# THE EFFECTS OF DIFFERENT TYPES OF IMAGERY DELIVERY ON PERFORMANCE AND SELF-EFFICACY

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## ABSTRACT

The main objective of this thesis is to identify the most effective way of delivering imagery to athletes. Researchers have proposed that imagery effectiveness is affected by a number of factors, including the method used to deliver imagery. One type of imagery delivery, referred to as routine imagery (RI) in this thesis, has been used in many studies and applied settings (for a review, see Cooley, Williams, Burns, & Cumming, 2013) where the same scenario was imagined without any changes throughout the intervention period. Another method recently used in the literature, which is called progressive imagery (PI) in this thesis, is to implement various elements of imagery in a progressive way (Wakefield & Smith, 2012). In other words, in PI we start the imagery training programs with simple images, few objects, and little action, then create more complex situations by adding information in steps. Another alternative training method introduced in this thesis is retrogressive imagery (RETI), in which the process of PI is reversed.

In Study 1 and 2, I examined these imagery delivery methods with 60 limited-ability players (aged 18-37 years) and 49 highly-skilled players (aged 18 -37 years) respectively. Prior to the intervention, imagery ability of participants was screened using the Sport Imagery Ability Measure to ensure they all possessed at least moderate ability. Eligible participants were assigned randomly to 4 conditions: PI, RI, RETI, or control (C). Imagery condition participants were assigned to 12 sessions (three times a week for four weeks), followed by completion of the imagery manipulation check. Regardless of their condition, FT performance of all participants was measured before the intervention phase and after every three imagery sessions. The FT test contained two sets of 10 FT shots with a 15-minute rest between the two trials. FT self-efficacy (FTSE) of all participants was tested before the intervention phase, at the end of the second week and on the last day of the intervention phase using a scale I developed based on Bandura's (1977) microanalytic technique.

Two-way mixed-design ANOVA and Tukey post hoc tests of Study 1 data revealed that participants in the RETI condition improved in their performance significantly more than PI and C participants. Participants in the RETI condition recorded significantly higher self-efficacy than those in the C. Analysis of Study 2 showed that PI participants improved significantly more than participants in the RETI and C conditions. Participants in the PI condition recorded a significantly larger gain in FTSE than those in the RETI and C conditions.

In Study 3, I investigated the effects of the PI training method on FT performance of highly-skilled basketball players in competition, based on the results from Study 2. Five male basketball players participated in an ABCD single-case study design throughout a competition season. The FT percentage of all participants in all of their games was recorded at baseline phase (A) and intervention phases (B, C, D). Visual inspection and split middle technique analysis of individual graphs indicated improvement in performance of all five players after the PI intervention compared to their baseline phase. I employed inductive content analysis to analyze the social validation questionnaire. In general, participants stated that they were able to identify the positive effects of PI on their FT shooting percentage in matches. The findings of three studies in the current thesis indicate that the most effective way to deliver imagery depends on the level of skill development in athletes. It is recommended that further research is conducted to refine the relationship between delivery method and skill level.

**STUDENT DECLARATION**

I, Fatemeh Fazel, declare that the PhD thesis entitled "The Effects of Different Types of Imagery Delivery on Performance and Self-efficacy" is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, 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.

Signature: [redacted] Date: 30-09-2014

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# GLOSSARY OF ACRONYMS

Abreviation – Explanation

CC - Control Condition

CG - CognitiveG

CLT - Cognitive Load Theory

CS - Cognitive Specific

EMG - Electromyography

FMRI - Functional Magnetic Resonance Imaging

FT - Free Throw

FTSE - Free Throw Self-efficacy

GST - Gain Score Time

LSRT - layered Stimulus and Response Training

M - Mean

MG - Motivation General

MG-A - Motivational General Arousal

MG-M - Motivational General Mastery

MI - Motor Imagery

MS - Motivation Specific

MSAC - Melbourne Sport and Aquatic Centre

NBA - National Basketball League

NBL - National Basketball League

PETTLEP - Physical, Environmental, Task, Timing, Learning, Emotional, and Perspective

PI - Progressive Imagery

RETI - Retrogressive Imagery

RI - Routine Imagery

SCL - Victoria State Championship League

SD - Standard Deviation

SEABL - South East Australian Basketball League

SIAM - Sport Imagery Ability Measure

SIQ - Sport Imagery Questionnaire

SPI - Self Progressive Imagery

SRETI - Self Retrogressive Imagery

USOC - U.S Olympic Committee

VUHREC - Victoria University Human Research Ethics Committee

# CHAPTER 1

## INTRODUCTION

Athletes, especially those competing at high levels, have indicated that their involvement in sport is both physically and mentally demanding, and the acquisition of performance skills alone is insufficient for them to advance in their respective sports. Important attributes that can discriminate champion or world record holding athletes from other elite athletes include their psychological characteristics and mental skills. One of the prevalent mental techniques, and essential pre-requisites of outstanding performance in the domain of sport, is imagery. Weinberg (2008) described imagery as the ability to use all the senses in order to recreate an experience in the mind.

Many well-known athletes such as Lebron James and Tiger Woods use this acquired mental skill to take their game to the next level. It is now accepted by many sport psychologists who have studied imagery that sport imagery not only facilitates the performance of sport tasks (Morris, Spittle, & Watt, 2005; Munroe-Chandler, Hall, Fishburne, & Strachan, 2007b; Weinberg & Gould, 2011) but also has a positive effect on psychological variables associated with successful athletic performance, such as by increasing self-efficacy, confidence, motivation, and reducing competitive sport anxiety (Callow & Hardy, 2004; Hall, Singer, Hausenblas, & Janelle, 2001; Munroe-Chandler, Hall, & Fishburne, 2008). Athletes at all levels of competition use imagery as a fundamental mental training technique, more frequently than other psychological skills (Jedlic, Hall, Munroe-Chandler, & Hall, 2007; Munroe-Chandler et al., 2007; Thelwell, Greenlees, & Weston, 2006).

Imagery has received substantial attention by researchers in sport psychology (Munroe-Chandler & Morris, 2011) and its effectiveness is studied and approved in a variety of sports such as high jump (Olsson, Jonsson, & Nyberg, 2008), gymnastics (Smith, Wright, Allsopp, & Westhead, 2007), golf (Brouziyne & Molinaro, 2005; Smith, Wright, & Cantwell, 2008), and basketball (Post, Wrisberg, & Mullins, 2010). Applied sport psychology practitioners and coaches attempt to enhance the effectiveness of imagery by guiding athletes about the most effective way to use imagery in training and competition. Studies with designs, including experimental designs, single-subject designs, descriptive studies, and qualitative semi-structured interviewing, have been conducted to better understand this phenomenon (see a review by Weinberg, 2008). Moreover, frameworks and imagery models have been developed to facilitate and operationalize the benefits of imagery interventions. One of the main aims of previous research using these approaches has been to determine variables affecting imagery use and its effectiveness to gain the optimal benefit from imagery interventions.

Holmes and Collins' PETTLEP model of imagery (2001), based on findings generated within the neurosciences, includes seven elements that should be taken into consideration when implementing imagery interventions to optimize their effectiveness. Recently, the efficacy of this model has been supported in various sports, including long jump (Potter, Devonport, & Lane, 2005), golf (Smith et al., 2008), and strength tasks (Wakefield & Smith, 2011; Wright & Smith, 2009). Researchers have suggested that neglecting certain elements may affect performance facilitation (Ramsey, Cumming, Edwards, Williams, & Brunning, 2010). A more recent imagery model introduced by Guillot and Collet (2008) was the Motor Imagery Integrative Model in Sport (MIIMS). They underlined 11 key components, which need to be controlled by athletes to ensure the effectiveness of motor imagery including duration and number of trials, individual characteristics, imagery ability of individuals, and positive/negative MI.

When developing an imagery training program, sequentially, it is important to ask athletes to generate positive images and then, recreate all the senses like sounds and smells that a person may hear or feel during a real scene (Weinberg & Gould, 2011). It is suggested in the PETTLEP model that all seven elements should be included in imagery interventions to maximize imagery effectiveness for performance (Holmes & Collins, 2001). Although ignoring certain elements may impact performance facilitation (Ramsey et al., 2010), introducing all seven components of the PETTLEP model at one time may be impractical and create overload for athletes (Wakefield & Smith, 2012), particularly for those who are new to imagery interventions. Therefore, the question of how athletes should include these components within an imagery traning program remains unanswered.

The main proposition of the present thesis is that for imagery training to be more effective, trainers should utilize a gradual progressive imagery (PI) program, rather than an unchanging scenario, which could be termed routine imagery (RI), through the whole program. PI means starting imagery training programs with sessions of relatively simple imagery consisting of few objects and little action, then progressively creating situations in which athletes imagine more difficult or complex and dynamic situations than imagined in previous sessions in order to acquire additional insight into effectiveness of imagery. This proposition will also give athletes a formal instruction to use relevant images at the appropriate time and optimum situations to produce the desired effect. The current thesis was designed in three studies to examine whether implementing an imagery training program specifically designed for the purposes of this study affect free throw performance and free throw self-efficacy among limited-skill and highly-skilled Australian basketball players. In addition, to determine which skill-level players benefit more from which imagery training program, the present thesis comprised two studies with different level basketball players and a third study to examine the effect of the superior imagery delivery method in the competition context.

Imagery interventions have also led to increased self confidence and self-efficacy (e.g. Jones, Mace, Bray, MacRae & Stockbridge, 2002; Nordin & Cumming, 2005; Short et al., 2002). Bandura (1986, 1997) has argued that imaginal experiences are a source of self-efficacy. He stated that "Seeing or visualizing other similar people perform successfully can raise self-percepts in observers that they too possess the capabilities to master comparable activities" (1986, p. 399). People can generate efficacy beliefs by imagining themselves or others behaving successfully in anticipated performance situations. Bandura (1997) referred to this as cognitive self-modeling (or cognitive enactment) and described it as a form of modeling influence. Imaging somebody else performing a skill perfectly refers to the self-efficacy source of vicarious experience. It is plausible that imaging oneself performing a skill perfectly could also provide past performance information (a sense of having done it perfectly before), which is an even stronger source of self-efficacy if the image has actually been experienced (i.e., drawn from a past memory of a real performance). For example, imagining oneself winning against an opponent has been shown to increase self-efficacy and endurance performance (Feltz & Riessinger, 1990). This point has been argued previously by several authors (e.g., Abma, Fry, Li, & Relyea, 2002; Callow & Hardy, 2001; Feltz, 1984; Martin & Hall, 1995; McKenzie & Howe, 1997; Moritz et al., 1996; Short et al., 2002), and findings from studies employing qualitative as well as quantitative research designs suggest that imagery may influence self-efficacy (Calmels et al., 2003; Calmels & Fournier, 2001; Garza & Feltz, 1998; Mamassis & Doganis, 2004; McKenzie & Howe, 1997; Nordin & Cumming, 2005; Short et al., 2002; White & Hardy, 1998).Therefore, self-efficacy was measured in this study to examine the effects of imagery interventions on participants' perception of their performance.

Several of the important practical guidelines (e.g., how to implement load into the imagery training and what should be or should not be included) will be utilized in the research to assist imagery users to make the best out of their practice and substantiate research pathways. The findings should provide practitioners, sport professionals and researchers with a better understanding of athletes' imagery use and the challenges of designing and implementing a program, and further the current research knowledge base on the development of imagery programs.

# CHAPTER 2

# REVIEW OF LITERATURE

In this chapter, I provide an overview of the literature pertaining to imagery, including definitions of imagery, theories of imagery, applied models, and the various uses of imagery that have been well-documented in the literature. In addition, I review research examining the efficacy of mental imagery interventions within sports performance with an emphasis on factors that affecting imagery and imagery delivery methods. In the chapter, I aim to underline the significance of implementing the most appropriate imagery training method.

## Definition of Imagery

People use imagery in their daily life for all sorts of activities with most of them not aware of this valuable mental technique. Imagery is a process that can be intentional or unintentional, which involves experiencing of movements by sights, sounds, smells and tastes, although the real sensations are not actually present. For example, individuals who are invited to a job interview might imagine being in the interview room before it happens, triggered only by thinking that they have an interview appointment. Sometimes individuals use imagery as a way of solving problems. For example, people who are trying to find a shortcut to a certain destination might plan the route in their mind. Athletes are no exception to this type of engagement in the imagery experience. They use imagery commonly, regardless of their level of expertise in their sport. They retrieve images of their past competition and how they performed, and even imagine an upcoming game. They use imagery in ways that can typically assist them, but occasionally their imagery can hinder them. As a consequence, sport psychologists regularly incorporate imagery as key part of their psychological training programs (Morris et al., 2005). Although psychologists recognize the importance of imagery for athletes, defining imagery is not simple because imagery is an unobservable mental process.

There is a broad variety of imagery definitions in both the general and sport psychology literature (Denis, 1985; Matlin, 1989; Moran, 1993; Murphy, 1994; Richardson, 1969; Solso, 1991; Suinn, Sheikh, & Korn, 1994; Vealey & Greenleaf, 2001). However, no clearly and universally accepted definition of imagery has been created. In an early definition, Richardson (1969) described imagery as a self-conscious awareness of quasi-sensory and quasi-perceptual experiences under conditions where the actual stimuli that produce the real sensorial and perceptual experiences are absent. Richardson's definition was the basis of developing many measures of imagery ability (e.g., Shortened Questionnaire Upon Mental Imagery; Richardson, 1969). After half a century, it is still one of the most widely cited definitions in sport psychology. However this definition does not explain the term comprehensively, as the focus is only on perceptions, not mentioning sensory or emotional experience (Bhasavanija, & Morris, 2014). Elaborating on Richardson's definition, Morris et al. (2005) described imagery as "creation or recreation 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). According to Morris et al., (2005) their definition was developed by combining some key factors that were proposed by previous researchers. The definition proposed by Morris et al. (2005) is generizable to a range of sports situations.

Recently, the definition of imagery by Morris et al. (2005) has been modified by Holmes and Calmels (2008). They explained imagery as a conscious controlled process that generates or regenerates parts of a brain representation or neural network. This was done to distinguish between imagery and observation learning. The focus of Holmes and Calmels' definition is more on neuropsychological aspects of imagery because the emphasis is on neural activities in the brain that are involved in the imagery process. They recommended using imagery scripts accompanied by modelling or observation training to optimize the efficiency of imagery and activate the emotion-related part of the brain.

The capacity to generate images is different from one person to another and the imagery ability of athletes can influence the effectiveness of the imagery process (Gould & Damarjian, 1996; Start & Richardson, 1964). Morris (1997) defined imagery ability as "an individual's capability of forming vivid, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal" (Morris et al., 2005). Imagery ability is a skill and can be improved through frequent and organized practice (Evans, Jones, & Mullen, 2004).

The main characteristics of imagery ability that constitute measureable components are the dimensions and modalities. Vividness, controllability, duration, ease of generation, and speed of formation, are characteristics of images that have been categorised as dimensions. The most influential factors, regularly discussed in the literature, are vividness and controllability (Morris et al., 2005; Vealey & Greenleaf, 2001). Vividness is the clarity and sharpness of the imagery (Richardson, 1988). The more the image reflects what people experience in real life, the greater is the quality of vividness for individuals doing imagery. Vividness involves the colour of the images, the involvement of various senses, and emotional or physical sensations experienced when engaging in the imagery. Isaac (1992) proposed that athletes who experience more vivid imagery improve their performance more than those with low vividness imagery ability. However, vividness is not the only factor that influences imagery effectiveness (Pie et al., 1996). Controllability is another important dimension of imagery as it makes the image more realistic by manipulating the image in productive ways. Controllability refers to the degree of control a person has over what happens in the imagery. Smith (1987) stated that the more control athletes have over their imagery, the more beneficial the imagery will be enhancing their performance. For example, basketball players whose imagery is represented as missing the shot every time they try to imagine a successful FT shot may have limited control over what they imagine. As experienced athletes have greater understanding of their skills and can generate a clear picture in their mind of a particular skill, their images may be more vivid and controllable, thus, improving imagery efficacy.

In addition to controllability and vividness, there are other essential factors that need to be considered (Murphy, 1990). Ease of imaging is just as important as vividness and controllability as this pertains to all aspects of the imagery process (generation, inspection, transformation, and maintenance). Ease of generation refers to how easily people can evoke images (Hall, Pongrac, & Buckholz, 1985; Morris et al., 2005; Tower & Singer, 1981). A vivid image can be easy or difficult to image (see Williams et al. 2012 for a detailed explanation). The importance of ease as a dimension is also evident by its inclusion in popular measures of imagery ability (e.g., SIAM, MIQ/MIQ-R/MIQ-3/MIQ-S, MIAMS, & SIAQ).

The amount of time someone can clearly hold images in the mind until they disappear represents the dimension of duration (Denis, 1985). The speed of formation of images is a dimension that also warrants investigation in determining the status of imagery skills. To date, only limited research and conceptual discussion of the imagery process proposes the assessment of this attribute (Watt, Morris, & Andersen, 2004). Another important characteristic associated with imagery ability pertains to the sensory modality or modalities associated with imagery. Researchers have proposed that, when using imagery, individuals should involve all the senses (Weinberg, 2008). The more senses that are included in imagery, the more effective are the images that are created (Pie et al., 1996). In contrast, Moran (2004) defined imagery as "perception without sensation" (p. 133), which requires some clarification of the evident involvement of sights, sounds and other "sensory" experiences in imagery. Some other authors (Cox, 1998; Wann, 1997) have stated in their definitions of imagery that the process involves only the visual sense. Most researchers now agree that imagery is multi-modal and multi-dimensional. Individuals can imagine things in all senses and not just the visual sense (Weinberg, 2008). There is a difference, however, between the proposal that all the senses should be involved in imagery and individual difference that occur in the senses in which different individuals imagine more frequently and more effectively. For example, swimmers might use sense of smell when imagining a competition scene more than other this sense is used in other sports, because the smell of chlorine in swimming pools is a primary characteristic of that context, whereas gymnasts might use the auditory sense more when imagining performing a floor routine because music is central to performance of that discipline of gymnastics. Another important component of imagery is feelings and emotions associated with various sporting experiences (Morris et al., 2005; Murphy, Nordin, & Cumming, 2008; Suinn et al., 1994; Vealey & Greenleaf, 2001). For example, to retrieve and re-experience a successful performance achieved in the past, like breaking a record, athletes should feel the emotions associated with those experiences, such as elation, satisfaction, pride, and self-esteem (Vealey & Greenleaf, 2006).

In summary, imagery is a powerful and effective mental technique in enhancing athletes' performance. Therefore, it is important to understand how imagery actually leads to such performance benefits.

## Theoretical Explanations for Imagery Effectiveness

Understanding how imagery operates is the basis for every practitioner to use it effectively. Theories have been developed to describe the mechanisms by explaining how imagery functions and affects performance. Morris et al. (2005) summarized these theories into four different categories: Early theories, cognitive, neurophysiological, and psychological explanations with each category containing theories for the effectiveness of imagery. Early theories were developed to explain why mental practice works, not the mental imagery itself (Murphy, 1990) and include psychoneuromuscular theory, symbolic learning theory, and gross framework theory. Cognitive-based theories explain the foundation in the mental processes involved in imagery. Cognitive theories include dual code theory, bioinformational theory, and triple code theory. The psychological theories emphasize the influence of psychological states, such as arousal and motivation. They include self-efficacy theory and the attention-arousal set theory. Finally, and the most recently, is a category of theories that explain imagery based on neurophysiological processes, such as functional equivalence theory. However, few of the imagery theories have been tested rigorously (Murphy et al., 2008). In this section, seven theories are briefly outlined to provide a background in understanding the major elements and how imagery influences sports performance.

Psychoneuromuscular theory, also referred to as muscle memory, established by Carpenter (1894), was premised on physiological reference to the brain and neurons. According to the theory, imagining a movement produces nerve impulses from the brain to the muscles to accomplish a particular movement identical to when executing that movement, but the nerve signals are weaker in magnitude than those associated with physical movement. In other words, imagining builds a memory for the motion in the muscles (Hall et al., 2001). For example, imagining basketball FT shooting can activate relevant muscles, such as triceps, wrist flexors, and hamstrings of basketball players in the same way as actually performing the shots does. Suinn (1980) conducted a study that supported this theory by detecting muscle activity in the legs of skiers while they imagined a downhill run. Muscle activation during imagery provides feedback to the pre-motor cortex, which will facilitate motor performance in the future by providing appropriate visual (e.g., knowledge of results, knowledge of performance) and kinaesthetic (e.g., muscle movement, body positioning) information to performers (Guillot, & Collet, 2005a; Guillot, Lebon, & Collet, 2010). A factor that may impact the degree of muscle activation during imagery is athletes' level of sports skills. Harris and Robinson (1986) noted in their study that advanced skills participants recorded higher electromyography (EMG) muscle activity compared to beginner athletes. EMG activity has also been found to increase when participants imagined dumbbell curves compared to rest, but it did not mirror that of actual performance (Slade, Landers, & Martin, 2002). Nonetheless, studies examining the psychoneuromuscular theory have been criticized, because of their lack of experimental control over key variables and that EMG measurement used in those studies does not represent a reliable technique to detect imagery responses (Guillot et al., 2010).

Another early theory explaining imagery is the symbolic learning theory. Sackett (1934) suggested that imagery creates a mental blueprint of the skills that they are trying to learn in athletes' minds. In other words, by imagining an action, individuals symbolize a motor program in the central nervous system (Arvinen-Barrow, Weigand, Thomas, Hemmings, & Walley, 2007), which familiarizes them with the skill (Hall et al., 2001).Therefore, their bodies know the plan when they subsequently perform the skill physically because they rehearsed it mentally. Thus, this familiarity allows athletes to learn a skill, correct mistakes, and successfully perform it. Similar to the psychoneuromuscular theory, in symbolic learning theory imagery could provide the opportunity for the individual to change behavior based on feedback received from the imagery (Corbin, 1972). Some researchers have argued that this theory can only explain the effectiveness of imagery on tasks that are cognitive (e.g., a finger maze activity) or symbolic in nature (Murphy et al., 2008). Symbolic learning theory only focuses on the cognitive information of a skill, such as movement sequencing and timing, or planning of a movement, and cannot explain improvements on strength and motor tasks (Guillot et al., 2008; Morris et al., 2005). In contrast, it has been proposed that imagery impacts athletes' performance in specific (cognitive or physical) and combination tasks positively (Guillot, & Collet, 2010; Sapien & Rogers, 2010).

It can be argued from the explanation of imagery on symbolic learning theory that imagery is only beneficial for learners in the early stage because these mental blueprints are already well established in more advanced and highly-skilled players. Recently, however, some research has shown positive effects on elite athletes' performance after using imagery (see review by Weinberg, 2008). In their meta-analysis, Feltz and Landers (1983) identified that imagery practice in experienced participants was associated with slightly higher performance improvements compared to novice participants. Feltz and Landers found no significant differences between the early stage of learning (beginner participants) and advanced stage of learning (expert participants), with reference to the effects of imagery training on cognitive improvement. Therefore, imagery seems to be an effective tool for individuals regardless of their stage of learning. For example, in a study by Guillot, Nadrowska, and Collet, (2009), elite basketball players showed improvement in capability of learning cognitive dominant new game plans or tactical strategies after imagery training. This suggests that imagery is also effective in improving the cognitive components of movement tasks at more advanced learning stages, not just influencing beginner athletes (early stage of learning).

In gross framework theory, Lawther (1968) proposed that individuals must be able to envision the entire desired movement in order for the imagery to be effective. Corbin (1972) supported gross framework theory, stating that the learner must have some previous knowledge of the task, either actual or vicarious, in order for the mental practice to be successful. He further stated that for imagery to effectively improve the performance of a skill, one must be able to image the entire movement constituting the task to be learned. Nevertheless, more scientific research seems to be necessary to give this theory a stronger meaning in relation to the efficacy of mental training (Morris et al., 2005). Lawther (1968) emphasized the importance of imaging the holistic picture of a movement in order to experience performance improvements. This is a completely opposite viewpoint to Bruner's (1960) theory of selective attention. Bruner (1960) proposed that learners must omit nonessential elements of the skill and only include key elements into the imagery. Based on this view, detailed observations or perceptions are not central to consideration of the impact of imagery on skilled movement (Hale, Sheikh, & Korn, 1994). In support of selective attention theory, Corbin (1972) stated that learners benefit from imagery only by calling attention to the important details necessary for the successful completion of the skill. That is, in order for the imagery to be effective, aspects of the skill must be narrowed down, and the imagery refined through eliminating the unnecessary elements of the skill being learned.

Another category of imagery theories based on information-processing is called cognitive-based theories of imagery. In bioinformational theory, Lang (1979) stated that an image should be viewed and classified as products of the brain’s information-processing capabilities. The image in this theory is a functionally organized, finite set of propositions stored in the brain. In order to produce a mental image a network of propositionally coded information in long-term memory is activated. Simply put, if athletes observe a stressful situation during an event, they will feel their anxiety levels increase. Hecker and Kaczor (1988) and Murphy (1990) supported the bioinformational theory. Lang (1977, 1979) suggested that individuals are able to access two types of information when engaging in general imagery scenes: stimulus and response information. Stimulus propositions are statements that describe specific stimulus features of the scenario to be imagined, which includes all descriptive details that establish the context of an imagery script. Response propositions, on the other hand, are statements that describe the imager's response to the particular scenario, and they are designed to produce physiological activity (Weinberg & Gould, 2007). For example, in basketball FT shooting, imagining the rim, the texture and feel of the ball, teammates and opponents, and the people sitting or standing on the sidelines are stimulus propositions. The response to this scene would be players' experience of excitement, arousal, feelings of confidence, and all the emotions and reactions, such as muscle tension or possible changes in cardiovascular and respiratory responses. It should be observed that these examples of response propositions reflect physiological processes because bioinformational theory was developed by Lang in the context of the clinical treatment of anxiety, not sport performance. Most applications of bioinformational theory in sport have used only stimulus and response propositions (Popescu, 2005). In addition to these two proposions, Lang (1979) highlighted the importance of meaningfulness of situations imagined during emotional imagery, which several studies have referred to as "meaning propositions" (Callow & Hardy, 2004; Calmels, Holmes, Berthomieux, & Singer, 2004; Cooley et al., 2013; Sisterhen, 2005). A similar concept was also suggested in Ahsen's (1984) triple code theory. Meaning propositions are the meaning of the stimulus and response propositions to individuals and emotions associated with the image (e.g., feeling determined to win or feeling nervous before a game). According to bioinformational theory, it is important to include both stimulus and response propositions in imagery to increase functional equivalence (Murphy et al., 2008) and imagery vividness (Calmels et al., 2004). Lang, Kozak, Miller, Levin, and McLean (1980) recommended stimulus response training as a technique to aid athletes to incorporate those propositions in order to generate more vivid images and to use imagery with greater ease. In a study that included only stimulus propositions compared to both stimulus and response propositions in imagery scripts performance improved more in the condition where both types of representation were included than in scripts that only contained stimulus propositions (Smith & Collins, 2004; Smith, Holmes, Whitemore, Collins, & Devonport, 2001). However, in a recent study by Cumming, Olphin, and Law (2007), response proposition participants recorded higher heart rate and anxiety symptoms compared to their baseline. Based on the self-report psychological state data collected in their study, Cumming et al. suggested that psychologists should carefully choose the imagery content prescribed to athletes according to their cognitive state to achieve the desired level of psychological and physiological activation in a competition. For example, imagining some response proposition content (e.g., increasing heart rate) might lead to deterioration in athletes' self-confidence and performance because it may increase the athletes' stress levels and this most probably would not be beneficial. Meaning propositions describe the relationships between the stimuli and response propositions, which reflects that different interpretations of the same imagery content can occur for a wide rnage of reasons, including previous experience and various psychological variables. For example, imaging the crowd in a competition might produce anxiety for one athlete and build confidence for another. Therefore, the same response propositions can have different psychological responses depending on how different athletes interpret them. This will subsequently affect the outcome of the imagery. In summary, including relevant information that has meaning for athletes is a key consideration when psychologists prepare imagery scripts.

A more cognitive-based theory that applies more generally to individuals' behavior was proposed by Ahsen (1984) as the triple code theory of imagery. Triple code theory includes the personal meaning attached to an image, thus, highlighting three components of the image. Those essential components to the imagery process are the image itself, the somatic response, and the meaning of the image to the individual. The image is the event, situation, or movement created in the mind, which should include as much information as possible along with all the same sensations as the actual experience to make imagery as realistic as possible. The somatic response represents the psychophysiological changes, such as emotions elicited by the specific image, muscle tension, and elevation of heart rate (Mulder, 2007). The most important aspect acknowledged in triple-code theory, which is mostly neglected in other imagery models (Kornspan, Overby, & Lerner, 2004), is the meaning of images that varies according to every individual's interpretation of their imagery and how they perceived the imagery content. The meaning of an image can be different from one imager to another, depending on individuals' background, experience, and previous conceptions of the imagery, even when they are given the same set of imagery instructions (Morris et al., 2005; Murphy, 2005; Weinberg & Gould, 2011). Therefore, the personal meaning attached to the image by different individuals provides vital information that must be accounted for in developing an effective imagery training program. The triple code theory was supported by Kornspan et al. (2004), who examined novice golfers' pre-performance imagery strategies in golf putting. From the qualitative results of their study, individuals' belief and previous experience emerged as crucial factors to the creation of imagery experiences meaningful for participants and that permitted the athletes to benefit from imagery training. Although triple-code model has provided a useful framework for investigating the imagery process, its utility in sport imagery is limited. Further study of triple-code theory in sport and performance is likely to provide a clearer understanding of the application of this theory (Morris et al., 2005).

The third category of theories explaining the effects of imagery, based on the groupings proposed by Morris et al. (2005), is psychological state explanations, which illuminate athletes' psychological state and the consequences that their state has for the way imagery affects behavior, thoughts and feelings. One psychological explanation is known as the attentional-arousal set theory. Imagery is considered to be a tool that athletes use to focus attention on the upcoming competition (Feltz & Landers, 1983; Hale, 1994; Hecker & Kaczor, 1988; Janssen & Sheikh, 1994). This assumption, better known under the name of the attentional-arousal set theory in applied sport psychology books (e.g., Cox, 2012). According to this theory, imagery functions as a preparatory set that helps athletes to achieve an optimal arousal level for performance. The optimal level of arousal then allows the performer to focus on task-relevant cues and screen out task-irrelevant cues which detract from their performance (Weinberg & Gould, 2007). For example, basketball players may use imagery prior to a game as a way to assist them to focus their attention on what they need to do in order to be successful during the competition. Imaging to shoot an important goal in front of many spectators can influence athletes' motivation or arousal, even self-confidence or anxiety. This in turn can influence performance (Kiefer, 2011). Another psychological approach to understanding how imagery works is self-efficacy. Perry and Morris (1995) argued that researchers have identified increases in self-efficacy associated with imagery use by athletes. This increase in self-efficacy could be associated with enhanced performance based on Bandura's (1977) theory of self-efficacy. A substantial body of research supports the positive impact of increasing self-efficacy on performance in sport as well as on a range of other behaviors (Koehn & Morris, 2011). Thus, research evidence indicates that imagery enhances self-efficacy and that increasing self-efficacy leads to enhanced performance. Perry and Morris argued that this sequence of imagery enhancing self-efficacy, which in turn enhances performance, might explain how imagery works to enhance performance.

One of the most recent explanations for imagery effectiveness is categorized as a neuropsychological explanation. This approach is known as the functional equivalence explanation. Proponents of this explanation state that imagery and actual perception and motor control involves some of the same neural networks (Holmes & Collins, 2002; Kosslyn, Ganis, & Thompson, 2001; Martin, Moritz, & Hall, 1999). The 'functional equivalence' hypothesis suggests that cognitive simulation processes (e.g., imagery) share, to some degree, certain representations, neural structures, and mechanisms with like-modality perception and with motor preparation and execution processes (Moran et al., 2011). During imagery the brain executes processes that are necessary to trigger the physical movements of a given skill even in the absence of physical execution (Morris et al., 2005). For example, the brain of basketball players who are imagining FT shooting will go through some of the same processes as when the task is physically performed. It is proposed that the brain sends messages to the muscles that are involved in the physical execution of FT shooting, but a parallel message inhibits muscle action, so the skill is not executed. Consequently, players are more likely to successfully execute the skill physically in the future because the brain has been trained to send the messages to the correct muscles, due to the similarity between the image and actual physical performance.

Empirical results have shown that imagery training incorporates similar neurophysiological mechanisms to what happens during actual motor activities or sport performance (see Guillot & Collet, 2005a for a review). Many researchers have shown similarity in brain activity during imagery and physically performing a task (Holmes & Calmels, 2008; Klein, Paradis, Poline, Kosslyn, & LeBihan, 2000; Kosslyn, Thompson, Kim, & Alpert, 1995). For example, neuro-imaging studies show that mentally simulating an action activates many common brain areas (such as the posterior, parietal, pre-motor, and supplementary motor cortex) as when the action is executed (de Lange et al., 2008; Munzert et al., 2009). However, in order to increase the functional equivalence between imagery and execution of the given task, one should include all the relevant cognitive, motor, sensory, and affective elements and increase the imagery vividness as much as possible (Holmes & Collins, 2001).

All these imagery theories had been developed over many decades to address how imagery influences athletes' performance of cognitive and motor tasks. Aside from bioinformational theory that has been well-supported in the sport psychology literature (e.g., Slade et al., 2002; Smith et al., 2001; Smith & Collins, 2004; Wilson et al., 2010), there is not sufficient research to support any of the other theories discussed (Morris et al., 2005). This is the current status of research on the theoretical propositions propounded to explain how imagery works. Despite extensive investigation of the effectiveness of imagery and many research results reporting positive effects of mental training on sport performance, as described in the review of research on imagery and performance that follows, no theory of how imagery works is considered to adequately explain all the effects attributed to imagery in the context of sport.

## Uses of Imagery in Sport

Imagery is one of the most commonly used psychological tools in sport and exercise (Morris et al., 2005) and can be used for different purposes to support participation in sport and exercise. First imagery was explained as a tool that athletes use for learning and training a skill (Feltz & Landers, 1983). But more research in imagery use revealed that imagery was also being used by athletes of different skill level for reasons other than learning a skill such as enhancing performance and psychological skills (Hall, Rodgers, &

Barr, 1990; Munroe, Hall, Simms, & Weinberg, 1998; Paivio, 1985; Weinberg & Gould, 2011). For example, 92% of 40 elite gymnasts reported using imagery to practise their skills and strategies, to recall and control emotions, to improve concentration, and to set goals, (Smith et al., 2007). Morris et al. (2005) categorized a number of athletes' imagery uses that have been identified in the literature as skill learning and practice, tactical and game skills, competition and performance, psychological skills, and recovery from injury.

The most common uses of imagery are based on learning a new skill or acquisition, detecting and correcting errors to refine a learnt skill, and to rehearse specific sport skills. This use of imagery helps athletes to learn the concept of a new skill, and maintain technical skills for their sport. For example, beginner golfers may practise their putt in their mind to learn different aspects of their skills. Imagining a correct version of the task in hand works like a source from which learners can get feedback, enabling them to correct their mistakes by comparing their performance with the imagined skill.

In addition to using imagery for the purpose of learning and rehearsing motor skills, athletes have reported using imagery for developing, learning, and practising tactics and strategies of their games (Feltz & Landers, 1983; Hecker & Kaczor, 1988; Paivio, 1985). Athletes can develop game plans or create new strategies, such as a trapping defense plan in basketball, and rehearse them prior to competition by using imagery. This use of imagery is especially beneficial when used to rehearse tactical skills and strategies and for solving unexpected problems that may arise during a competitive event (Guillot & Collet, 2008). It can also be integrated into an athlete's pre-performance routine as a means to refine a specific strategy before engaging in a competitive event (Guillot & Collet, 2008). Guillot and Collet (2008) suggested that athletes learn their game plan and team strategies through imagery first and then physical practice. Athletes also use imagery to familiarize themselves with upcoming competition and prepare for it, play the game in their mind and deal with situations that might arise in games. Elite athletes have found using imagery mostly effective for competition preparation (Cumming & Hall, 2002a). Pre-performance imagery has been shown to improve performance (Malouff, McGee, Halford, & Rooke, 2008; Mamassis & Doganis, 2004). However, very limited research has been carried out this type of imagery and its effectiveness (Murphy et al., 2008).

