	9.58
2	De Luca	Conquerors of the Ages: Attila the Hun	3.16
3	De Luca	Conquerors of the Ages: Theme and Prelude	1.58
4	Dvorak	Slavonic Dances, Series 2, Op.72, B147 in B Major	4.20
5	Mussorgsky	A night on the Bare Mountain	10.23
6	Mussorgsky	The Hut on Fowl's Legs	3.45
7	Mussorgsky	The Great Gate of Kiev	6.36
8	Respingi	Feste Romane (Roman Festivals): IV Epiphany	5.18
9	Stravinsky	The Rite of Spring : Arousing excerpt)	18.52
10	Shostakovich	Music from the Gadfly: Finale	3.48

Appendix B

Demographic Information Form (Study 1)

Participant Number (Office use): ______

Date: _________________

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

PARTICIPANT DEMOGRAPHIC FORM

Please answer ALL the following questions by placing a cross (X) in the appropriate box or writing in words or numbers as appropriate.

Gender : ☐ Female ☐ Male Age (in years)_______________

Highest Educational Level Completed:

☐ Less than high school ☐ High school graduate

☐ College graduate ☐ University graduate ☐ Other_____________

Status: ☐ Unemployed ☐ Employed

Occupation: ______________________________

Hearing ability: ☐ Poor ☐ Normal

What sport you participate in: _________________________

Years of sport participation: ___________________ (years)

Do you currently participate at a competitive level? ☐ Yes ☐ No

Approximately, how many competitive seasons have you played?

☐ Less than 5 seasons ☐ 5-10 seasons ☐ More than 10 seasons

- THANK YOU -

Appendix C

Sport Imagery Ability Measure (SIAM)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Introduction

This questionnaire involves creating images of four situations in sport. After you image each scene, you will rate the imagery on twelve scales. For each rating, place a cross on the line at the point you feel best represents the image you produced. The left end of the line represents no image or sensation or feeling at all and the right end represent a very clear or strong image or feeling or sensation.
Ensure the ***intersection*** of the cross is on the line as shown in the examples below.

Correct X

Incorrect x X

An **example** of the style of scene to be created is as follows:

You are at a carnival, holding a bright yellow, brand new tennis ball in your right hand. You are about to throw it at a pyramid of six blue and red painted cans. A hit will send the cans flying and win you a prize. You grip the ball with both hands to help release the tension, raise the ball to your lips and kiss it for luck, noticing its soft new wool texture and rubber smell. You loosen your throwing arm with a shake and, with one more look at the cans, you throw the ball. Down they all go with a loud "crash" and you feel great.

Below are some possible ratings and what they represent to give you the idea.

1. How **clear** was the image?

no image X perfectly clear image

This example shows an image was experienced but was quite unclear

6. How well did you **feel the muscular movements** within the image?

no feeling X very strong feeling

This example indicates very strong imagery of the feel of muscular movements

7. How well did you **hear** the image?

no hearing X very clear hearing

This example reflects the strongest possible image, like hearing the real sound

12. How strong was your **experience of the emotions** generated by the image?

no emotion X very strong emotion

This example reflects a degree of emotion which is moderate

Do you have any questions regarding the imagery activity or the way you should respond using the rating scales? Please feel free to ask now.

DO NOT TURN THE PAGE UNTIL YOU ARE ASKED TO DO SO.

Please attempt the following practice question. Listen carefully to all the instructions. Note that this question does not count. It is here to help you get used to imaging and rating your experience

Fitness Activity

Imagine yourself doing an activity to improve your fitness for your sport. Get a clear picture of what you are doing, where you are, and who you are with. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you get the sensation of **taste** within the image?

no taste ____________________ very clear taste

2. How **long** was the image held?

image held for a very short time ____________________ image held for the whole time

3. How well did you **feel the texture** of objects within the image?

no feeling ____________________ very clear feeling

4. How **clear** was the image?

no image ____________________ perfectly clear

5. How well did you **hear** the image?

no hearing ____________________ very clear hearing

6. How **easily** was an image created?

image difficult to create ____________________ image easy to create

7. How well did you **see** the image?

no seeing ____________________ very clear seeing

8. How **quickly** was an image created?

image slow to create ____________________ image created quickly

9. How strong was your **experience of the emotions** generated by the image?

no emotion ____________________ very strong emotion

10. How well did you **feel** the muscular movements within the image?

no feeling ____________________ very strong feeling

11. How well could you **control** the image?

unable to control image ____________________ completely able to control image

12. How well did you get the sensation of smell within the image?

no smell ____________________ very clear smell

Check that you have placed a cross on all 12 lines.

NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Your "Home" Venue

Imagine that you have just got changed and made your final preparations for a competition at your "home" venue, where you usually practice and compete. You move out into the playing area and loosen up while you look around and tune in to the familiar place. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **feel the texture** of objects within the image?

no feeling |________________________________| very clear feeling

2. How **clear** was the image?

no image |________________________________| perfectly clear

3. How well did you get the sensation of **taste** within the image?

no taste |________________________________| very clear taste

4. How **long** was the image held?

image held for a very short time |________________________________| image held for the whole time

5. How well did you **hear** the image?

no hearing |________________________________| very clear hearing

6. How **easily** was an image created?

image difficult to create |________________________________| image easy to create

7. How strong was your **experience of the emotions** generated by the image?

no emotion |________________________________| very strong emotion

8. How well did you **see** the image?

no seeing |________________________________| very clear seeing

9. How well did you **feel** the muscular movements within the image?

no feeling |________________________________| very strong feeling

10. How well could you **control** the image?

unable to control image |________________________________| completely able to control image

11. How well did you get the sensation of **smell** within the image?

no smell |________________________________| very clear smell

12. How **quickly** was an image created?

image slow to create |________________________________| image created quickly

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Successful Competition
Imagine you are competing in a specific event or match for your sport. Imagine that you are at the very end of the competition and the result is going to be close. You pull out a sensational move, shot, or effort to win the competition. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **see** the image?

no seeing ________________ very clear seeing

2. How **quickly** was an image created?

image slow to create ________________ image created quickly

3. How strong was your **experience of the emotions** generated by the image?

no emotion ________________ very strong emotion

4. How **clear** was the image?

no image ________________ perfectly clear

5. How well did you get the sensation of **taste** within the image?

no taste ________________ very clear taste

6. How well could you **control** the image?

unable to control image ________________ completely able to control image

7. How well did you get the sensation of **smell** within the image?

no smell ________________ very clear smell

8. How **easily** was an image created?

image difficult to create ________________ image easy to create

9. How well did you **feel the texture** of objects within the image?

no feeling ________________ very clear feeling

10. How **long** was the image held?

image held for a very short time ________________ image held for the whole time

11. How well did you **feel** the muscular movements within the image?

no feeling ________________ very strong feeling

12. How well did you **hear** the image?

no hearing ________________ very clear hearing

Check that you have placed a cross on all 12 lines.
DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