In addition, athletes may also use imagery for psychological purposes. Some psychological skills that have been shown to benefit from imagery are self-confidence (e.g., Callow et al., 2001; Evans et al., 2004; Short, Tenute, & Feltz, 2002), managing stress and reducing levels of competitive anxiety (Evans et al., 2004; Hale & Whitehouse, 1998; Martin et al., 1999), enhancing motivation (Beauchamp, Bray, & Albinson, 2002; Hall et al., 2001; Martin & Hall,1995), boosting self-efficacy (Feltz & Riessinger, 1990; Jones, Mace, Bray, MacRae, & Stockbridge, 2002; Orlick, 2008; She & Morris, 1997) and controlling attention (Calmels, Berthoumieux, & Arripe- Longueville, 2004). It has also been demonstrated that specific types of imagery are effective in changing athletes' perceptions of anxiety from harmful and negative to facilitative and challenging (Evans et al., 2004; Hale & Whitehouse, 1998; Mamassis & Doganis, 2004; Page, Sime, & Nordell, 1999).

Injured athletes tend to use imagery for reasons other than those mentioned above, such as recovering from injury, dealing with over-training or chronic injury and to manage the pain associated with injury during both rehabilitation and competition (Taylor & Wilson, 2005). It has been suggested that imagery can enhance the healing process by reducing anxiety and tension in muscles, increasing blood flow, and stimulating strength gains (Driediger, Hall, & Callow, 2006; Green, 1992; Smith, Collins, & Holmes, 2003; Taylor & Taylor, 1997). In addition, it allows injured athletes to work on technical, tactical, and psychological skills when they should avoid physical practice.

Imagery is a ubiquitous process that can be used for different purposes and its effectiveness is demonstrated in sport (Garza & Feltz, 1998; Post & Wrisberg, 2012). Furthermore, one image could be used for several reasons as readily as several types of imagery could be used for a single purpose (Callow & Waters, 2005; Fish, Hall, & Cumming, 2004; Murphy et al., 2008; Nordin & Cumming, 2005; Short, Monsma, & Short, 2004; Short, Ross-Stewart & Monsma, 2006).

## Applied Models of Imagery Use in Sport

Various conceptualizations of imagery have been developed as a framework to explain the different roles of imagery and to highlight some of the key components required to ensure its effective implementation. Paivio's (1985) proposition, which has been used in many recent studies, was based on two functional roles of imagery, motivational and cognitive, with each operating at specific and general levels, and represented by four effects of imagery. The four imagery functions labelled cognitive specific (CS), cognitive general (CG), motivation specific (MS), and motivation general (MG) are shown in Figure 2.1.

| | Imagery Function | |
|---|---|---|
| | Motivation | Cognitive |
| General | Arousal and Affect | Strategies |
| Specific | Goal-oriented Responses | Skills |

*Figure 2.1.* Analytic framework for imagery effects. (Reprinted from Paivio Cognitive and motivational functions of imagery in human performance, 1985).

CS is related to imagery of developing and producing sport skills, such as a basketball jump shot, while CG is about competitive strategies, game plans, and tactics like a full court press defense strategy in basketball. MS function of imagery involves specific goals and goal-oriented behaviors (Murphy et al., 2008), such as imagining FT shooting to achieve a set goal of a 70% success rate . This type of imagery helps athletes to cope with tough situations and persist longer in overcoming obstacles as the imagined scenarios work as a reinforcement to keep them motivated to achieve their goals. The MG function of imagery is related to general emotional arousal and physiological arousal, such as images that increase heart rate. Hall, Mack, Paivio, and Hausenblas (1998) developed the Sport Imagery Questionnaire (SIQ) to examine the content of imagery use. The factor analysis of the SIQ revealed two distinguishing MG types, motivational general arousal (MG-A) and motivational general mastery (MG-M). MG-M is when athletes imagine being confident, controlled, focused and resilient during challenging situations – such as imagining staying focused during a critical situation in sport competition (Murphy et al., 2008; Murphy & Martin, 2002). Imagery related to emotional and somatic experiences in sport, like feelings of relaxation, coping with stress, arousal, and competitive anxiety, is categorized as MG-A. This type of imagery assists athletes to reach their optimal arousal level by using imagery that either relaxes or psyches up the athlete. Generally, MG-M has been found to be the most used function of imagery by athletes (Arvinen-Barrow et al., 2007; Gregg, Hall, & Nederhof, 2005). Paivio's framework has provided reliable guidelines for imagery interventions and has been successfully applied in sport settings (e.g., Driediger et al., 2006; Fish et al., 2004; Gammage, Hall, & Rodgers, 2000). The main outcome of the model is that athletes should use imagery function that matches their purpose of using imagery. For example, athletes who aim to learn new skills should employ CS imagery, and MG-M imagery should be used to enhance self-confidence. However, Paivio's framework is limited in terms of the number of key components included, which influences the athlete's desired outcome. For example, it did not consider imagery ability of athletes, which is an important factor that could influence the imagery effectiveness (Martin et al., 1999; Salmon, Hall, & Haslam, 1994).

Munroe, Giacobbi, Hall, and Weinberg, (2000) proposed the Four Ws model of imagery use by athletes: What, Where, Why, and When. This qualitative approach is based on a six-stage model describing how athletes may integrate imagery into their sport. Where to use imagery is related to the environment (training or competition), while When refers to the time of imagery use (before, during, or after a competitive event, as well as during practice). Why represents the reason for imagery use (CG, CS, MG-A, MG-M, or MS imagery functions), and What athletes imagine relates to the detailed elements of imagery content (sessions, effectiveness, nature of imagery, types of imagery, surroundings and controllability of images). Finally, the subcategories include more specific components related to quality and process of imagery, such as sensory involvement, image generation, image manipulation, emotional state, and perspective. Sessions refer to the length of the imagery training. Effectiveness relates to whether the images were positive or negative from the participants' point of view. Surroundings encompass the venue (practice or competition) and those in attendance. Types of imagery include the senses that are used during imagery (e.g., vision, auditory, kinesthetic, and olfactory). Controllability of the image is the individual's ability to manipulate the image. This model highlights some essential guidelines by including an important number of the key components of imagery use to make imagery interventions more effective, especially for competitive sporting situations (Guillot & Collet, 2008). Nevertheless, the model does not include all key factors affecting imagery effectiveness and does not consider the specificity of each key component with regard to the athletes' outcomes (Guillot & Collet, 2008).

Imagery content was divided into characteristic and type of imagery in a study by Nordin and Cumming (2005) exploring Where, When, Why, and What dancers image. Imagery characteristic refers to how the image is experienced (Fournier, Deremaux, & Bernier, 2008; Munroe, et al., 2000; Nordin & Cumming, 2005). The authors subdivided imagery characteristic into ability (accuracy, vividness, manipulative ability, and difficulties), direction (facilitative or debilitative), deliberation (spontaneous or deliberate imagery), amount (how often imagery should be used), duration (how long it takes for an image to emerge), and senses (visual, kinesthetic, tactile, auditory, gustation and olfaction). Nordin and Cumming (2005) identified six types of images dancers use during imagery namely; execution (i.e., images related to skill learning, planning, and strategies), metaphoric and artistic (i.e., images of color, objects, and themes), context (i.e., the environment, other people, and specific situations and venues), body-related (i.e., anatomy, appearance, and health concerns), character and role (i.e., imagining a swan when performing swan lake in dance), and irrelevant images (spontaneous images not related to the task). Their applied model received some support from the literature (Cumming & Ramsey, 2008). A new dimension that emerged from Nordin and Cumming's study (2005) was "How" the dancers employed imagery. How is about obtaining images (from external stimuli, retrieving memories, and by creating triggers), interpreting images (feelings of an image and how it translated into movement), and creating layers of images (imagining skills first, and thereafter adding qualitative elements such as emotions and characterization).

Cumming and Williams (2012) revised their model to distinguish between the type of imagery (i.e., its content and characteristics) and the function of the imagery use. They also added the personal meaning of the image to the model. They stated that the meaning of the image to each person needs to be considered to determine the most appropriate imagery content for a particular function (Cumming & Williams, 2012). Their model was not just developed based on dance research, but from sport, exercise, dance, and rehabilitation research to be applicable to a wide range of domains. Imagery ability is a key component of the model along with who, when, where, what, why, and how as well as personal meaning.

Although the list is not extensive, a number of key components of imagery use emerged from the model proposed by Cumming and Williams that need to be taken into account for the development of effective imagery interventions. These components are modality, perspective, the viewing angle (seeing themselves from above, front, behind or either side when imagining), the agency (imagining themselves or somebody else), and deliberation (spontaneous or deliberate imagery). A new key component that was addressed in this model was the layered imagery approach whereby new layers of detail are added to imagery scripts in stages. Further investigation is required to test whether modifying imagery script approach is beneficial for imagery users.

Holmes and Collins (2001) suggested a model known as PETTLEP. The seven components that they suggested to be taken into consideration are physical, environmental, task, timing, learning, emotional, and perspective. They proposed that imagery shares similar neural mechanisms to physical practice. Therefore, the effectiveness of imagery depends on how well it stimulates the brain areas that are active during the actual execution (Murphy et al., 2008). Holmes and Collins (2001) argued that the seven imagery components should mirror the actual performance environment as much as possible, to increase functional equivalence between real experience and imagery experience. Expanding on PETTLEP, the physical (P) element is the physical characteristics of imagery, which should reflect those of actual performance. For instance, basketball players imagining a FT shot should wear their basketball shoes and uniform, standing in their FT position as they practise imagery with a basketball in their hands to increase functional equivalence. Ramsey et al. (2010) stated that close attention should be paid to the physical responses that would occur during actual execution of the skill. The environment (E) element refers to the physical environment in which the imagery is performed, being identical to the actual performance environment by including components such as smell, sights, and sounds or by performing the imagery in the environment where the actual performance takes place (Murphy et al., 2008; Ramsey et al., 2010). A gymnast could, for example, perform the imagery in the stadium where the next competition will be held. The task (T) element suggests that the imagined task should mimic the actual task and the athlete's expertise level. Athletes should experience the same feelings, thoughts, and actions when they are imagining a task as they do during the actual execution of the task (Murphy et al., 2008). Since it would be likely that novices and experienced players have different thoughts about particular tasks, their imagery should be different (Holmes & Collins, 2001). For example, expert golfers might try to emphasise thoughts related to successful outcomes in their imagery, but novice golfers might focus on thoughts about technique in their imagery. The timing (T) element conveys that the speed of imagined performance should be the same as the speed of actual performance, especially when the timing of the task is important. Imagining a task slower or faster than the performance speed is likely to result in an incorrect mental representation of the movement (Murphy et al., 2008). The learning (L) element suggests that athletes' imagery practice should be matched with their current stage of learning, and subsequently imagery should be adjusted as skill level develops (Ramsey et al., 2010). For example, novice basketball players should not imagine a reverse lay-up until they master a lay-up. The emotion (E) element indicates that imagery should incorporate all emotions and arousal typically experienced during actual performance, which helps strengthen memory representation (Murphy et al., 2008). These vary in different sports. For example, weightlifters should include things that increase their emotional arousal level when imagining prior to lifting weights while dart throwers, in contrast, would include relaxed emotions as they image their performance. The perspective (P) element indicates that imagery perspective should be appropriate for both the individual and the task. When adopting imagery techniques, there are two distinct imaging perspectives. Mahoney and Avener (1977) defined perspective as the vantage point from which people see images in their mind when using imagery, which could be either internal or external. When people imagine being inside their body and the image looks and feels the way they normally experience while executing the movement, they are using internal imagery (Mahoney & Avener, 1977). In other words, internal imagery is when individuals imagine from a first person perspective. For example, to imagine a basketball FT, players might imagine themselves behind the FT line, feeling the ball in their hands, concentrating on the rim, and then throwing the ball from inside their body as they would when actually doing it. External imagery involves people observing themselves performing an action from outside their body as if watching a movie (Mahoney & Avener, 1977). External imagery occurs when individuals imagine from a third-person perspective. In the FT example, when using external imagery, the players' experience is like watching themselves perform the task from outside their body, as if standing behind, to either side, in front of, or even above or below their body as they perform the movement.

By including all these seven elements, it is more likely that the functional equivalent increases, and consequently imagery, will be more effective (Murphy et al., 2008). Researchers have found the PETTLEP model to have positive effects on performance in a variety of sports by evaluating the model's effectiveness as a whole, or the effectiveness of certain elements of the model (Forlenza, 2010; Jenny & Munroe-Chandler, 2008; Ramsey et al., 2010; Smith et al., 2008; Smith et al., 2007; Wakefield & Smith, 2011; Wright & Smith, 2009). For example, Smith et al. (2007) compared the effectiveness of the model as a whole by having three different imagery interventions. One group of hockey players imagined themselves performing while wearing the hockey uniform and standing on the hockey pitch. Another group did the same except that they practised imagery at home instead of the hockey pitch. Finally, the traditional imagery group performed the imagery seated in a chair at home wearing their everyday clothes. The results showed that the sport-specific imagery group improved more on penalty flicks than the clothing imagery group, which in turn, improved more than the traditional imagery group. These results indicate that including more elements to increase imagery's functional equivalence is beneficial. However, it is not necessarily the case that the more aspects of the PETTLEP model that are included, the better performance will be. Instead, the key issue is that the imagery intervention should be individualised through a process of response training and should include those aspects of the PETTLEP model most pertinent to the individual performer (Wakefield & Smith, 2012). 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 et al. (2013) suggested that applied sport psychologists should identify functional equivalence of the imagery performance environments and behavioral function to further enhance sport performance of athletes.

More recently, Guillot and Collet (2008) proposed the Motor Imagery Integrative Model of Imagery in Sport (MIIMS) to combine imagery types into a multimodal format and a complete mental image of the specific movement based on integrations from the previous imagery conceptual models (e.g., PETTLEP, Holmes & Collins, 2001; Imagery Training Program Model, Morris et al., 2005). Guillot and Collet named four distinct goals athletes could be aiming to achieve using imagery, namely motor learning and performance motivation, self-confidence and anxiety, strategies and problem-solving, and injury rehabilitation. Many types of imagery may be used in order to achieve positive motor imagery, including internal or external visual imagery perspectives, as well as kinesthetic, tactile, auditory, or olfactory imagery (Guillot & Collet, 2008). This model takes into consideration many key components that should be condidered for effective imagery and it has been suggested that has potential to be used as a global guiding framework in motor imagery research (MacIntyre & Moran, 2010).

Although the efficacy of these models has been supported in some studies (Jenny & Munroe-Chandler, 2008; Lebon, Collet, & Guillot, 2010; Ramsey, Cumming, Brunning, & Williams, 2007; Smith & Collins, 2004; Smith et al., 2007), it is limited in several respects (See Wakefield, Smith, Moran, & Holmes, 2013). Specifically, the authors did not address the role of complexity, vividness, control, ease of imagery, nor the length of time that each scene should be imagined.

performer's beliefs about the nature and regulation of their own imagery skills" (Moran, 2002, p. 415), was illuminated only in PETTLEP and MIMMS models. This aspect of imagery appears to be an important factor in the efficient application of imagery processes (MacIntyre & Moran, 2010) and can differentiate novices from experts (Moran et al., 2012). Meta-imagery refers to people's belief about how their minds work (meta-cognition knowledge), their ability to monitor some aspects of their thinking (meta-cognition monitoring), and strategies that they use to improve their performance (meta-cognition control). The knowledge aspect of meta-imagery, was studied by McIntyre (2006). The findings indicate that the majority of canoe slalom competitors and gymnasts who participated in his study were aware of the effectiveness of the mental practice and that imagery engages different sensory modalities. More importantly, participants were aware of the mental travel principle, the fact that imagining a movement generally should take the same amount of time as the actual execution of that action.

In two other studies, MacIntyre and Moran (2007a, 2007b) found that athletes use imagery in flexible and creative ways for purposes like developing creative strategies (turning a debilitative image into the desired outcome image) and to regulate and/or improve their skills or performance (meta-cognitive control). These strategies included holding relevant sporting implements during imagery, and even moving physically during imagery. Although a great deal of research has examined imagery effectiveness (Kosslyn et al., 2006), only a few studies have been conducted to attest people's knowledge and belief about their own imagery experience. Only two imagery models (PETTLEP, MIIMS) explicitly deal with factors that are relevant to the concept of meta-imagery both in terms of declarative knowledge (meta-imagery knowledge) and strategies (meta-imagery control). For example, knowledge of providing environmental cues (e.g., holding an implement) and the role of changing perspective dependent upon function are highlighted in both these models.

Taken together, imagery models were developed to inform the specific content of an imagery script to make imagery training as beneficial as possible. The models offer valuable guidance by covering a large and important aspect of imagery training that needs to be considered by athletes to ascertain imagery effectiveness. However, none of the models universally gained approbation among practitioners and coaches as each model focused only on a limited number of key components.

## Factors That Affect Imagery Effectiveness

To date, many theories and models have been developed to guide imagery training interventions (Holmes & Collins, 2002; Wright & Smith, 2009). However, there is still a lack of research examining the best structure to optimize imagery effectiveness. In this section, I detail factors that influence imagery effectiveness to establish the key components that should be taken into account when designing imagery training programs for the development and implementation of guided imagery interventions. Vealey and Greenleaf (2006) stated that learning how to use imagery in a productive way is essential for its use to be effective. Imagery effectiveness is influenced by a number of factors, which are framed within imagery models that are designed to optimize the delivery of imagery interventions (Holmes & Collins, 2001; Martin et al., 1999). To fully benefit from imagery practice, these factors need to be taken into account (Vealey & Greenleaf, 2001). I categorized these factors in relation to individuals' characteristics, skill characteristics, and imagery characteristics. Individual characteristics, such as imagery ability, vividness and control of images, are of primary concern when using imagery training programs (Munroe et al., 2000). In addition, imagery training characteristics, such as performing imagery in the sport environment, frequency of imagery training sessions (Callow & Hardy, 2004; Munroe-Chandler, 2005), and instruction for delivering imagery (Guillot & Collet, 2008), have all been reported to influence the efficacy of imagery training.

## Individual Characteristics

Athletes' imagery use and type are influenced by characteristics of the individuals, including imagery ability (vividness and controllability in particular), imagery perspective, preference of the imager, skill level, age, and gender. Each one of these variables is important to consider when designing and developing imagery training programs.

**Imagery ability.** Imagery ability is "an individual's capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal" (Morris, 1997, p. 37). To fully benefit from imagery training, participants should engage in imagery effectively. Therefore, practitioners should always keep in mind that the effectiveness of imagery depends on individuals' imagery ability (Murphy & Martin, 2002). Irrespective of the level of sport they compete in, athletes can be strong or poor imagers. They can vary in their ability to imagine on key dimensions, such as vividness and controllability. High vividness and low controllability is a particularly problematic combination, because athletes imagine very clearly, but they cannot control their imagery, so they can have very effective imagery of incorrect skills (Morris et al., 2005). Athletes are even different in their ability to image cognitive and motivational imagery content

(Williams & Cumming, 2011). Further, athletes vary in their capacity to image in different sense modalities. Some individuals have rich visual imagery, so they can readily imagine what performance of the task looks like, but they have weak kinaesthetic imagery, so they cannot imagine what the feeling in their muscles should be like when they perform. Others find it difficult to visualize their performance, but have very clear feeling in their muscles of how to perform the skill correctly (Morris et al., 2005).

Numerous studies have also demonstrated that those with greater imagery ability may benefit more from utilizing imagery than those with less developed ability in imagery (e.g., Goss, Hall, Buckolz, & Fishburne, 1986; McKenzie & Howe, 1997; Robin, Dominique, Toussaint, Blandin, Guillot, & Her, 2007). It has been established in the literature that strong imagers demonstrate greater overall performance improvement following an imagery intervention, in comparison to those who are weaker in imagery skills (e.g., Callow & Waters, 2005; Gregg, Hall, & Butler, 2007; Robin et al., 2007). For example, Robin et al. (2007) found that although all athletes recorded significantly higher tennis service return accuracy following imagery combined with physical practice, those who scored higher on imagery ability gained the greatest improvements. Therefore, it is very important to screen athletes' imagery ability prior to any imagery intervention and to enhance the imagery ability of athletes prior to skill-specific imagery training. It has been shown in the literature that imagery ability can be improved through systematic practice (Cumming & Williams, 2012; Evans et al., 2004). Researchers have demonstrated that imagery can be improved by including response propositions into an image already containing stimulus propositions (Lang et al., 1980; Williams, Cooley, & Cumming, 2013).

As explained earlier, the two most influential factors of imagery ability are vividness and controllability (Morris et al., 2005; Vealey & Greenleaf, 2006). Fournier et al., (2008) noted that vividness of the image is important to consider within the context of imagery. The more vivid the image, the more it positively affects performance (e.g., Gould, Damarjian, & Greenleaf, 2002; Murphy, 2005; Weinberg & Gould, 2011). Imagery vividness effects on performance outcome are supported in studies. For example, Callow, Roberts, and Fawkes (2006) reported a relationship between imagery vividness of participants and completing a task (down-hill skiing) in a shorter time. Researchers have also shown that imagery vividness improves with practice (Calmels et al., 2004). According to Weinberg and Gould (2011), the clarity of the image (vividness) is increasable by practising to use all the senses.

In addition to vividness, the ability to control images is a critical factor in the effective use of imagery in a mental training program. Athletes must be able to manipulate images in productive ways to prepare themselves to perform at an optimal level. Imagery controllability has been observed to range from spontaneous images with no control to fully manipulated images on a continuum (Murphy et al., 2008). Controllability is an important factor especially when athletes are able to create very vivid images. The importance of controllability was shown in an early study by Clark (1960), in which one participant reported mentally attempting to bounce a basketball preparatory to shooting only to imagine that it would not bounce, but stuck to the floor. This disturbed that athlete to a point where he could not successfully visualize the shooting technique. Imagery ability of athletes, in terms of vividness and control of images should be considered when developing a mental training program (Munroe et al., 2000). Imagery ability differences can be one explanation for equivocal results of imagery effectiveness in the literature (Vealey & Greenleaf, 2006).

Imagery ability of athletes is an important factor that influences the effectiveness of imagery in enhancing performance (Hall, 1998). Therefore, vividness and controllability of athletes should be regularly examined (Morris et al., 2005) to assure that they are able to generate vivid images with an appropriate level of control. Research and applied work on imagery training indicates that imagery abilities can be improved by systematic training (Morris et al., 2005). Therefore, if suitable tests of imagery ability indicate that particular athletes have weak imagery ability, it is more practical to improve athletes' abilities to imagine first and then focus on their imagery training for a desired sport performance outcome.

As highlighted earlier, individuals' ability in imagery influences the outcome of the imagery (Martin et al., 1999). Individuals vary in proficiency to generate and control images and generally imagery is more effective for individuals with higher imagery ability (e.g., Robin, et al., 2007). In a study to improve service return accuracy in tennis, for example, Robin et al. (2007) found greater improvements to performance for the stronger imagers compared to their lower level counterparts. It has therefore become common practice to screen athletes' imagery ability prior to interventions (Cumming & Ramsey, 2009). Despite individual differences existing, however, imagery ability can be improved with invested time and effort (for review see Cumming & Williams, 2012b). This can be done via imagery practice (Cumming & Ste-Marie, 2001; Rodgers, Hall, & Buckolz, 1991), combining observation with imagery (Rymal & Ste-Marie, 2009; Williams, et al., 2011), and incorporating response propositions into an image already containing stimulus propositions (Lang, Kozak, Miller, Levin, & McLean, 1980; Williams, Cooley, & Cumming, 2013).

Imagery ability not only refers to the content being generated and maintained but also how the imagery is carried out (e.g., athletes will prefer to image from a visual perspective that enables them to more easily generate and control vivid images). For example, if an individual finds it difficult to image how a movement feels in third person perspective, it is less likely that they adopt this visual perspective when imaging kinesthetically. Callow and Roberts (2010) found that a small correlation exists between an individual's preference for a visual perspective and the ability to image in this perspective. However, no relationship was found between athletes' third person visual imagery ability and the viewing angle used. In sum, individuals use imagery sense modalities and dimensions to different extents and in different ways which can affect how effective their imagery is. Thus, it might be that two people who imagine the same basketball shot, one using visual imagery and the other kinaesthetic imagery, would have different outcomes.

**Imagery perspectives.** Researchers have endeavored to determine if either internal or external imagery perspectives are advantageous. Investigators have examined elite athletes' use of imagery and the perspective they chose. In two studies, elite level athletes reported the use of internal perspective more frequently (Orlick & Partington, 1988; Salmon et al., 1994). Gymnasts who qualified for the US Olympic team reported using internal imagery more than gymnasts that did not qualify, and elite gymnasts who used the internal perspective tended to be more successful (Mahoney & Avener, 1977). Rotella, Gansneder, Ojala, and Billing (1980) provided further support to Mahoney and Avener's (1977) findings. Rotella et al. (1980) found that less successful skiers adopted a third person (external) imagery perspective as opposed to more successful athletes. Rotella et al. (1980) proposed that this was because the less successful skiers had not yet mastered the technical requirements of the skills. Therefore, in the early stages of learning, an external perspective might be more beneficial as it allows learners to examine the motor movements involved in the skill from outside of their body, giving the most inclusive view of their limbs and relevant visual cues. However, skill level is not the only factor that determines the success of one imagery perspective.

Other deciding factors are the type of task (Annett, 1995; Kearns & Grossman, 1992; McLean, Richardson, Sheikh, & Korn, 1994; Morris et al., 2005), and individual preference. Whether the task is cognitive/visual or motor/kinesthetic can influence which perspective is more effective to adapt for performance enhancement. Glisky, Williams, and Kihlstrom (1996) signified that internal imagery is superior for cognitive/visual tasks, whereas external imagery is more effective for motor/kinesthetic tasks. Jowdy, Murphy, and Durtschi, (1989) stated that internal perspective has a stronger relationship with kinesthetic sensations, while external perspective may not stimulate the feel of the movement (Hall et al., 1990). However, some studies indicate that kinesthetic imagery can accompany both internal and external perspectives (White & Hardy 1995; Hardy & Callow 1999). In contrast, several studies did not show significant performance differences between internal imagery training and external imagery training conditions (e.g. Gordon, Weinberg, & Jackson, 1994; Harris & Robinson, 1986; Mahoney & Avener, 1977). Two other studies have shown that external imagery perspective is more efficient in enhancing performance on tasks that depend heavily on form, such as those involved in karate and gymnastics (Hardy & Callow, 1999; White & Hardy, 1995). Overall, current evidence suggests that it is more a case of which perspective is more effective for which task or part of a task, rather than that one perspective is just superior. In other words, both internal and external perspectives are beneficial in different aspects of many skills, which makes it difficult to say one perspective is always superior to the other.

Hall (1997) stated that the athlete is the most important factor in determining the most effective imagery perspective. Hall suggested that athletes would benefit from using the perspective with which they feel most comfortable. This is further supported by White and Hardy (1995) who discovered that each athlete's imagery experience is individual. Therefore, it is up to the athletes to work with both perspectives and determine which perspective works best for them (Vealey & Greenleaf, 2001). However, Spittle and Morris (2011) showed that it is possible to train extreme internal imagery users to use more external imagery perspective and extreme external imagery users to use more internal imagery. They also showed that both extreme internal and external perspective users performed at a higher level when they were trained to use more balanced internal and external perspectives respectively. Spittle and Morris also conducted a study in which imagery perspective was examined in the context of open and closed skills and found no difference between internal and external imagery percpectives on open or closed skill based on the perspective category to which participants were assigned at the start of the study. When participants were reclassified on the basis of the perspective they used most after perspective training, internal perspective imagery was associated with superior performance for the closed skil, darts, and external perspective imagery was superior for the open skill, returning a table tennis ball.

Regardless of the factors that govern their preferred perspectives, such as skill level and type of task, elite and non-elite athletes use both internal and external perspectives during imagery (Gordon et al., 1994; Hall et al., 1990; Harris & Robinson, 1986; Weinberg, Butt, Knight, Burke, & Jackson, 2003). It is not clear from existing research why, but it is likely that athletes switch from one perspective to another because they intuitively or consciously feel that it is more effective to imagine certain aspects of the task internally, whereas other aspects are best imagined externally (Guillot et al., 2009; Morris et al., 2005). For example, in basketball shooting players may imagine the feel of the ball, the positioning of the body, and the location of the rim most effectively from an internal perspective, but imagining the trajectory of the ball from hands to basket may be done with greater effect from an external perspective, for example, side-on. Nordin and Cumming (2005) found that dancers imagine the emotions of a character internally, and imagine their appearance on stage using external imagery. In addition, when individuals imagine themselves from outside of their body, they can do it from a variety of angles in order to take advantage of different viewing angles (Callow and Roberts, 2010; Holmes & Calmels, 2008). Callow and Roberts (2010) recently found that athletes participating in their study reported 10 different viewing angles when using external imagery.

A variety of results emerged from studies that aimed to identify the most effective imagery perspective and there is still a debate on whether internal or external perspective is more effective. Some researchers (Nordin & Cumming, 2005) have found that athletes use both internal and external perspectives to imagine different aspects of their sport skill. Thus, although it is recognized that athletes' imagery perspective preference is another key consideration for practitioners and sport psychologists when developing imagery, research does not clearly indicate which perspective is most efficacious in what sport imagery contexts.

**Skill level.** Another individual characteristic that should be considered when developing intervention programs is the level of expertise of the athletes who are intended to use the imagery (Reed, 2002; Short, Tenute, & Feltz, 2005). Some researchers have argued that imagery is more beneficial for beginners because they are in the early stages of learning and their skill execution is more cognitive (Hall et al., 2001). However, others have stated that imagery is more effective for more skilled performers and that skill level influences imagery effectiveness (see Murphy & Martin, 2002 for a review) because competitive level will influence imagery ability (Roberts, Callow, Hardy, Markland, & Bringer, 2008). Elite athletes reported greater vividness of movement images (e.g., Roberts et al., 2008) and that they could more easily generate a sport-related scene (Williams & Cumming, 2011). Therefore, it has been proposed that elite athletes benefit more from imagery training because they have higher ability than novices. Similarly, Barr and Hall's (1992) study on elite and novice rowers showed that athletes who have greater experience benefit more from imagery use. They reported that skilled rowers could create more realistic images (i.e., feeling the blade, muscles, parts of the stroke, and the boat and its action in the water), and that experienced rowers had greater imagery ability in relation to their sport.

Pie et al., (1996) argued that elite athletes have greater understanding of the demands and skills in their sport, leading them to more effectively apply imagery to both practice and competition situations. Driskell, Copper, and Moran (1994) also proposed that having previous experience in performing a task can influence the effectiveness of imagery. Olsson, Jonsson, Larsson, and Nyberg (2008) conducted a study in which they assessed brain activity during imagery of high jumpers with different levels of skill. Functional magnetic resonance imaging (FMRI) scanning clearly showed that elite high jumpers were able to activate motor regions, whereas novices activated visual and parietal regions. Olsson et al., (2008a) concluded that in order to achieve neural overlap between imagery and action, having previously physically executed the action at a reasonable level was beneficial. In other words, if athletes could not perform a task physically, they were not be able to imagine it in a way that is necessary for a high degree of functional equivalence. This means that for imagery interventions to be effective, a certain level of expertise is necessary. However, this is not always the case and it has been proposed that imagery can be effective for both beginners and highly skilled performers if the content of the imagery matches the stage of development of the skill (see review by Weinberg, 2008). For example, novices experience greater benefits when imagining cognitive tasks as opposed to physical tasks (Driskell et al., 1994). Callow and Hardy (2001) concluded that different functions of imagery are effective for different stages of learning, consequently imagery should be adjusted as skill level develops.

**Age.** Some imagery research has demonstrated an association between imagery effectiveness and the age of people performing the imagery. Imagery research in early childhood indicates that younger children are less competent at scanning, rotating, and generating objects in images, with a lesser ability to maintain images compared to older cohorts (Kosslyn, Margolis, Barrett, Goldknopf, & Daly, 1990). Marmor (1977) suggested that children as young as 4 and 5 years old have the ability to imagine an object turning in space. This was in contrast to Piaget and Inhelder’s (1971) claim that children under the age of 7 are not capable of spatially transforming the sequence of movements when they imagine it, and that their imagery remains static. Piaget and Inhelder proposed that children develop dynamic imagery at 7 and 8 years old. More recently, Molina, Tijus, and Jouen (2008) also reported that 5 year-old children are not able to form accurate mental images and imagine themselves performing an action. This result was supported by three previous studies (Bruner, Olver, & Greenfield, 1966; Kosslyn et al., 1990; Piaget, Inhelder, & Bovet, 1997). The overall pattern of findings of these studies was that children younger than 7 are poor at certain imagery processes, such as scanning, rotating, and generating objects, and have difficulty generating active moving images, but are able to maintain images. Bideaud and Courbois (2000) later concluded that before the age of 6, children's imagery ability depends on their motor abilities, as they would not be able to form accurate mental images if they cannot execute the actual motor task. Bideaud and Courbois argued that after 6 years of age childen would be able to use mental imagery per se, without executing the task (Hoyek, Champely, Collet, Fargier, & Guillot, 2009). Researchers have acknowledged that there appears to be a turning point in relation to imagery ability of children after the age of 7 (Fishburne, Hall, Franks, Hahn, & Carl, 1987; Hall & Pongrac, 1983; Kosslyn et al., 1990; Wolmer, Laor, & Token, 1999).

In imagining difficult tasks however, older children (11–12 year-olds) would be able to engage in imagery processes more accurately (Caeyenberghs, Tsoupas, Wilson, & Engelsman, 2009). Caeyenberghs et al. (2009) also reported lower correlations between imagined and executed movement times for 6 –7 year-old children, but suggested that this gradually increases as they get older. Hoyek et al. (2009) found that duration of motor imagery was closer to that of actual execution in middle school children compared to elementary school children. Parker and Lovell (2012) also found significant age differences in imagery vividness between 12-13 and 20-21 year-old age groups, with the older group recording greater imagery vividness.

Imagery is a learning process and the ability of individuals to image improves as they get older. Therefore, age difference should be considered when implementing imagery technique for different age groups.

**Gender.** Imagery may also be affected by gender. Studies including men and women have produced controversial results. In their theoretical model, Munroe-Chandler and Gammage (2005) included gender and age as factors that could moderate the effectiveness of imagery. In many studies, researchers reported that there were no gender differences in imagery ability (e.g., Lorant & Nicholas, 2004; Monsma, Short, Hall, Gregg, & Sullivan, 2009), therefore, participants were not separated according to their gender. For example, Munroe et al. (1998) found no significant differences between males and females in the use of imagery and grouped their participants regardless of their gender into different conditions.

However, some studies did show gender differences in both imagery use and imagery ability (e.g., Campos, Pérez-Fabello, & Gómez-Juncal, 2004; Williams & Cumming, 2011). Burhans, Richman, and Bergey (1988) examined the effects of imagery on stress level and found females reported significantly lower stress levels than males after imagery use prior to a competition. In addition, Epstein (1980) revealed that a significant gender difference exists in the variability of improvement following imagery sessions. Munroe-Chandler, Hall, Fishburne, and Hall (2007a) and Munroe-Chandler et al. (2007b) did not find any differences in imagery ability between genders, but gender differences in imagery use were found. Girls specifically reported imagining their surroundings and using imagery to control arousal, anxiety, to relax and to improve self-confidence, while boys used imagery to control mental execution of movement. In another study, findings indicated that the imagery duration in boys were closer to actual task execution time than girls (Hoyek et al., 2009). Gender difference was reflected in imagery ability and use in some studies, however, more research is needed to verify whether gender differences reported in some studies represent general patterns, rather than idiosyncratic outcomes with particular samples.