A Slow Start

Imagine that the competition has been under way for a few minutes. You are having difficulty concentrating and have made some errors. You want to get back on track before it shows on the scoreboard. During a break in play, you take several deep breaths and really focus on a spot just in front of you. Now you switch back to the game much more alert and tuned in. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How strong was your **experience of the emotions** generated by the image?

no emotion ———————————————— very strong emotion

2. How **easily** was an image created?

image difficult to create ———————————————— image easy to create

3. How well did you **feel the texture** of objects within the image?

no feeling ———————————————— very clear feeling

4. How well could you **control** the image?

unable to control image ———————————————— completely able to control image

5. How well did you get the sensation of **smell** within the image?

no smell ———————————————— very clear smell

6. How **clear** was the image?

no image ———————————————— perfectly clear

7. How well did you **hear** the image?

no hearing ———————————————— very clear hearing

8. How **quickly** was an image created?

image slow to create ———————————————— image created quickly

9. How well did you get the sensation of **taste** within the image?

no taste ———————————————— very clear taste

10. How **long** was the image held?

image held for a very short time ———————————————— image held for the whole time

11. How well did you **see** the image?

no seeing ———————————————— very clear seeing

12. How well did you **feel** the muscular movements within the image?

no feeling ———————————————— very strong feeling

Check that you have placed a cross on all 12 lines.

DO NOT TURN OVER UNTIL YOU ARE ASKED TO DO SO.

Training Session
Think of a drill you do in training that is really tough. Now imagine yourself doing the drill. As you get a picture of yourself performing the skill in practice, try to complete an entire routine or drill. Take notice of what you can see around you, the sounds you hear, and the feel of any muscles moving. Do you get the sensation of any smells or tastes? Can you feel the equipment and surfaces you are using? Do you get an emotional feeling from this activity? Now you have 60 seconds to create and experience your image of the scene. When the 60 seconds is up, complete **all** 12 scales below. Don't spend too much time on each; your first reaction is best. Remember to place a cross with its **intersection** on the line.

1. How well did you **feel** the muscular movements within the image?

no feeling ⎣______________________________________⎦ very strong feeling

2. How well could you **control** the image?

unable to control image ⎣______________________________________⎦ completely able to control image

3. How well did you **hear** the image?

no hearing ⎣______________________________________⎦ very clear hearing

4. How **long** was the image held?

image held for a very short time ⎣______________________________________⎦ image held for the whole time

5. How well did you get the sensation of **taste** within the image?

no taste ⎣______________________________________⎦ very clear taste

6. How well did you **see** the image?

no seeing ⎣______________________________________⎦ very clear seeing

7. How **easily** was an image created?

image difficult to create ⎣______________________________________⎦ image easy to create

8. How strong was your **experience of the emotions** generated by the image?

no emotion ⎣______________________________________⎦ very strong emotion

9. How **quickly** was an image created?

image slow to create ⎣______________________________________⎦ image created quickly

10. How well did you get the sensation of **smell** within the image?

no smell ⎣______________________________________⎦ very clear smell

11. How **clear** was the image?

no image ⎣______________________________________⎦ perfectly clear

12. How well did you **feel the texture** of objects within the image?

no feeling ⎣______________________________________⎦ very clear feeling

Check that you have placed a cross on all 12 lines.

Appendix D

Relaxation, Familiarity, and Preference Rating Scale

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Introduction

INSTRUCTIONS: The purpose of this questionnaire is to assess the extent to which the piece of music you had heard would help you in your imagery. For our purposes, the word "arousal" means music that would make you awakening, alert, energetic, and stimulating responses; the word "relaxing" means music that would make you less tense, feel good, and smoothing to you. As you finished listening to the piece of music, rate each item by **placing a cross (X) on the line** at the point you feel best represents you. We would like you to provide an honest response to each statement. Give the response that best represents your opinion and avoid dwelling for too long on any single statement.

1) How **relaxing** or **arousing** is the music?

Relaxing ____ Arousing

2) How **familiar** or **unfamiliar** is the music?

Not familiar ____ Very familiar

3) What is your **preference** on the music?

Dislike ____ Highly preferred

- THANK YOU -

Appendix E

A Table of the 9 preselected classical music excerpts: Unfamiliar relaxing music, familiar arousing music, and unfamiliar arousing music excerpts.

Unfamiliar Relaxing Music			
	Composer	**Name**	**Time**
1	Copland	Appalachian Spring: Ballet for Martha	26.34
2	Delius	Florida Suite: III Sunset - Near the Plantation	10.10
3	Respighi	The Birds: The Dove	4.27

Familiar Arousing Music			
	Composer	**Name**	**Time**
1	Orff	Carmina Burana: O Fortuna (orchestra only)	2.40
2	Tchaikovsky	1812 Overture: Grand Finale	3.41
3	Wagner	Die Walkure: The Ride of the Valkyries	3.08

Unfamiliar Arousing Music			
	Composer	**Name**	**Time**
1	De Luca	Conquerors of the Ages: Attila the Hun	3.16
2	Mussorgsky	The Great Gate of Kiev	6.36
3	Shostakovich	Music from the Gadfly: Finale	3.48

Appendix F

Participant Information Sheet (Study 1)

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

You are invited to participate

You are invited to participate in a research project entitled Subjective and Bodily Reactions to Music during Imagery of Sports Performance.

This project is being conducted by a student researcher, Garry Kuan, as part of a PhD study at Victoria University under the supervision of Professor Tony Morris from the College of Sport and Exercise Science.

Project explanation

The aim of this study is to investigate the effects of different pieces of music on sweat on the hands, peripheral temperature, muscle tension, and heart rate, on your personal reactions during imagery of a sport task.

What will I be asked to do?

First, you will be asked to supply some information about yourself (e.g., your age, gender, sports participation, sports experiences), followed by completing three questionnaires measuring your emotions and your imagery skills. Your responses to these questionnaires will be kept completely confidential. Then, you will be asked to perform imagery of your sport, as you listen to each piece of music, while your sweat on the hands, peripheral temperature, muscle tension, and heart rate are recorded. Both imagery and music tasks will last 3 minutes, and the first task will be separated by approximately 10-minutes interval from the second task conducted, using the same procedure. When you have completed the music and imagery tasks, we will conduct a short interview to further explore your subjective experience of the music. The total duration of each session will be approximately 60-80 minutes, for three separate occasions. Confidentiality will be maintained throughout the analysis of the data and in any published findings; that is, no information that identifies you will be included in any findings or reports. Rather, all identifying information will be coded. Recordings will be saved under password protection and hard copies will be kept in a locked file cabinet. You are encouraged to ask any questions about the study at any time. Participation is voluntary and you may withdraw at any time.

What will I gain from participating?

Knowledge gained from this study will assist coaches, sport psychologists, and rehabilitators in the development of psychological skills and rehabilitation programs for athletes. Participation in imagery may beneficial to your sport performance.

How will the information I give be used?

The information gained from this study will be used to examine the effect of different types of music on bodily reactions and personal feelings during imagery of a sport task.

What are the potential risks of participating in this project?

There are some small risks associated with participation. The short interview and the questionnaires could, prompt you to recall negative emotions that could lead you to become distressed. You can withdraw permanently from the study with no reflection on you at all. However, if you still experience the negative emotions or feelings, you can consult a registered psychologist, Professor Mark Andersen, from the College of Sport and Exercise Science, Victoria University.

How will this project be conducted?

We will ensure the confidentiality of all the information you provide in completing the questionnaires. Participation in this study is voluntary. You are in no way obliged to carry through with your expression of interest in participating in this study, and you can withdraw at any time without giving a reason. If you would like to participate in this study and require more information, please do not hesitate to contact us (our details are provided below).

Thank you very much.

Who is conducting the study?

Principal Researcher:
Professor Tony Morris
Phone: 03 9919 5353
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Student Researcher:
Garry Kuan
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Prof. Mark Anderson may be contacted if you experience emotional or psychological distress as a result of your participation on (03) 9919 5413.

Any queries about your participation in this project may be directed to the Principal Researcher listed above. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781.

Appendix G

Participant Consent Form (Study 1)

CONSENT FORM
FOR PARTICIPANTS
INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS:
We would like to invite you to be a part of a study into a research project entitled Subjective and Bodily Reactions to Music during Imagery of Sports Performance. The aim of this study is to investigate the effects of different pieces of music on sweat on the hands, peripheral temperature, muscle tension, and heart rate, and your personal reactions during imagery of a sport task.

CERTIFICATION BY SUBJECT

I, (please print your name)____

of (postal address)____

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: "Subjective and Bodily Reactions to Music during Imagery of Sports Performance" being conducted at Victoria University by Professor Tony Morris and Garry Kuan.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Garry Kuan

and that I freely consent to participation involving the below mentioned procedures:

- Filling in three questionnaires, lasting around 15 minutes, on two occasions.
- Imagining doing my sport skills with nine different pieces of music.
- Having my sweat on the hands, peripheral temperature, muscle tension, and heart rate recorded during imagery with nine different pieces of music on 3 occasions.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time, and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:____

Date :____

Any queries about your participation in this project may be directed to the researcher Professor Tony Morris at 03 9919 5353. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781

Appendix H

Demographic Information Form (Study 2)

Participant Number (Office use): ______

Date: _________________

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

PARTICIPANT DEMOGRAPHIC FORM

Please answer ALL the following questions by placing a cross (X) in the appropriate box or writing in words or numbers as appropriate.

Gender : ☐ Female ☐ Male Age (in years)_______________

Highest Educational Level Completed:

☐ Less than high school ☐ High school graduate

☐ College graduate ☐ University graduate ☐ Other_____________

Current status: ☐ Full time student ☐ Part time student

Hearing ability: ☐ Poor ☐ Normal

What sport you participate in: _________________________

Years of sport participation: ___________________ (years)

Do you have previous experience in dart throwing? ☐ Yes ☐ No

If yes, how many years of dart throwing experience? ____________________ (years)

Do you currently participate at a competitive level? ☐ Yes ☐ No

Approximately, how many competitive seasons have you played?

☐ Less than 5 seasons ☐ 5-10 seasons ☐ More than 10 seasons

- THANK YOU -

Appendix I

Revised Competitive State Anxiety-2 (CSAI-2R)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INSTRUCTIONS: A number of statements that athletes have used to describe their feelings before competition are given below. Read each statement and then **tick (√)** the appropriate box to the right of each statement to indicate how you feel right now — at this moment. There is no right or wrong answers. Do not spend too much time on any one statement, but choose the answer which describes your feelings right now.

Not at all	Somewhat	Moderately so	Very much so
1	2	3	4

		1	2	3	4
1.	I feel jittery				
2.	I am concerned that I may not do as well in this competition as I could				
3.	I feel self-confident				
4.	My body feels tense				
5.	I am concerned about losing				
6.	I feel tense in my stomach				
7.	I'm confident I can meet the challenge				
8.	I am concerned about choking under pressure				
9.	My heart is racing				
10.	I'm confident about performing well				
11.	I'm concerned about performing poorly				
12.	I feel my stomach sinking				
13.	I'm confident because I mentally picture myself reaching my goal				
14.	I'm concerned that others will be disappointed with my performance				
15.	My hands are clammy				
16.	I'm confident of coming through under pressure				
17.	My body feels tight				

- THANK YOU –

Appendix J

Sample Interview Outline for Study 2 – Dart throwing

Sample imagery interview outline

We are interested to know your opinion on the 12 sessions of Imagery Training.

Part A:

- Can you describe your sporting history? How long have you been in this sport? And your best experience?
- Tell us how you feel regarding the overall of this imagery training?
- How did you feel during the imagery sessions?
- How did the imagery training affect your performance? Improvement / decrease in performance?
- How did you feel about the duration of the imagery session? Is it too long?
- How has the imagery training affected your confidence level in dart-throwing?
- Can you walk me through your thoughts during the last session of this imagery?

Part B:

- Tell us about the challenges experiences / situations that you've faced during the last of imagery training?
- Tell me about how you were able to overcome or avoid these situations?
- What different strategies did you use to overcome these barriers?
- What strategies would you recommend for future imagery training sessions?
- Finally please tell us about any issues or experiences that have been relevant for you during the last session of imagery training, that you have not mentioned previously?

\- THANK YOU -

Appendix K

Imagery script for dart throwing

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Imagery Script-Dart throwing

Please find a quiet place and sit down comfortably with your feet resting flat on the floor, knees resting comfortably, hands resting on thighs with fingers facing upward, and your eyes slowly closed as I count to 5… (1, 2, 3, 4, 5). Start by becoming more aware of your breathing and how your body feels at this moment. Remember to always inhale through your nose and exhale through your mouth, taking slow and deep breaths each time. Let any distracting thoughts enter and exit your mind freely, do not try to force any thoughts. I am going to guide you through your next breath, inhaling slowly as I count to four, hold for a count of two and finally release for a count of four. Ok, Inhale [**Count**] 1, 2, 3, 4, hold 1, 2, and release 4, 3, 2, 1. [**Repeat twice**]. Now I want you to feel good with every breath… keep breathing slowly…. in and out…

I can see you are in a positive state now. Now, I would like you to picture yourself in a room, performing a dart throwing exercise…. I can see you are at the scene. Now, slowly, I want you to enter the room; you immediately recognise the familiar smell of the room. You scan the scene, taking in the overall layout of the room and its occupants. You notice the sounds of some people throwing darts, the people around talking and cheering. You feel good and you are in a positive state. Imagine you have done a lot of preparation, so you are confident and your game becomes automatic.