**Task Characteristics**

Some researchers have proposed that the content and characteristics of imagery should be specific to the type of skills being imagined by athletes. Task characteristics and type of task may affect imagery effectiveness (Driskell et al., 1994). Although all types of sport skills and tasks (e.g., high cognitive and low cognitive motor skills, fine and gross motor skills, open and closed motor skills) have been shown to benefit from imagery (see a review by Weinberg, 2008), initially researchers identified that tasks with high cognitive components show greater effects of imagery training (Denis, 1985; Driskell et al., 1994; Feltz & Landers, 1983; Ryan & Simons, 1982). For example, Ryan and Simons (1982) illustrated significant improvements on a cognitive task (completion of a maze) after imagery training, whereas imagery did not improve a motor task (balance times on a stabilometer). More recently Wright and Smith (2007) also found a short-term PETTLEP imagery intervention to be effective on a cognitive task. Other research has shown that motor tasks benefit from imagery as well as cognitive tasks (Smith & Collins, 2004; Taktek, 2004; Wright & Smith, 2009). For example, Wright and Smith (2009) found PETTLEP imagery training significantly improved biceps curls, a strength task with little cognitive involvement, from pre-test to post-test. Yet, the effectiveness of imagery for gross motor skills, such as running and swimming has not been examined. Theory and research have supported the proposition that athletes in different sports should utilize different imagery functions (i.e., CS, CG, MS, MG-M, MG-A) for different tasks. In addition, most sport skills are not solely cognitive or motor tasks. Therefore, imagery seems to enhance the performance of all types of sport skills as they all have cognitive components (Ryan & Simons, 1982).

Another related task dimension is the domain of open versus closed skills. One recent study compared the effects of imagery on the performance of a closed skill (tennis serve) as well as the performance of an open skill (returning a tennis serve), between an imagery condition and a control condition (Coelho, De Campos, Da Silva, Okazaki, & Keller, 2007). The results showed that participants in the imagery condition improved their tennis serving significantly more than those in the control condition, whereas no significant difference in returning tennis serve was found between the imagery and control condition. However, more research comparing the effectiveness of imagery interventions on different task types is necessary before a strong conclusion can be drawn (Morris et al., 2005).

It has been suggested that different motor skill types (closed or open) benefit from different imagery perspectives (Guillot, Collet, & Dittmar, 2004; Hardy & Callow, 1999; McLean et al., 1994; White & Hardy, 1995). Some researchers have proposed that internal imagery should be more effective in open skills that rely on perception (White & Hardy, 1995), whereas external imagery would be more appropriate for closed skills (Hardy & Callow, 1999). However, recently researchers have proposed alternatives that contrast with these assumptions and suggested that the imagery perspective employed should be appropriate for both the individual and the task (Mellalieu & Hanton, 2008). It is very important to consider individual preferences when aiming to design successful interventions, because some athletes prefer one type of imagery to another or simply find one type of imagery difficult. This could be a possible reason why neither perspective has been found to be superior to the other in all studies with a range of tasks and athletes. Imagery perspective preference of individuals can be discovered by interviewing them, followed by a trial period of imagery and an evaluative discussion. Moreover, Spittle and Morris (2011) demonstrated that it is possible to increase internal imagery use by athletes for whom external imagery is the preferred perspective and vice versa through training imagery perspectives. Therefore, if the task demands internal imagery training and the athletes' preference is to use external, practitioners should develop internal imagery use first by using a specific training program before any other imagery training, to make imagery more effective. For example, for darts players who are internal imagery users, the ideal is to train them to use external imagery and then ask them to imagine task-related scenes externally. It has also been outlined in previous literature that before providing imagery guidelines, considering individuals' imagery type preference, and matching it with the desired imagery type associated with specific skill is recommended (Morris et al., 2005). Nonetheless, there is only limited research on open and closed motor skills in relation to imagery (Arvinen-Barrow et al., 2007) and further exploration is necessary.

In summary, a wide range of research suggests that imagery is beneficial for improving all types of skill, but that certain factors influence the effectiveness of imagery programs for each type of task. Thus, it is important to match the imagery athletes use with the demands of specific skills. For example, one function of imagery, such as cognitive specific, might be highly suitable for one type of task, such as learning basketball free-throw shooting, and not for other tasks, such as rehearsing a basketball offensive strategy that involves all five players on the court. Individuals' preference is another influencing factor that should be considered. Thus, for example, it is not always preferable to instruct athletes in only one particular imagery perspective. Also, athletes do not always self-select the most effective perspective, so sport psychologists designing imagery training programs should consider a range of variables in deciding how to include imagery perspective in a specific context.

**Imagery Training Characteristics**

Another set of factors that strengthen the quality of imagery interventions relates to the characteristics of imagery. For example, whether an image is positive or negative can influence how well imagery works (Weinberg, 2008). Imagery characteristics refer to everything that should and should not be included in imagery training and the way it should be delivered to the athletes to make imagery training more effective.

**Facilitative (positive) and debilitative (negative) imagery.** An important issue that has been repeatedly demonstrated in many studies to ensure the effectiveness of imagery training, is positive imagery (Nordin & Cumming, 2005; Ramsey, Cumming, & Edwards, 2008; Taylor & Shaw, 2002). Positive or facilitative imagery refers to a form of imagery whereby athletes imagine successful performances. In contrast, negative or debilitative imagery refers to those forms of imagery in which athletes imagine unsuccessful actions or outcomes. For example, a basketballer imagining the ball going through the net prior to taking FT shots is an example of positive imagery. Imagining FT shots missing the net is an example of negative imagery. This issue has long been examined because applied sport psychologists have reported that in competition athletes often experience negative images. This led researchers to question whether negative imagery has a debilitative effect on performance. Researchers have found that positive images improve athletes' performance, whereas negative images lead to performance decrements (e.g., Murphy et al., 2008; Nordin & Cumming, 2005a; Short et al., 2004; Smith & Link, 2010; Taylor & Shaw, 2002; Woolfolk, Parrish, & Murphy, 1985). For example, for a golf putting task, Woolfolk et al. (1985) found that participants using positive imagery demonstrated significantly greater improvements in performance compared to a control group. Participants using negative imagery showed a significant decrease in performance. Another study by Nordin and Cumming showed that imagining missing the dart board decreased dart throwing performance and reduced participants' self-efficacy levels.

Despite the fact that negative images result in underperforming, athletes have commonly reported experiencing them. Therefore, it is important to give structure to athletes' imagery training to help them avoid negative images. Athletes should be taught strategies to cope with negative images (MacIntyre & Moran, 2007) and how they can turn negative images into positive ones, as it can be difficult to simply forget about negative performances that have occurred in the past. For instance, a combination of imagery and positive self-talk is suggested as a useful technique to prevent debilitative imagery from hampering performance (Cumming, Nordin, Horton, & Reynolds, 2006). Another possible way to avoid negative imagery is to select the best performance athletes have experienced and use imagery training to recreate them. This means that just before executing a task, athletes should mentally review their best performance and the feeling associated with it. Using a self-modeling video can work as an adjunct to imagery of best performance. This strategy of imagining was the approach that the professional golfer Fred Couples implemented during his playing career (Rotella, 2007). It can be applied to any sport. For instance, in basketball FT shooting, it would be helpful for players to imagine a perfect FT attempt or their best FT percentage prior to each shot.Furthermore, suppressive imagery (trying to avoid an error) was also found to debilitate performance and self-confidence (Beilock, Afremow, Rabe, & Carr, 2001; Taylor & Shaw, 2002). Asking participants not to do something (e.g., do not miss your shots), or not to think about previous mistakes (e.g., forget your last attempt) may actually increase the probability of a person imagining the negative scenario. Frequent application of suppressive imagery has been demonstrated to affect performance negatively (Beilock et al., 2001; Taylor & Shaw, 2002). More recently, Ramsey et al. (2008) found similar results whereby an instruction to participants not to putt towards a sand bunker resulted in significantly fewer successful putts. To avoid these kinds of instructions leading to precisely the imagery that is not desirable, replacing negative imagery with positive imagery through imagery training is an alternative that could be suggested.

The direction of imagery (whether the images are positive or negative) is an important and often- discussed factor that influences the efficacy of mental training. Research has consistently illustrated that positive images will lead to performance enhancement (Murphy, 1994; Smith & Link, 2010), whereas negative images are seen as detrimental to performance (Immenroth, Eberspächer, & Hermann, 2008).

**Imagery and physical practice.** To achieve optimal benefit from imagery training, researchers have reported that imagery should be combined with physical training. It is not appropriate to replace physical training by imagery training (except where injury is involved), according to research findings. Imagery has been widely used in combination with physical practice to improve performance (Allami, Paulignan, Brovelli, & Boussaoud, 2007; Driskell et al., 1994; Post et al., 2010; Schuster et al., 2011) and to improve motor learning (Driskell et al., 1994; Feltz & Landers, 1983; Guillot & Collet, 2008; Schuster et al., 2011). In a meta-analysis, Driskell et al., (1994) reported that imagery is effective in enhancing overall performance, but not as effective as physical practice. Imagery and physical practice together have been demonstrated to be superior to physical practice or imagery practice alone (Darling, 2008; Gould et al., 2002; Kohl, Ellis, & Roenker, 1992; Taktek, 2004; Thompson, 2003; De Vries & Mulder, 2007; Weinberg, 1981), while the use of imagery alone does not usually lead to superior performance to physical practice alone (

Driskell et al., 1994; Feltz & Landers, 1983). A combination of PETTLEP-based imagery training and physical training has been shown to have more of a positive impact on performance than PETTLEP imagery alone and physical practice only (Smith & Holmes, 2004; Smith et al., 2008). However, some studies did not find a significant difference in using imagery with or without physical practice (Kohl et al., 1992; Taktek, 2004). Davies (1989) proposed that imagery can sometimes be more effective than actual practice because players can imagine themselves playing in a competitive situation, which, to an extent, can provide greater benefits of transfer to real competition than simply practising skills.

Overall, research findings indicate that a combination of imagery training and physical practice can improve performance more than imagery training only. Nonetheless, imagery training adds benefits that can enhance physical practice, so a combination of physical and imagery practice can often be most effective.

**Physical environmental context.** The physical characteristics in which the imagery is performed should be identical to the actual performance environment, according to research finding on PETTLEP imagery model (for a review see, Wakefield & Smith, 2012). This means that imagery interventions should include wearing the same clothes as when performing, holding any associated implements whilst standing on the pitch or court, feeling the emotions prior to performance, and more importantly, feeling kinaesthetic sensations when performing the skill (dynamic imagery). This is in contrast to the way that athletes have often practiced imagery (static imagery: performing imagery in quiet environments or at home). For example, when attempting an imagery session to improve a bicep curl task, Wright and Smith (2009) encouraged athletes to sit at the weight machine and grasp the handles, unlike traditional imagery models that often encourage athletes to adopt a comfortable position. Callow et al. (2006) also emphasized dynamic imagery, and found significantly higher imagery vividness scores compared to both a static imagery condition and a control condition. However, they did not find a notable difference between conditions in their performance. Munroe-Chandler, Hall, Fishburne, and Shannon (2005) suggested that having athletes perform dynamic imagery instead of static imagery can be an effective way to increase imagery use among young athletes. Guillot, Moschberger, and Collet (2013) revealed that imagery coupled with actual movement (dynamic imagery) enhanced both imagery quality and the technical efficacy of the jump of high jumpers. This is one of the crucial elements of the PETTLEP model and its importance is strongly supported by research (e.g., Callow et al., 2006; Guillot & Collet, 2005a; Smith et al., 2001; Smith et al., 2007). The idea is that the competitive environmental conditions could facilitate the ability of athletes to recall and to depict conditions by giving details of what should be included in the scenes they will imagine and feeling the sensations that are correlated with actual execution. If performance of imagery in a sport environment is not possible, then video, audio, and photographs could be used to assist the imagery experience (Holmes & Collins, 2001; Wakefield & Smith, 2011). It could also be useful to wear the same clothing for better movement representations while videotaping the performance. Generally, researchers have concluded that maximizing the incorporation of the senses when doing imagery should be beneficial to performance enhancement (Moran, 2004; Weinberg & Gould, 2011).

**Emotion (arousal).** Researchers have recently addressed the importance of recreated emotions felt during performance as part of imagery practice, as opposed to the relaxed state associated with traditional imagery. Initially, it was argued that imagers should be in a relaxed state during imagery sessions (e.g., Janssen, Sheikh, & Korn, 1994; Weinberg, Seabourne, & Jackson, 1981) to help limit distractions and improve concentration on the mental images, as well as reduce somatic or bodily tension (Janssen et al., 1994). Janssen et al. (1994) further agreed that starting imagery training with relaxation should facilitate athletes generating vivid mental images and/or it should reduce distractions. Relaxation prior to imagery has been suggested to increase imagery efficacy (Eberspächer, 2001), as has focusing attention during relaxation (Mayer & Hermann, 2009).

However, researchers have recommended that athletes should not remain relaxed during the entire imagery session and their arousal level should increase gradually as would occur during their physical performance. Recently, Smith et al. (2007) suggested that athletes should reach the level of arousal experienced during actual performance. Smith et al. (2007) provided support that employing emotion is more effective than using imagery with instructions to relax. However, Ramsey et al. (2010) did not find any beneficial effects of an emotional imagery condition over a relaxing imagery condition. In their model, Guillot and Collet (2008) suggested that the association of imagery with relaxation techniques is useful when the aim is to achieve motivation and self-confidence, and not when using imagery to improve motor performance and learning. For example, Wilson, Smith, Burden, and Holmes (2010) found that personalized, emotion-laden imagery scripts led to greater muscle activity and higher self-rated imagery vividness compared to more generic interventions.

**Time equivalence.** Timing has been underlined in many models. Time equivalence is conveying that the speed of imagined performance should be the same as actual performance (Calmels, Holmes, Lopez, & Naman, 2006; Guillot & Collet, 2005b; Holmes & Collins, 2001; Louis, Guillot, Maton, Doyon, & Collet, 2008; Moran, 2004; Weinberg & Gould, 2011). For example, imagining a 100-meter sprint should take the same time that a person actually takes when performing it. Boschker, Baker, and Rietberg (2000) compared imagining a movement either at a slower or faster pace than the performed time. This resulted in decreasing and increasing actual speed respectively. Louis et al. (2008) went further and looked for a similar imagery-related effect in a complex motor task, including an upper and a lower body movement. They confirmed that changes in imagery speed may have some negative effects on actual motor speed, which could be detrimental to performance.

It has been suggested that slow motion imagery may elicit different neural patterns from those created during physical performance or real-time imagery, and therefore lead to errors in actual execution (e.g., Holmes & Collins, 2002). However, when using motivational imagery, speed of imagined sequences is not as important and athletes reported using slower, real-time, and faster imagery to achieve different outcomes (Hall, Munroe-Chandler, Fishburne, & Hall, 2009). In addition, Nordin and Cumming (2005) reported that dancers used slow, actual, and fast speeds when imagining their dance, especially when memorizing sequences and reviewing their routines. In two other studies (Debarnot, Creveaux, Collet, Doyon, & Guillot, 2009; Debarnot, Louis, Collet, & Guillot, 2011), researchers compared the effects of performing either real-time or fast imagery on motor performance and found no change following fast imagery training, but they found real-time imagery training was effective.

At this time the research indicates that imagery of a task taking the same time as actual performance is more effective than imagery that is slower or faster than real time. Adopting incorrect speed when imagining a movement may therefore be detrimental for the efficacy of imagery (Morris et al., 2005). However, in imagery for motivational purposes, speed of imagery is not an important factor.

**Duration and number of trials.** Practice variables, such as frequency and duration of the imagery session, have been found to influence imagery effectiveness (Weinberg, 2008). However, these variables have often been neglected. In a meta-analytic study, Driskell et al. (1994) determined that the interval between practice and performance, and the length of time the athlete practised using imagery, may influence imagery effectiveness. The duration and number of trials performers should imagine in order to achieve maximum effectiveness has interested both researchers and practitioners. However, this element still needs to be clarified (for reviews, see Morris et al., 2005). In other words, the questions of “how much?” and “how often?” need to be answered to help athletes to benefit more from imagery training and to avoid mental fatigue and inattention. Regarding the length of sessions, reviews of the mental practice literature have highlighted that longer duration sessions were as effective as shorter sessions and more effective than intermediate length sessions. In some of these reviews, short duration mental practice sessions may be more effective than longer duration mental practice sessions (Etnier & Landers, 1996; Feltz & Landers, 1983; Hinshaw, 1991). Hinshaw (1991) argued that sessions less than or equal to 1 minute, and 10-15 minute sessions, elicit the largest effects on performance. This is consistent with Feltz and Landers (1983) who reported that sessions lasting either less than 1 minute, or 15-25 minutes, were most effective in enhancing performance. Morris et al. (2005) argued that sessions lasting approximately 10 minutes were typically recommended, although no empirical data was given for this instruction. Driskell et al. (1994) indicated that sessions lasting 20 minutes appeared to be the most effective to enhance performance. Another study by Etnier and Landers (1996) showed that one or three minutes of imagery practice improved task performance more than five minutes, or seven minutes of mental practice. However, the length of the imagery session is highly dependent on the task that is imagined. For instance, imagining one specific skill like a basketball free throw shot might take a very short time, while imagining a floor routine in gymnastics would take much longer.

Another factor that may affect imagery effectiveness, and consequently influence performance improvement of individuals, is how frequently they use imagery. Blair, Hall, and Leyshon (1993) acknowledged that how often athletes should use imagery is unclear and that evidence pertaining to the timing of imagery routines is equivocal. Researchers in two recent studies examined an imagery intervention in netball (Wakefield & Smith, 2009) and biceps curl performance (Wakefield & Smith, 2011). They indicated that at least three imagery sessions per week were needed to produce optimal results and less frequent imagery was not effective. Tenenbaum et al. (1995) suggested that one imagery session per week for four weeks is enough to improve knee extension strengthening by 9.0%. Yue and Cole (1992) conducted a study incorporating more frequent imagery sessions than Tenenbaum et al.'s study (five times per week for four weeks) and showed a 22% strength increase in muscle. More recently, Smith et al. (2003) and Smith and Collins (2004) used Yue and Cole's strength task protocol, but with a much lower frequency of imagery (twice a week for several weeks), and found similar strength increases to those reported by Yue and Cole (1992) involving more frequent training.

Wakefield and Smith (2009) conducted a study to examine the effects of differing frequencies of PETTLEP imagery on netball shooting performance involving 32 female participants in either a control or PETTLEP imagery condition. The PETTLEP imagery condition was further divided into three conditions with different frequencies: once a week, twice a week, or three times a week. Participants in the control condition, the two sessions per week imagery condition and the one session per week imagery condition did not show significant improvement in shooting performance, whereas participants who experienced three sessions of imagery per week did show significant improvement. These results suggested that for PETTLEP imagery to be effective, imagery training is necessary at least three times per week. Wakefield and Smith (2009) examined the effects of differing frequencies of PETTLEP imagery on bicep curl performance with the same protocol. Results indicated that the higher the frequency of imagery practice, the greater the effectiveness of imagery training for performance. Meanwhile, meta-analytic results have shown no relationship between the frequency of imagery sessions and its effects on performance (Driskell et al., 1994; Feltz & Landers, 1983). Popescu (2005) also did not find significant differences in performance outcomes nor the imagery ability of skilled gymnasts after receiving either one imagery session or three imagery sessions per week for the duration of imagery training over five weeks.

In terms of number of trials per session, schedules from one to more than 20 imagery trials have been reported (Morris et al., 2005). Hinshaw (1991) found that 15 to 25 trials yielded the largest effects on performance. Results of a similar study indicated no difference between 25, 50, and 100 trials of a dart-throwing task (Kremer, Spittle, McNeil, & Shinners, 2009). Potter et al. (2005) further proposed that simple skill-rehearsal scenes may require more repetition than complex skill-rehearsal scenes. In one recent study (Kremer et al., 2009), 209 students were randomly assigned to a control condition, or one of three mental practice conditions (25, 50, or 100 trials of imagining dart throwing task). This one-session pre-test and post-test design study did not show differences for the three mental practice conditions. Kremer et al. suggested that more than a certain number of mental practice trials do not influence effectiveness and will produce similar effects; however, there is the possibility that more than100 mental practice trials lead to an effective practice pattern. This is opposed to Hinshaw’s (1991) finding that between 15 and 25 imagery trials per session were more effective. Feltz and Landers (1983) reviewed more than 100 studies on imagery and concluded that more benefits, physically (e.g., improved strength, less errors) or/and psychologically (e.g., improving imagery ability), were obtained by using either 6 or fewer trials or between 36 and 42 trials. They further compared the most effective number of trials on cognitive tasks and motor tasks. They demonstrated that for cognitive tasks, less than 6 trials were required to achieve large effect sizes, whereas a greater number of trials or more time was required to produce similar results on motor or strength tasks. This lack of agreement in relation to practice trial patterns warrants further examination. This is an issue that should be examined more systematically. In the studies to date, researchers have usually compared only two frequencies of imagery practice and no more than three. Further, researchers have not systematically controlled for the number of repetitions of the task during each imagery session or the duration of sessions. It is necessary to examine these three aspects of imagery practice together over a substantial number of studies to determine whether there are any underlying principles associated with the frequency and amount of imagery practice.

Although one-session imagery interventions have also been shown to stimulate behaviour changes (Cumming, Hall, & Shambrook, 2004), longer-term imagery programs appear to be more effective (Calmels et al., 2004; Li-Wei, Qi-Wei, Orlick, & Zitzelsberger, 1992; Munroe-Chandler, 2005). In a systematic review of interventions ranging from 3 to 16 weeks in length, Cooley et al. (2013) found a strong and positive correlation between the length of imagery intervention and its success.

Taken together, the research seems to suggest that imagery training programs ranging from 7 to 16 weeks are most successful in achieving desired outcomes than shorter or longer programs (Cooley et al., 2013; Cumming et al., 2004; Li-Wei et al., 1992; Rodgers, Hall, & Buckolz, 1991). The research literature supports the idea that longer imagery sessions do not guarantee greater skill proficiency. To date, a variety of repetition schedules and frequencies of imagery training have been used in imagery studies and contrasting results have emerged. This can mislead athletes as to how often they should implement imagery in their training, how long the trials should be and how many trials should be used in a session. There is still much potential for further research on what Morris et al., (2012b) called imagery “dose-response” because the previous studies have not controlled the duration of sessions, number of trials, and number of sessions per week. Li-Wei et al. (1992) also suggested that both athletes and researchers might best establish the length of sessions based on their personal experiences. It also seems unlikely that the same imagery training frequency of practice characteristics will be most effective for all sports and movement tasks, considering that there is great diversity of such tasks.

**Instruction.** Instruction refers to the media through which imagery is delivered, the description (detailed or simple keywords) that participants imagine and modification of content. Imagery scripts can be delivered to athletes in different ways, such as live or pre-recorded audio, video, or written scripts. The self-modeling video technique (watching a video of the self performing the task successfully) allows athletes to have a clear and vivid picture of exactly what they are supposed to imagine (Ram, Riggs, Skaling, Landers, & McCullagh, 2007; Rymal & Ste-Marie, 2009). Smith and Holmes (2004) conducted a study comparing the use of video, audio and written scripts to deliver imagery training. They demonstrated that the video-tape condition and the audio condition were associated with greater improvements in overall golf-putting performance than the written script condition. They suggested that having athletes watch themselves, or hear what they are supposed to imagine, helps them to image in real time.

Athletes use imagery spontaneously, which typically does not have any specific purpose (Hardy, Jones & Gould, 1996). For example, when awarded a free shot a basketball player might automatically imagine missing the shot as she walks to the free throw line. Evidence supports the effectiveness of controlled and systematic imagery training in improving sports performance and learning a skill, as well as the regulation of thoughts, emotions, and arousal levels (Cumming &Williams, 2012; Murphy, 2005). Systematic and well-structured imagery training is a more effective way of applying imagery in sport than in a random or non-directed fashion (Simons, 2000; Vealey & Greenleaf, 2001). Through instructions the function of imagery, the sensory modality used, the content of imagery and how detailed it should be can be determined. The function of imagery chosen should match athletes' needs and goals (Martin et al., 1999; Munroe et al., 1998). Although imagery interventions should be customized for each individual based on their needs, it is still important to provide clear instructions for guided imagery use. The content of imagery must also be meaningful for the individual and appropriate for the situation to be effective. Imagery content that is inappropriate to the situation or athlete may be detrimental to performance (Holmes & Collins, 2002).

Despite the fact that the imagery ability of individuals is an important factor to consider when developing imagery training, researchers often assume that participants have sufficient ability to independently generate appropriate images and therefore do not provide detailed and specific instruction for imagery use. For example, Etnier and Landers (1996) instructed participants to imagine a FT for 2 minutes without giving any instruction to them in terms of what to imagine and how. They simply asked them to imagine appropriately. In this case, participants could have imagined unsuccessful FT shots or included some inappropriate details. One way to avoid this is to instruct athletes to follow a detailed script whilst imagining. Imagery scripts are pre-planned descriptions that include a controlled level of detail about the competitive context of specific performances that athletes should emphasize (Taylor & Wilson, 2005). To some extent, using imagery scripts leads athletes to have clearer information about specifically what they should imagine by including details about people, places, and events that can make imagined scenes as realistic and vivid as possible (Cumming & Anderson, 2013). By using imagery scripts, practitioners aid athletes to generate images and ensure that the correct imagery is being used, thereby decreasing the likelihood of generating inappropriate images.

An efficacious imagery description is very detailed (Di Rienzo, Collet, Hoyek, & Guillot, 2012), vivid, refers to as many sensory modalities as possible and includes the emotional experience of real execution, thoughts, and actions (Vealey & Greenleaf, 2001). Therefore, in order to obtain the most effective imagery, athletes should incorporate as many senses as possible, emotion associated with the image to make the imagery identical to the actual scenes (Hale, 2005; Morris et al., 2005). In basketball FT shooting, for example, to effectively utilize imagery, players should imagine the colour of the ball and their jersey, the hardwood floor, all the sounds in the gymnasium including their coach's voice, the crowd cheering, and even all the scents in the gymnasium. Imagery models and theories inform the specific content of an imagery script to serve the desired function of imagery. For example, it is suggested in the PETTLEP model that all seven elements should be included in imagery interventions to maximize imagery effectiveness for performance (Holmes & Collins, 2001). In the bioinformational theory, Lang (1979) described three sets of information that an imagery script should include – stimulus propositions (e.g., details of the environment, the crowd, and the task), response propositions (e.g., increased heart rate and respiration), and meaning propositions (e.g., feeling and emotions associated with winning). Calmels et al. (2004) proposed that imagery training incorporating all three propositions will be more vivid and effective. These models detail components that should be considered when designing imagery interventions in order to maximize their benefits. Nonetheless, the question of how athletes should include these components within an imagery traning program remain unanswered. It should be acknowledged that although ignoring certain elements may impact performance facilitation (Ramsey et al., 2010), introducing all seven components of the PETTLEP model at one time may be impractical and create overload for athletes (Wakefield & Smith, 2012), particularly for those who are new to imagery interventions. Thus, researchers have examined the most effective ways in which to deliver imagery training.

## Imagery Delivery Methods

In the previous section, I highlighted influential factors that need to be considered when designing an imagery intervention. It is recommended to include stimulus, response and meaning propositions when imagery training athletes to assist them to generate more vivid and more effective images (Calmels et al., 2004). When sport psychologists and practitioners support athletes in the practice of imagery, they often use a prepared script. The content of the imagery is based on athletes' needs and what they want to achieve. Typically once a script has been developed there is no modification of the content throughout the imagery training program. This traditional imagery delivery method, which is called routine imagery in the current thesis, has been used in many studies and applied settings, (for a review see Cooley et al., 2013), in which the scenarios contained the same propositions throughout the intervention. In a systematic review by Cooley et al., (2013) studies were compared in terms of various factors that can affect the efficacy of imagery, including the imagery delivery method. Cooley et al. reported that 15 studies out of 20 included no changes in imagery scripts throughout the interventions. For example, some researchers examined the effectiveness of the PETTLEP model by including all its elements in the imagery intervention with no change to the script throughout the study (e.g., Wakefield & Smith, 2009; Wright & Smith, 2007). It has been suggested that incorporating all PETTLEP elements strengthens the functional equivalence between imagery and task execution (Holmes & Collins 2001), which results in more effective imagery training (Smith et al., 2007). Nonetheless, implementing the various elements of the model can be impractical in some situations and create overload for athletes (Wakefield & Smith, 2012). This means that including all imagery elements from the start of the intervention may cause difficulty for athletes in concentrating on the appropriate stimulus and response propositions, for example, because of the large amount of information provided, particularly for athletes who are experiencing systematic imagery for the first time, or those who have low imagery ability. For example, for basketball players to imagine free throw shooting effectively, many aspects, such as colour, texture, shape, and size of the ball, teammates, opposition, referees, voices, and all feelings that are associated with free-throw shooting when they are actually involved in the situation, should be included in their imagery which could be too much information for them to absorb. One way to avoid or to limit overloading athletes is to implement various elements of imagery in a progressive way (Wakefield & Smith, 2012).

In the review by Cooley et al. (2013) script modification happened in 5 interventions out of 20 that they studied. One method of modification, which Cooley et al. (2013) found in two studies, one by Smith et al. (2008) and the other by Shearer, Mellalieu, Thomson, and Shearer (2007), involved updating the script after consulting with participants to examine whether they wanted any modifications (additions or omissions) to make the imagery more effective, as perceived by the particpants. Another method of modification was found in Cooley et al.'s study (2013), which is referred to as progressive imagery in this thesis. This involved the researcher modifying imagery scripts by adding new details in stages. Cooley et al. only found two studies that used the PI method (Calmels et al., 2004; Nordin & Cumming, 2005). In PI imagery, the first scene normally includes very basic details, and progressively more details are added to the script as imagery sessions progress. This approach allows athletes to learn the parts of the script presented at the start, so that it is easier to cope with more details as they are added. It has also been suggested in the PETTLEP model that an imagery script should be continually updated due to ongoing changes in emotion, performance environments, skill level, and the participants' imagery ability (Holmes & Collins, 2001). PI imagery can also be applied to incorporate different propositions of bioinformational theory (Lang, 1979) progressively. For example, starting with stimulus propositions in the first scene of imagery and then adding response and meaning propositions (e.g., Cumming et al., 2007; Williams, Cumming, & Balanos, 2010), which avoids overwhelming athletes with too much information.

In one study to clarify how dancers use imagery, Nordin and Cumming (2005) asked elite and non-elite dancers how they imagined their performances. “How” referred to the way dancers obtained images (e.g., from books, pictures, memory), the complexity of the imagery they used, and layering (creating a basic image of a skill and then adding qualitative elements, like emotions). Nordin and Cumming found that higher-level dancers used the layered approach more than recreational dancers to facilitate the development of vivid images. Higher-level dancers described that they started with a very simple image and then they added more details to it layer by layer. Nording and Cumming suggested that athletes should use a simple layering of imagery and gradually increase the complexity of their images by building them up in layers. For example, the first layer of imagining a FT shot in basketball might include imagining physical or technical aspects of the skill, such as the action of players’ feet, legs, torso, and arms. Players might then add strategic components (e.g., surroundings), to the image in a second layer after several sessions with the basic imagery script. As a final layer, they might add emotional aspects, such as feelings of control and complete focus. Wakefield and Smith (2012) have proposed that it is wise to consider implementing the elements mentioned progressively in athletes’ imagery training programs to avoid overloading.

Furthermore, imagery is a trainable skill, and like any other skill, it can be improved through practice (Rodgers et al., 1991). Calmels et al. (2004) proposed that it could be beneficial to use the PI approach to enhance the imagery ability of individuals. They employed a similar layered approach with softball players in a multiple baseline across-subjects design. Imagery vividness of players increased after a total of 28 intervention sessions incorporating five phases of imagery training. During the first phase, participants imagined multi-environment conditions from internal and external perspectives. In the second phase, real game situations were created in participants' minds and how they successfully performed in those situations. The researchers then progressively added more details to the images (e.g., the trajectory of the ball, desired contact with the bat, the weather and the crowd noise) and also dealing effectively with distraction information (e.g., the reputation of the pitcher, score, and a perceived unfair umpire). The finding that imagery vividness increased gave initial support to the notion that progressive imagery training is effective for imagery ability improvement. However, this study has been criticized on the basis of its small sample ($N = 4$) and for not employing a control condition (Williams et al., 2013). Therefore, the imagery ability improvement can be due to the imagery training itself, which has been shown in previous research to improve imagery ability (e.g., Cumming & Ste-Marie, 2001; Rodgers et al., 1991), and not because of the imagery training method that the researchers used.

Some researchers suggested that to improve imagery ability, propositions suggested in Lang's bioinformational theory (1979) should be included in athletes' imagery training in layers (Cumming et al., 2007; Williams et al., 2010). In the studies just cited, Cumming and colleagues (2007, 2010) examined the effect of a layered stimulus response training (LSRT) by including some stimulus details in the participants' imagery script that they found easy to imagine (e.g., seeing the ball and the racket, and serving the tennis ball). Participants were then asked to include additional stimulus, response, and meaning propositions that they thought were important in order to make the images more vivid. Additional stimulus propositions (e.g., specific details about the competition venue or winning a race), response propositions (e.g., muscle tension, increased heart rate), and meaning propositions (e.g., the interpretation of the image such as having the spark of the will to win), were added to the original image in separate layers.

In a recent research, the layered imagery training method has not only been found to improve imagery ability, but also to positively affect performance of the imagined task (Williams et al., 2013). Williams et al., (2013) compared three different imagery-training methods, namely LSRT, motor imagery (MI) practice, and visual imagery (VI) practice. The LSRT and MI practice conditions imagined successfully performing the golf-putting task, whereas the VI practice condition imagined the ball rolling into the hole. In each session the participants in the LSRT condition were asked to add propositions that they felt would make the image more realistic, whereas participants in the other conditions experienced no changes in their imagery scripts during the four imagery sessions. Only participants in the LSRT condition improved significantly in their kinaesthetic imagery ability and actual golf-putting performance. Considering that the participants in this study by Williams et al. were all low in imagery ability and experiencing imagery for the first time, not directing them to incorporate specific propositions might not have been the most appropriate way to examine the effects of layered imagery.

In another study, Quinton et al. (2014) examined PETTLEP elements in the layered imagery method. More elements were introduced each week as the intervention progressed. In this study, children (age = 9.72 years, SD = 2.05) were involved in either a 5-week layered imagery training or nutrition control condition twice a week. Participants in the layered imagery condition first generated basic details of the gymnasium in their mind, and then they incorporated more detail, such as emotion, muscles working, and contact with the ball. Layered imagery was employed to maintain children’s interest and avoid boredom and also to prevent overloading them with too much information. Layered imagery did not have any significant impact on dribbling and passing performance. The imagery ability of participants did not improve after the layered imagery intervention. Quinton et al. reasoned that the number of imagery sessions per week might not have been enough to reveal significant improvement. It has been suggested in the literature that to elicit comprehensive results, a minimum of three imagery sessions per week are needed (Smith et al., 2007; Wakefield & Smith, 2009).

Another possible approach is narrowing down the information and propositions as the intervention progresses. That is, introducing a complete version of imagery that includes very detailed information at the beginning and systematically taking away elements in phases. Bruner (1960) proposed in his theory of selective attention that learners should only focus on key elements when they imagine a new skill and they must omit nonessential elements. In support of the selective attention theory, Corbin (1972) stated that learners will benefit from imagery only by paying attention to the important details necessary for the successful completion of the skill. On the other hand, the importance of imagining the holistic picture of a movement is highlighted in the gross framework theory (Lawther, 1968). Lawther proposed that learners must have some previous knowledge of the task in order for learning to be successful. Corbin argued that this also applies to mental practice if it is to be successful. Consequently, in order for imagery training to be effective, Corbin's arguments suggest that all aspects of the skill must be included in the imagery at the start so the imagers understand what the task is about as proposed by Lawther, and then the imagery script should be refined through eliminating the unnecessary elements of the skill being learned to focus on the key elements, as proposed by Bruner. For example, for basketball players to imagine free throw shooting effectively, many aspects, such as colour, texture, shape, and size of the ball, teammates, opposition, referees, voices, and all feelings that are associated with free throw shooting when they are actually involved in the situation, should be included in their imagery at the start. The imagery experience then becomes less detailed and simpler in stages by taking away some elements that are not appropriate to their level of expertise (e.g., pressure situations, spectators, and other players on the court) to focus on the key aspects of skill production to improve shooting performance.