You are motivated to play a good game today. Now, you imagine yourself getting ready to play the game, getting your best darts out. Can you feel the smoothness of the darts? The weight of the darts? Are you feeling positive and ready to play a good game today? Now, you are spending some time stretching and polishing the darts. You touch the dart head, wiping it with a soft towel, then sharpening the dart head with a small piece of sandpaper, you find yourself going over your routine of dart throwing in your head. This is your best training and you want to do your best performance today. You are well prepared to play this game and you are feeling mentally positive. Your concentration is focused on the performance and you know clearly what you want to do to perform well. You tell yourself, "I am capable to giving my best today. I am ready."

Now, it is your turn to play the game. Imagine yourself standing strong on the grid behind the line. You feel strong and focused. The energy is inside you, and you continue to focus on your breathing. The starter calls commandingly: "Are you ready?" You feel good, ready to play a good practice game. Your fingers, your arm, and your shoulder are well-prepared to give the best performance today. Do you feel it? You take the dart and focus on the bulls-eye. You are breathing gently and easily - well-prepared. You know clearly what is required and you can perform well because you have had lots of practice. You are confident in your performance.

Now, it is your turn to play the game. At the sound of the beep you throw the dart at the bulls-eye. Your body moves slowly and beautifully, throwing the dart, aiming towards the bulls-eye - neat, clean and streamlined. You hit the bulls-eye successfully. You aim at the bulls-eye again, and slowly throw the dart towards the bulls-eye. You hear the beautiful sound of the dart piercing the bulls-eye. You are very satisfied. You are amazed how well the coordination of your body works; it is all happening automatically. You believe you have the inner power and strength inside you. You continue the same routine, aiming towards the bulls-eye, for the third dart, fourth dart, and, finally the fifth dart. In your mind, you feel so good - as if there is a voice at the back of your head saying, "This is easy. This is how it should be." And you feel fulfilled, complete - no rush, no stress, no tension at all, only positive energy flowing over your body. You know you can do it well at your own pace. You continue to see yourself performing confidently as the music continues to play. Continue to feel the positive energy flow - you can do it [**Pause for 1 min**]. Well done, you did it. Well done, great practice today. You played well. You believe in yourself that you can do anything. Yes, indeed, you can.

Good. Now, focus again on your breathing, inhaling for a count of four, holding for a count of two and then exhaling for a count of four. This time, I would like you to say the words "well done" in your mind as you inhale and the word "Beautiful" as you exhale. Refocus your attention in your whole body and the way it feels right now. You are taking an active part in your imagery and will perform at your peak successfully each time you use this imagery in your routine. [**Pause for 10 secs**] I am going to count back from the number five, and with each step closer to the number one, I want you to become more aware of your surroundings and the noises around you. 5 [**Pause**], 4 become more alert, 3 wiggle your fingers and toes, 2 flex your arms and legs, and 1, when you are ready you can open your eyes.

You feel good. Well done. Very good training today.

Thank you for your participation in this imagery session. I hope you feel strong, with plenty of positive energy, and you believe in yourself you can do better with each practice. Please continue to perform the training to realise the optimum inner power in you. You can do it. See you in your next session. Please remember to fill in your imagery log book. See you again.

Appendix L

Logbook Imagery Sessions

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Name: ________________________

Instructions for Imagery log book

Please use this log booklet in conjunction with your imagery sessions. After having completed the imagery session, please fill in the **date**, **starting time**, and **duration of the imagery session**. The booklet also provides space to comment on the imagery experience, e.g., how strongly and vividly you experienced or how you felt while you are performing your imagery session.

	Date	Start time	End time	Comments on your imagery experience
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Signature of commitment:____________

- THANK YOU –

Appendix M

Participant Information Sheet (Study 2 – Music, imagery training, and dart performance)

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

You are invited to participate

You are invited to participate in a research project entitled Music, Imagery Training, and Darts Performance.

This project is being conducted by a student researcher, Garry Kuan, as part of a PhD study at Victoria University under the supervision of Professor Tony Morris from the College of Sport and Exercise Science.

Project explanation

The aim of this study is to investigate whether music affects the personal feelings that accompany your imagery and the performance of a dart-throwing task.

What will I be asked to do?

First, you will be asked to supply personal details (e.g., age, gender, sports participation, sports experiences), followed by completing three questionnaires measuring your emotions and your imagery skills. Your responses to these questionnaires will be kept completely confidential. Next, you will be asked to take five practice dart throws to familiarise yourself with the darts. Then, your dart performance on 40 pre-test throws will be recorded. After these throws, you will be instructed to listen to the imagery script and concentrate on the imagery, while your sweat on the hands, peripheral temperature, and heart rate are measured. You will be guided on two imagery sessions (one immediately after the first darts throwing trials, and the other during the twelfth and final session). On these two occasions, your sweat on the hands, peripheral temperature, and heart rate will be recorded. You will conduct the other ten imagery sessions at home following a log book that you will be given to help you decide when to do the imagery sessions. The imagery task will last approximately 9 minutes. Four weeks later, immediately after you have finished the 12 imagery sessions, your dart throwing skill will be measured again on 40 trials of dart throwing, preceded by five practice throws, followed by a short interview to explore your experiences during the 12 sessions of imagery training. The total duration of each session will be approximately 30 minutes. Confidentiality will be maintained throughout the analysis of the data and in any published findings; that is, no information that identifies you will be included in any findings or reports. Rather, all identifying information will be coded. Recordings will be saved under password protection and hard copies will be kept in a locked file cabinet. You are encouraged to ask any questions about the study at any time. Participation is voluntary and you may withdraw at any time.

What will I gain from participating?

Knowledge gained from this study will assist coaches, sport psychologists, and rehabilitators in the development of psychological skills and rehabilitation programs for athletes. Participation in imagery training may be beneficial to your sport performance.

How will the information I give be used?

The information gained from this study will be used to examine the effect of music during 12 sessions of imagery training on darts performance.

What are the potential risks of participating in this project?