Overall, a number of different approaches have been adopted and evaluated as methods for the delivery of imagery training. These methods have typically varied dependent on the specific requirements of the athlete, sport, performance situation, and program outcome goals. However, existing research that has compared the efficacy of different approaches to imagery training is limited. Therefore, additional studies are required to extend knowledge and understanding of best practice principles within the imagery literature.

## The Present Thesis

The systematic use of imagery by athletes of all levels continues to increase (Morris et al., 2005). However, the most effective imagery delivery method is yet to be determined and researchers and practitioners remain uncertain about which method they should recommend to athletes. Therefore, research failing to illustrate imagery effectiveness can be due to the imagery delivery method being inappropriate to the participants. The traditional imagery delivery method in which an imagery script or training program is presented indetailed form and practiced in the same way in all sessions is referred to as routine imagery (RI) in this thesis. RI has been used in many studies and applied settings (for a review, see Cooley et al., 2013). Another approach recently used is imagery training  starts with simple images, few objects, and little action, and then creates more complex situations by adding information in steps. Williams et al. (2013) referred to the program they used as "layered" imagery. In this thesis a similar approach is labelled as progressive imagery (PI).

Another alternative training method, which is introduced in this thesis for the first time, is retrogressive imagery (RETI). In RETI, athletes start with a fully detailed scene, as in RI, then the content of the imagery becomes simpler in stages by removing contextual factors. The reason I used the term ‘PI’ instead of ‘layered imagery training’ is that ‘layered imagery’ only suggests the presence of layers, but does not actually indicate whether those layers are added or taken away. The terms PI and RETI, however, clearly indicate whether layers are added or taken away.

The purpose of the present thesis is to determine the efficacy of different imagery delivery methods. To investigate that, I conducted two studies to compare the potency of the three imagery delivery methods (RI, PI, and RETI) with one another, and with a control condition on FT performance and FTSE. In Study 1, I examined these delivery methods in limited-ability players and in Study 2 the participants were highly-skilled players.

I conducted another study (Study 3) to investigate the effectiveness of the superior imagery training method in Study 2, PI, in the real world setting among highly-skilled players. To do so, I employed an ABCD single-case design to compare the participants’ game FT percentage during a playing season in three intervention phases (BCD), in which details were progressively added to the imagery script, with their baseline (A) performance of free throw shooting. At the end of Study 3, I conducted brief interviews with the aim of examining the athletes’ personal experience of the PI imagery method they used.

I hypothesized that all imagery interventions would lead to an overall increase in FTSE and performance enhancement compared to C condition. In addition, I predicted that the PI training method would show greater improvement in FT and FTSE than the RI method. As RETI was introduced in the present thesis, and the effectiveness of RETI imagery has not been examined in any other study, I had no specific hypothesis for RETI imagery effectiveness except that the participants in the RETI condition would improve in

FT performance and self-efficacy more than those in the C condition. The findings of this thesis can be a starting point for more empirical investigations to show which imagery training method is more advantageous and under what conditions. The information obtained from the three studies in this thesis can be used to provide practical knowledge to support psychology consultants, coaches, and athletes.

The aims of the present thesis were:

1. To compare the effectiveness of routine, progressive, and retrogressive imagery training methods on free-throw shooting performance, and self-efficacy in limited-skill basketball players (Study 1).
2. To compare the effectiveness of routine, progressive, and retrogressive imagery training methods on free-throw shooting performance, and self-efficacy in highly-skilled basketball players (Study 2).
3. To determine the effects of the superior imagery-training method from Study 2 on free-throw shooting performance of highly-skilled basketball players in competitive situations and explore athletes' personal experiences of doing imagery using that delivery method (Study 3).

# CHAPTER 3

# STUDY 1: THE EFFECT OF ROUTINE IMAGERY, PROGRESSIVE IMAGERY, AND RETROGRESSIVE IMAGERY TRAINING PROGRAMS ON FREE THROW PERFORMANCE AND FREE THROW SELF-EFFICACY OF PLAYERS WITH LIMITED BASKETBALL SKILLS

## Introduction

The purpose of the first study was to compare the impact of different imagery training methods, namely routine imagery (RI), progressive imagery (PI), and retrogressive imagery (RETI) training on basketball free throw (FT) performance and FT self-efficacy of limited skilled basketball players.

In RI training, athletes imagine performing the skill in a competition situation, from the first session until the end of the imagery training period with no changes from session to session. Thus, RI participants imagined FT shooting including all the details of the real match environment, such as the last few seconds of a tight game in which the player must make the free shot to win for the team in front of a large audience. This is the standard form of imagery training that is widely practiced in sport (e.g., Smith et al., 2008). It is thought that by including all elements, the functional equivalence at the neural level between imagery and performance will be increased (Holmes & Collins, 2001). PI is the form of imagery training in which the first sessions involve a very simple scene and, as sessions proceed, the scene becomes more complex, with the addition of more contextual factors and dynamic images. Some practitioners have proposed that PI is more effective than RI when athletes are undertaking imagery for the first time or starting a new imagery program. For example, sport psychologists from the U.S Olympic Committee (USOC, 1998) recommended that the content of imagery training should progress from nonthreatening and non stressful content toward more complex competitive situations. But this has not been systematically examined. In contrast, the RETI training method is introduced for the first time in this thesis. In RETI, athletes start with the fully detailed scene, as in RI, then as imagery sessions continue, the content of the imagery becomes simpler, by removing contextual factors until just the basic skill remains to be imagined in later sessions.

The RETI approach was developed from a combination of two theories, namely the gross framework theory and the theory of selective attention. In selective attention theory, Bruner (1960) proposed that learners of a skill must omit nonessential elements of the skill and only include key elements in their imagery of the skill. In support of selective attention theory, Corbin (1972) stated that "If a learner is to gain in skill proficiency, attention must be directed toward the important aspects of the skill to be learned" (Corbin, 1972, p. 101). Therefore, learners benefit from imagery only by calling attention to the important details necessary for the successful completion of the skill. That is, in order for the imagery to be effective, aspects of the skill must be narrowed down, and the imagery refined through eliminating the unnecessary elements of the skill being learned.

In gross framework theory, Lawther (1968) proposed that for optimal motor learning to occur, learners needed to be able to conceptualise the total picture (gestalt) of a task. The emphasis was placed on seeing the whole task (overall general impression) rather than the parts or details of it (Grouios, 1992; Hale, 1994; Morris, Spittle, & Watt, 2005). Corbin (1972) supported gross framework theory, stating that learners must have some previous knowledge of the task, either actual or vicarious, in order for the mental practice to be successful. He further stated that for imagery to effectively improve the performance of a skill, one must be able to image the entire movement constituting the task to be learned. When individuals have previous experience with a task, they develop a mental gross framework of the movements involved in the task.

The RETI approach starts with the whole picture of a task (e.g., free throw shooting in competition context in this thesis) to aid learners in establishing this "gross framework". Then learners' attention was directed towards the more important elements of the skill by narrowing down the amount of information they receive during imagery sessions in a manner consistent with selective attention theory.

It has been suggested by practitioners that imagery training should progress from simple to complex (Morris et al., 2005; Nordin & Cumming, 2005; Wakefield & Smith, 2012). PI not only has been found to improve performance of the imagined task (Williams et al., 2013), but it has also been reported to positively affect imagery ability (Calmels et al., 2004), which may subsequently lead to increase in performance (Gregg et al., 2005) following an imagery intervention. Fitts and Posner (1967) argued that learners in a motor skill focus on gathering information about what to do and how to do it. Sometimes the information gathered is too much for learners to absorb and to take everything in. For example, during the cognitive and associative phases of learning to perform free throw shots in basketball, much information and attention needs to be paid to the position of the body and the sequence of leg and arm movements and the establishment of a basic picture of the skill to build up a mental image of the skill. Based on these suggestions, the hypothesis of this study was that the PI training method would lead to significantly greater improvement in FT and FTSE than the RI, and a control condition (C) including no imagery training. There is no previous research on RETI on which to base hypotheses as RETI was introduced in the present study. Although the effectiveness of RETI imagery has not been examined in any study, some indications can be derived from imagery theory and research on learning. For example, based on the observation that the imagery script that participants in the RETI condition practiced was the same as that used in RI and PI, and that script was based on a number of evidence-based principles, I expected that participants in the RETI condition would improve in FT performance and self-efficacy more than participants in the C condition.

# Method

## Participants

I recruited 60 basketball players aged 18-37 years (M= 25.36, SD= 6.29) for this study (34 male, 26 female). Participants were recreational players (C or D grade basketball players in their local club), playing two games per week and having had a minimum of one year involvement in playing competitive basketball prior to the intervention. Almost all basketball associations in Victoria, Australia run domestic competitions during the year. They usually grade teams based on the quality of a team and players' skills. The best teams play A grade and the number of grades below (B, C and so on) depends on the number of courts and teams that register with the league. The A grade players are mostly ex-national players or State players who play on their off season to maintain their fitness. At Melbourne Sport and Aquatic Centre (MSAC), where I recruited my participants, there are 8 men's grades with a minimum of 9 teams in each grade. The C and D grade are fourth and fifth grade level with limited skilled players.

The participants had no previous experience in systematic imagery training. They were selected based on the following criteria:

a) The athletes volunteered to participate.

b) To ensure that participants had the ability to imagine what they would be instructed to imagine their imagery ability had to be a minimum average score of 150 out of 400 on the Sport Imagery Ability Measure (SIAM) dimension subscales (vividness, control) and sense modality subscales (visual, kinesthetic, tactile, auditory) that are considered to be most relevant to basketball free throw shooting performance.

Following the screening test on imagery ability, I assigned participants to one of four conditions (*n* = 15 in each condition): RI, PI, RETI, or C condition. Eleven participants withdrew from the study due to injury or personal reasons having been told they were free to do so at any time. Forty-nine of the participants continued with the study extension, 11 in RI, 15 in PI, 12 in RETI, and 11 in control condition.

**Study Design**

I employed a mixed design for the present study, with four independent conditions, RI, PI, RETI, and control, and repeated measures in terms of occasions to distinguish the mean difference in FT performance and FT self-efficacy between the four conditions and within each condition across four occasions. The Sport Imagery Ability Measure (SIAM; Watt et al., 2004) was used to check all participants' eligibility to take part in this study prior to the intervention. In the intervention phase, imagery condition participants employed the imagery training program (PI, RI, or RETI) that they were assigned to for 12 sessions (three times a week for four weeks). Participants in the C had no imagery training. Regardless of their condition, FT performance of all participants was measured before the intervention phase and after every three imagery sessions. Self-efficacy of all participants was tested before the intervention phase, at the end of the second week and at the last day of the intervention phase.

**Measures**

**Demographic information form.** A form was administered to the participants to record their age, gender, years of basketball experience, highest level played, and whether they had experienced imagery or other psychological techniques before (See Appendix A).

**Imagery ability.** The Sport Imagery Ability Measure (SIAM; Watt et al., 2004) was administered to ensure that participants had sufficient imagery ability to perform the imagery tasks in the interventions (See Appendix B). SIAM includes five dimensions, namely vividness, control, duration, ease, and speed of generation of images; six sense modalities, namely visual, auditory, kinaesthetic, tactile, gustatory, and olfactory; and the experience of emotion associated with imagery. The SIAM has internal consistency reliability ranging from good to very good with the alpha coefficient values of all scales above .75, except for speed and ease, which are .66 and .67, and moderate to very good test-retest reliability correlations of subscales over 4 weeks above .56, except for Auditory (.41), Ease (.5) and Speed (.53). Athletes imagined each of four sport-related scenes for duration of 60 seconds. Following each scene, athletes responded to 12 items, representing five imagery dimensions, six sense modalities, and imagery of emotion, by placing a cross on 100mm analogue scales with verbal extremes at the end of each scale. Scores for each dimension or modality were summed across the four scenes, so each subscale score varied between 0 and 400 points. The scores of the most relevant dimension subscales (vividness, control) and sense modality subscales (visual, kinesthetic, tactile, and auditory) to basketball free throw shooting performance were used to ensure that athletes' imagery ability is in a level that they can participate in this study. The cut off score was based on the normative scores in the SIAM manual (Watt et. al., 2004 ), and other research (e.g., Polish version of SIAM; Budnik-Przybylska, Karasiewicz, Morris, & Watt, 2014). The manual presents scores that represent low, moderate, and high levels of imagery ability on each of the 12 subscales. Mean subscale scores recorded in two papers were also noted and the cut off score for each subscale was then considered in relation to the instructions in the questionnaire.

**Performance.** The basketball free throw (FT) shot was selected because it is a closed skill that can be scored in practice, field study, or match conditions. It was tested before, during, and after the intervention. FT shots are generally awarded to players who are fouled by the opposing team while in the act of shooting. Players take their shots from behind the FT line, which is 15 feet from the basket. Each successful FT is worth one point. In the present study, to measure shooting accuracy more precisely, 3 points were scored for shooting the ball into the basket without hitting the rim; 2 points for shooting into the basket after hitting the rim; 1 point for hitting the rim, but not going in the basket; and, 0 for missing completely. Before performing the task, players were instructed to shoot directly at the basket, so hitting the backboard was considered to be a miss (0 points), even if the ball rebounded through the rim. Each test contained two sets of 10 FT shots with a 15-minute rest between the two trials. The total score for each test was calculated by summing the scores for the two sets of 10 shots, giving a range of 0 to 60 ( Appendix C).

**Free throw shooting self-efficacy (FTSE).** I developed this scale specifically for reporting of self-efficacy for basketball FT shooting using guidelines proposed by Bandura (2006) in the microanalytic technique. Participants were asked to imagine that they were about to shoot 10 FTs. They were asked how certain they were that they could successfully make 1 out of 10, 2 out of 10, all the way up to 10 out of 10. Participants assessed their self-efficacy from 0% (*totally uncertain*) to 100% (*very certain*) for making each number of shots out of 10. Their FTSE was the sum of the percentages they reported divided by the number of estimates (See Appendix D).

**Imagery manipulation check.** To verify the imagery experience, participants filled out a manipulation check form after each imagery session. This check followed recommendations previously made in the literature (e.g., Cumming & Ste-Marie, 2001; Nordin & Cumming, 2005; Smith & Holmes, 2004). Participants were asked to rate how well they saw, heard, felt, and how well they performed the imagery they were instructed to do (See Appendix E). This was assessed on a 4-point Likert scale ranging from 0 (*not at all*) to 4 (*very much*).

## Interventions

Participants were assigned to one of four conditions: routine imagery, progressive imagery, retrogressive imagery, or control condition. Those who were assigned to imagery conditions took part in 12 individual imagery sessions (three times a week for four weeks), each lasting approximately 10 minutes (via listening to pre-recorded audiotapes), where they imagined themselves performing successful FTs in each session. Participants in the C condition completed all the same measures as participants in the imagery conditions, that is, SIAM, FT performance, and FT self-efficacy at pre-test, at the same times as imagery participants performed tests after imagery sessions, and at the end of the intervention phase, but they were not instructed to perform imagery of FT shooting. This condition was included to control for any practice effect of performing a FT test after each imagery session in the imagery conditions.

**Routine imagery.** Participants in the RI condition were asked to imagine themselves on the basketball court, the lines of the court, their team-mates on and off the court and the coach, the opponent players on the court, and a close friend among the fans in the stands. They were instructed to imagine rich colour in their imagery scenes from the first session, including the colour of the uniforms of their team-mates, opponents, and the officials. They imagined being fouled in the last 1 seconds of the game and you are down by one point. They were asked to imagine the referee lining team-mates and opponents up around the key and giving the ball to them for the FT shot. They then imagined the feel of the ball, the dimples on the basketball, the cheering of the crowd and the coach encouraging them. Then they imagined bouncing the ball, the sweat running down their face, seeing the rim, and bending their knees to get power in their legs. Finally, they took all the power in their legs, up through their body to release the ball toward the net and experienced the good feeling after successfully making a clean basket. This script was repeated during all 12 imagery sessions in the intervention phase with no changes (See Appendix F).

**Progressive imagery.** Participants in the PI condition experienced different scripts each week, starting with a very simple scene and ending with the complex and detailed image that RI participants experienced through the entire intervention period. In the first week, the script they were instructed to follow involved simple static aspects of the basketball FT context. Players imagined the court lines, the rim and themselves standing at the foul line and performing FTs, focusing on their technique. In the second week, complexity was increased somewhat by adding imagery of team-mates and opponents standing around the key and noticing the colours of major aspects of the scenes, such as the colour of the ball, team-mates' and opponents' singlet colours, and the referee`s shirt colour. The complexity was increased further in the third week by imagining taking FTs while the coach was standing on the sideline encouraging them and attending to the sound of spectators and their close friends sitting on the stands cheering for them. During the three imagery sessions in the fourth and final week of the intervention, participants imagined a high-pressure situation and feeling the emotion they would experience in a real competition, in which there was one second left on the clock and being down by one point and the outcome of the game depends on their FT shots (See Appendix G).

**Retrogressive imagery.** The procedure was reversed for participants in the RETI condition. Thus, they started by imagining a complete version of the FT imagery script in Week 1 (what RI participants imagined in every session and PI participants imagined in the fourth week of the intervention phase). In Week 2, participants in the RETI condition were instructed to imagine the same scenario except taking the pressure situation away (what PI participants imagined in Week 3), then in Week 3 of RETI, the content of imagery was similar to that experienced in Week 2, but the spectators and the coach parts were omitted to make the script simpler (what PI participants imagined in Week 2) and, in Week 4, RETI participants finished with the simplest version of the imagery script (as in the first week of the PI script) (See Appendix H).

**Control condition.** Participants in this condition were not asked to participate in imagery training sessions, but they undertook all the measurements exactly as in the other conditions.

**Procedure**

After receiving approval from Victoria University Human Research Ethics Committee (VUHREC) and getting permission from the venue manager, I invited volunteer basketball players to participate in this study via recruitment flyers. Prior to the first phase, all volunteers were briefed about the study (Appendix I) and all their questions were answered. Consequently, the volunteer players for the study completed the consent form (Appendix J), demographic information sheet (Appendix A), and the SIAM questionnaire (See Appendix B). Their sport imagery ability was measured in order to determine if they met the criteria to take part in this study. Participants who scored at least 150 on the key SIAM dimensions (vividness, control) and sense modality subscales (visual, kinesthetic, tactile, auditory) were assigned to one of the three imagery conditions or the C condition randomly. The benefits and any potential risks of participation, plus a brief description of the program were provided to the participants diligently throughout the separate sessions for each condition (Appendix K & L). Those players who eventually decided to participate in the study signed the second phase consent form (Appendix M & N). Once each participant had completed the consent process and had been assigned to a research condition the pre-test of FT performance and FTSE were administered.

Participants who were assigned to imagery conditions took part in 12 individual imagery sessions (three times a week for four weeks), each lasting between 5 to10 minutes (via listening to pre-recorded audiotape), where they imagined themselves doing successful FTs during each session. The scripts were research driven and tested with one expert in sport psychology and two high level ex- basketball players. The FT shot accuracy of all participants, including those in the C condition was tested at the end of each week. All participants completed FTSE before the intervention phase, after the second week, and after the intervention phase.

**Analyses**

To make sure that there was no significant difference between participants in different conditions in terms of their imagery ability, I conducted MANOVA.

For analyses of FT performance and FTSE, I employed gain score, which is the difference between pre-test score and score at the end of Weeks 1, 2, 3, and 4 for each condition. Huck and McLean (1975) argued that in pre-test/post-test designs the MANOVA/ANOVA models underestimate the effect, because it includes the pre test occasion as an occasion which is active. One way to minimize its effective is to calculate gain scores and then do the ANOVA using gain scores. Use of gain scores provides control for chance differences between participants at pre-test by considering scores in terms of change from each individual's starting score. To test for possible significant gain score differences between conditions on different occasions I employed a mixed design analysis of variance (ANOVA) with one independent groups factor, conditions, with four levels, RI, PI, RETI, and control, and one repeated measures factor, occasions, with four levels, gain score at the end of intervention Week 1, 2, 3, and 4.

I conducted the same analysis to test the self-efficacy difference between conditions on different occasions. I employed a mixed design analysis of variance (ANOVA) with one independent groups factor, conditions, with four levels, RI, PI, RETI, and Control, and one repeated measures factor, occasions, with two levels, gain score at the end of intervention Weeks 2 and 4.

The Statistical Package for the Social Sciences (SPSS: version 21.0) software was used to calculate the means, standard deviations, gain scores (mean post-test score minus mean pre-test score), and ANOVA for all scales and scores. The Tukey HSD post-hoc test was used to explore interaction effects between conditions and occasions.

## Results

The overall purpose of the present study was to compare the effects of different imagery training methods namely: RI, PI, and RETI to each other and to a control condition that received no imagery. Specifically, the purpose of this study was to examine differences between the different conditions at different occasions on FT and FTSE of players with limited basketball skills. The results of the statistical analyses are presented in this section, beginning with the descriptive results of the SIAM and comparison of SIAM subscales between conditions in pre test using MANOVA. The performance raw scores for each condition are provided next, followed by the main analysis, comparing FT shot performance gain scores of the four conditions using ANOVA. Next I present the descriptive statistics for FTSE gain scores followed by examination of differences between FTSE gain scores for conditions.

### Imagery Ability

The SIAM was used to check participants' imagery ability at the pre test. Means and standard deviation of 6 more relevant SIAM subscales to basketball FT shooting for all conditions are shown in Table 3.1. This indicates that not only all participants overall were at a decent level of imagery ability, but also on the important of SIAM variables there was no significant differences between conditions at the start.

Table 3.1
*Means and Standard Deviations of SIAM Scores*

| SIAM subscales | CONDITION | *M* | *SD* | *F* | *p* |
|---|---|---|---|---|---|
| AUDITORY | RI | 221.54 | 46.13 | .13 | .94 |
| | PI | 230.26 | 68.43 | | |
| | RETI | 232.66 | 55.90 | | |
| | CONTROL | 220.54 | 53.53 | | |
| VISUAL | RI | 272.00 | 45.83 | .11 | .95 |
| | PI | 271.13 | 52.68 | | |
| | RETI | 266.00 | 50.29 | | |
| | CONTROL | 262.18 | 37.19 | | |
| KINESTHETIC | RI | 215.72 | 59.71 | .40 | .75 |
| | PI | 225.73 | 41.77 | | |
| | RETI | 243.16 | 77.36 | | |
| | CONTROL | 231.18 | 66.41 | | |
| TACTILE | RI | 268.36 | 53.16 | 1.5 | .22 |
| | PI | 228.73 | 44.17 | | |
| | RETI | 245.83 | 37.52 | | |
| | CONTROL | 244.27 | 51.79 | | |
| CONTROL | RI | 257.27 | 58.57 | .18 | .91 |
| | PI | 270.40 | 52.85 | | |
| | RETI | 258.91 | 61.24 | | |
| | CONTROL | 269.72 | 54.85 | | |
| VIVIDNESS | RI | 283.81 | 63.60 | 1.8 | .15 |
| | PI | 273.46 | 47.52 | | |
| | RETI | 292.08 | 56.42 | | |
| | CONTROL | 321.63 | 43.94 | | |

Analysis revealed no systematic difference on important subscales of the SIAM between conditions in their pre-test scores.

**Performance Outcome**

The results presented in Figure 3.1 shows the mean for the raw FT scores in each occasion of testing. Participants' FT performance was measured once before the intervention (occasion 1), and at the end of each week during the intervention phase (occasions 2, 3, 4, and 5). This figure indicates that there were no noticeable changes over time for PI and C conditions. RETI and RI conditions showing relatively higher scores than the other two conditions and they scored higher in FTs on occasions 4 and 5.  As it is clear in the figure, RETI and RI are spreading away from the third occasion with RETI having higher impact on FT performance. RI condition is not as steep slope as RETI condition between Occasion 3 and 4but sustained improvement between Occasion 4 and 5. Because the close overlap between the lines in Figure 3.1 made it very difficult to distinguish which error bar referred to which condition, error bars for this data are presented in a bar graph in Appendix R.

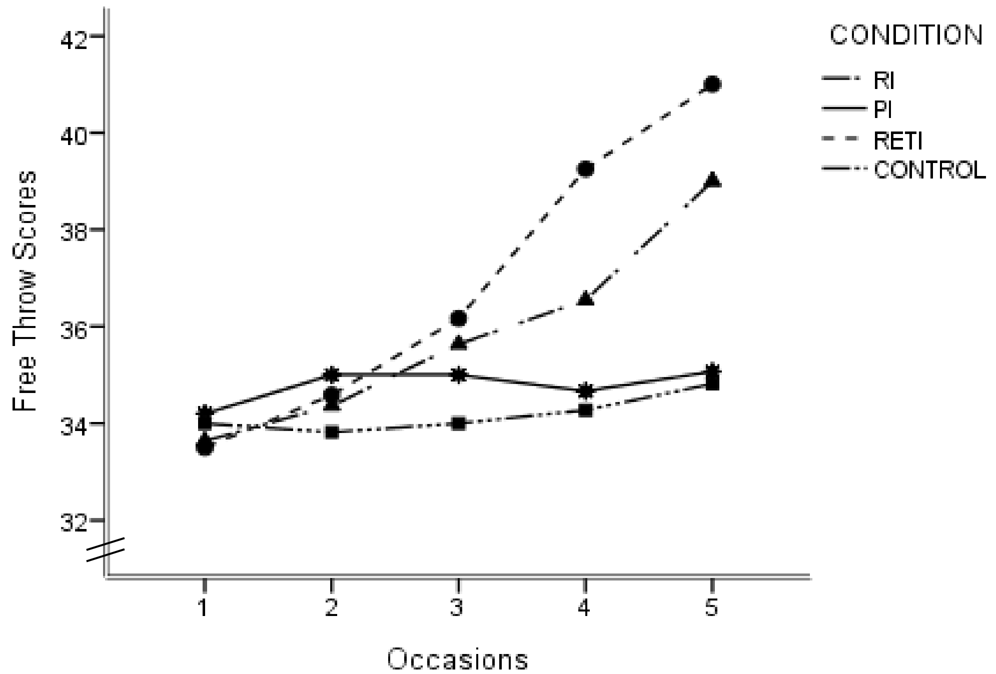


*Figure 3.1.* Free Throw Scores of each Condition in Different Occasions

Means and standard deviations for FT performance gain scores for each condition on each occasion are outlined in Table 3.2. The FT gain score means (*M*s) and standard deviations (*SD*s) between the pre-test and each other occasion are presented as Gain Score Time (GST) 1-2, GST 1-3, GST 1-4, and GST 1-5.

The gain score means and standard deviations of FT performance scores show that RETI and RI conditions produced noteworthy changes on last two occasions, whereas the changes for PI and C conditions were minimal. These results are presented graphically in Figure 3.1, which clearly shows that there was not much impact on the first two weeks of intervention for any of the conditions. The larger performance increases for RETI and RI occurred from GST1-3 onward. Table 3.2 also illustrates that participants in the RETI and RI conditions improved, but not at the same rate with RETI having the highest impact on FT performance.

Table 3.2
*Gain Score Means and Standard Deviations of FT Performance Scores*

| | GST 1-2 | | GST 1-3 | | GST 1-4 | | GST 1-5 | |
|---|---|---|---|---|---|---|---|---|
| Conditions | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| RI | .72 | 2.37 | 2.00 | 2.86 | 2.90 | 3.59 | 5.36 | 2.58 |
| PI | .80 | 3.21 | .80 | 5.23 | .46 | 4.38 | .86 | 4.89 |
| RETI | 1.08 | 2.50 | 2.66 | 5.43 | 5.75 | 3.67* | 7.50 | 5.33* |
| CONTROL | -.18 | 2.71 | 0 | 4.00 | .27 | 3.87 | .81 | 3.94 |

A mixed design ANOVA was employed to compare the gain score differences between conditions on different occasions. Analysis revealed a significant time effect *F* (2.22, 100.06) = 12.19, $p < .001$, $\eta_p^2$ = .21with very large effect size, as well as a significant condition effect, *F* (3, 45) = 3.86, $p = .015$, $\eta_p^2$ = .06 with medium effect size, and a significant interaction effect $F$ (6.67, 100.06) = 3.51, $p$ = .002, $\eta_p^2$ = .19 with very large effect size.

Post hoc Tukey tests showed significant differences at GST 1-4, in which participants in the RETI condition improved more than PI participants ($p$ = .006), and C ($p$ = .009). At GST 1-5, the RETI improvement was significantly higher than that for PI ($p$ = .002), and C ($p$ = .004) conditions. Post-hoc tests also revealed that the RI gain score was higher at GST 1-5, although not significant, in FT performance than the C condition ($p$ = .08), with the RI gain score being higher than the C condition in the final week. Overall, the results indicate that differences between conditions in FT performance gain scores increased at times that corresponded to GST1-4 and GST 1-5.

**Self-efficacy**

FTSE was measured three times, prior to the intervention (Time 1), after two weeks of intervention (Time 2), and post intervention (Time 3). The results presented in Figure 3.2 show the mean for the raw FTSE scores in each occasion of testing.

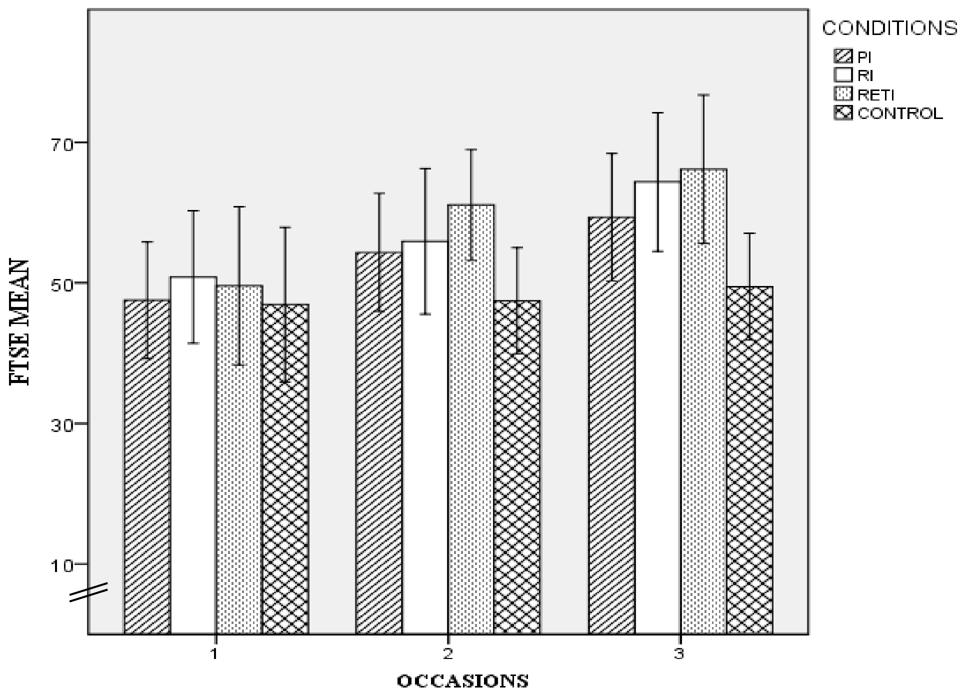


*Figure 3.2.* Free Throw Self-efficacy Scores of each Condition in Different Occasions

Gain scores were calculated from Time 1 to Time 2 (GST 1-2) and from Time 1 to Time 3 (GST 1-3). Means and standard deviation for gain scores for each condition are presented in Table 3.3. Possible scores on FTSE ranged from 0 (*no confidence*) to 100% (*very confident*). Results indicated that participants in all conditions improved throughout the intervention with gain scores ranging from *M* = .54 to *M* = 16.58, but with some variation within the conditions.

Table 3.3
*Means and Standard Deviation of FTSE Scores in three occasions*

| Conditions | GST1-2 | | GST1-3 | |
|---|---|---|---|---|
| | M | SD | M | SD |
| RI | 5.09 | 2.84 | 13.54 | 5.16 |
| PI | 6.80 | 2.98 | 11.80 | 3.73 |
| RETI | 11.5* | 13.84 | 16.58* | 9.47 |
| CONTROL | .54 | 7.16 | 2.54 | 7.09 |

A mixed design ANOVA followed by Tukey post hoc tests, where significant effects were identified, was employed to determine the differences between participants' self-efficacy gains in different conditions. Analysis revealed a significant main effect of imagery training program on self-efficacy gain score at GST 1-2 with a medium effect size (after two weeks of the intervention), *F* (3, 45) = 3.76, *p* = .02, $\eta_P^2$ = .06, and similarly a significant gain score at GST 1-3 (after the intervention phase), *F* (3, 45) = 3.61, *p* = .02, $\eta_P^2$ = .06, also with a medium effect size. Post hoc Tukey tests showed that only participants in the RETI condition recorded significantly higher self-efficacy than those in the C condition after two weeks of the intervention, *p* = .01, as well as after four weeks of the intervention, *p* = .01.

**Imagery Manipulation Check**

To verify the imagery experience, participants filled out a manipulation check form after each imagery session. Participants were asked to rate how well they saw, heard, felt, and how well they performed the imagery they were instructed to do on a 4-point Likert scale ranging from 0 (*not at all*) to 4 (*very much*). Table 3.4 shows mean and standard diviation of  total score of each condition in each week.

Table 3.4
*Means and Standard Deviation of Imagery check  Scores in Four Weeks*

| Condition | | Week 1 | Week 2 | Week 3 | Week 4 |
|---|---|---|---|---|---|
| RI | *M* | 2.48 | 2.54 | 3.40 | 3.17 |
| | *SD* | .45 | .37 | .07 | .38 |
| PI | *M* | 2.32 | 2.56 | 3.46 | 2.82 |
| | *SD* | .53 | .61 | .13 | .35 |
| RETI | *M* | 2.32 | 2.53 | 3.39 | 2.85 |
| | *SD* | .60 | .43 | .14 | .26 |

A mixed design ANOVA was conducted to compare scores of imagery manipulation checks between imagery conditions across four weeks periods (Week 1, Week 2, Week 3, and Week 4). There was no significant interaction between conditions and occasions, $F$ (4.58, 80.14) = .83, $p$ = .52, $\eta_p^2$ = .04 with small effect size. There was a significant main effect for occasion, $F$ (2.29, 80.14) = 57.07, $p$ < .001, $\eta_p^2$ = .62 with very large effect size, with all three conditions of showing an increase in imagery manipulation check scores across the four week intervention (see Table 3.4).

## Discussion

I compared routine, progressive, and retrospective imagery training programs and a no imagery control condition in terms of effects on performance and self-efficacy of limited skilled basketball players. Based on the proposition that athletes would benefit more from imagery which progresses from simple to complex (Morris et al., 2005; Nordin & Cumming, 2005; Calmels, et al., 2004), I hypothesized that athletes would demonstrate more improvement in two outcomes after experiencing the PI training than those who experienced the other two training methods and the control condition. The findings of this study showed that for players with limited skills the greatest improvement occurred for the RETI condition. This indicated that starting with a complex imagery context and making the imagery simpler with less details was more beneficial than getting exactly the same complex imagery script all the way through (RI), or a condition that started with very simple imagery and became more complex (PI).

Participants of the present study were all basketball players with limited skills, experiencing the first stages of learning categorised as cognitive and associative stages by Fitts and Posner (1967). In these stages, learners need basic, specific, short, simple and brief instructions, rather than more complex instructions. Based on the conception of the early phases of learning motor skills, the amount and speed of information provided by teachers and coaches should be controlled, and the task itself should be clarified. Limited attention to the possibility that learning happens in stages and using too many images at once, may overwhelm learners, and can compromise the effectiveness of imagery. It might be that the consequence of providing a complex set of instructions is that it overwhelms learners by presenting too much information. This could explain why participants in the RI condition did not show significant improvement compared to those in the PI and C conditions. Notwithstanding that the content in the RI condition might have been too much to absorb, participants did benefit from it, although not significantly, showing greater improvement in FT performance than participants in the PI and C conditions. PI condition participants did not effectively benefit from the imagery training program that focused on the technique at the start and added layers of contextual factors progressively. RI participants showed no significant difference from the C condition in which participants did not experience imagery. There is an issue specifically with RI that participants did not improve as quickly as participants in the RETI condition. This means the duration of practicing the imagery intervention might not have been enough for RI participants to show significant improvement.A significant effect may have been observed if the intervention phase had gone for additional sessions.

The results of this study indicate that having the experience of the whole skill and gradually breaking the skill into parts and focusing on each part is more beneficial for athletes who are in their first stages of learning rather than practising a whole skill. Imagery acts as a source of feedback, which is very important during the first stages of learning. For feedback to be of value performers must be aware of the correct performance. This can be established through demonstration and description of the skill and by imagining the whole skill to start with and then simplifying it. By comparing their performance to that of a model, learners highlight areas that they must work on to bring about improvement. However, they may need to limit the number of cues depending on each performer's stage of learning (Foxon, 2001) not to overwhelm the process of learning. Keeping the imagery script the same or starting with a rich detailed imagery and making it simpler seemed to help more compared to having it simple to start with and becoming more complex according to the results of the current study. This finding highlights that using the full version of the imagery script from the start was more beneficial. In the RI and RETI conditions, in which the correct form of a free throw shot was presented to participants at the beginning, they could use this description as a model, to which they could return to and compare it with their performance. This led to greater improvement in performance in the RETI and RI conditions than in the PI condition, in which participants did not have a rich detailed imagery script until the last week of the intervention.

Various methods of imagery used in this study could correspond to different modes of teaching motor skills, such as whole practice, part practice or a combination of them.

Thus, the principles of practice for learning motor skills can be generalised to the results of this study. Part practice refers to simplifying a skill via breaking it into smaller parts, and then, combining the units after mastering them to form the whole, which is then practiced in its entirety. Despite the beneficial effects of part practice, it may change the execution of the task biomechanically, particularly for complex tasks (Fontana, Mazzardo, Furtado Jr, & Gallagher, 2009; Haibach, Reid & Collier, 2011) and it does not aid in learning of timing of the whole task (Edwards, 2011). Segmentation, fractionization, and simplification are three types of part practice frequently used in motor learning, in which the first two are closely associated with the progressive and retrogressive interventions applied in this study respectively. The segmentation method, which is well known as progressive part practice or forward chaining refers to practicing the first segment separately then adding parts sequentially until the whole skill being practiced. In backward chaining, the segmentation process starts with learning the last part and adding parts in the reverse order. Fractionization is the method of separately practising the components of a task that are normally performed simultaneously, for example, shooting in basketball. Selecting the appropriate method of part practice depends on different factors, most importantly task complexity (the number of components or parts of a skill and the attention demanded to execute the skill) and task organization (interdependence among the components of a skill). Hence, decisions can be made in terms of these two critical elements, as well as the demands made on memory (Edwards, 2011; Haibach et al., 2011; Schmidt & Wrisberg, 2008). In the present study, the RETI intervention is similar to whole-part practice and the PI method can be compared with part-whole practice, whereas the RI imagery is allied to whole practice. According to the principles of part practice, it was expected that participants in the PI condition would benefit more and demonstrate superior performance, whereas what I found was that participants in the PI condition showed no improvement.

Participants in the RETI condition showed a significantly larger gain in the last two weeks of the intervention phase during which their imagery script included fewer components than it had at the start. This finding indicates that narrowing attention and concentrating more on crucial parts of the practice, particularly during the last sessions of RETI, helped participants to focus more on their technique, which was a valuable aspect of the intervention, leading to positive outcomes. Hence, participants had this chance to devote more attentional resources to the central task.

Imagery, routine imagery in particular, has been widely applied in diverse fields, such as cognitive psychology, neuropsychology, neurophysiology, neurorehabilitation, motor learning, motor control, physiology, and sport psychology (Cumming & Williams, 2012), but there is a paucity of support for progressive imagery in the literature (Cooley et al., 2013) and retrogressive imagery is introduced in this study for the first time. These methods have only been addressed by a small number of researchers and no research has yet systematically tested the effectiveness of these methods and compared them with routine imagery or no imagery conditions, except for Calmels et al. (2004) and a very recent study reported by Williams et al. (2013) that only used progressive imagery. Calmels et al. found that imagery ability of national softball players significantly improved following progressive imagery training. Williams et al. compared layered stimulus and response training (LSRT) with motor imagery (MI) training on novices with low imagery ability. The difference between the two conditions was that in the layered approach participants started with a simple image and tried to build up the image and make it as realistic as possible by adding in additional propositions that they believed would enhance their imagery quality. The MI did not include the layered approach and continued with the same propositions throughout. Williams et al. reported that only participants in the LSRT condition experienced an improvement in actual golf putting performance, kinaesthetic motor imagery ability, and mental imagery ability of more complex skills, compared to the MI training condition, which is in contrast with the result of the present study.

Williams et al. (2013) investigated the effects of a similar but distinctly different approach within novice athletes with lower imagery ability. Participants in their study imaged the entire scene to begin, reduced the details, and then built the image back up in layers (e.g., sensory elements, bodily sensations, emotions, and contextual aspects are added in progressive layers). This corresponds with a combination of the RETI approach followed by PI, as these terms are used in the present thesis. In the present thesis, however, the effects of each imagery approach was examined separately. Therefore, it is unclear from the study by Williams et al. which phase of the intervention (RETI, PI, or even combination of both) was responsible for the improvement found in the physical task, as well as imagery ability.

Another difference between the PI and LSRT approaches that may explain why limited-skilled participants did not benefit from the PI approach is that LSRT is participant generated and individuals were not directed to incorporate specific propositions by the researcher; rather, ecah participant chose propositions that the participant felt would make the image a more realistic representation of the actual situation if they were added to the image. In contrast, a researcher-driven approach was adopted within the current set of studies, meaning that the researcher decided what layers to add and when.

Additionally, the imagery ability improvements resulting from the intervention by Calmels et al. (2004) occurred over 28 imagery sessions. Unlike the layering technique used by Calmels et al., LSRT has been previously confined to a single imagery session, with the intention of having the participant experience more immediate benefits to their imagery ability before receiving guided imagery as part of an experimental protocol (Williams et al., 2010). LSRT benefits are more immediate (e.g., Cumming et al., 2007;

Williams et al., 2010). For example, in their study Williams et al., (2013) used a four-consecutive-day LSRT intervention. The authors suggested that it should be investigated whether LSRT benefits can be retained by participants to bring about more permanent changes in imagery ability or whether this is lost after a few days or weeks.

Further, a different imagery ability scale was used in the study by Williams et al. (2013), who described participants as low in imagery ability when they fell below a desired criterion on an SIAQ scale (e.g., scoring below 5 on a self-reported imagery ability questionnaire). Participants in all three studies in the present thesis scored at least moderate imagery ability on SIAM. It can be concluded that participants with imagery below the threshold benefit more from the LSRT approach and individuals with moderate ability in imagery benefit more from a different imagery training approach based on their level of proffeciancy in the task in hand ( eg., RETI for limited skill and PI for highly skilled).

Participants in the study by Williams et al. were novice golfers who had little or no experience with the putting task and participants in the study by Quinton et al. were children. Participants of the current study, however, were recreational players, playing two games per week and having had a minimum of one year involvement in playing competitive basketball in a league prior to the intervention.

The complexity of learning processes has been discussed by researchers, who have presented various theories and it becomes more controversial when placed in the context of Cognitive Load Theory (CLT; Mayer & Moreno, 2003; Paas, Renkl, & Sweller, 2003; Paas & van Gog, 2009; Sweller, 1994; Wickens, Hutchins, Carolan, & Cumming, 2012). CLT refers to the amount of information being processed in working memory at one time. The general drift of this theory is that people have limited working memory capacity (Cowan, 2001) and duration (Peterson & Peterson, 1959), and unlimited long-term memory.

Intrinsic, extraneous, and germane loads are three identified sources of loads within the learning environment (for more extensive discussion, see Sweller, van Merriënboer, & Paas, 1998; Sweller et al., 2011) that can influence cognitive processing during mental activities like imagery. In another study, Cumming et al. (2007) demonstrated beneficial effects of a semi-personalised LSRT approach on self-efficacy level and facilitating interpretations of the symptoms associated with competitive anxiety. Based on the self-report psychological state data collected in their study, Cumming et al. suggested that psychologists should carefully choose the imagery content prescribed to athletes according to their cognitive state to achieve the desired level of psychological and physiological activation in a competition.

Intrinsic load, which is based on the complexity of the learning materials, has great relevance to the main task being trained (Halford, Wilson, & Phillips, 1998; Kalyuga, 2011). Intrinsic load is heavily affected by element interactivity (Sweller 1994; Sweller & Chandler, 1994). An element is anything that needs to be or has been learned, such as a concept or a procedure. Low element interactivity materials allow each element to be learned with minimal reference to other elements and therefore, impose a low working memory load, whereas high element interactivity consists of elements that heavily interact and so cannot be learned in isolation, imposing a heavier working memory load (Marcus, Cleary, Wong & Ayres, 2013; Marcus, Cooper, & Sweller, 1996; Sweller & Chandler, 1994). For example, in the present study, the intrinsic load of the simple script in the first session of RETI (or last session of PI ) is greater than that of the last session of RETI (or first session of PI) because of the greater number of images and learning components, which leads to more working memory demands.

In the learning or training environment, loads that are irrelevant to the task being learned, but are included in the cognitive processing demanded for the task due to suboptimal instructional design, are considered as extraneous load, and can result in direct interference with learning. Extraneous load can be generated by poorly designed instructional materials that occupy the limited working memory resources available for learning (Sweller et al., 1998; Wickens et al., 2013). For example, in this study, all images related to performance of FT shooting are intrinsic, whereas images regarding spectators, coach, and referees, which were less relevant to the task of FT shooting, could be considered to be extraneous load, depending on the goal of the imagery training. Chandler and Sweller (1991) found that reducing or eliminating unnecessary and redundant material decreased cognitive load and increased comprehension., Design strategy, therefore, needs to be taken into consideration to reduce cognitive load if there is low element interactivity when developing instructions for learning  (Paas et al., 2003).

Finally, germane load refers to load that is generated by instructional activities, which lead to schema development and automation (Mayer, 2005; Moreno, 2006). This takes place when learners' working memory is not overburdened by intrinsic cognitive load, so that learners are able to retain and store the information as schema in their long-term memory for later use (Gerjets et al., 2004). This is both desired and beneficial for learners who will be able to use the schemas when they are needed in working memory to reduce cognitive load. Applying effective instructional designs leads to boosting of germane load, and conversely, depleting extraneous load. The distinction between intrinsic and germane load, however, is somewhat blurred (Hutchins, Wickens, Carolan, & Cumming, 2013; Kalyuga, 2011).

According to CLT, reducing the extraneous load of a task during training provides more devoted resources for learning. Dividing tasks into parts or simplifying tasks are two suggested training strategies to achieve this goal (Wickens et al., 2013). The results of the present study, involving basketball players with limited skill, support CLT, since participants improved their FT performance applying the RETI intervention. The extraneous load was reduced every week throughout the RETI condition and this improved FT shooting performance more than other conditions in the early stages of learning, whereas participants in the PI condition received increasing load weekly, which was associated with less improvement in their performance.

The results of this study showed substantial similarity between the changes in self-efficacy and the changes in performance. RETI results in performance and self-efficacy actually mirrored each other closely in terms of showing significance improvement compared to the other conditions. That is in agreement with a great deal of research, which has indicated that self-efficacy tends to be closely associated with performance (for a review see Feltz, Short, & Sullivan, 2008). Bandura (1977, 1997) proposed that performance enhances self efficacy, and self efficacy enhances performance, which he called reciprocal determinism. The current study supports this aspect of Bandura’s theory of self-efficacy.

In conclusion, the current study adds to the existing imagery research literature examining the effectiveness of different imagery training methods for athletes with limited skill. Overall it can be suggested that applying different imagery training methods had different impacts on performance. Furthermore, it can be concluded that athletes with limited skill benefited more from a retrogressive imagery training program than from a progressive or a routine imagery program. The retrogressive program was one in which participants first imagined the task with a very detailed script about the court, basket, people on and off the court by including their senses (hearing, touch, visual, kinaesthetic, tactile), and the feeling of performing under pressure to give them an idea what the whole task was about and then the task was made easier by instructing them to imagine simpler versions by including fewer contextual components at each step. So in the second week, participants in RETI they imagined the same script except from the pressure situation that they imagined in their first week. In their third week they imagined only the people on the court and in their last week they just imagined doing the free throw technique with no one around them.

**Methodological Issues**

I have identified several methodological issues that require consideration. A principal issue relates to the recruitment of participants, which was restricted to basketball players in a single stadium location. Some participants from the same club and possibly even from the same team were assigned to different conditions. Thus, participants who knew each other could have talked and shared their experiences of the specific condition they were assigned to in this study. This could lead to an effect of demand characteristics. This refers to participants making assumptions about what the researcher is investigating and what this implies for how participants are expected to behave. When people in a study who know each other are assigned to different conditions in an intervention that lasts over 4 weeks, it is possible that they might make assumptions about the demands of the task during conversations with other participants. For example, players in the control condition could talk to participants in the other conditions and conclude that they are not supposed to improve in FT performance or FTSE as much as the others, so they do not try hard in tests of performance and they under-report any increase in FTSE. However, the results indicated that participants in the PI condition who received treatment showed very little improvement, like those in the C conditions who did not receive any treatment. In addition, there was not an obvious systematic basis in the content of the three imagery conditions from which participants could predict which kind of imagery would affect performance more. Further, it is unlikely that I gave participants any signals about this because the results were not what were expected. Although the context of participants' recruitment suggests a risk of demand characteristics, it seems unlikely that demand characteristics had a major influence in this study because the performance changes observed were not readily predicted by experts prior to the study.

Another methodological issue was associated with the script elements. The scripts were developed and devised for competitive basketball players. One aspect of the content that was not meaningful to participants in this study was including performance in front of large audiences into the imagery scripts. As limited skill players, participants of this study had never experienced having large crowds watching them in real life, which made it difficult for them to imagine this element of the imagery scripts. One comment that was made informally after the completion of the study by some players who participated was that they had difficulty imagining performing in front of a large crowd. One player stated that "we are very lucky if we have 10 spectators and more than that never happened to me”. It was an unrealistic scene for them to imagine. While this is a noteworthy issue for future imagery research with samples playing at lower competitive levels, it should not have affected the comparison between conditions in this study, because participants in all conditions had the same large crowd imagery scene in their training. Crowd imagery scene was introduced in different times in each condition during the intervention phase. It appears from the results that the FT performance of participants improved substantially when the spectators’ element was taken away from participants’ imagery training in RETI at occasion 3 (see Figure 3.1). The effect of spectators is also can be seen in PI at occasion 3 that how including spectators adverse the effects of imagery training (see Figure 3.1).

The intervention phase of the present study was 12 sessions (three times a week for four weeks) based on the intervention phases used in other imagery studies, which ranged from 3 to 16 weeks in length (Cooley et al., 2013). In addition, Wakefield and Smith (2009) found that three imagery sessions a week provided greater benefits than only one or two sessions per week. However, it is still not clear how much imagery practice is enough or how long an imagery intervention should be. Cooley et al. (2013) proposed that longer interventions demonstrate greater success. There was an issue in the present study specifically with RI that although participants' FT shooting performance improved, they did not show significant improvement. Perhaps duration of the intervention was not enough for RI to show significant performance enhancement. Thus, there might be a significant effect if the intervention phase continues for more sessions. This should be examined in future studies.

**Further Research**

This study has raised a number of issues that warrant further examination. Replication studies should be conducted to examine whether this effect is repeated in different samples of basketball players with similar characteristics to those who participated in this study. Similar studies with participants from other sports would be valuable to ascertain whether the present results are transferable and do not reflect something unique about basketball FT shooting. Studies on other common closed skills in sport such as netball shooting, penalty taking in soccer, putting in golf, and serving in tennis would provide opportunities to examine whether the present results are replicable. Widening the scope to examine open skills in racquet sports, team ball games, and combat sports would also be of interest in the future.

In the present study RETI was found to be the most effective delivery method. However, the effectiveness of RETI for participants' performance did not commence until the third week of the intervention. There is no direct evidence to explain why this might be. It could be due to the content of the imagery delivered in the early imagery training sessions. As explained earlier, inclusion of a large number of spectators in the content of the imagery presented during the first two weeks in the RETI condition appeared to be a distraction for the participants of this study as limited skilled players, who did not perform in front of large audiences. Therefore, key factores of RETI that match competition environments for the level of expertise of the participants (e.g., team-mates, opponents, referees) should be examined before conducting any further study to test whether other factors delay the impact of imagery delivery using the RETI method. Researchers should replicate this study with the same procedure and study design, but with modified imagery scripts. One direction is to examine whether not including spectators would increase the effectiveness of RETI and RI. These kind of studies will help researchers to understand what delayed participants from improving in the first two weeks of the intervention in the present study.

Another possible reason for the delay in improvement in the first two weeks of the intervention in both RETI and RI is the imagery ability of participants. Participants were not only in the first stages of learning in basketball, but also experiencing imagery training for the first time, so their understaning of imagery in the context of sport may may have been limited. Because it was a new experience for participants to have systematic imagery training, it is logical to propose that in the first one or two sessions of imagery training, they were learning and improving their ability in imagining the scenes that were presented. To examine whether the absence of improvement in the first two weeks of the intervention, followed by noteworthy improvement in the third and fourth weeks in the RETI and RI conditions, was due to participants being new to the use of imagery in sport, research with the same structure as the current study should be conducted to compare more advanced imagery ability participants with participants with lower imagery ability but where participants in both conditions have limited sport skills. This will clarify if imagery ability is a mediator for sport skill improvement. If imagery ability improvement causes improvement in sport skill performance, then imagery ability is a mediator between imagery training and performance improvement. Should results show that imagery ability is not a mediator, this suggests that imagery training itself is the key factor.

The duration and frequency of the imagery intervention are other variables that should be considered more specifically. Imagery interventions that have a larger number of sessions than the intervention employed in the present study could be associated with different effects, as could more or less frequent imagery sessions. To further understand what characteristics of imagery training influence the effectiveness of imagery training delivered in different ways (e.g., RI, PI, RETI) to performers in the early stages of skill development and competition in various sports, research in which key characteristics of imagery training are systematically varied would be valuable. For example, whether the number of steps in a RETI program affects the impact it has on performance should be examined. It is possible that the impact of a RETI program that has large steps down from a full imagery script to a script that focuses on technique is very different to the impact of a RETI program in which the steps to a focused script are small and gradual. It is also appropriate to examine these issues for RI and PI imagery training.This would provide a clearer picture of the factors that affect RETI, RI, and PI delivery of imagery and demonstrate the role of different types of imagery delivery in the development and performance of motor skills with developing performers.

It would also be helpful to replicate the study with systematic variations in characteristics that could affect the outcome, such as skill level. Given the argument presented in this discussion regarding CLT and the development of skills through cognitive and associative stages to the automatic stage, it is possible that skill level interacts with the type of delivery of imagery training. For example, research should be conducted to examine the delivery characteristics of imagery training programs that would be most suitable for elite athletes. This was the primary purpose of the second study in this thesis.

# CHAPTER 4

# STUDY 2: THE EFFECT OF ROUTINE IMAGERY, PROGRESSIVE IMAGERY, AND RETROGRESSIVE IMAGERY TRAINING PROGRAMS ON FREE THROW PERFORMANCE AND FREE THROW SELF-EFFICACY OF HIGHLY-SKILLED BASKETBALL PLAYERS

## Introduction

In Study 1, I compared three methods of delivering imagery with no imagery training and with each other to identify whether any of these imagery-training methods helped athletes with limited skills to enhance their performance and self-efficacy more than the other methods. The main purpose of the second study was to determine whether any of the imagery training methods helps highly skilled basketball players to improve their FT performance and FT self- efficacy more than the other methods. One method is to give participants a very detailed imagery script all the way through without changing the content (RI), another method is to start with a very simple imagery script and make it more complex by adding details into athletes' imagery scripts week by week (PI), and another imagery training method is to start with a very detailed and complex imagery script as in RI, then gradually simplify it by taking details away (RETI). These methods of imagery training were also compared with a no imagery training condition. Study 1 suggested that athletes with limited skill benefitted more from imagery training if the whole idea of what the task is about, including the context, was given to them at the start then the script was broken down step by step until their imagery training focused on the technique required performing the skill (RETI).

As discussed in Chapter 3, the stages of learning sport skills might explain why RETI participants performed at a higher level in FT shooting and reported higher self-efficacy than other conditions by the end of the imagery programs. The somewhat unexpected findings in Study 1 raise the question of whether the RETI approach to delivery of imagery training is the most effective for all skill levels or whether a different imagery delivery method is more beneficial for athletes with higher skill level. To address this question, in Study 2, I examined the impact of the same three imagery delivery methods on FT shooting as well as self-efficacy, with the same design, but in highly-skilled basketball players.

Based on suggestions by researchers that the complexity of imagery training programs should increase gradually (Calmels et al., 2004; Morris et al., 2005; Nordin & Cumming, 2005; Wakefield & Smith, 2012), I hypothesized that, for highly-skilled athletes, significantly greater improvement in FT performance, as well as self-efficacy, would be detected from using the PI delivery of imagery than the RI delivery method and the C condition. I found RETI to be the most effective method of applying imagery for basketball players with limited skills in Study 1. Based on that, I hypothesized that RETI conditions would lead to significantly greater improvement in FT performance and self-efficacy than the C condition. However, no specific prediction was made for RETI imagery effectiveness because the effectiveness of RETI imagery has not been compared with any other imagery training method in highly-skilled players.

## Method

### Participants

Participants of this study were 49 highly-skilled basketball players (25 male, 24 female), aged between 18 and 37 (*M* = 28.26 years, *SD* = 4.25) who had been playing this sport for at least 9 years. Participants had no previous experience in systematic imagery training at the time of recruitment. They were selected based on the following criteria:

a) Voluntary participation.

b) Imagery ability. To make sure that they had the ability to imagine competently, they were required to have a minimum average score of 150 out of 400 on the 6 SIAM subscales most relevant to basketball free-throw shooting, namely the dimensions of vividness and control, and the visual, kinesthetic, tactile, and auditory sense modalities.

c) Their level of expertise in basketball. Victorian Division 1 basketball players were chosen for this study. They were playing in Division 1 of the Victorian Basketball League (Big V). The Big V is the senior basketball league in Victoria, Australia comprising 102 semi-professional teams incorporating three levels of senior competition for men and women (State Championship League, Division 1, and Division 2) and youth leagues. Big V corresponds to state level and is ranked level 3 among Australian basketball leagues after the National Basketball League (NBL, level 1) and the South East Australian Basketball League (SEABL, level 2). Players in the highest level of competition, NBL, represent Australia in Olympic Games and World Championships, where the Australian men's team has consistently been ranked in the top 10 in the world. There are many players in Big V who are skilled enough to compete in SEABL, but as they are semi-professional players, playing basketball is not their profession and they have to work besides playing. Many high-level retired players compete in the State Championship and Division 1 of Big V, in addition to a large number of talented young players who represented Australian youth teams in international games. This all increases the quality of Big V games. In Australia, Melbourne to be specific, children under the age of 10 start playing basketball and have organized competitions. This includes, junior games for different age groups (under 12, 14, 18, and 20), Division 2 Youth League, Division 1 Youth League, the Victorian Youth Championship. Rookies, young players, and those who want to improve and prepare themselves to step up to higher levels of basketball play in the Victorian Youth Championship. The next levels of progression are the Big V Division 2 and Division 1.

Normally, the best players of each division will be selected to take part in the higher level. However, some talented young players have been selected to take part in Big V, or even State Championship, when they were younger than 18 years. Thus, participants in this study can be considered to be highly-skilled, competition basketball players.

**Study Design**

As in Study 1, I applied a mixed methods design in this study with four independent-group conditions, RI, PI, RETI, and C, and a repeated measure across occasions to compare FT shooting performance for the imagery delivery methods for each week of a 1-month intervention phase. Self-efficacy of all participants was assessed before the intervention phase, at the end of the second week and on the last day of the intervention phase.

**Measures**

**Demographic information form.** As described in Study 1 (See Appendix A).

**Sport Imagery Ability Measure.** (SIAM; Watt et al., 2004) As described in Study 1 (See Appendix B).

**Free Throw (FT) Shoting Performance.** As described in Study 1 (See Appendix C).

**Free throw shooting self-efficacy (FTSE).** As described in Study 1 (See Appendix D).

**Imagery manipulation check.** As described in Study 1 (See Appendix E).

**Interventions**

Participants in all three imagery conditions (RI, PI, RETI) were involved in 12 individual imagery sessions (3 times a week for four weeks), each lasting between 5 and 10 minutes (via listening to pre-recorded audiotapes). They imagined themselves performing successful FTs in each session. The difference between the three imagery conditions was the method of imagery being delivered to them.

Although the elements for delivering imagery of all three-intervention conditions were as in Study 1, I assumed that participants would have a different experiential process with respect to their skill level compared to the participants in Study 1. Because these performers had been practicing, training, and playing competitively for many years, I decided that this would influence their skill production, their experience of the imagery training, and the meaningfulness of other aspects of the content of imagery that was given to them (i.e., playing in front of a substantial audience, facing intensive opposition, experiencing the stress associated with the last minute of the game). I also assumed their imagery vividness and controllability would be richer and more elaborate than the imagery vividness and controllability of the limited-skilled participants in Study 1 because of their difference in skill level. Therefore, the same instructions as Study 1were used for the present study. In fact, these instructions seemed more meaningful for participants in the present study than those in Study 1 because participants in Study 1 were not used to playing in front of a large crowd whereas the participants had often played matches with a large number of spectators watching them.

**Procedure**

The experimental procedure used in this study was the same as described in Study 1. Upon approval from Victoria University Human Research Ethics Committee (VUHREC), and getting permission from the Victorian Basketball Association, I invited volunteer basketball players from Division 1 of the Victorian Basketball League to participate via recruitment flyers. There were two information sessions that were associated with two different stages of informed consent. The first information session was at the beginning of the study to explain the SIAM to participants. Volunteers were asked to give written consent (see Appendix J). I then examined their sport imagery ability in order to determine if their imagery ability met the criteria for them to take part in this study. Eligible participants then completed the demographic information form, undertook a pre-test of FT performance, and a pre-test of FTSE. Then participants were randomly assigned to one of four conditions. Following the pre-tests, there was another information session for each imagery condition and the C condition separately to explain the benefits and any potential risks of participation and to describe what they need to do (Appendix K & L). Players that decided to participate in the study signed the second-phase consent form (Appendix M & N). After the baseline measures were completed the intervention began three times a week for four weeks for imagery conditions each lasting between 5 and10 minutes via listening to pre-recorded audiotapes. I measured FT performance of all participants, including participants in the C condition, at the end of each of the four weeks of the intervention phase. FTSE was measured three times for all groups, including prior to the intervention, after two weeks, and after four weeks of the intervention phase.

**Analyses**

The Statistical Package for the Social Sciences (SPSS: version 21.0) software was used to calculate the means, standard deviations, gain scores (mean post-test score minus mean pre-test score), ANOVA, and MANOVA for all scales and all scores. I used MANOVA to make sure that there was no significant difference between participants in different conditions at the start in terms of their imagery ability. To analyze FT performance and FTSE, I employed gain scores, which is the difference between pre-test score and each measurement that follows for each condition. Use of gain scores provides control for chance differences between participants at pre-test by considering score changes from each individual's starting score. Huck and McLean (1975) argued that ANOVA designs underestimate effects of treatments when pre-tests are included because ANOVA assumes that the interventions are active on all occasions, including pre-test. A mixed design

ANOVA was employed to test for possible significant differences in gain scores between pre-test score and scores at the end of Weeks 1, 2, 3, and 4 for shooting performance scores, as well as between pre-test score and score at the end of Weeks 2 and 4 of self-efficacy. The Tukey HSD post-hoc test was used to examine interaction effects between conditions and occasions.

## Results

The overall purpose of the present study was to evaluate the effectiveness of three different imagery intervention methods namely: RI, PI, and RETI by comparing them to each other and to a control condition that received no imagery intervention. I present SIAM means and standard deviations in the first section, followed by MANOVA analysis of the six highlighted SIAM subscales. In the next section, I present results of the statistical analyses, including descriptive results for all study variables. The main analysis section includes analysis of the effectiveness of the intervention on FT performance and FT performance gain scores for each condition, using ANOVA. I conclude the Results section by presenting descriptive statistics of FTSE gain scores and the outcome of ANOVA examining differences between conditions, as well as occasions.

### Imagery Ability

The SIAM was used to check participants' imagery ability at pre-test to ensure that all participants had at least moderate levels of imagery ability on the major imagery ability subscales. Imagery ability was also examined to make sure that there was no difference between conditions on any of the six highlighted SIAM subscales before the intervention. Means and standard deviations of the six SIAM subscales when participants were asked to rate their imagery ability in the context of basketball FT shooting are shown for all conditions in Table 4.1. This table indicates that no condition scored significantly higher or lower than the others systematically across these SIAM subscales. A check of individual scores indicated that all participants exceeded the minimum threshold on all these six imagery subscales.

Table 4.1
*Means and Standard Deviation of SIAM Pre Test Scores*

| SIAM subscales | CONDITION | *M* | *SD* | *F* | *p* |
|---|---|---|---|---|---|
| AUDITORY | RI | 245.00 | 56.00 | 1.94 | .13 |
| | PI | 268.26 | 63.12 | | |
| | RETI | 207.16 | 58.73 | | |
| | CONTROL | 228.16 | 81.22 | | |
| VISUAL | RI | 300.50 | 39.67 | .78 | .50 |
| | PI | 265.98 | 104.13 | | |
| | RETI | 303.41 | 51.52 | | |
| | CONTROL | 292.00 | 55.70 | | |
| KINESTHETIC | RI | 265.75 | 64.78 | .48 | .69 |
| | PI | 277.92 | 64.19 | | |
| | RETI | 257.08 | 61.11 | | |
| | CONTROL | 249.00 | 62.23 | | |
| TACTILE | RI | 310.00 | 39.54 | 2.4 | .08 |
| | PI | 255.69 | 66.33 | | |
| | RETI | 272.41 | 43.54 | | |
| | CONTROL | 265.91 | 57.74 | | |
| CONTROL | RI | 310.41 | 53.57 | .74 | .53 |
| | PI | 281.34 | 74.24 | | |
| | RETI | 287.41 | 42.44 | | |
| | CONTROL | 290.50 | 71.03 | | |
| VIVIDNESS | RI | 338.00 | 28.30 | 1.4 | .24 |
| | PI | 305.84 | 60.96 | | |
| | RETI | 326.41 | 37.40 | | |
| | CONTROL | 304.33 | 55.26 | | |

**Performance Outcome**

Mean FT performance scores for all conditions are presented in Figure 4.1. Participants' FT performance was measured once before the intervention (Occasion 1), and at the end of each week during the intervention phase (Occasions 2, 3, 4, 5). The potential range of scores on this scale has a minimum score of zero, if all FT shots were unsuccessful and the ball did not hit the rim, and a maximum score of 60 if every shot went through the ring without hitting the rim. Players who participated in this study typically scored above 40 out of 60 at pre-test. This needs to be interpreted in light of the 4-point scoring system (0 for miss, 1 for rim and miss, 2 for rim and basket, 3 for clean basket), which rewards greater accuracy, but can distort real-world performance. For example, a player could score 40 out of 60 by hitting the rim with every shot, when all 20 shots produced successful baskets. Nonetheless, this scoring system more sensitively reflects improvements in accuracy within each participant across the imagery training study. It is clear from Figure 4.1 that there was not much impact in the first three weeks of the intervention for any conditions, except that participants in the PI condition showed deterioration in their FT performance after the first week of the intervention. Larger performance differences between conditions occurred in the last two weeks of the intervention phase at which time PI illustrated a substantial increase in FT shooting performance. Figure 4.1 also illustrates that improvement for RETI and C conditions were minimal with no noticeable difference between them. The graph points in the line graph are too close together to make error bars clear, so they are illustrated in a bar graph in Appendix R.

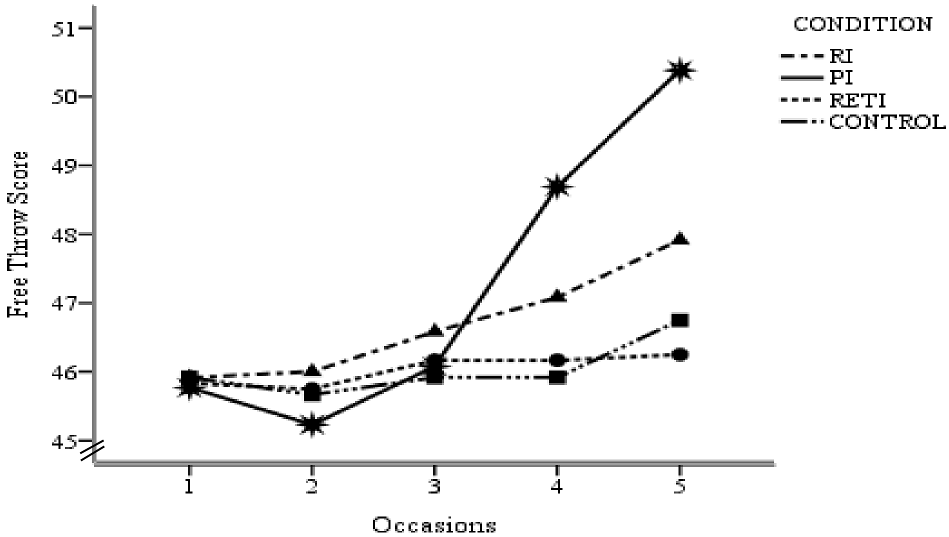


*Figure 4.1.* Free Throw Scores of Each Condition on Different Occasions

All means and standard deviations of FT gain scores (difference between pre-test score and score of each other measurement time) for each condition are presented in Table 4.2 as Gain Score Time (GST) 1-2, GST 1-3, GST 1-4, and GST 1-5.

Table 4.2
*Gain Score Means and Standard Deviation of FT Scores*

| | GST 1-2 | | GST 1-3 | | GST 1-4 | | GST 1-5 | |
|---|---|---|---|---|---|---|---|---|
| Conditions | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| PI | -1.00 | 2.41 | -.15 | 4.28 | 3.61 | 3.62* | 5.76 | 3.76* |
| RI | 1.08 | 1.83 | 1.33 | 1.77 | 1.91 | 1.93 | 3.83 | 2.92 |
| RETI | -.08 | 2.27 | .33 | 2.38 | .33 | 2.23 | .41 | 2.02 |
| CONTROL | -.25 | 2.22 | .00 | 2.29 | .00 | 1.70 | .83 | 1.11 |

The gain score means and standard deviations of FT shooting scores indicate that PI participants scored lower FT performance than their pre-test after the first two weeks, but their FT gain scores increased at GST1-4 and again at GST1-5. RI participants did improve gradually with their biggest improvement on the last week of the intervention. Analysis revealed a significant main effect *F* (2.43, 109.72) = 25.11, *p* < .001, $\eta_p^2$ = .36 with very large effect size, as well as a significant condition effect *F* (3, 45) = 3.17, *p* = .03, $\eta_p^2$ = .17 with very large effect size, and a significant interaction effect *F* (7.31, 109.72) = 8.21, *p* < .001, $\eta_p^2$ = .35 with very large effect size.

Tukey post hoc tests showed significant differences in GST 1-4, in which the PI gain score increased more than those for the RETI ( *p* = .01) and C conditions (*p* = .004). In GST 1-5, the PI increase in gain score was significantly higher than those in the RETI (*p* <.001) and C conditions (*p* <.001). The post-hoc tests also revealed that RI had a significantly higher gain score in FT performance than the RETI condition (*p* = .01) and C condition (*p* = .04) in the last week of the intervention. Overall, the results indicate that gains in FT shooting performance occurred gradually, becoming significant between Week 3 and Week 4 with PI producing larger gains than the other imagery conditions, RI and RETI, and the no imagery control condition.