There are some small risks associated with participation. The short interview and the questionnaires could, prompt you to recall negative emotions that could lead you to become distressed. You can withdraw permanently from the study with no reflection on you at all. However, if you still experience the negative emotions or feelings, you can consult a registered psychologist, Professor Mark Andersen, from the College of Sport and Exercise Science, Victoria University.

How will this project be conducted?

We will ensure the confidentiality of all the information you provide in completing the questionnaires. Participation in this study is voluntary. You are in no way obliged to carry through with your expression of interest in participating in this study, and you can withdraw at any time without giving a reason. If you would like to participate in this study and require more information, please do not hesitate to contact us (our details are provided below).

Thank you very much.

Who is conducting the study?

Principal Researcher:	Student Researcher:
Professor Tony Morris	Garry Kuan
Phone: 03 9919 5353	Phone: 04 33252 606
Email address:	Email address:
Tony.Morris@vu.edu.au	garry.kuan@live.vu.edu.au

Prof. Mark Anderson may be contacted if you experience emotional or psychological distress as a result of your participation on (03) 9919 5413.

Any queries about your participation in this project may be directed to the Principal Researcher listed above. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781.

Appendix N

Participant Information Sheet (Study 2 – No music, imagery training, and dart performance)

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

You are invited to participate

You are invited to participate in a research project entitled Imagery Training and Darts Performance.

This project is being conducted by a student researcher, Garry Kuan, as part of a PhD study at Victoria University under the supervision of Professor Tony Morris from the College of Sport and Exercise Science.

Project explanation

The aim of this study is to investigate whether imagery training affects the performance of a dart-throwing task.

What will I be asked to do?

First, you will be asked to supply personal details (e.g., age, gender, sports participation, sports experiences), followed by completing three questionnaires measuring your emotions and your imagery skills. Your responses to these questionnaires will be kept completely confidential. Next, you will be asked to take five practice dart throws to familiarise yourself with the darts. Then, your dart performance on 40 pre-test throws will be recorded. After these throws, you will be instructed to listen to the imagery script with music and concentrate on the imagery, while your sweat on the hands, peripheral temperature, and heart rate are measured. You will be guided on two imagery sessions (one immediately after the first darts throwing trials, and the other during the twelfth and final session). On these two occasions, your sweat on the hands, peripheral temperature, and heart rate will be recorded. You will conduct the other ten imagery sessions at home following a log book that you will be given to help you decide when to do the imagery sessions. The imagery task with music will last approximately 9 minutes. Four weeks later, immediately after you have finished the 12 imagery sessions, your dart throwing skill will be measured again on 40 trials of dart throwing, preceded by five practice throws, followed by a short interview to explore your experiences during the 12 sessions of imagery training with music. The total duration of each session will be approximately 30 minutes. Confidentiality will be maintained throughout the analysis of the data and in any published findings; that is, no information that identifies you will be included in any findings or reports. Rather, all identifying information will be coded. Recordings will be saved under password protection and hard copies will be kept in a locked file cabinet. You are encouraged to ask any questions about the study at any time. Participation is voluntary and you may withdraw at any time.

What will I gain from participating?

Knowledge gained from this study will assist coaches, sport psychologists, and rehabilitators in the development of psychological skills and rehabilitation programs for athletes. Participation in imagery training may be beneficial to your sport performance.

How will the information I give be used?

The information gained from this study will be used to examine the effect of 12 sessions of imagery training with music on darts performance.

What are the potential risks of participating in this project?

There are some small risks associated with participation. The short interview and the questionnaires could, prompt you to recall negative emotions that could lead you to become distressed. You can withdraw permanently from the study with no reflection on you at all. However, if you still experience the negative emotions or feelings, you can consult a registered psychologist, Professor Mark Andersen, from the College of Sport and Exercise Science, Victoria University.

How will this project be conducted?

We will ensure the confidentiality of all the information you provide in completing the questionnaires. Participation in this study is voluntary. You are in no way obliged to carry through with your expression of interest in participating in this study, and you can withdraw at any time without giving a reason. If you would like to participate in this study and require more information, please do not hesitate to contact us (our details are provided below).

Thank you very much.

Who is conducting the study?

Principal Researcher:
Professor Tony Morris
Phone: 03 9919 5353
Email address:
Tony.Morris@vu.edu.au

Student Researcher:
Garry Kuan
Phone: 04 33252 606
Email address:
garry.kuan@live.vu.edu.au

Prof. Mark Anderson may be contacted if you experience emotional or psychological distress as a result of your participation on (03) 9919 5413.

Any queries about your participation in this project may be directed to the Principal Researcher listed above.
If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781.

Appendix O

Participant Consent Form (Study 2 – Music, imagery training, and dart performace)

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS:
We would like to invite you to be a part of a study into a research project entitled Music, Imagery Training, and Darts Performance. The aim of this study is to investigate whether music affects the personal feelings you have while doing imagery and the performance of a dart throwing task.

CERTIFICATION BY SUBJECT

I, (please print your name)____

of (postal address)____

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: "Music, Imagery Training, and Darts Performance" being conducted at Victoria University by Professor Tony Morris and Garry Kuan.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Garry Kuan

and that I freely consent to participation involving the below mentioned procedures:

- Participating in 12 sessions of imagery training.
- Filling in the questionnaires of Revised Competitive State Anxiety Inventory – 2 (CSAI-2R) and Sport Imagery Ability Measure (SIAM).
- Having my sweat on the hands, peripheral temperature, and heart rate recorded during imagery.
- Performing dart throwing before and after participation in imagery training.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time, and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:____

Date :____

Any queries about your participation in this project may be directed to the researcher Professor Tony Morris at 03 9919 5353. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781

Appendix P

Participant Consent Form (Study 2 – No music, imagery training and dart performance)

CONSENT FORM
FOR PARTICIPANTS
INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS:
We would like to invite you to be a part of a study into a research project entitled Imagery Training and Darts Performance. The aim of this study is to investigate whether music affects the personal feelings you have while doing imagery and the performance of a dart throwing task.

CERTIFICATION BY SUBJECT

I, (please print your name)____

of (postal address)____

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: "Imagery Training and Darts Performance" being conducted at Victoria University by Professor Tony Morris and Garry Kuan.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Garry Kuan

and that I freely consent to participation involving the below mentioned procedures:

- Participating in 12 sessions of imagery training.
- Filling in the questionnaires of Revised Competitive State Anxiety Inventory – 2 (CSAI-2R) and Sport Imagery Ability Measure (SIAM).
- Having my sweat on the hands, peripheral temperature, and heart rate recorded during imagery.
- Performing dart throwing before and after participation in imagery training.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time, and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:____

Date :____

Any queries about your participation in this project may be directed to the researcher Professor Tony Morris at 03 9919 5353. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781

Appendix Q

Demographic Information Form (Study 3)

Participant Number (Office use): ______

Date: _________________

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

PARTICIPANT DEMOGRAPHIC FORM

Please answer ALL the following questions by placing a cross (X) in the appropriate box or writing in words or numbers as appropriate.

Gender : ☐ Female ☐ Male Age (in years)_______________

Highest Educational Level Completed:

☐ Less than high school ☐ High school graduate

☐ College graduate ☐ University graduate ☐ Other_____________

Status: ☐ Unemployed ☐ Employed

Occupation: ______________________________

Hearing ability: ☐ Poor ☐ Normal

What sport you participate in: _________________________

Years of sport participation: ___________________ (years)

Do you currently participate at a competitive level? ☐ Yes ☐ No

Approximately, how many competitive seasons have you played?

☐ Less than 5 seasons ☐ 5-10 seasons ☐ More than 10 seasons

The most recent competition you participated? _________________________________

The best performance scoring you completed in your sport? _______________________

- THANK YOU –

Appendix R

Sample Interview Outline for Study 3

Sample imagery interview outline (Study 3)

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

I'm interested to know your opinion on the effectiveness of 12 sessions of imagery training… First, can you describe to me your sporting history? How long have you been weightlifting / shooting?

Tell me how you feel regarding the imagery training…

How did you feel during the imagery sessions?
How did the imagery training affect your performance?
How did you feel about the duration of the imagery session?
How has the imagery training affected your confidence level in your sport?
Can you walk me through your thoughts during Session 12?

Tell me about the music used during the imagery training…

How did you feel when the music was played?
What were your thoughts when the music was played?
What do you think about using music during imagery training?
What are the advantages / disadvantages of using music in relation to your experiences?

Tell me about the challenging experiences / situations that you've faced during the 12 sessions of imagery training…Tell me about how you were able to overcome or avoid these situations?

What different strategies did you use to overcome these barriers?
What strategies would you recommend for future imagery training sessions? Why?

Tell me about any issues or experiences that have been relevant for you during the 12 sessions of imagery training, that we haven't mentioned previously?

\- THANK YOU -

Appendix S

Imagery script for pistol shooting

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Imagery Script-Pistol Shooting

Introduction:

Thank you for volunteering to be involved in this training program using mental imagery with music - instead of the usual physical training - to rehearse your shooting skills.

This is a research project, so it is important that you apply all that is asked of you in these recorded instructions for doing imagery of shooting, and to fill out the imagery logbook that has been provided for you.

You are asked to listen to this recording every second day at a time and place that is convenient for you where you can be in a comfortable position to follow the script and listen to the music as you imagine the scene. Imagery is an exciting method of training, which you may have used in the past or you might not have used at all. Music has been shown to have a beneficial effect on sport performance. Imagery involves you actually thinking about your shooting skills mentally, and perceiving yourself actually performing in real situations, using all the senses to play out situations in your mind. Physical situations may arise, especially under pressure, which you cannot apply in the training context. Perhaps imagining, in your mind, situations, especially pressure situations that may arise in games, will give you the mental skills to perform your physical skills at your best when you need to perform in high pressure competition. That is the objective of this imagery project.

You will be asked to listen to the recording using an MP3 for approximately 9 minutes every second day. On the recording, there will be some instructions which you will apply in a relaxed manner to imagine yourself in that situation, using all your senses. At the completion of the recording, you will just stop the MP3 player, so that the next session, you will continue to listen to the recording.

The recording will commence whenever you press the on button on the player, and at the conclusion of the recording the statement will be "You have completed this session, please fill in the sheet in your booklet and make sure you put both the recording and the booklet away, so it will be readily available the next day." The researcher will contact you at regular intervals, to ensure that you are able to follow the instructions. It is important for you to be honest in logging your imagery rehearsal sessions in your booklet provided. If it so happens for some particular reason that you miss a session, please don't just fill in the log book for the sake of doing it, rather kindly acknowledge in the log book that you have missed out on that particular session.

When you are ready, we will begin our imagery and music session.

Imagery Rehearsal Script-Shooting Performance

Welcome to the imagery rehearsal training. Please listen and follow my instructions as I help you to imagine yourself performing your pistol shooting in a competition as the music plays. When you imagine, see yourself inside your own body, as if you are there and experiencing it from your own eyes. [**Pause for 5 secs**]

Now, I would like you to picture yourself having just arrived at the entrance of the competition venue. You feel happy and positive, preparing for the upcoming important competition here, where you usually practise and compete. As usual, you walk slowly towards your shooting bay. You greet your colleagues and your coach. You feel happy and positive because you know that you have an advantage today, competing where you have always trained. Slowly, you move inside the shooting range, feeling relaxed and calm while you look around and tune in to the familiar place. You can see that all the shooting lanes have been perfectly set up and are ready for the competition. You sense and recognise the smell of the shooting area. You move out into the shooting warm-up area and loosen up. You feel happy and good. You tell yourself that I am in a positive state today, and I am capable of performing my personal best. Your concentration is focused on your performance and you know clearly what you need to do to perform well. You believe in yourself and your ability to create a good performance today. You ask someone to pin your competition number on your back.

Slowly, you bring out all your equipment and place it in your shooting lane. You are fully focused and relaxed, knowing that you are prepared to perform well because you had lots of practice and you are very skilful. You are confident in your performance today. You pick up your air-pistol, checking the air-pistol’s mechanism and feeling the balance of your air-pistol. Are you able to feel the balance, the weight of the pistol, see the colour of the pistol? Are you feeling relaxed and good? You are maintaining a strong focus. Then, you check the grip on your pistol, to ensure that your head positions are aligned naturally [**Pause for 5 secs**]. You feel the grip is good and comfortable. You place your pistol carefully into the shooting hand, using the non-shooting hand. You feel your pistol belongs to you and you are satisfied with all the adjustments. You are confident that your air-pistol will function well and you will be achieving your best performance today. You know that you have the skill to help you perform well today. You feel relaxed, focused, positive, and confident. You are now in a positive mental state and you remind yourself – I am capable of shooting a good score today. I am ready. This is my day, and I will perform today. Just do it. You feel confident.

Now, you measure and assume a good stance by checking if you are well-aligned with the correct target in front of you. You adjust until you feel satisfied. Take one or two comfortable deep breaths. You are ready to shoot, feeling that you will give your best performance today. The target is only 10 metres away; you press the button and bring the target up in front of you. You concentrate on the sights and say to yourself that you want to get consistent performance today. You feel confident and ready now.