**Self-efficacy**

The results presented in Figure 4.2 shows the mean for the raw FTSE scores in each occasion of testing.

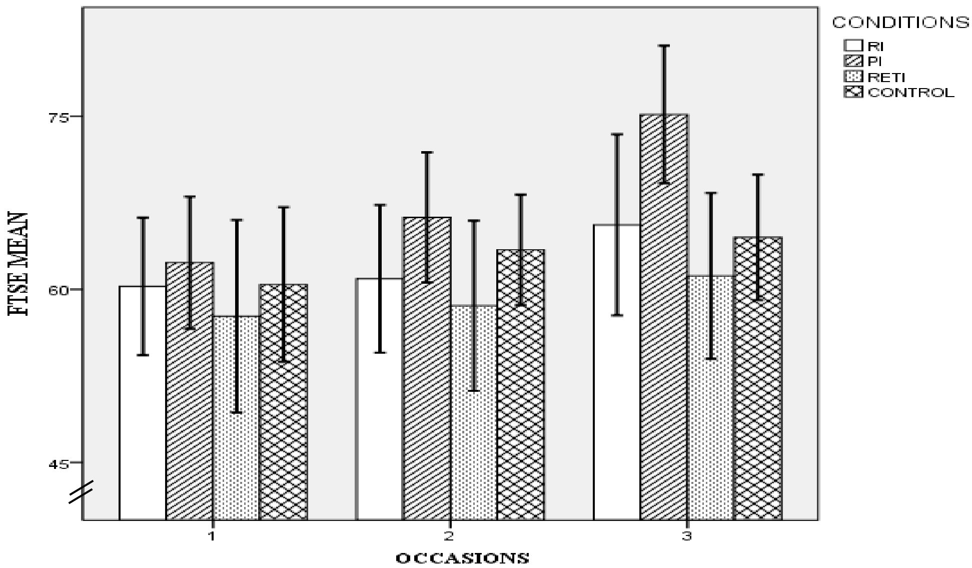


*Figure 4.2.* Free Throw Self-efficacy Scores of Each Condition on Different Occasions

FTSE was measured three times, prior to the intervention, after two weeks of intervention, and post intervention. There were two gain scores of free throw self-efficacy, gain score time (GST) 1-2 and GST 1-3 which are presented in Table 4.3. This table shows that participants in all conditions improved in their self-efficacy throughout the intervention. However, the rates of improvement vary with RI and RETI conditions showing little change by the end of Week 2, whereas PI and C show an increase in self-efficacy of 3 to 4 points. By the end of the intervention the PI condition shows a substantial increase in self-efficacy of almost 13 points. Routine imagery is associated with a moderate increase of more than 5 points, whereas the RETI condition has increased to a level comparable to the C condition, which showed little additional increase in the last two weeks of the intervention period.

Table 4.3
*Means and Standard Deviation of FTSE Gain Scores*

| Conditions | GST1-2 | | GST1-3 | |
|---|---|---|---|---|
| | M | SD | M | SD |
| RI | .66 | 6.36 | 5.33 | 9.09 |
| PI | 3.92 | 7.35 | 12.84 | 6.50* |
| RETI | .91 | 7.61 | 3.50 | 6.71 |
| CONTROL | 3.00 | 7.31 | 4.08 | 7.89 |

I employed one-way ANOVA with follow-up Tukey post hoc tests to determine if there was any significant difference between conditions in participants' self-efficacy after two weeks of the imagery intervention, as well as after four weeks of the intervention. Analysis revealed no significant effect of imagery training program on self-efficacy gain score at GST 1-2 with a small effect size (after two weeks of the intervention), $F$ (3, 48) = .61, $p$ = .61, $\eta_p^2$ = .03. However, a significant effect was detected in GST 1-3 (after the intervention phase) with a very large effect size, $F$ (3, 48) = 4.15, $p$ = .01, $\eta_p^2$ = .21. Post hoc Tukey tests showed that the PI condition recorded a significantly larger gain in FTSE than RETI, *p* = .01, and a significantly larger gain than the C condition, *p* = .03, with no significant difference between PI and RI conditions after 4 weeks of the imagery intervention.

**Imagery Manipulation Check**

Like in Study 1, manipulation checks were performed to verify the imagery experience. Participants rated the quality of their imagery experience they were instructed to do on a 4-point Likert scale ranging from 0 (not at all) to 4 (very much so) after each imagery session. Table 4.4 presents mean and standard diviation of total score of each condition in each week.

Table 4.4
*Means and Standard Deviation of Imagery check Scores in Four Weeks*

| Condition | | Week 1 | Week 2 | Week 3 | Week 4 |
|---|---|---|---|---|---|
| RI | *M* | 2.63 | 2.20 | 2.96 | 2.85 |
| | *SD* | .34 | .37 | .36 | .28 |
| PI | *M* | 2.48 | 2.32 | 3.16 | 2.94 |
| | *SD* | .56 | .40 | .37 | .20 |
| RETI | *M* | 2.33 | 2.56 | 2.87 | 3.02 |
| | *SD* | .32 | .64 | .20 | .16 |

A mixed design ANOVA was conducted to compare scores of imagery manipulation checks between imagery conditions across four weeks periods (Week 1, Week 2, Week 3, and Week 4). There was no significant interaction between conditions and occasions, *F* (4.62, 78.51) = 2.24, *p* = .06, $\eta_p^2$ = .12 with large effect size. There was a significant main effect for occasion, *F* (2.31, 78.51) = 25.85, *p* < .001, $\eta_p^2$ = .43 with very large effect size, with all three conditions showing an increase in imagery manipulation check scores across the four week intervention (see Table 4. 4).

## Discussion

The purpose of the present study was to compare the impact of three different imagery delivery methods, namely RI, PI, and RETI training, and a no imagery control condition, on FT performance and self-efficacy. RETI was found to be the most effective way of delivering imagery for limited skilled players in Study 1. No previous research has examined the effects of RETI before to test whether it is a more effective way of delivering imagery for highly-skill players or whether the RI or PI delivery method is superior. Therefore, this study aimed to examine this question with the same design and the same imagery intervention delivery methods as Study 1, but with the exception of recruiting highly-skilled basketball players to participate. My hypothesis that athletes would benefit more from using the PI training method than RI or the control condition was made on the basis of the proposal that athletes benefit more from imagery that progresses from simple to complex (Morris et al., 2005; Nordin & Cumming, 2005; Calmels et al., 2004; Wakefield & Smith, 2012). I made no specific hypothesis for the RETI condition because its effectiveness was tested for the first time in Study 1 on limited-skill players and this was the first study to examine RETI in highly-skilled players. As in Study 1, however, I did expect RETI to produce larger gains in performance and self-efficacy than the Control condition because participants in the RETI condition undertook an imagery training program, whereas the Control participants did not.

The findings of this study showed that for highly-skilled players the PI condition was the most advantageous delivery method compared with the RI, RETI, and C conditions. This suggests that progressing from a simple to a more complex, detailed imagery context is a more beneficial way to deliver imagery training for highly-skilled players than either routine imagery that doesn't change throughout imagery training, or imagery delivery that starts with a complex imagery script and focuses more on the core aspects of the skill as imagery sessions continue. The finding of the present study is consistent with what is described in the autonomous stage of learning by Fitts and Posner (1967). They suggested that learners in early stages of learning should start with basic, specific, short, simple and brief instructions and then combine the elements of a skill to form more complex performance and eventually execute the whole task without thinking about the details as their skill improves. In fact, skill learning seems to generally progress from the foundational to the sophisticated (Haywood & Getchell, 2009). Fitts and Posner (1967) argued that novices in a motor skill focus on gathering information about what to do and how to do it, whereas experts rarely think about the verbal or cognitive elements and whereby their emphasis is on the production of automated, accurate, consistent, and efficient movements.

Sweller (2002) proposed that everything that is learned can, with practice, become automated and this leads to processing some information with less conscious effort, which reduces the working memory load. "For example, schemas that permit us to read letters and words must initially be processed consciously in working memory. With practice, they can be processed with decreasing conscious effort until eventually reading letters and words becomes an unconscious activity that does not require working memory capacity" (p. 1503). Beilock and Carr (2004) reported that "regressing" and producing actions with conscious awareness about movements of the limbs can be destructive for those who have achieved higher levels of skill and may cause underperforming as they primarily perform the task automatically. PI participants in this study who were highly-skilled at FT shooting, followed the stages of learning imagining the task from simple to complex, complying step by step with instructions. During the first phase of the PI intervention, more attention was paid to the position of the body and the sequence of limb movements to build up a mental image of the FT shooting skill. Interestingly, PI participants scored marginally lower than their pre-test and also lower than other conditions after the first phase of the intervention. As highly-skilled players they already had a dominant image of the skill and the skill had been automated. Executing the task with conscious awareness that has already been automated could be a reason why PI participants performed slightly worse than their pre-test in the first phase. After the establishment of a basic picture of the skill, more images were added to the PI script gradually cultivating the scenes to simulate the real world competition situation. As the imagery became more representative of the real world situation, participants in the PI condition showed a noteworthy improvement, especially during the last two intervention phases.

Participants in the RETI condition experienced imagery with a delivery method that was the reverse of PI. In the RETI condition participants had to imagine the whole scene in the first phase of imagery training and then returned step-by-step, through three more phases of imagery to the first stages of learning where the focus was on details of the FT shooting task. The results showed the athletes in the RETI condition had the lowest FT scores after receiving the intervention. This could be due to focusing on the details while executing the task, as returning to the first stages of learning and thinking about the movements of body and details can be counterproductive for highly-skilled performers. That could explain why RETI participants' FT scores were lower than those of participants in the Control condition in the final phase of imagery training, in which more attention was being paid to the position of the body and the sequence of limb movements during imagery of shooting. Therefore, PI appears to have been the most effective method of delivering imagery for highly-skilled players considering their stage of learning. High-level athletes execute the task automatically with less attention or conscious awareness on the details of technique and more focus on the kinds of external factors that would be present during matches.

The results for RI condition showed that participants of this condition benefited from their imagery training, but their improvement in FT shooting was not as large as for the PI participants. The difference between RI and PI was that RI participants listened to the same script, which included information about the on-court activities, the crowd, and the stressful context of shooting to win the match, during all sessions of the study, whilst PI participants started with a simple script and practiced more complex scenes progressively throughout the intervention. However, both conditions received the same script in the final phase, which was the most complex script. The lower scores obtained by RI participants compared with those in the PI condition could be due to providing RI participants with the script consisting of all aspects of last-minute FT shooting in imagery of full match conditions. The results for the RI condition depicted only a subtle improvement after the first two phases of the imagery intervention, possibly because of inundating participants with the large amount of information received via detailed imagery scenes right from the start of imagery training. Similar to participants in Study 1, athletes in the present study were novices in using imagery as none of them had systematic imagery training, and participating in this study was a completely new experience of imagery for them. Therefore, giving too much detailed imagery at the start could have been overwhelming for them.Their scores increased as they practiced more during the last two intervention phases, possibly due to the practice effects of imagery training and to having adjusted to imagining a complex set of information. So the RI participants might have shown greater improvement if imagery training had continued for more sessions. Thus, the limit imposed to the number of intervention sessions, as in Study 1, might not have allowed enough time and practice for RI participants to achieve the optimum advantage. This suggests that, as learners of imagery, participants of both Study 1 and Study 2 could gain more benefit from imagery training if they first attain a certain level of skill in performing imagery, enabling them to easily generate more complex scenes. However, this needs to be examined in further research, particularly in relation to the outcome that RI participants did not improve as quickly as players in the PI condition.

The self-efficacy results of the current study reflect the FT performance result. Participants in the PI condition recorded a significantly larger gain in FTSE than those in the RETI and C conditions after four weeks of the imagery intervention. This is very similar to the FT performance results, which showed that PI participants improved significantly more than those in the RETI and C conditions. The FTSE results indicate that performance and self-efficacy were closely related, which is consistent with existing research that has shown a high correlation between self-efficacy and performance (for a review see Feltz et al., 2008). Bandura (1997) proposed that there is a two-way relationship between self-efficacy and performance. He called this reciprocal determinism, a relationship in which performance enhances self-efficacy, and self-efficacy enhances performance. This means that high self-efficacy leads to performance enhancement, which leads to high self-efficacy in return. As in Study 1, the current data set support Bandura's reciprocal determinism proposition.

Overall, the results of this study indicated that, for highly-skilled FT shooters, gradually progressing the imagery scripts from simple scenes to more complex scenes was more advantageous than either a complex imagery script throughout training or beginning with a complex script, which was simplified as imagery training progresses. Further, training with the full version of the imagery script throughout the program was more effective than a retrogressive approach to imagery training with this sample. Comparison of the findings of Study 1 and Study 2 demonstrated that the standard provision of a complex or multifaceted imagery script that remains the same throughout imagery training programs might not be as effective as varying script content, but the specific characteristics of the most effective imagery script delivery protocol might differ depending on skill level of the sport performers. This is an outcome that should be examined further.

**Methodological Issues**

Several methodological issues arise from this study. One issue in Study 1 was that the content of imagery training was not chosen to effectively match the level of expertise of participants. For example, in Study 1 some of the players found it difficult to imagine playing in front of a large crowd, because they had never experienced this in real life. With respect to the content of imagery used in the current study, it was assumed that the content used in Study 1 would be more suitable for Study 2 based on participants' level of expertise and imagery ability as the imagery vividness and the richness and control of images was higher in these players. Participants of study 2 had much more substantial experience of playing basketball which should have influenced their skill production and their experience and the meaningfulness of other aspects of the content (e.g., the crowd, last minute of the game). I expected that the imagery of these highly-skilled players would be richer and more elaborate than the imagery of the limited-skilled players. Therefore, I did not try to give them a different set of instructions, so the same imagery content as in Study 1 was used for the imagery scripts in Study 2. One phase of imagery intervention was allotted to the FT shooting technique. During this phase attention was focused on the position of the body and limb movement during FT shooting, which was what PI participants imagined in their first phase (Week1) and RETI participants imagined in their last phase (Week 4) of the intervention. As highly skilled players, participants of the present study usually execute the FT shot automatically and unconsciously. For such skilled performers, performing the skill that has already been automated with conscious awareness (controlled processing) can cause underperforming (Beilock & Carr, 2004; Mesagno, Marchant, & Morris, 2009). As I mentioned earlier in this chapter, a reason why participants in PI showed marginally lower scores after the first phase (Week 1) might be due to imagining the FT technique, which led them to revert to controlled processing when they actually performed the task. This might also be considered as a possibility for the absence of improvement in the RETI condition in the final phase (Week 4) of the imagery process. RETI participants had lower FT performance scores than Control condition participants in the last phase, which was when the participants imagined the basic technique of the FT skill.

A question that can be raised is why the performance environment in the imagery scripts that I designed was different to the performance environment of the actual performance test that participants undertook. Imagery scripts included real life elements such as teammates, opponents, referee, and crowd, whereas the test situation was players performing FT shooting in a field test environment on a quiet basketball court with just the researcher present in both Study 1 and Study 2. The reason for including the competition based characteristics was to make the imagery scene as realistic as possible by incorporating more of the experience that participants have during real life basketball competition to enhance the effectiveness of the imagery training. Thus, I designed the content of the imagery script to reflect what imagery training should be for serious competitive performers, if the aim of that training is to produce a beneficial outcome in the real world. At the same time, I chose a performance field test environment to ensure a level of control over the measurement of performance that was appropriate for the main purpose of the study, namely to compare different modes of delivery of the same imagery content. This does mean that the effects of imagery training delivery methods on performance in real world situations were not examined in this study. It is certainly necessary to confirm the effectiveness in real world competition of the imagery method found to be the most effective in this study with a performance field test. One way to approach this would be to create a field test environment that more closely resembles the competition context. Adding team-mates, opponents, referees, spectators, and a feeling of high pressure during FT shooting would involve massive logistical demands. An alternative would be to examine the effects of delivery of imagery training in the real world competition setting. In this case a degree of control over the research design would inevitably be lost, but improvements in performance would be more meaningful.

**Further Research**

Three different imagery delivery methods were compared in terms of their effectiveness for enhancing FT shooting performance and FT shooting self-efficacy of highly-skilled basketball players. PI was found to be the most effective imagery training delivery method. Review of the general pattern of results of this study raises a number of suggestions for further research.

One focus of for continued investigation concerns the content of scripts. An issue in the present study was including FT technique and reviewing the position of the arms and legs in the imagery scene. Participants in the study were highly-skilled players and considered to be in the automatic or autonomous stage of learning. It is possible that content of the script that instructed them to imagine elements of technique, such as movements of their arms and legs might have encouraged them to revertto controled processing of the FT technique. According to the authors of studies that have been done on choking (Beilock & Carr, 2004; Mesagno et al., 2009), this can lead to deterioration in performance and even cause underperforming. It is important to select the appropriate content in accordance with participants' skill level and the outcome they have targeted for improvement. Therefore, to investigate the hypothesis more thoroughly, replication studies should avoid including inappropriate content that might adversely affect imagery (for instance, asking highly-skilled players to imagine details of FT technique).

Another issue in this study relates to the duration of the intervention and the number of imagery sessions. The results, indicated that there was only marginal improvement after the first two phases of the intervention. This might be a result of a toned for participants to familiarize themselves with the content of the imagery scripts by rehearsing the scripts more. Only limited literature appears to be available that reports research on the relationship between number of imagery sessions and effect on performance of sport skills or duration of imagery sessions and effect on performance (Smith, 2011; Wakefield & Smith, 2009). It has been suggested that to determine optimal imagery training for a task and those who perform it, a dose-response protocol needs to be employed in which duration and number of sessions for imagery research are systematically varied to examine the effects of these factors on performance (Morris et al., 2012b). PI was found to be the most effective imagery delivery method for highly-skilled athletes. To make imagery training more effective, the optimal dose of imagery training should be examined, using PI imagery with highly-skilled sports performers.

In the current study, I developed each phase including the amount and the order of the elements based on the elements in competitive basketball FT shooting to make the imagery scene as realistic as possible by incorporating those elements that experienced players use during competition FT shooting to enhance the effectiveness of imagery training. In a recent study, Williams et al. (2013) examined a kind of PI that they called Layered Stimulus Response Training. They found this imagery training method to be effective for enhancing participants' performance as well as imagery ability in adults with low imagery ability. One difference between their study and the current study was that the researchers in the Williams et al. study asked participants to add something that they believed would enhance the imagery quality to each layer in the progression, what might be termed self-progressive imagery. Thus, Williams et al. relied on participants to create their own levels of complexity in the imagery training. It would be useful to examine whether it is more advantageous to present imagery structure to participants, based on established principles of imagery, or to let each participant add elements that they consider to be important for them as imagery training progresses. However, participants' skill level should be considered as a variable, because elite athletes have a great deal of experience in relation to various aspects of their performance, whereas novices have a greater need to be instructed and supervised by mentors. Researchers could examine this type of contrast by comparing five imagery conditions, PI, self progressive imagery (SPI), RETI, self retrogressive imagery (SRETI), and an RI condition with athletes who have different skill levels. It would be interesting to see the results of SRETI in particular because participants will omit the elements that they think distract them from focusing on their task. Athletes could then be asked to explain their decisions in a post study interview. It would also be interesting to interview participants after each phase to understand their priority of taking away or adding particular components to increase understanding about what athletes think the important elements are and their order of priority for inclusion. Studies of this kind will help to identify other key elements of imagery scripts, so it is clearer what should and should not be included in imagery scenes.

Finally, there was a controversy in Discussion section regarding the point that these highly-skilled players had no previous experience of systematic imagery training. Although they received some instructional guidelines with their first imagery script, in both Studies 1 and 2, none of the conditions showed noticeable improvement during the first two weeks. This could be due to the lack of skill at doing imagery to enhance performance. Their skill in using imagery developed as they practised within the imagery training sessions. The level of experience with imagery could be a mediating factor in terms of the impact of the imagery training for performance enhancement. Therefore, it is suggested that researchers allocate some time before starting interventions for imagery training familiarization. It could be that imagery training of scenes not related to sport or some daily activity would be helpful to examine the effects of the imagery delivery method on performance with more control over other effective variables. One research pathway is to do studies with the same design as Studies 1 and 2, but initially undertake several sessions to familiarize participants with using imagery and then comparing the three different imagery delivery methods.

# CHAPTER 5

# STUDY 3: THE EFFECT OF A PROGRESSIVE IMAGERY TRAINING PROGRAM ON FREE THROW SHOOTING OF HIGHLY-SKILLED BASKETBALL PLAYERS IN COMPETITION

## Introduction

In Study 2, I discovered that highly-skilled basketball players benefitted more from PI training than RI or RETI training in a practice situation. FT shooting might be affected differently during highly competitive matches, where team-mates, opponents, officials, and spectators can all affect the individual, as well as the physical environment, particularly when it is not the home court. Experimental research designs do not fit comfortably with the characteristics of an applied setting (Mahoney, Anderson, Miles, & Robinson, 2002), as laboratory-based research creates an artificial environment, which bears little resemblance to competition (Goldfried & Wolfe, 1996). Studies 1 and 2 were field studies in which it was possible to control the scheduling and the number of FT shots performed by each participant. Such field studies performed away from the real competition context examine performance in "sterile" situations lacking the stress of competition, as well as all the complications related to the presence of team-mates, opponents, referees, and spectators. This provided only a partial test of the different imagery delivery methods. In particular, it did not create a context to fully examine the impact of many key factors of high-level competition (the team-mates, opponents, referees, spectators, and the pressure of the competition context) as they were progressively added in the PI condition. This was the primary motivation for Study 3, in which I employed a single-case design to examine the impact of PI on FT shooting performance among high-level basketball players in league matches across a whole basketball season. Single-case design research allows interventions to be studied in real world contexts. The single-case study design was chosen to confirm, challenge, or extend the findings of Study 2 in a real competition context.

More than the other modes for imagery delivery that were examined in Studies 1 and 2, PI includes imagery content that prepares athletes for these aspects of the performance environment. Thus, it would be expected that PI would remain effective for FT performance of highly-skilled basketball players in competition contexts. This study was conducted to examine the effects of PI training on FT performance in game situations. Based on the increases in level of self-efficacy and performance found in Study 2, I predicted that this imagery training delivery method would have a positive influence on basketball players' performance of FT shooting and level of self-efficacy in actual game situations. To examine highly-skilled basketball players' FT performance in game situations, I adopted a single-case research design, following five players over an 18-week basketball season. In addition, to understand what participants' experienced over that period in terms of the PI training and its impact on their FT performance in competition I interviewed each player at the end of the season. In this way, I acquired more detailed information regarding what they liked and disliked about the intervention and its effect on their match performance to help elucidate the quantitative results.

## Method

### Participants

Participants in this study were five male Victoria State Championship League (SCL) players aged between 28 to 36 years (*M* = 31.8, *SD* = 3.4) with a minimum experience of 15 years playing basketball (*M* = 22.2, *SD* = 5.3). They had no previous experience in systematic imagery training. They were selected based on the following criteria:

a) volunteered to participate

b) demonstrated the ability to imagine to the content of the PI intervention. Players were required to have a minimum score of 150 out of 400 on the most relevant SIAM subscales for performing PI (vividness, control, visual, kinesthetic, tactile, and auditory).

c) had a minimum of six FT shots during each game

d) had a record of successful FT performance defined as a percentage less than 60% in their previous playing season. Currently, the NBA's highest free throw shooting percentage is 92.9% and the lowest is 41.8%. In the Australian league, the highest percentage is 90.9%. However, this value is not comparable with NBA performance, because, according to the NBA, a player must make at least 125 free throws in a single season in order to qualify for the free throw ladder. In the Australian league, the 90.9% record belongs to Bryan Dougher who had 50 successful FTs out of 55, which is less than half the NBA minimum. Of course, the more FT shots a player is awarded during a season, the more possibilities there are of missing shots.

The SCL league is the highest level of men's basketball competition in Victoria, Australia and ranked level 3 among Australian basketball leagues after the National Basketball League (NBL, level 1) and the South East Australian Basketball League (SEABL, level 2). Players in the highest level of competition, NBL, represent Australia in Olympic Games and World Championships, where the Australian men's team has consistently been ranked in the top 10 in the world. The SCL contains a mix of NBL players near the end of their careers, young players, many of whom are destined to play in the SEABL or NBL in the near future, and those who have not quite made the transition to the highest levels.

**Study Design**

A multiple treatment (ABCD) single-case design was employed to examine how a PI intervention affected the performance of FT shooting in competitive situations of each participant throughout a competition season. The multiple treatment single-case design was selected because it matched the PI intervention, in which new elements were added to the script, making the imagery content in each intervention phase more complex than that of the previous phase. Following the baseline (A), which was a no imagery phase, the PI intervention was introduced to the participants progressively in three follow-up intervention phases. Phase B, C, and D were the three intervention phases, during which participants received more complex content in the imagery script in each phase. Although the interventions were the same in nature (they are all part of PI imagery), what participants received in Phase B was not the same as Phase C or D. Thus, the intervention process extended the simple AB design to an ABCD design, so the separate impact of each intervention phase could be evaluated and compared (Kazdin, 2011). Each phase lasted one month which included between 4 to 8 home or away games, and each participant's data were measured individually in each game.

At the end of Study 3, I invited all participants to take part in an interview session. I conducted an individual face-to-face interview with each player to acquire feedback about their experiences of using progressive imagery and to obtain their estimate of the effectiveness of the progressive imagery related to competition FT performance. Players were also asked if they have any suggestions to enhance the effectiveness of the PI program. At the end, I answered participants' questions about the study and thanked them for participating.

**Measures**

**Demographic information form**. As described in Study 1.

**Sport Imagery Ability Measure (SIAM).** As described in Study 1.

**Free Throw shooting percentage.** The participants in this study were playing in the same league and sometimes at the same time in different stadiums, so it was impossible for me to collect the data in person. Thus, I used the league's statistics regarding the participants' FT attempts and FT success for each game. Data was also obtained from the official score sheets of the games. In case of any discrepancy between these two sources, I used the official score sheets due to the high level of accuracy of this data recording system. Game free-throw percentages were calculated for all home and away games.

**Imagery manipulation check**. As described in Study 1.

**Social validation questionnaire.** At the end of the intervention phase, I interviewed all participants in a one on one session to explore their personal experiences and acquire more detailed information regarding the progressive imagery intervention and its effectiveness. The social validation questionnaire was structured in open-ended questions (see Appendix O) to discover the participants' perceptions and experiences of the imagery intervention with an emphasis on PI imagery and how players thought it affected their performance and self-efficacy. The interview also aimed to elicit the players perceived advantages and disadvantages of the intervention, and to gain their feedback regarding the efficacy of the intervention and if they felt different at the time of the interview after the intervention both in their mental preparation and the execution of free throw compared to beforehand. The interviews were conducted for each participant a week after their final game of the season, recorded and transcribed verbatim. The social validation questionnaire started with a brief overview of the meaning and charateritics of sport imagery and PI imagery and assuring players about confidentiality of all data collection, followed by asking questions about their playing season and where they ended up in the league ladder to help participants to relax and encourage them to talk. The social validation questionnaire questions focused on two main topics, imagery experience and performance enhancement, specifically to explore participants' perceptions and views regarding the imagery and the effect of employing PI on their performance. The main research questions focused on participants' imagery experience, their adherence to the intervention, perceived effects of the intervention, aspects of the imagery content that were easy-hard-useful, how they felt during the imagery process and during real FT shooting they were awarded during the game, and if their preparation to execute FT had changed during the course of the season.

**Intervention**

I presented players with three individual PI training sessions each week during the intervention phase for the rest of the season, after a standard baseline phase. The first intervention phase was the players' first experience of imagery, which included very little information with simple actions. For example, they imagined performing FT shots with players around the key ready for rebound. In the second and third phases of the intervention players experienced more complex imagery scenes than the previous phase as described earlier for Studies 1 and 2, building up to the full richness of imagery that simulates the real experience of FT shooting in high pressure situations. A description of the phases will now be presented.

Phase A was the baseline no intervention phase, during which I monitored FT performance of athletes for five games. After baseline was completed, I introduced the first intervention phase (Phase B) by instructing athletes to imagine simple static aspects of the basketball FT context during a game three times a week for four weeks. Players imagined court lines, the rim, and themselves standing at the foul line and performing FTs. The imagery script content was derived from the results of Study 2 and the literature (Gladwell, 2000) that shifting from implicit to explicit processes in motor control (reviewing the technique for athletes who already have automated their technique) is likely to worsen their performance. Therefore, this element of imagery training (imagining the technique like arm movement, knee bending) was excluded from the script. In Phase C, I instructed the players to include more details in their imagery scene by adding more people (for instance teammates and opponents standing around the key). This was followed by the final intervention phase, Phase D, during which I increased the complexity further. Participants imagined a high-pressure situation in which there was one second left on the clock, their team was behind by one point, and the outcome of the game depended on their FT shots. All participants commenced their involvement in the study at the same time, that is the start of the season, but did not finish at the same time. This was because some of the players were in teams that reached the finals, so they had two additional games, semi-final and grand-final. They were asked to practice their last PI script until the end of the competition season, so their FT performance for the final games was counted as a part of Phase D.

**Procedure**

I selected Victorian Championship players who were likely to have substantial numbers of free throws during most games by looking at their free throw statistics from their previous season and the first three games of the current season, because that is the best indicator of what their standard was at the time when they entered the study. I invited them to participate in the study by sending an email to them. In the first individual meeting, after explaining imagery to them and giving them the structure of the intervention and measurement and siging consent form (Appendix Q), their sport imagery ability was assessed using the SIAM.

I implemented a single-case design procedure to assess each player's free throw percentage improvement in all games during the playing season. To attain a stable baseline, Phase A varied between 4 and 6 games to generate pre-intervention data for competitive FT shooting, and the intervention phases (Phase B, C, and D) lasted for 4- 6 games each. In each intervention phase, players listened to each stage of progressive imagery presented on an mp3 format and saved on each player's mobile phone, in three sessions a week for four weeks. In some weeks during the intervention phase, players had two games over the same weekend (Saturday night and Sunday morning), so there was no imagery practice between those games. Players who made the finals had two extra games in the last intervention phase. This means that once they reached the full imagery content in Phase D, they continued to listen to the final imagery script for the rest of the season. At the end of the intervention (a week after the final game of the season), I invited all five participants to attend an interview to capture the participants' personal experiences. Finally, I gave each participant the opportunity to ask any questions or make any comments. After this debriefing, I thanked them for their participation.

**Analyses**

I employed a combination of techniques to analyse the data. I plotted graphs for each participant using Microsoft Excel 2010 to examine any changes in the FT percentage of each phase. I determined changes in trend from one phase to another throughout the study by visual analysis. The visual inspection method has been widely used to analyze the data from single-case design studies by looking for changes in trend, level, slope, and variability. Visual inspection remains the most frequently applied method for detecting treatment effects in single-case designs (Ximenes, Manolov, Solanas, & Quera, 2009). The main criteria used in this study to visually analyze the graphs of each participant were change in the mean, change in level, and slope or direction of the celeration line from phase to phase. I calculated the mean of each phase by summing the values of all the data points of each phase and dividing the total by the number of data points in that phase to check whether FT shooting performance either increased or decreased from the previous phase. I calculated trend lines to provide a descriptive aid for visual inspection and allow for level and slope measurements to be calculated. To create a trend or celeration line for the purpose of examining the results in single-case design studies, a technique called the Split-middle Technique has been developed (White, 1972, 1974). I applied the split-middle technique to determine trend lines for each phase and to calculate the level and slope of the lines for visual inspection of the data as proposed by White (1974). Steps for creating a trend line are, a) draw a vertical line in the middle of the data points, so there will be the same number of data points in each half. If there are odd numbers of data points, the line will be drawn between the two middle data points. b) Find the median of the data points in the left half, as well as median of the right half. c) Draw a vertical line in the middle of each half so you divide the data points into 4 quarters with an equal number of data points in each quarter. d) Find the intersection between the vertical line in the middle of each half and the median of the same half. e) The trend line will be the line connecting the two intersection points.

Level refers to the value of the dependent variable where the celeration line passes through the end of one phase (last game in the baseline phase, Phase A, for instance) with the beginning of the next phase (first game in Phase B). To calculate the change in level, the larger of the two values is divided by the smaller. The trend or slope refers to the direction of successive data points within each phase, compared to the next phase. The slope of the line for each phase is calculated by arbitrarily identifying a point on the line along with the point on the ordinate through which the line passes (Kazdin, 2011). The larger value of these two phases is then divided by the smaller to gain the slope of the line. A multiplication sign (x) is given to the line if an increment (shift up) occurs in level as well as in slope, and a division sign (÷) is used if a decrement (shift down) occurs.

I employed inductive content analysis to analyze the social validation questionnaire. In the interviews I aimed to explore participants' experience of imagery, PI in particular, and their attitude towards it and not to drive a new theory (Patton, 2002). Therefore, I only conducted the content analysis. To do so, I transcribed the recorded interviews verbatim and checked the content accuracy by reading the transcribed interviews and listening to the interview records several times. Raw data interview statements were grouped to derive themes related to participants' experience by reading, rereading, and coding (known as open coding; Patton, 2002) and to ensure that all the raw statements were categorized into the most suitable theme. To ensure reliability and trustworthiness, the method of triangulation was used (Patton,1990), in which two or more researchers independently review and interpret the same set of transcripts of qualitative data and then compare their interpretations, discussing differences until consensus is reached. To do this triangulation analysis, I asked a sport psychology researcher familiar with the social validation questionnaire analysis process to independently examine the transcripts of the interviews, after which we met to discuss and resolve any issues where we disagreed about coding.

## Results

In this study, the effect of progressive imagery training on competition FT performance of highly-skilled basketball players were examined. Game FT percentage for all five participants is illustrated in separate graphs followed by their interview responses. Particularly, I include in the interview responses section the explanation of participants' feelings during the imagery training and during the FT performance in a real-time situation, and if their experience changed during the season. The names used in this section are pseudonyms.

### Scott

**Participant's profile**. Scott was 35 years old with 29 years of basketball experience. He played in the Australian Junior Basketball Championships when he was younger and currently he plays in the State Championship League. He was one of the valuable players in his team and scored 22.8 points each game in average (SD = 6.74). He had no previous experience in any kind of psychological training program.

**Screening for Imagery Ability**. At the beginning of the study, the sport imagery ability of participants was measured using SIAM to make sure that they could adequately imagine what they would be asked in the PI scripts. A minimum score of 150 out of 400 on the 6 most relevant SIAM subscales was required for participants to be eligible for this study. Scott's imagery ability on the six key subscales is presented in Table 5.1.

Table 5.1
*Imagery ability scores of participant 1 (Scott)*

| SIAM Subscale | Score |
|---|---|
| Auditory | 293 |
| Visual | 232 |
| Kinaesthetic | 257 |
| Tactile | 259 |
| Control | 286 |
| Vividness | 299 |

**Performance.** Scott's percentage of in game FT is reflected in Figure 5.1.

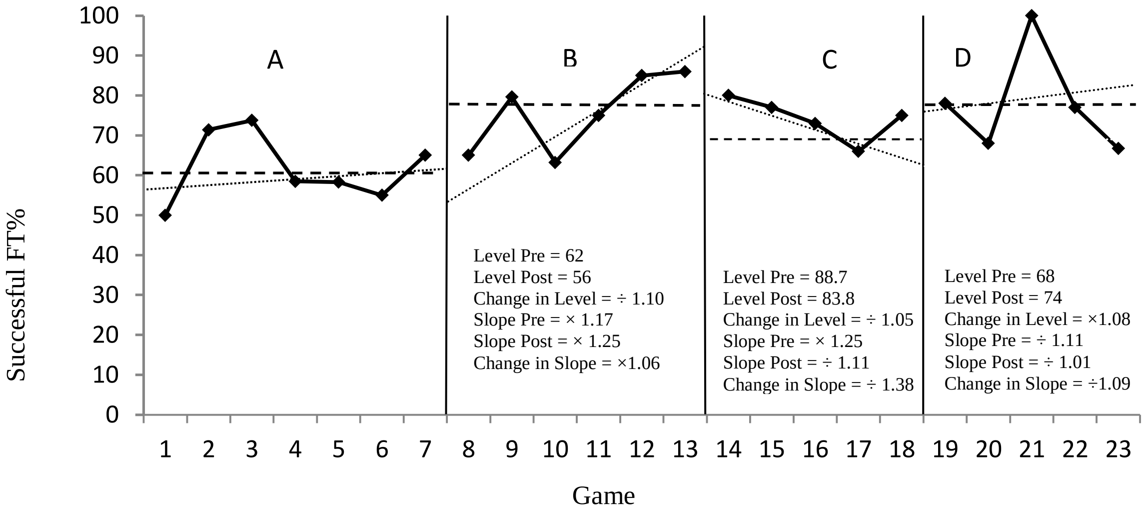


*Figure 5.1.* Split-middle analysis of Scott's FT percentage throughout the season.