You wait until the Range Officer calls “start”, and you are ready to begin the 60 shots. You take two long deep breaths, and then slowly you extend your arm and pick up a good focus on the sights. After that, you extend your natural respiratory pause whilst settling into the aiming area. You load the pistol slowly. You are relaxed, feeling the positive energy, and get into the flow of your normal practice mode. You look straight and begin the initial trigger pressure. You can feel that you are maintaining a good sight alignment and you are ready to make an accurate shot. Take another long deep breath, and begin to increase positive pressure on the trigger. Then, continue having full concentration on the sight alignment. You continue putting more pressure on the trigger and constantly align your sights. You produced a perfect shot, and you continue to have a straight sight through. Your first shot is good. You are very satisfied and happy, knowing that you can perform the same routine again and again to achieve your best today. You analyse your shot and get ready to perform a similar movement and shot.

You continue the same routine, slowly loading your pistol, maintaining your focus, then take a long deep breath. Again you follow the same routine, increasing the pressure on the trigger, and follow through on the trigger. You produce another great shot. You are confident you can repeat the same shot and achieve the same results on a consistent basis today. You focus and refocus on each shot, being confident and maintaining the positive energy flow on your palm. And now you perform another shot [**Pause for 3 secs**]. Great performance. Continue this same routine at your own pace and time, concentrating on each shot with consistent positive energy flow until you finish your 60 shots as the music continues. [**Pause for 5 secs**] You maintain positive energy, knowing that each successful shot leads you closer to becoming the best shooter. You are immersed in your performance today. Well done. Many of your shots found the centre successfully. [**Pause for 1 min**].

Now, you have finished all 60 shots at the target. You did well and you are satisfied with your performance today. You feel great. You are pleased with how well the coordination of your body works. It all happened automatically. Positive thoughts fill your mind and you are confident in your ability to perform again. You know you have the inner power and confidence inside you, the positive energy flow on your palm and fingers. In your mind you feel great, as if there is a voice at the back of your head saying "You can do it" You did well.

Good. Now, focus again on your breathing. Inhaling for a count of 4, holding for a count of 2, and then exhaling for a count of 4. Refocus your attention in your whole body and the way it feels right now. You have taken an active part in your imagery and will perform at your best each time you use this imagery. Now, I am going to count back from the number 5, and with each step closer to the number 1, I want you to become more aware of your surroundings and the noises around you. 5 [**Pause for 4 sec**],…4…become more alert…, 3…wiggle your fingers and toes…, …2 …flex your arms and legs…, and 1, when you are ready you can open your eyes and feel confident and refreshed.

You feel good. Very good imagery training today.

Thank you for your participation in this imagery session. I hope you feel confident and you believe in yourself. Please continue to perform the training to continue developing your shooting skill performance. You can do it.

You have completed this session, please fill in your imagery logbook and make sure you put both the recording and the booklet away, so it will be readily available in the next session. See you again.

Appendix T

Imagery script for weightlifting

Imagery Script-Weightlifting

Introduction:

Thank you for volunteering to be involved in this training program using mental imagery with music instead of the usual physical training to rehearse your weightlifting skills.

This is a research project, so it is important that you apply all that is asked of you from listening to these recorded instructions for doing imagery of weightlifting, and to fill out the imagery logbook that has been provided for you.

You are asked to listen to this recording every second day at a time and place that is convenient for you where you can be in a comfortable position to follow the script and listen to the music as you imagine the scene. Imagery is an exciting new method of training, which you may have used in the past or you might not have used it at all. Music has been shown to have a beneficial effect on sport performance. Imagery involves you actually thinking about your weightlifting skills, and perceiving yourself actually performing in real situations, using all the senses to play out situations in your mind. Physical situations may arise, especially under pressure, which you cannot apply in the training context. Perhaps imagining, situations, especially pressure situations that may arise in games, will give you the mental skills to perform your physical skills at your best when you need to perform in high pressure competition. That is the objective of this imagery project.

You will be asked to listen to the recording using an MP3 player for approximately 9 minutes every second day. On the recording, there will be some instructions which you will apply in a relaxed manner to imagine yourself in that situation, using all your senses. Upon completion of the recording, you will just stop the MP3 player, and in the next session you will continue to listen to the recording.

The recording will commence whenever you press the on button on the player, and at the conclusion of the recording the statement will be “You have completed this session. Please fill in the sheet in your booklet and make sure you put both the recording and the booklet away, so it will be readily available next time.” The researcher will contact you at regular intervals, to ensure that you are able to follow the instructions. It is important for you to be honest in logging your imagery rehearsal sessions in your booklet provided. If it so happens for some particular reason that you miss a session, please don’t just fill in the log book for the sake of doing it, rather kindly acknowledge in the log book that you have missed out on that particular session.

When you ready, we will begin our imagery and music session.

Imagery Rehearsal Script-Competitive Weightlifting performance

Welcome to the imagery rehearsal training. Please listen and follow my instructions as I help you to imagine yourself performing your weightlifting skill – "Clean and jerk" in a competition environment as the music plays. When you imagine, see yourself inside your own body, as if you are there and experiencing it from your own eyes. [**Pause for 5 secs**]

Now, I would like you to picture yourself having just arrived at the entrance of the competition venue, you feel happy and positive, preparing for the upcoming important competition here, where you usually practise and compete. As usual, you walk slowly to the weighting room, and weight in. You greet your colleagues and your coach. You feel happy and positive today because you know that you have an advantage, competing where you have always trained. Slowly, you move inside the changing room, feeling relaxed and calm while you look around and tune in to the familiar place. You feel good and happy. You tell yourself, "I am in a positive state today, and I am capable of performing my personal best." Your concentration is focused on your performance and you know clearly what you need to do to perform well. You believe in yourself and your ability to create a good performance today. You prepare your lifting gear and are ready to perform.

You can see the competition platform has been perfectly set up and is ready for the competition. You sense and recognise the smell of the platform and you can see yourself as a strong competitor and fully prepared today. You move out into the warm-up area and loosen up. You are fully focused and relaxed, knowing that you are prepared to perform well because you had lots of practice and you are very skilful. You are confident in your performance today. You are psyched up to perform your best overall lifts today. You are in a positive mental state, and you tell yourself, "I am capable of achieving my personal best result today. I am ready". You feel relaxed, positive, and confident.

Now, you are fully psyched up and warmed up, preparing to make your first attempt in this competition. You wait until your name is called. You take one or two comfortable deep breaths. You then hear your name has been called. You walk slowly to the platform, chalk up, feeling psyched up, and you tell yourself "I can do it". You are now in a positive mental state…. Up on the platform, you see the bar on the floor, you are pumped up and you want to lift it. You measure your hand on the bar to find a comfortable position, having your feet at hip-width apart, getting ready and feeling strong, you take a deep strong breath.