*Note.* In all figures, solid bolded vertical lines indicate the point of phase change, horizontal dashed lines represent mean performance for each phase, and dotted lines in each phase signify celeration lines.

Performance was measured in terms of successful FT percentage of each game throughout the season. Figure 5.1 shows performance across the four phases in the study, including the mean for each phase, the level of the celeration line, and the slope of the celeration line into the next phase. Scott's mean FT shooting percentage increased by 16.06 %, the level shifted down 6%, and the trend line increased (x 1.06), during Phase B compared to the baseline phase (A). In comparison with Phase C (2nd intervention phase), Scott's FT% mean decreased 3.56%, the level shifted down 4.9%, and the trend line decreased (÷1.38). During Phase D, Scott's FT% mean recovered by 3.74%, approximately to the same mean level as Phase B, the level shifted up by 6%, and the trend line decreased (÷ 1.09) compared to Phase C. Overall, Scott showed an improved FT% mean in the second phase and maintained the improvement in Phase D at the end of the season.

**Social validation questionnaire analysis.** Scott reported that he found the progressive imagery very clear and the structure was easy to understand. Imagery was a new experience for him. He mentioned in his interview that "I have never done imagery before". Therefore, he found it hard to generate the images initially and he did not have a vivid image, but towards the end of the intervention he was generating more vivid images. He told me that the audio itself helped him to get into the position to start to do what the script asked him. Regarding his feeling during the imagery practice, he said he felt awkward to start with, but he got more confident as he developed and as he did it with more repetition. To a lesser extent, Scott claimed that, towards the end of the intervention, he experienced some of the feelings that he would get when he was actually on the FT line, but not the game type anxiety. He brought up using all senses as the main reason why the imagery was effective for him, saying "trying to engage all the senses made it more realistic". Based on his two first answers, it seems that Scott managed to improve his imagery ability through imagery practice because he said he had more vivid imagery towards the end of the intervention, used more senses, and had greater experience of the feelings that he would experience when he was about to shoot FTs during matches.

When he was asked whether he thought the imagery was helpful, Scott answered that imagery definitely did no harm. “I had a feeling that I shot better towards the end of the season and I can say that part of it could have been due to the imagery” he said. He argued that looking at statistics to check if imagery helped to improve FT percentage is not an accurate way to determine this for several reasons. First, it is a natural progression in your FT as you go through the season because you practice much more than early on the season. Second, your percentage really depends on how you shoot the first two or three shots of the game. “So if I go to the line and miss 3 to 4 in a row then I am more likely to miss the next one. But if I go to the FT line and hit 3 or 4 in a row then mentally I am more confident and I shoot the ball with a better percentage”. Towards the end of the season, Scott felt more confident on the line, but whether or not that was due to practice or was an effect of the imagery training, he was not sure. Scott reported that what the imagery helped him with was the way he approached the FTs during the game, particularly to sort out his routine. He noticed that during imagery practice he concentrated more on shooting, rather than talking to the players and the referee as opposed to the real game situation. The FT imagery scenario was the kind of action that he never played out during previous FT execution. “It made me think that if my brain doesn’t want me to do those things when I am thinking about it, and maybe in the real game I shouldn’t do them either. So I have decided not to talk back to the players and the referees when I am going through my routine of shooting free throw. Imagery did not change me technically, but made me more focused when I got to the line”.

**Tom**

**Participant's profile.** Tom was 28 years old at the time of this study. He had been playing basketball since he was 7 years old and State Championship was the highest grade he played in. Tom was a tall player, which meant that he was often fouled and awarded FTs, but he had a low percentage of successful FTs, around 50% of successful FT shots during the previous season. In terms of psychological training programs, Tom had only experienced a short period of training in a relaxation technique, so he had no experience of imagery training.

**Screening for Imagery Ability.** Tom was screened for imagery ability on the six imagery subscales considered to be most relevant for performing basketball FT shooting imagery. His scores are presented in Table 5.2. In general Tom's scores were high and well above the cut off for acceptance in the study.

Table 5.2
*Imagery ability scores of participant 2 (Tom)*

| SIAM Subscale | Score |
|---|---|
| Auditory | 299 |
| Visual | 316 |
| Kinaesthetic | 244 |
| Tactile | 270 |
| Control | 316 |
| Vividness | 306 |

**Performance.** Tom's FT shooting percentage throughout the basketball season is reflected in Figure 5.2. Tom's FT percentage mean increased by 2.84%, the level shifted down 8.3%, and the trend line increased (x 1.51) during Phase B compared to the baseline phase. Tom's FT percentage mean increased further by 11.07%, however, the level shifted down by 10.4%, and the trend line decreased (÷1.39) during Phase C compared to the Phase

B. During Phase D, performance improved by 4.57%, the level shifted up 14.5%, and the trend line decreased (÷1.10) compared to Phase C.

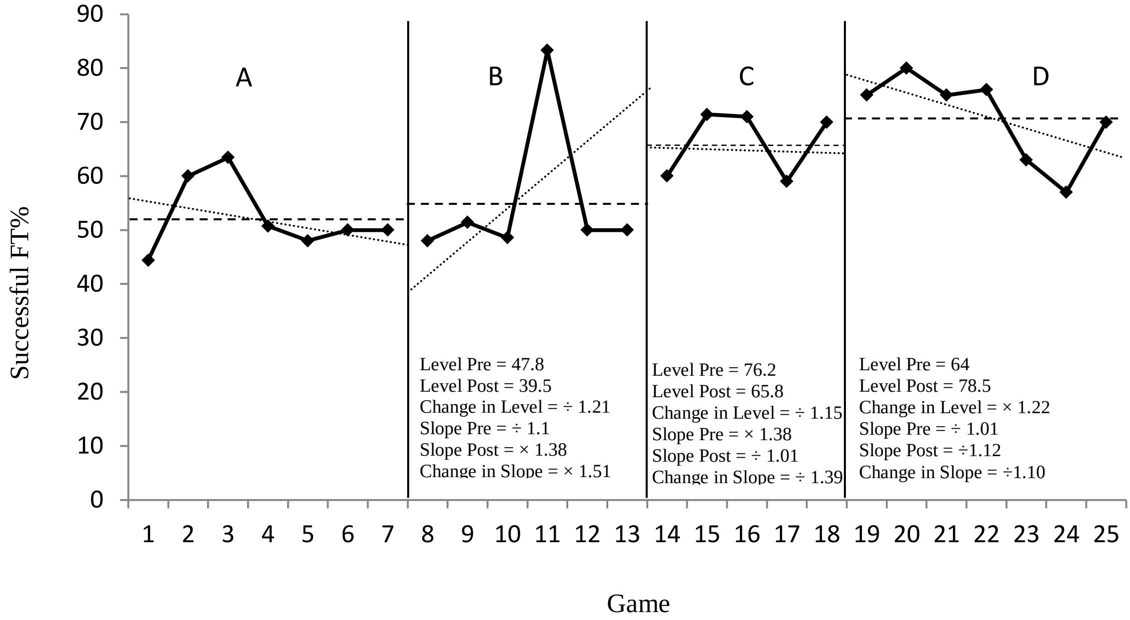


*Figure 5.2.* Split-middle analysis of Tom's FT percentage throughout the season.

In summary, Tom's FT shooting improved in gradual steps through the phases. His FT percentage mean was 52.37 and after the imagery intervention he improved his FT percentage to 70.85.

**Social validation questionnaire analysis.** Tom explained his imagery experience very clearly and in great detail. He reported that he had high imagery ability as it is shown in his SIAM scores. He could visualize the brand of the basket stand, including the colour of it, and the basketball shoes that he always wears, as well as players and referee. He even mentioned imagining in three dimensions. "I often try to imagine the space I am in as well; perceive it as more three-dimensional". He thought that feeling the dimples of the ball (Tactile Sense) as part of the audio script was helpful. In total he found imagery a very pleasant experience. He stated that it helped him not to think too much. For Tom imagery helped him to remove all emotions and everything else that was going on. "I focused so much on physical, and that takes me out of my head." he said. In other words, thinking about physical aspects of FT shooting helped him to pay less attention to his normal emotional reactions during the FT and he suggested that the more you think physically, the less emotion can interfere with your performance. “We often describe it (imagery) as a picture, but if I open myself up and realize it is a big room and take it in as much as I can I am wasting my head off repetitive emotional stuff. And you know, my legs feel kind of strange, why is it feeling strange? I am thinking of my breathing at times. Yes, so try to think more physically”. According to Tom, imagery training also helped him to feel more neutral and more relaxed than he was used to feeling when performing FT shots. Imagery training gave him the time to slow things down in his mind, which he explained was what he needed. “It slowed the FT preparation down and removed the emotions. And it made it more instinctive, which is good. You know I would have said that I was 50-50 before doing this and now it is around 70% for what I perceive myself to be”.

Detail from the interview transcript indicated that Tom’s self-efficacy improved by taking part in imagery training sessions. “I used to feel, I don’t know, scared is the word or embarrassed even, because I have played for a while and I should be able to kick this FTs, but now I’m feeling more confident, which is good”. He found PI unpredictable and he indicated that it helped him to use his own creativity because he did not know what was coming up next.

**Jason**

**Participant’s profile.** Thirty-three year old Jason had played basketball for the past 21 years and was playing in the State Championship for the Melbourne University team, when he participated in the study. He also played two nights a week in the off season at Melbourne Sport and Aquatic Centre in A grade. Jason had never had any kind of psychology training program and he was very eager to take part in the study because his FT percentage during games was 60% and anything that could help him in his FTs he was happy to try.

**Screening for Imagery Ability**. Jason's sport imagery ability was measured using SIAM to make sure that he could adequately imagine what he would be asked in the PI scripts. Jason's imagery ability on the six key subscales is presented in Table 5.3. Jason scored above 150 on all six imagery ability subscales most relevant to the present study.

Table 5.3
*Imagery ability scores of participant 3(Jason)*

| SIAM Subscale | Score |
|---|---|
| Auditory | 250 |
| Visual | 259 |
| Kinaesthetic | 208 |
| Tactile | 206 |
| Control | 313 |
| Vividness | 281 |

**Performance.** Jason's FT% throughout the season is shown in Figure 5.3.

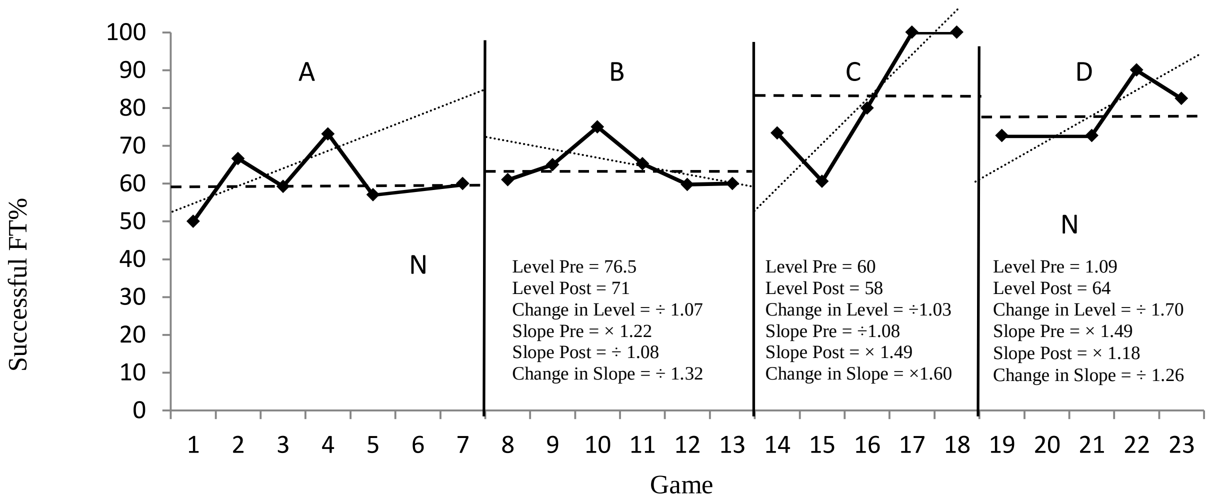


*Figure 5.3.* Split-middle analysis of Jason's FT percentage throughout the season.

*Note.* The symbol N in the Phase A and Phase D of this figure indicates that no free throw was awarded to the player during Game 6 and Game 20.

In relation to Jason's performance, his FT percentage mean showed 4% improvement, the level shifted down 5.5%, and the trend line decreased (÷ 1.32) during Phase B compared the baseline phase. During Phase C, Jason's FT percentage dramatically increased by 20.15%, the level shifted down marginally 2%, and the trend line increased (×1.60) compared to Phase B. In Phase D, Jason's mean performance decreased by 5.67%, the level shifted down 45%, and the trend line decreased (÷ 1.26) compared to Phase C.

Overall Jason's mean performance increased in Phases B and C. Even though performance dropped a little in Phase D, there was still a big improvement compared to the baseline. Jason started with 61% FT shooting and increased to 85.15% in Phase C and finished the intervention phase with FT shooting performance of 79.48%, a largeincrease from the baseline phase.

**Social validation questionnaire analysis.** Jason stated that he had a very enjoyable experience practicing imagery and he thought it opened a new world to him. "The content of the imagery training was very well structured and gave me a very clear visual of what I have been doing during the game" he said. As he was explaining in detail exactly what he was imagining during the imagery sessions, he experienced the imagery very vivid, according to Jason, and he could see a lot of people from the sidelines, which are quite often there for those games. "The experience was very vivid that I felt the potential of nerves to approach, but they never did throughout the test and I think that was a good experience" he mentioned. When he imagined himself performing FT in an important situation during the game, he felt very calm, relaxed, and more confident than before. "This is in direct contrast to the situation in the past where I have felt rather nervous at the FT line, especially if I am in a period of bad form where I haven't hit a few in a while, and I get extremely nervous in those situations". This means that PI helped Jason to control his emotions especially during the high pressure situations. He brought up the observation that if you miss a couple of shots you are more likely to miss the next ones and how the imagery process affected those kinds of situations. “Last week I had a very big game team 1 vs 2 and I airballed (when the ball misses the rim completely) my first FT and it didn’t make any difference mentally to approach to the next free throws. I was engaging the same process for the second shot and it didn’t affect my confidence at all”. An interesting point that Jason mentioned in his interview was that since he started to do imagery, he felt like he was enacting his “visualization” when he actually went to the FT line. He does the same thing when doing his routine. As he is going through his routine process he imagines each step before he does it. “So before I spin the ball I imagine myself spin the ball, and before I dribble the ball I imagine myself dribble the ball. So it is sort of a step-by-step process” he said.

Overall, Jason thought that imagery improved his FT shooting especially with listening to the first two audio scripts. He did not perform well in his last game of the season; however at the end of the game he made the two crucial FTs which won the game for his team, just as in the PI script for Phase D. He was mentally prepared for those kinds of moments because he had imagined this situation repeatedly in his imagery training. He reported that imagery improved his performance and he would recommend it to other people that he knows.

**Sam**

**Participant’s profile**. Sam is an Iranian basketball player with 16 years experience. He was 28 years old at the time of this study. He played in his juniors’ national team back home when he was 18 years old and after that played in the highest league in Iran before coming to Australia. He had a few sessions of relaxation as well as meditation when he was at national camp and he said he was aware of the importance of psychological practice and that was the main reason he said yes to the invitation.

**Screening for Imagery Ability.** Sam was screened for imagery ability on the six imagery subscales considered to be most relevant for performing basketball FT shooting imagery. His scores are presented in Table 5.4. In general Sam's scores were above the cut off for acceptance in the study. He scored very high on visual and vividness imagery subscales, which are key aspects of imagery. However, his tactile imagery score was moderate, but it was still above the cut off score.

Table 5.4
*Imagery ability scores of participant 4(Sam)*

| SIAM Subscale | Score |
|---|---|
| Auditory | 290 |
| Visual | 382 |
| Kinaesthetic | 244 |
| Tactile | 173 |
| Control | 256 |
| Vividness | 362 |

**Performance.** Figure 5.4 shows Sam's FT% throughout the basketball season in each phase.From the visual inspection analysis, specifically during Phase B, Sam's FT percentage mean improved slightly by 7.50%, the level shifted down 14.4%, and the trend line increased (x 1.00) compared to the baseline phase. During Phase C, second intervention phase Sam's performance mean increased substantially by 21.05%, the level shifted up marginally 0.6%, and the trend line increased (x 1.09). In Phase D, his FT percentage deteriorated by 14.39%, the level shifted down by 16%, and the trend line decreased (÷ 1.08) compared to Phase C.

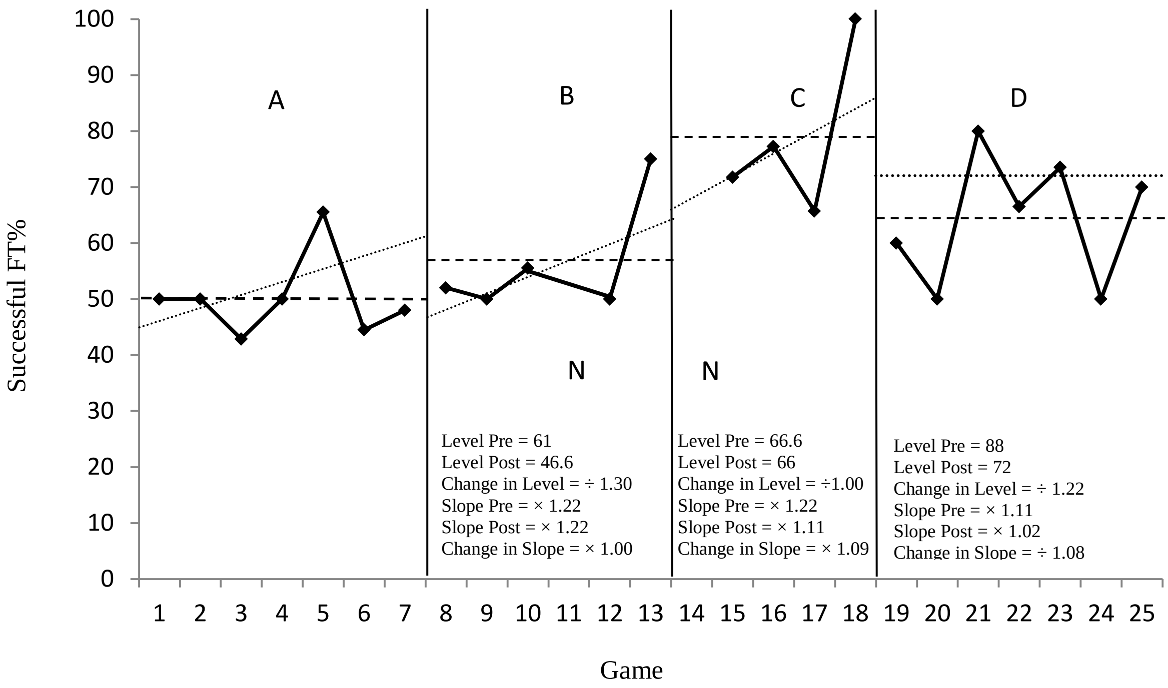


*Figure 5.4.* Split-middle analysis of Sam's FT percentage throughout the season.

*Note.* The symbol N in the Phase Band Phase C of this figure indicates that no free throw was awarded to the player during Game 11 and Game 14.

Overall, Sam's improvement showed a similar pattern to that demonstrated by Jason. He showed improvement in FT percentage mean in Phases B and C, with a very large improvement in Phase C, but dropped down in Phase D compared to the Phase C, but his performance in Phase D was greatly improved compared to Phase A, the baseline.

**Social validation questionnaire analysis.** Sam had previous experience of some psychological skills when he was participating in the national junior camp in Iran some years ago, but he was not introduced to imagery. In his opinion, the imagery experience during the present study, was good and was like meditation for him. He could imagine the scenes that he was asked to do so clearly. The thing that Sam found useful in Phase B when the focus of the imagery script was on the task itself, was feeling the dimples of the ball and touching the ball especially when he listened to the audio before his games. "It took me to the basketball world" he said. The part that he liked the most was imagining the crowd, which he thought helped him very much. He said that it helped him in two ways; firstly, if you imagine doing the imagery with a crowd watching you and with so much pressure, it makes the situation much easier when there are a few people watching you performing FT as you feel less pressure and more relaxed and perform more effectively in low pressure situations. Secondly, even if you are in the situation that you feel the pressure of the crowd or you have got deciding FTs during the game, because you practiced those kinds of situations in your mind and you know how to manage to go through them, you can do the same when you really are in those situations. He pointed out that he always failed to ignore people who were watching him and imagery training taught him that he should deal with it instead of trying to ignore the pressure. “No matter how much I had tried to ignore the people around me, I felt the pressure and I heard their voice every time I was in those situations, but the imagery training helped me to deal with the pressure and not ignoring it and it was more like a training the atmosphere to me. Now I am more relaxed even if there are thousands watching me”.

In the last three weeks of the intervention, however, Sam had not practiced his shots and he was not sure if his bad FT statistics occurred because of the lack of shooting practice or the imagery practice, specifically the last imagery scene that he had to imagine in Phase D. To review, the last imagery scene was when the player imagined shooting the match-deciding FTs in a very stressful situation and Sam was not sure if the last imagery had helped him improve his FT percentage. “I can’t tell that the influence is because of the imagery or lack of training that I could not go behind the FT line confidently. I could feel that my hand is not ready for the shot. But as far as mental preparation, I was in my best performance ever”.

Emotionally, Sam engaged to a high extent in the imagery that his heart rate increased during imagery practice, but not in a way that his emotions were out of control.

He could control his emotions and regain his confidence while he was shooting FTs in his mind. This helped him to feel more relaxed when he was doing FTs during his games compared to before the imagery training. He reported that since he did the imagery training he thinks about the imagery script every time he goes to the FT line and to give confidence to himself he imagines and remembers the last successful training session that he had before executing the shots. For example, exactly before executing FTs during the game he says to himself in his mind, you made 8 out of 10 FTs in the last training session, which increases his confidence.

Overall, Sam found imagery to be a really effective way to enhance his competition FT shooting. He stated that imagery helped him to share the pressure in the days when he practiced his imagery, rather than feeling all the pressure when executing FT. Therefore he felt less pressure when he actually performed FT. In addition, he had practiced his shots under pressure conditions in his mind, so he could perform more successfully when he was awarded FTs with less pressure on him based on the game situation. “You can handle mental pressure better especially when you have made your FTs in your imagery training. You say to yourself so I can make this one too” he said. “Experiencing imagery was good and I don’t have anything to add to the script. I mean if I want to talk to myself that would have been the same things” he added. At the end of the interview Sam mentioned that making FTs is highly dependent on your previous shots. “Whenever I go to the line to shoot, if I make the first one, I am more likely to make the second and third and the rest of the shots, whereas if I miss the first couple of shots that I get during the game it is hard to gain that confidence back” he stated.

**Manny**

**Participant’s profile.** Thirty-one year-old Manny is African-American. He had 18 years playing and 10 years coaching experience at the time of the study. He had been playing for different basketball clubs and in different leagues. State championship was the highest league he had played. He had never experienced any kind of systematic mental training. However, he said he was aware of its importance.

**Screening for Imagery Ability.** Manny was screened for imagery ability on the six imagery subscales considered to be most relevant for performing basketball FT shooting imagery. His scores are presented in Table 5.5. Manny's imagery ability scores were above the cut off for acceptance in the study.

Table 5.5
*Imagery ability scores of participant 5(Manny)*

| SIAM Subscale | Score |
|---|---|
| Auditory | 254 |
| Visual | 318 |
| Kinaesthetic | 232 |
| Tactile | 257 |
| Control | 326 |
| Vividness | 287 |

**Performance.** Manny's FT% throughout the basketball season is reflected in Figure 5.5. Based on the split middle analysis, Manny's mean FT percentage performance improved by 8.4%, the level shifted up 3.9%, and the trend line decreased (÷ 1.02) in Phase B compared to the baseline phase . Manny's mean performance in Phase C increased around 4.36%, the level shifted down 6.2%, and the trend line increased (x 1.21) compared to Phase B. In Phase D mean FT percentage performance improved by 5.77% the level shifted down 21.1%, and the trend line decreased (÷ 1.00) compared to Phase C.

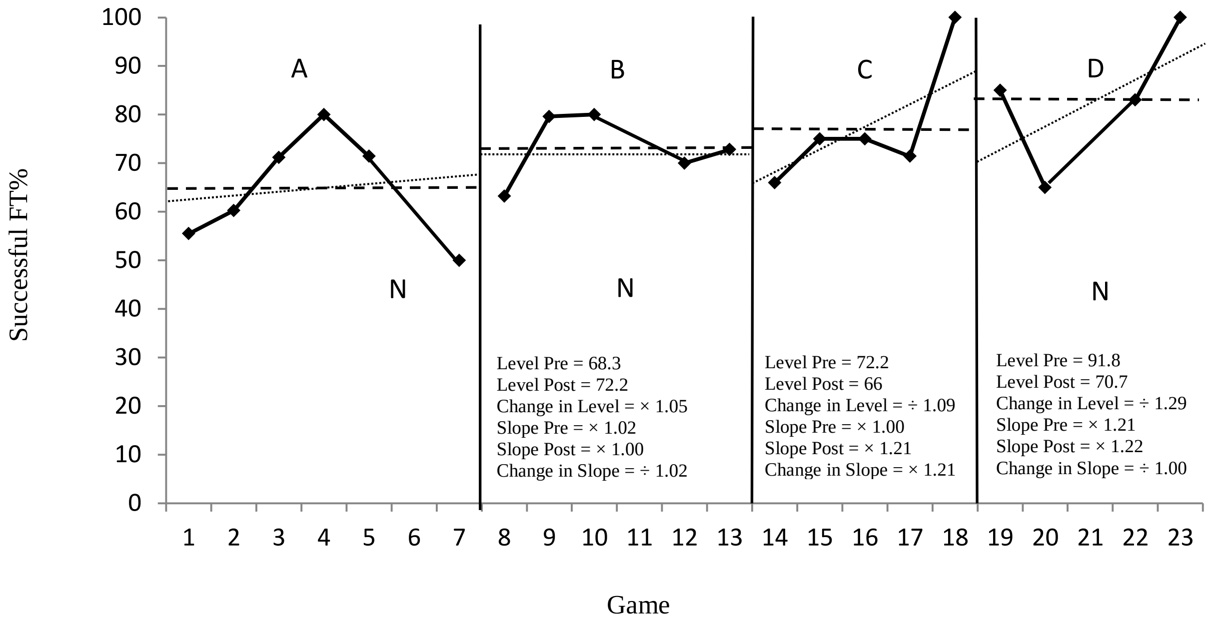


*Figure 5.5.* Split-middle analysis of Manny's FT percentage throughout the season.

*Note.* The symbol N in Phase A, B, and D of this figure indicates that no FTs were awarded to the player during Games 6, 11, and 21.

Overall, like Tom, Manny, improved in his FT percentage mean and continued to improve phase by phase. Before the intervention phase he was shooting 64.72% and after taking part in the imagery intervention his FT percentage improved to 83.25%.

**Social validation questionnaire analysis.** Manny found imagery training really helpful because it helped him to focus on certain things that he needed to do at the FT line and block a lot of things out. Manny reported that he was able to concentrate on his shots more, rather than just getting to the line and rushing it or letting distracting thoughts come into his mind. The imagery content helped him to get a clear image of what he was supposed to do during the game situation and "the images were pretty clear" he said. He added that "Imagery was kind of mind management for me meaning that you reject some of your thoughts you do not need and they are kind of stress you out or distract you and instead you think about some other useful hints like ignoring everyone around you and just focusing on the rim and making the basket".

Emotionally, Manny was engaged in the situations during imagery in a way that was similar to how he said he used to be in real game situations. Manny found it difficult to control his emotions especially in the first two sessions when he started the under pressure situation imagery scene. Slowly he came to control his emotions not only when he was practicing imagery, but whenever he was awarded FTs during a real game. His worries were about the outcome. Even when he was practicing imagery of pressure situations he tended to think about what if I miss and these kinds of thoughts crossed his mind. But he learnt to block them out by practicing imagery, as highlighted in the following comment. "It is a familiar scene when you go through your routine. It is like you have been in those situations hundred times and you feel more relaxed". He found imagery very helpful by saying "The picture is painted clearly in your mind and it is good because if you have been in a situation like that even in your mind, you can get those points in real games as well". He added, "In certain game situations when the game is under pressure, players tend to go away from what they have always done. But the imagery kind of gets you to focus on your shot and block out all the other noises and everything will be fine to execute really well".

Imagery played an important role in Manny's FT improvement by helping him concentrate more while executing FT during a game and block all distracting thoughts and noises out. Manny stated that imagery was a key especially to get to the next level. He encountered players who are very good but when they go to the FT line in high-pressure situations they buckle under pressure. "They should practice those situations in their mind and think about how they can handle those situations" he said. Manny stated that human beings just naturally worry about losing and negative things and imagery helps players to think positively instead. He mentioned that he will encourage all his players to use imagery as he found it really beneficial.

## Discussion

The main objective of the current study was to examine the effect of progressive imagery training on FT shooting performance of highly skilled basketball players in competition. Following inspection of the quantitative data, analysis of interviews was used to further assess the effectiveness of PI and to examine individuals' experiences. There are some points that need to be considered before discussing the results of this study. Firstly, as opposed to an experimental setting, relying on uncontrolled situations in real world research experiences can cause several problems. For example, in the present study, the number of FT attempts each participant had during each game was not under research control. In some games players had more than 15 FTs and in other games they had no FTs at all. The number of shots a person gets in a game might affect the percentage. If players have only three shots, they might really focus and might get all 3 and shoot 100%, but if they get 10 shots then obviously there is much more opportunity for them to miss one or two. In this study, the number of shots that players had varied in a manner that was uncontrollable.

Secondly, there was inconsistency in the quality of opposition. This meant that one week the participants might dominate their opponent and another week the opponent could restrict the participant's performance. Therefore, in some weeks participants were performing FTs under more pressure when they were playing against a strong team compared to when they played against a less strong team. So, there was some fluctuation in the conditions from game to game in the real world competition situations. These factors mean that the results from a real world study, like this one, do tend to be more variable than the data obtained from controlled field studies like Studies 1 and 2 when players were asked to perform in a controlled environment on their own. On the other hand, examination of performance in competition increases the ecological validity of research. These issues need to be considered when considering the results. They suggest that more caution is needed in interpretation of results, but the findings could be very meaningful.

All five participants improved their FT shooting percentage during the intervention phases compared to the baseline phase. This result supported the field study by Williams et al. (2013) that demonstrated that layered imagery training not only improved imagery ability, but also positively affected performance of the imagined task. However, it should be noted that being tested in a field study does not have the same impact as performing in high-level competition across a whole season. Two out of five participants (Tom and Manny), appearing to increase their FT shooting performance progressively from phase to phase, as reflected by the mean increasing from Phase A to Phases B, C, and D, finishing at a considerably higher level than baseline. However, two very high FT percentages that Manny had during Game 18 (Phase C) and Game 23 (Phase D) make interpretation of his data more difficult. Referring to the statistics of Manny's performance from week to week, in a very competitive game he was remarkable and scored 10 successful FTs out of 10 in Game 18. During all three games after that he was under a lot of pressure because those games were vital for the team to be able to make the finals, which could explain the performance deterioration he had during those games. He once more played exceptionally well on his last game of the season. This might be explained by a  reduction in pressure on him because the result of that game did not affect whether the team reached the finals. The team could not make the finals even if they won that game. Overall, Tom and Manny's performance continuously increased and PI was demonstrated to enhance their competitive performance in actual game situations. This is in line with results reported by Callow et al. (2001) and Guillot et al. (2008).

Two participants (Jason and Sam) had similar improvement patterns to Tom and Manny except that their FT percentage rose substantially in Phase C compared to Phase B and declined a little in Phase D. This could be related to aberrant data points in Phases C and D. Percentages were unusually high in Jason's Games 17 and 18 (100%) and Sam's Game 18 (100%). Sam had only 4 FT shots in Game 18 and his high percentage was probably related to the small number of FT shots he received in that game (he had an average of 8 FT shots in each game). Game 17 was an easy game for Jason as he played against a team that were placed second last on the ladder. It is possible that because Jason was not worried about losing the game, he could shoot with no pressure, thus facilitating a higher score. Game 18 was a more challenging game for Jason as he played against a highly-placed team in the league. He played exceptionally well and scored 8 out of 8 FTs on that particular occasion. The particularly high percentages of Sam and Jason on these games were associated with very high Phase C means and celeration lines during Phase C that cannot be used to interpret the data meaningfully because the steepness of the Phase C celeration lines is largely due to those atypical 100% FT scores. The exceptionally high level of FT shooting performance in Phase C is followed by a decrease in Phase D. Even though the FT shooting percentage for Jason and Sam dropped in Phase D, they both still showed a big improvement in Phase D compared to the baseline (Phase A) as well as Phase B. Thus, it is possible to propose that the results for Jason and Sam show a trend of progressive improvement from the baseline to Phase D with unexpectedly high performance in Phase C. In contrast, the fifth participant, Scott, improved in Phase B and then showed a decrease in performance in Phase C, but was still above the baseline during Phase C. Scott's performance increased in Phase D to a similar same level to Phase B. Scott had a 100% successful FT percentage in Game 21 (Figure 5.1), which had a noteworthy impact on the improvement of his Phase D performance. This was due to the small number of FT shots he had during that game because of the smaller amount of court time he played (2 out of 2 FTs). One out of five participants showed distortion in the celeration line during phase D and two others steady celeration lines. For example, Tom showed a large positive change in the Phase B celeration line, followed by a steady celeration line in Phase C, and a negative celeration line in Phase D. The negative celeration line in Phase D could be associated with two extra games which Tom played in the finals. The pressure of the final games might have had a negative impact on his performance. Tom's FT shooting performance percentage decreased in the finals because he played under greater pressure than in league games. Sam's results provide another example of a negative celeration in Phase D, which could be explained by the high pressure situation in the finals games. Although the imagery script of the last phase was developed to prepare players for those kinds of stressful situations, it is possible that it was too soon for players to get the benefit of doing imagery with stress of performance under pressure because they were experiencing high pressure in the real world competition at the same time. Nonetheless, the performance mean lines of these players were still higher than their baseline mean.