Feeling ready, powerful and explosive, you grab the bar, squatting down, and putting your stomach between the legs. You take a deep strong breath, and you are ready to lift the weight. When you are ready, you then pull it as high as you can and drive under it with a huge shout. You then stand with the bar on your shoulders. Then, you see yourself standing up strong, and prepare to do the second half of the lift. You feel confident. In an instant, you push the bar overhead and straighten your arms with your full explosive power. You use your powerful legs to help to push it upward. You are happy and excited to lift the weights and are now waiting for the referee to signal to lower the bar. The signal sounds, and you feel satisfied; you have successfully done a great lift. You are in a positive state as you performed well. You come down from the stage and mentally prepare for your next lift. You are very satisfied and happy, knowing that you can perform the same routine again to achieve a good result.

You continue the same routine as you attempt the next two attempt lifts. You tune in to a relaxing and powerful flow, knowing that each successful lift leads you closer to becoming a better weightlifter. You focus and refocus, being confident and maintaining the positive energy flow on your palm. Now, you continue in the same routine at your own pace and time, maintaining the positive energy. You are immersed in your performance today. [**Pause for 1 min**] You again did very well in the next two attempts and you did a good lift on the final third attempt. You are very satisfied with your performance today. You feel great. You achieved your personal best lift and you are pleased with how well the coordination of your body worked. It all happened automatically. The positive thoughts fill your mind and you are confident in your performance. You believe that you can do it again. You know you have the inner power and confidence inside you. In your mind you feel good, as if there is a voice at the back of your head saying, “You can do it”. You did well.

Good. Now, focus again on your breathing, inhaling for a count of 4, holding for a count of 2, and then exhaling for a count of 4. Refocus your attention in your whole body and the way it feels right now. You have taken an active part in your imagery and will perform at your best each time you use this imagery. Now, I am going to count back from the number 5, and with each step closer to the number 1, I want you to become more aware of your surroundings and the noises around you: 5[**Pause for 4 secs**],…4…become more alert…, 3…wiggle your fingers and toes,…2…flex your arms and legs…, and 1. When you are ready you can open your eyes and feel confident and refreshed.

You feel good. Very good imagery training today.

Thank you for your participation in this imagery session. I hope you feel confident and you believe in yourself. Please continue to perform the training to continue developing your weightlifting skills performance. You can do it.

You have completed this session, please fill in your imagery logbook and make sure you put both the recording and the booklet away, so it will be readily available next time. See you again.

Appendix U

Participant Information Sheet (Study 3)

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

You are invited to participate

You are invited to participate in a research project entitled Music, Imagery Training, and Sports Performance.

This project is being conducted by a student researcher, Garry Kuan, as part of a PhD study at Victoria University under the supervision of Professor Tony Morris from the College of Sport and Exercise Science.

Project explanation

The aim of this study is to investigate the personal feelings you experience while listening to music during imagery training for a weightlifting task. We are interested in your experiences as you imagine your sport task with music. To study these feelings in detail we would like you to participate in a semi-structured interview lasting approximately 15 minutes. We expect that the general results of this project will assist in the development of programs that use music with imagery training that suits the specific task.

What will I be asked to do?

After you have finished the 12 imagery sessions in Study 3A, you will be requested to talk about your subjective experiences during participation in the imagery sessions with music. Your responses to these questions will be kept completely confidential. You will be asked to reflect on your experiences during the imagery process and to make any observations about how this appeared to you to affect your performance. The interview will last approximately 30 minutes and will be digitally recorded and typed word for word into a written transcript. Confidentiality will be maintained throughout the analysis of the data and in any published findings, that is, no information that identifies you, will be included in any findings or reports. Rather, your identity will be replaced by a code and any other identifying words or phrases will be removed or de-identified. Recordings will be saved under password protection and hard copies will be kept in a locked file cabinet. You are encouraged to ask any questions about the study at any time. Participation is voluntary and you may withdraw at any time.

What will I gain from participating?

Knowledge gained from this study will assist coaches, sport psychologists, and rehabilitators in the development of psychological skills and rehabilitation programs for athletes. Participation in imagery training may be beneficial to your sport performance.

How will the information I give be used?

The information gained from this study will be used to examine the personal feelings experienced while listening to music during imagery training on the sport task.

What are the potential risks of participating in this project?

There are some small risks associated with participation. You might think of bad experiences associated with the music and imagery program or the performance associated with it. If this happens you can take a break from the interview. If you wish you can withdraw permanently from the study with no reflection on you at all. However, if you still experience the negative emotions or feelings, you can consult a registered psychologist, Professor Mark Andersen, from the College of Sport and Exercise Science, Victoria University.

How will this project be conducted?

We will ensure the confidentiality of all the information you provide in completing the questionnaires. Participation in this study is voluntary. You are in no way obliged to carry through with your expression of interest in participating in this study or you can withdraw at any time without giving a reason.

Thank you very much.

Who is conducting the study?

Principal Researcher:	Student Researcher:
Professor Tony Morris	Garry Kuan
Phone: 03 9919 5353	Phone: 04 33252 606
Email address:	Email address:
Tony.Morris@vu.edu.au	garry.kuan@live.vu.edu.au

Prof. Mark Anderson may be contacted if you experience emotional or psychological distress as a result of your participation on (03) 9919 5413.

Any queries about your participation in this project may be directed to the Principal Researcher listed above. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781.

Appendix V

Participant Consent Form (Study 3)

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

INFORMATION TO PARTICIPANTS:
We would like to invite you to be a part of a study into a research project entitled Music, Imagery Training, and Sports Performance. The aim of this study is to investigate the effects of music during imagery training on subsequent performance of your sport skills, and the way you feel about the music that is played during imagery training.

CERTIFICATION BY SUBJECT

I, (please print your name)____

of (postal address)____

certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study:“Music, Imagery Training, and Sports Performance” being conducted at Victoria University by Professor Tony Morris and Garry Kuan.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed hereunder to be carried out in the research, have been fully explained to me by:

Garry Kuan

and that I freely consent to participation involving the below mentioned procedures:

- Participating in 12 sessions of imagery training.
- Filling in the questionnaires of Revised Competitive State Anxiety Inventory – 2 (CSAI-2R) and Sport Imagery Ability Measure (SIAM).
- Having my sweat on the hands, peripheral temperature, and heart rate recorded during imagery.
- Performing dart throwing before and after participation in imagery training.

I certify that I have had the opportunity to have any questions answered and that I understand that I can withdraw from this study at any time, and that this withdrawal will not jeopardise me in any way.

I have been informed that the information I provide will be kept confidential.

Signed:____

Date :____

Any queries about your participation in this project may be directed to the researcher Professor Tony Morris at 03 9919 5353. If you have any queries or complaints about the way you have been treated, you may contact the Secretary, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4781