All five players performed at substantially higher levels after the progressive imagery intervention than they did at the start of the season during the baseline period. This result is consistent with prior research that demonstrated that single-subject designs are effective in examining the influence of imagery interventions on sport performance (see Bell, Skinner, & Fisher, 2009; Jordet, 2005; Post et al., 2010). By comparison, imaging the execution of football strategies did not lead to significantly improved implementation of these strategies in game situations for players on an Under-13 team (Munroe-Chandler et al., 2005).Two players' performance progressed in steps across the three progressive imagery phases, one player showed a decrease during Phase C, and the other two players reached a particularly high level of performance in Phase C, then their performance decreased a little in Phase D, but they were still attaining a much higher level than during the baseline period (Phase A). Closer observation of the FT shooting performance of the players whose results fluctuated during the intervention phase suggests that a typically high or low phase means might be associated with the occurrence of one or two extreme game scores, such as Sam's exceptionally strong shooting in the $18^{th}$ game. Accepting such deviations and focusing on the general trends, the progressive approach to imagery training appears to have worked well. These patterns indicate that FT performance improved considerably from the baseline, Phase A, to Phase D, suggesting that PI was an effective performance enhancement technique, as suggested in the previous field study. This result conflicts with results of a study by Quinton et al. (2014) that examined PETTLEP elements using the layered imagery method. Layered imagery did not have any significant impact on dribbling and passing performance in soccer in their study. Quinton et al. reasoned that the number of imagery sessions per week might not have been enough to reveal significant improvement. Wakefied and Smith (2009) raised a similar issue, finding that to elicit significant results, a minimum of three imagery sessions per week were needed.

Athletes' experiences of imagery have been used as a source of rich information in many studies through qualitative investigation techniques (Fournier et al., 2008; MacIntyre & Moran, 2007a; Hall et al., 2009). The social validation technique has been documented as a measure that supplements statistical analyses of objective data by subjectively assessing socially important outcomes (Dempsey & Matson, 2009), and the importance of social validation has been considered in many disciplines (Page & Thelwell, 2012). For example, social validation procedures have enabled researchers to demonstrate that increases in rugby performance as a result of a goal-setting intervention were perceived as effective by the players and that the changes in performance were viewed as useful to the team (Mellalieu, Hanton, & O'Brien, 2006). This technique also was used in the current study to explore participants' experience of imagery, PI in particular, and their attitude towards it. During the interviews, the athletes provided information about their experience of imagery use and how effective they found imagery of FT shooting for their performance. In general, the content of imagery in this study was suitable to all participants. This is supported by their reports that PI was well structured and very easy to understand and gave a clear visual picture of what they were supposed to imagine. This was reflected in a comment by Jayson, who stated " The content of the imagery training was very well structured and gave me a very clear visual of what I have been doing during the game." Some participants reported experiencing several sensory modalities in their imagery, visual, auditory, and tactile in particular.

Two participants actually addressed using all senses as the main reason for the effectiveness of imagery because it made it more realistic. For example, Scott stated that "trying to engage all the senses made it more realistic". One other participant, Tom, mentioned imagining three-dimensional scenarios which suggests high imagery ability. "I often try to imagine the space I am in as well; perceive it as more three-dimensional". Although some of the participants had difficulty generating the images initially because it was their first systematic imagery training, they stated that they could image more vividly and much more easily toward the end of the intervention. This suggests that the learning effect of PI, which is presented step by step, adding complexity at each step, helped the skilled basketball players to manage the difficulty of imagery training.

Commenting during interviews also allowed the players to report how they had felt when they were doing imagery. They described experiencing the feelings they would get during real FT attempts, but with a little less emotion. This infers that they engaged well in the imagery scenes, so that they felt the experience was like the real thing. "It slowed the FT preparation down and removed the emotions. And it made it more instinctive, which is good", Tom stated. It also suggests that there was an improvement in imagery ability. Scott, for example, reported that he felt awkward at the start, but got more confident with repetition and practice of the imagery. Imagery helped players to control those emotions, not only during the imagery practice, but also during real game FT. Jason explained that he felt very calm, relaxed, and more confident than before doing the imagery and PI helped him to control his emotions.

Participants also expressed their opinion regarding the effectiveness of PI as a technique for increasing FT shooting percentage in matches. PI helped each participant in different ways. For instance, Scott reported that what the imagery helped him with the way he approached the FTs during the game, particularly to sort out his routine. PI made him more focused when going to the FT line. He added that "Imagery did not change me technically, but made me more focused when I got to the line". PI helped Tom to control his emotions, anxiety, and excitement, and to feel less emotional and more relaxed when executing FTs. It can be concluded from Tom's interview that his self-efficacy improved and he felt more confident when performing FT shooting after the PI intervention than he did before doing the intervention. Sam reported that his experience of the PI training was that it was like training himself to manage the atmosphere of the game. Experiencing the kind of pressure that occurs during competition in the imagery practice context, rather than during matches helped Sam to more effectively handle the mental pressure of FT shooting during matches. Also he learnt that he should develop skills to cope with the pressure of the situation, including the crowd, instead of trying to ignore them, which had not proved to be a successful strategy. This is clear from his comment "imagery training helped me to deal with the pressure and not ignoring it and it was more like a training the atmosphere to me". This result supported the study by Post, Muncie, and Simpson (2012), who reported that some of the participants found the imagery intervention beneficial in practice and competition because it helped them to focus and relax.

Both Jason and Sam's FT performance in competition were highly dependent on their previous shots. This meant that they were more likely to miss following FT shots if they had not made their first FT shot. They reported that imagery helped them to think about each FT shot separately, so they realized that missing the first FT shot in a match, for example, should not affect other FT shots they get during a game. For Manny, imagery was like a filter of his thoughts that helped him to focus on performing the FT shots and block out all sources of distraction. During the PI intervention Manny said that he learned to replace negative thoughts with positive ones. For instance, he mentioned

> Imagery was kind of mind management for me meaning that you reject some of your thoughts you do not need and they are kind of stress you out or distract you and instead you think about some other useful hints like ignoring everyone around you and just focusing on the rim and making the basket.

For all participants imagery was a very pleasant experience. Two participants stated that they would recommend the PI intervention to other people they know. Only one participant thought that his improvement was not primarily due to the PI intervention. He stated that part of his improvement was due to imagery and the other part was a natural progression of performance through the season. The explanation that players improve as the season progresses seems questionable because the participants in the present study were highly skilled performers who have performed in competition for years. Thus, it seems unlikely that 15-20% improvements in FT shooting performance represent some kind of practice effect. To test the possibility of practice effects more closely, I examined the previous season FT shooting percentage of the players involved in this study, as well as their career FT percentage, which was available on the league website. No practice effects was obsereved comparing FT shooting percentages of the players' career or their previous season. This evidence increases confidence that the improvement during the season when the study was conducted was due to the intervention. There were positive trends for all participants and the improvements continued across all the phases, which might be the indication of the benefits of PI. In summary, the interview analysis illustrates that PI affected each participant differently in a number of ways. This supports the argument of researchers and practitioners who propose that individualised imagery training should provide strategic advantages (Munroe-Chandler & Morris, 2011; Weinberg, 2008).

**Methodological Issues**

The present study raised a number of methodological issues. The design of the study had a number of positive aspects, as well as several elements that might be improved upon in further investigations of this kind. Studies 1 and 2 in this thesis were field studies in which it was possible to control the scheduling and the number of FT shots performed by each participant. Such field studies performed away from the real competition context examine performance in “sterile” situations lacking the stress of competition, as well as all the complications related to the presence of team-mates, opponents, referees, and spectators. This provided only a partial test of the different imagery delivery methods. In particular, it did not create a context to fully examine the impact of many key factors of high-level competition (the team-mates, opponents, referees, the spectators, the pressure of the competition context) as they were progressively added in the PI condition. This was the primary motivation for Study 3, in which I employed a single-case design to examine the impact of PI on FT shooting performance among high-level basketball players in league matches across a whole basketball season. Single-case design research allows interventions to be studied in real world contexts. This was a strength of the present study.

At the same time, a methodological issue that originated from the use of a single-case design to examine FT shooting in the real competition setting was that I was not able to control all the factors that might influence performance. In the present study, the number of FT attempts that players had during each game varied, which could have affected the percentage of successful FT shots in that game. For example, if players had only three shots, they might have really focused, resulting in success with all three shots. Such a shooting record in one game equates to a percentage of 100%. This is not strictly comparable to FT shooting performance in games in which players had 10 or 12 FT shots. Records at the highest level indicate that players rarely shoot 100% when they have a large number of FT shots in games. If they get 10 shots, there is more opportunity for them to miss one or two. As noted at the start of this chapter, the top-ranked NBA shooter, that is the best basketball FT shooter in the strongest basketball competition in the world, only shot just over 90% across a season and most of the good shooters in the world's best league had percentages in the range of 70 to 80. In a single-case study like the present one, outlying performance can occur when a player shoots three baskets out of three in a game, giving a game percentage of 100%, when that player typically performs around 70-80%. When there are only four data points in a phase, one point at 100% could change the mean for that phase, leading to considerable distortion of the celeration line. This happened in a few cases, such as for Manny at the end of Phase C and again at the end of Phase D, and even more markedly for Sam at the end of Phase C. In my interpretation of the impact of PI on FT shooting performance I have acknowledged the possible reasons for those unusual game percentages.

In addition to the number of FT shots each player was awarded in each game, other factors that could not be controlled in the real competition setting include when in the game each FT shot occurred, what the game context was at that moment, whether the opposition was the league's outstanding team or one of the weaker opponents, and even how a home or away crowd reacts differently to players' FT shooting success. Nonetheless, the conduct of this study in real high-level competition balances the loss of control over some aspects of the performance environment with the substantial increase in ecological validity in this study, in which I examined the impact of a PI intervention on FT shooting. The FT shooting results show clearly that players improved their percentages by between 15% and 20%, which is a very meaningful outcome in the context of high-level competition.

Another strength of the current study was the end of season interviews with the five participants. In early single-case studies in sport, researchers advocated the conduct of a limited “social validation” interview at the end of a study, primarily to check that the intervention was delivered as intended (e.g., Hrycaiko & Martin, 1996). More recently, researchers have expanded the use of interviews to give single-case studies a mixed method design in which post-intervention interviews explore participants’ subjective experiences of all key aspects of the study. The information provided by participants in such interviews can illuminate observations of the quantitative results of the study that raise questions (e.g., Callery & Morris, 1993, 1997; Khan & Morris, 2011). For example, Khan and Morris measured self-efficacy using the microanalytic technique, in a study of the use of portable devices to deliver imagery with video modeling to netball shooters. Although performance increased, self-efficacy did not. In post-intervention interviews netball shooters reported that they judged the model in the video to be a far superior player to themselves, so did not believe that because she could make those shots, so could they. This explanation is consistent with research in video modeling (Ste-Marie, Rymal, Vertes, & Martini, 2011). In the present study, although participants said they felt more confident and reported more control over their emotions, they did not show such clearcut increases in FT percentage when more emotion elements were added to the imagery scripts in Phase D.

Another aspect of the ecologically-valid single-case design resulted from the structure of the basketball league season. In the Victorian Basketball League, as in many competitions, at the end of the regular league season the top teams on the ladder played off for the league title in two semi-finals, a final, and a third-and-fourth deciding match. I included FT shooting in these matches in the figures for players who were involved in the finals. I noted from visual inspection of the FT shooting figures for Tom (Fig 5.2) and Sam (Fig 5.4) that there appeared to be deterioration in performance during the finals, particularly in the semi finals. I did not include a specific imagery phase for any players who were involved in the finals, so I instructed the players to continue to do the Phase D imagery in which they imagined a high pressure situation for FT shooting in front of a large crowd. This imagery script contained the key ingredients of finals basketball. Perhaps because Tom and Sam were actually performing in high pressure situations at the same time as they were undertaking imagery of such situations to prepare them for such demands, it was too soon for them to benefit from imagining the high pressure situations. It is possible that if these players had experienced more imagery sessions in Phase D before they faced the high pressure of real finals the additional imagery training would have ameliorated the impact of finals pressure on FT shooting performance. This is a question that can only be examined empirically by further research, as noted in the next section.

**Further Research**

Many studies raise more questions than they answer and while this study provided some useful information it raises a number of issues for further research. Replications of the general design with other highly-skilled players in basketball and in other sports across a whole season is needed. Tasks that have different stucture might reveal a different imagery delivery method to be more effective than what was found for basketball shooting in the current study. For example, tasks that are more physically demanding (e.g., weightlifting) may gain more from totally different patterns of imagery delivery method for beginners and skilled athletes. Replicating the study design and interventions of this study in different sport tasks will allow other variables to be examined and could be compared with the results of this study.

The results of Study 2 highlighted how the content of imagery in each phase affects its impact. For example, players were in the automatic phase of FT shooting and imagining the technical details of the skill was shown to decrease their FT performance, most likely because it forced them to shift from automatic to controlled processing, which is associated with a reduction in performance of skilled performers (Beilock & Carr, 2004; Mesagno et al., 2009). In the current study, I omitted the phase that concerned imagining the technical production of the skills and the body motion during practicing the skill mentally to avoid any distracting content. This suggests that further examination of the key factors in progressive imagery in ecologically valid contexts is necessary. It is also important to clarify if and how the quantity of imagery in each phase affects its impact and whether the quantity of imagery depends on characteristics of individual performers. It could be possible to find answers to these questions by doing more systematically-designed single-case studies with more elaborate interviewing. Perhaps interviewing participants at the end of each phase as well as probing those factors more at the end would help to further examine PI and what should and should not be included in imagery content. It is possible to use this kind of interviewing in replication studies and then to design imagery scripts based on the interview results.

There was a decline for two participants who played in the finals, as well as for those who were fighting to get to the finals (e.g., Scott), which could be associated with a number of factors. For example, it could be that these competition contexts reflected genuine effects of performing in high pressure situations. It does not seem that imagery of performing FT shots in the high pressure situation helped participants to overcome the real high-pressure situation they faced during those final games of the season. One future research path is to compare the effect of high-pressure imagery training versus low-pressure imagery training on performance under pressure more systematically to examine whether it was a good idea to practice those kinds of situation using imagery. Another explanation for imagining performing in a high-pressure situation not appearing to be effective for those players who faced high-pressure situation in real world could be that the high-pressure phase (Phase D) was not long enough. Participants only had four imagery sessions of the high-pressure situation and that was perhaps too short to be beneficial for them to overcome the pressure they experienced, especially during finals. One direction is to do more systematic study of the effect of more imagery training sessions incorporating high-pressure situations prior to real performance under pressure and comparing the different numbers of high-pressure imagery sessions, such as 5, 7, or 9 imagery sessions. It would be also beneficial to add a different high-pressure situation scene as a new phase instead of imagining the same scene for a longer period or even comparing the two delivery schedules to examine whether one helps participants cope with high pressure situation more than the other.

Another possible explanation for the decline in FT shooting performance that was observed for players in high-pressure situations toward the end of the season is that the timing of the high-pressure imagery was inappropriate. In this study, participants undertook high-pressure imagery concurrently with facing high pressure in the final games of the season. This might have had a negative effect on performance. It might be that to be effective high-pressure imagery training should precede competition performance under high-pressure conditions. Studies could be informative in which imagery training that includes imagery of performing well in high-pressure contexts is conducted prior to competition performance in such contexts and this is compared with the same imagery training conducted concurrently with competition performance under high pressure.

Finally, the specific content of high-pressure imagery should be examined systematically. It is possible that simply imagining the pressure of taking the final shot of a match in which victory depends on success, while constituting a high-pressure situation, does not adequately prepare players for the experience of performing in a final or a game that will determine whether the team makes the final. In such a situation, the feeling of pressure is likely to arise before the game even starts and might pervade the whole period of the match. In this case, different imagery content would be desirable to help players to cope with the pressure. Research would be interesting on the content of imagery that compares different kinds of pressure experiences and ways of coping.

In summary, the present study was an ecologically valid study conducted with highly-skilled basketball players performing in high-level competition over a whole season. Participants of this study showed improvement in their FT performance during all three intervention phases in competitive contexts compared to the baseline phase. In addition, qualitative analysis in this study suggested that all participants found adopting PI training was related to their improvement in performance, however, each of the participants reported that PI helped them in different ways. The findings of Study 3 provide strong support for the results attained in Study 2. Future research on the use of the PI delivery method, especially in real world situations, should provide valuable information.

# CHAPTER 6

# GENERAL DISCUSSION

## Introduction

This chapter consists of four sections. First, I present a summary of the conclusions of three studies of the present thesis. In addition, I discuss the current findings in relation to research and methodological considerations. Next, I provide suggestions for future research based on the findings from all three studies of this thesis. Then, I examine implications for the practice of imagery for performance enhancement in sport. Finally, I make some concluding remarks that reflect on the outcomes of the thesis.

## Conclusions

The purpose of the present thesis was to compare the impact of different imagery training methods, namely RI, PI, and RETI training on basketball FT performance and FT self-efficacy of limited-skilled and highly-skilled basketball players (Studies 1 & 2) and on highly-skilled basketball players in real world competition (Study 3).

As proposed within the key theme of this thesis, imagery script can be delivered to athletes using different methods. The traditional technique for delivering imagery, RI, has been used for many years with a view to apply imagery systematically. A review of the literature reveals interventions that previously employed RI (e.g., Klug, 2006; Post et al., 2010; Wakefield & Smith, 2009). Although RI was found to be effective and resulted in successful outcomes in many imagery intervention studies (e.g., Klug, 2006; Post et al., 2010; Smith et al., 2008), applying this method of imagery delivery can be inappropriate for participants due to the large amount of information that can create overload (Wakefield & Smith, 2012). Also, because the imagery script remains the same for long periods of time through an RI training program, it has the potential todisengages those performing the imagery. Hence, researchers have endeavoured to find solutions to these specific problems, that involve the proposing of new imagery delivery methods.

Regular updating of the content of imagery scripts has been postulated in the PETTLEP model by integrating changes in circumstances, such as psychological and physiological changes of the imager, variations in the performance environment, quality of performance and skill level, and imagery ability (Holmes & Collins, 2001). Several methods have been suggested to modify imagery content (Cooley et al., 2013). The first method was through eliciting information from participants and amending the original script accordingly. This is a way of personalizing imagery scripts pursuant to consulting with the imager to improve the quality of imagery interventions (e.g., Smith et al., 2008; Shearer et al., 2007). The second suggested method is progressive imagery (layered imagery), where details and information are added to imagery scripts step by step, as new phases, to enhance imagery effectiveness (Nordin & Cumming, 2005; Wakefield & Smith, 2012). In the studies by Cumming and colleagues (Cumming et al., 2007; Ramsey et al., 2010), researchers examined the effect of layered stimulus-response training (LSRT) by including some stimulus details in the participants' imagery script, then, in following phases, including additional stimulus, response, and meaning propositions in separate layers, in order to make the images more vivid without overwhelming athletes with too much information. Performance and kinaesthetic imagery ability of participants in the LSRT condition improved significantly.

The studies by Cumming and colleagues were consistent with an earlier study by Calmels et al. (2004) that used a structured imagery intervention in a study in which imagery was introduced in five stages that added more details to the imagery script. This study showed that PI was beneficial to enhance the participants' imagery ability, but performance was not tested. However, a recent study did not show any significant impact on performance and imagery ability of participants after a layered PETTLEP imagery intervention (Quinton et al., 2014). Although this approach has been employed in research, no systematic study has been found to compare its effectiveness with other imagery delivery methods.

The original script is usually very simple and focuses on the basic parts of performance based on the experience of the imager. The information added to each phase seems to depend on the improvement of participants' imagery ability as well as the level of proficiency in the skill. In addition, it is crucial to determine the best time to add successive phases in progressive imagery method, because inappropriate timing may cause imagers to be overwhelmed with extra information, if too much is presented too soon. There is also potential that participants could get bored if they must continue to imagine simple images because new imformation is delayed for too long, in either case reducing the efficiency of the imagery intervention (Calmels et al., 2004; Nordin & Cumming, 2005; Quinton et al., 2014). However, the amount of information added and the time of implementing it needs to be more systematically examined by researchers.

Another method that researchers have used to modify imagery scripts is replacing the original script with an entirely new script containing the same task or situation with different images (e.g., Callow et al., 2001). As imagers become more proficient, the content of imagery should be adjusted to meet the participants' new requirements, such as skill level, task difficulty, and details of the environment (Callow et al., 2001; Cooley et al., 2013). Applying a completely new script containing the recent needs of imagers, rather than rehearsing and repeating the previous script, which may lose its efficiency after a while, is an approach that should be studied further to compare it with other techniques in which scripts are modified across sessions of imagery programs.

In the design of Studies 1 and 2, consideration was given to useful suggestions drawn from the literature, thus, one of the methods I followed was the approach in which more details are added to initially simple scripts, that is the PI method. I introduced a new method of modifying imagery in this thesis, in which I reversed the PI process as the content was simplified to reduce the details by eliminating information from the original, full script in stages (RETI). Although the PI approach has been called "layered" imagery in the literature, I used the term 'PI' instead, because layered only suggests the presence of layers, but does not actually indicate whether those layers are added or taken away. The terms PI and RETI, however, clearly indicate whether layers are added or removed.

I compared three different imagery interventions and a control condition to find the most effective imagery delivery method to use when structuring an imagery training intervention. The findings of Studies 1 and 2 showed that the skill level of the participants is a critical factor in deciding which imagery delivery method to apply in any specific context. Study 1 demonstrated that those with limited-skills benefit more from an imagery delivery method that starts with a very detailed script and the imagery script becomes simpler by deleting some content as the intervention progresses (RETI). In Study 2, however, highly-skilled participants benefited more from the PI delivery method compared to other conditions, where more details were progressively added to the imagery content. Therefore, based on the results of Studies 1 and 2, the effectiveness of imagery training methods depends on athletes' skill levels. The results of the first two studies are a testament to the importance of considering skill level when choosing an imagery delivery method.

Another noteworthy finding of this thesis was that in both Study 1 and 2, participants in the RI training method scored the second highest gain in performance score amoung the four conditions, reflecting a greater gain than PI in Study 1, than RETI in Study 2, and than the Control condition in both studies. Thus, it can be argued that RI is a useful method of presenting imagery to athletes. The RI script used in these studies was comprehensive, including all aspects of the imagery scene that was developed. This entire script was delivered to PI participants only in their final session or RETI participants only in their first session.

Self-efficacy results in Study 1 and Study 2 mirrored performance results closely. In Study 1, only participants in the RETI condition recorded significantly higher self-efficacy than those in the C condition, whereas only participants in the PI condition recorded significantly higher self-efficacy than the Control condition in Study 2. In other words, the imagery delivery method that I found to be the most effective for each of the studies, not only was the most effective method for performance enhancement, but I also found those to be more effective than the other methods for improving participants' self-efficacy. These findings are in line with previous studies on self-efficacy (See Moritz, Feltz, Fahrbach, & Mack, 2000 for a review), which found a high correspondence between self-efficacy and performance. Additionally, participants in Study 2 had higher self-efficacy than participants in Study 1 at the pre-test. Each study showed a different type of imagery delivery to be more effective. The current finding can be interpreted in line with social cognitive theory (Bandura, 1997). Bandura stated that individuals with higher self-efficacy would prefer to get involved in more challenging tasks. Wood and Bandura (1989) further concluded that individuals who demonstrate strong self-efficacy are more likely to undertake challenging tasks, persist longer, and perform more successfully than those with lower self-efficacy beliefs. Thus, it can be concluded that individuals with higher self-efficacy (participants in Study 2) enjoyed the challenges presented in PI in a progressive way, and individuals with lower self-efficacy (participants in Study 1) could not rise to the challenges presented to them in PI imagery.

One way MANOVA of SIAM scores between participants in Study 1 and Study 2 at pre-test showed a statistically significant difference in participants' imagery ability, F (6, 91) = 2.89, p =.01, partial η2 = .16. Highly-skilled basketball players reported significantly greater imagery ability than limited-skilled players as measured by the SIAM. Post hoc Tukey tests revealed that four out of six SIAM subscales in Study 2 (Kinesthetic, Tactile, Control, and Vividness) were significantly higher than Study 1. This is consistent with the literature that individuals with greater skill possess greater imagery ability (Roberts et al., 2008; Williams & Cumming, 2011). Numerous studies have also demonstrated that those with greater imagery ability may benefit more from utilizing imagery than those with less developed ability in imagery (e.g., Goss, Hall, Buckolz, & Fishburne, 1986; McKenzie & Howe, 1997; Robin, Dominique, Toussaint, Blandin, Guillot, & Her, 2007). However, this is not always the case and by a compareson of Studies 1 and 2, it can be suggested that individuals with different levels of imagery ability may benefit to different extents from different imagery delivery methods. This means that imagery delivery method should match the stage of development of the imagery ability, as well as the skill level of individuals.

Overall, according to the findings of the first two studies of this thesis, the most effective imagery method depends on athletes' skill level in the task being imagined. In accordance with the findings of this study, the skill level has the paramount role in selecting the method of delivering imagery, as evidenced by RETI being more beneficial for lower-skilled imagers while PI is more efficient for higher-skilled athletes. Additional work needs to be done to examine the optimum duration of interventions and how individual differences in imagery strength and skill levels might influence imagery delivery.

For further exploration, I adopted a single-case ABCD design to examine the effects of PI delivery method in actual game conditions. Study 3 was designed according to the findings of the second study, wherein highly-skilled basketball players benefitted more from PI training than RI or RETI training in a practice situation. I examined the ecological validity of the findings of the Study 2 in Study 3 by monitoring highly-skilled basketball players' performance in real world situations and interviewing them after the intervention. I used PI because I found it to be more effective for the highly-skilled athletes in Study 2, however, I modified the script based on the results of Study 2. For example, the first phase of imagery in PI in studies 1 and 2 was imagining the technique of FT shooting. In Study 2, this did not lead to a gain in FT shooting performance, which only began to improve in later phases. This is understandable because highly-skilled basketball players would already have automated their FT shooting technique, so imagining the technique would be unlikely to enhance FT shooting performance. In fact, it could lead to a deterioration in performance by encouraging players to think about performance of an automated skill, which has been shown to interfere with skilled performance (Beilock & Carr, 2004; Mesagno et al., 2009). Therefore, this element of imagery training (imagining the technique like arm movement, knee bending) was excluded from the script in Study 3. Participants of this study showed substantial gains in their FT performance during all three intervention phases in competitive contexts compared to the baseline phase. Results from interviews were consistent with participants' performance results as all participants stated and comprehensively explained that adopting PI training was associated with their improvement in performance. Taken together, in Study 3, PI was demonstrated to be a useful imagery delivery method, particularly to enhance highly- skilled athletes' sports performance in a competition context. The results of Study 3 provides support for the proposition that experienced performersusing PI are also able to achieve success in competitive situations. Following examination of the literature, it appears that Study 3 was the first study to examine PI in an ecologically valid setting with highly skilled athletes over a season in their main competition performance where PI was used and shown to be effective.

## Methodological Considerations

Imagery training programs might have varying benefits and effects on athletes in different contexts, depending on key factors, such as imagery ability. Researchers have generally shown athletes with higher imagery ability to experience greater improvements compared to poorer imagers (Cooley et al., 2013; Goss et al., 1986; Robin et al., 2007). Researchers should match conditions according to participants' imagery ability to ensure that differences in the results for different imagery training conditions cannot be explained by differences in imagery ability between the conditions. Thus, the first step in all of the three studies was to ensure that all participants were able to effectively perform imagery training they were assigned to. To do so, I assessed participants' imagery ability at the beginning of all three studies and compared participants' imagery ability to ensure that there was no significant difference between imagery ability of participants in the different conditions. In this way, I minimised the possibility that imagery ability was a confounding factor.

Without the use of imagery scripts, athletes would be asked to imagine a particular image, such as FT shooting in basketball, with little or no control of the images that different athletes created, the level of accuracy of the images in relation to the behaviour to be performed, or the duration of individuals' imagery. It is possible that systematic differences in these aspects of imagery could arise between research conditions that could influence results. A part of this problem has been solved by utilizing imagery scripts, where the content and duration of the imagery intervention are equalized between participants in different conditions by using the same script content in all conditions to compare the effectiveness of imagery interventions. The implications of implementing imagery training in this are beneficial results for participants, particularly to those who were unfamiliar with systematic imagery training, thereby encouraged researchers and practitioners to work more on the details of the scripts. The content of the imagery script used in this thesis was based on competitive basketball players' experience of the task and was the same for all imagery conditions. Although personalized imagery interventions have been found to be more effective (Lang, 1985; Wilson et al., 2010), particularly in the motor domain (Smith et al., 2007), to equalize the conditions and make comparison possible, generic imagery content was used for all participants in all conditions. However, conditions differed in the way the content were delivered to them (RI, PI, or RETI).

Appropriateness of imagery content could be another crucial factor in the success of an imagery program. In other words, the content must be selected in accordance with the demands of the situation and key characteristics of the athlete. Therefore, unsuitable content for the situation or the athlete may be detrimental to performance (Holmes & Collins, 2002). For instance, the content of imagery for a high intensity sport should not be similar to a low intensity sport. Depending on the sport and the individual, athletes might need images that facilitate an increase/decrease in their arousal level to perform optimally. Hence, the optimum level of control and accuracy should be deployed to prepare an imagery script containing all possible aspects and demands for successful performance (Hanin, 2000; Holmes & Collins, 2002; Nordin & Cumming, 2005). I employed exactly the same imagery content for Study 1 and Study 2 to make the comparison of two skill levels possible. The scripts used were developed for competitive basketball players and the meaningfulness of the content was not modified for different participants of different skill levels, thus, leading to the possibility of greater applicability to certain participants more than others. For example, performing in front of a large audience for participants of Study 1 who had never experienced it in real life was less meaningful than for participants in Study

2, who regularly played matches in front of substantial numbers of spectators. In Study 2, imagining FT shooting technique with emphasis on the position of the body and limb movement might not have been appropriate for highly-skilled participants for whom FT shooting technique should be an automatic process. It is possible that this element of the script led them to revert to controlled processing when thinking about performing the task, which could disrupt actual performance. However, as participants in all conditions in each study had the same content, but presented at different times, comparison between conditions in each study and also comparison of two different skill levels were meaningful. Several theories have been suggested in connection with the content of imagery scripts to achieve desired outcomes, such as Paivio's imagery functions framework (1985), the applied model of imagery use (Martin et al., 1999), and Lang's bioinformational theory (Lang, 1977 & 1979). To develop lifelike and more vivid images, the PETTLEP model was proposed by Holmes and Collins (2001), involving stimulus, response, and meaning propositions. The meaningfulness of the content of imagery was proposed in Lang's bioinformational theory (1978) and has been supported in a number of studies (Callow & Hardy, 2004; Calmels et al., 2004; Sisterhen, 2005). Thus, the meaning of imagery components to the participants should be considered when designing imagery interventions in order to maximize their benefits (Calmels et al., 2004).

The length of the imagery training sessions varied depending on the condition and the stage of the intervention. RI received the most minutes of imagery training (12 sessions x 10 minutes) whereas the duration was less for PI in the first three weeks and for RETI in the last three weeks of intervention. However, there was no systematic relationship between duration of script and changes in dependent variables, either for longer duration to be associated with larger improvements or for shorter duration to be more effective. For example, in Study 1, no significant difference was detected between the RETI and RI coditions. Likewise, in Study 2, the RI condition did not show significantly greater improvement than RI.Therefore, it can be concluded that the different length of the imagery sessions in each condition did not confound the results of Studies 1 and 2.

## Further Research

Substantial expansion and development in imagery research in sport has been seen during the last decade with more focus on the significance of transferring theoretical knowledge to practical situations and introducing more efficient approaches of delivering imagery programs. Reviewing the lieterature suggests that an area that has potential for development concerns determining the most effective ways to deliver imagery interventions. A variety of delivery methods has been examined in research and discussed in the applied literature (for a review see Cooley et al., 2013), leading to debate surrounding the most effective way to deliver imagery. Recently, a small number of studies have been conducted in which researchers specifically investigated the effectiveness of PI on performance and/ or imagery ability (Calmels et al., 2004; Nordin & Cumming, 2005; Quinton et al., 2014; Williams et al., 2013), and no available research whereby other imagery delivery methods have been examined (e.g., RETI) or compared with each other. Therefore, the study design utilized in this thesis, particularly in Studies 1 and 2, can offer suggestions for improving the quality of intervention designs in further research. Specifically, different imagery delivery methods can be thoroughly investigated in studies that replicate the design of Studies 1 and 2 in a variety of sports skills and various sport types (e.g., individual, team sports). It could be also beneficial to conduct single-case study designs that examine delivery methods in real sport competition over an extended period. One problem that I faced during collecting data in Study 3 was that I had no control over the number of FT shots that participants performed in each match. Replicating the general design of Study 3 in more controlled sports in terms of the number of attempts participants perform during a game situation (e.g., shooting, archery, darts) would produce more controlled data and larger data sets for each competition. This could provide more information on the usefulness of imagery delivery methods in competition contexts.

The findings of the studies presented in this thesis provide information for a specific population of athletes (limited-skill and highly-skill athletes) on methods of delivering imagery. RETI and PI were found to enhance the effectiveness of mental imagery trainings with athletes of limited-skills and highly-skill respectively. Based on the results of these studies, it can be suggested that the application of these two methods directly depends on the skill level of the imager. As PI and RETI have been introduced as the latest innovations in imagery delivery, a question that may be raised is whether the superior imagery training found in each skill level could be expanded by different skill levels (e.g., beginners, intermediate, elite athletes). In addition, it would be interesting to examine whether a point can be identified in the development of skill when the most effective delivery method changes and whether this has consistency across skills. Thus, in future, researchers should examine different imagery delivery methods  across the skill-level continuum and compare the efficacy of the delivery interventions at each skill levels. For instance, studies could be done comparing players of different levels with the same study design and the same conditions as Studies 1 and 2, modified for the demands of specific sports, to explore where the RETI advantage disappears and where PI becomes more effective on the continuum. It would be valuable for coaches and athletes who are working with players of different skill levels to know whether there is an identifiable boundary between low and high-skilled performers in terms of the delivery of imagery.

A common outcome of Studies 1 and 2 was that participants in the RI condition produced the second highest gain scorers in FT performance after RETI condition for limited-skill players (Study 1) and after the PI condition for highly-skilled players (Study

2). Participants in the RI condition imagined the full version of the competitive FT shooting imagery script from the first session and continued to imagine the same script with no change throughout the study. Although not significant, participants in the RI condition in both studies showed notable improvement during the last two weeks of the intervention. It coould be argued that if the imagery intervention was longer they could have scored significantly higher than the control condition. This leads to the suggestion that it would be useful to compare the impact of different imagery delivery methods over longer intervention periods to examine whether RI significantly facilitates performance as well as self-efficacy, supporting the trend observed in Studies 1 and 2.

In addition, future research should be conducted to examine other possible imagery delivery methods. For example, for future investigation imagery can be delivered to athletes by a combination of methods used in this thesis. Based on the discussion of Study 1, RETI was determined the most effective imagery delivery method as this method first gives participants an idea about the skill and then simplifies the script in stages. One explanation was that imagining the whole skill acts as a source of feedback, which helped limited-skill participants to be aware of the correct form of the skill. Thus, they could compare their performance to that of a model and highlight areas that they must work on to bring about improvement. Given that finding, another possible method of imagery delivery is to give participants an idea about the skill, using the full version of the imagery script, and then, unlike the RETI condition in Studies 1 and 2, continue with a PI delivery method, giving participants the basic information in a very simple script and adding details progressively. Thus, in studies examining this kind of delivery method, the first script that should be delivered to participants is the most detailed imagery script to build a model of how the skill should be performed. Subsequently, the next imagery script should be the simplest imagery script with very basic information about the skill in hand. From there on, details should be added to the script progressively. Thus, the same study design as in Studies 1 and 2 can be used to compare this combined imagery delivery method with other imagery delivery methods found to be effective in this thesis.

Another recommendation that can be offerd for the design of future research is the use of personalised imagery scripts (e.g., Wilson, Smith, Burden, & Holmes, 2010). One way of doing this is by continually modifying an imagery script through a series of intermittent consultations with the participants, who are asked if they would like to make any additions or modifications to enhance the imagery experience and the individual meaning of the imagery (e.g., Smith, Wright, & Cantwell, 2008; Shearer, Mellalieu, Thomson, & Shearer, 2008). For example, Cumming et al. (2007) and Williams et al. (2010) used this semi-personalised method by giving imagery scripts to participants, who were asked to add propositions that they felt would make the image more realistic.

Study 3 was designed to test ecological validity of the effectiveness of PI for highly skilled basketball players' performance in real world situations based on the findings of Study 2. The effectiveness of RETI for limited-skilled players in competitive contexts has not been investigated. Thus, similar studies to Study 3 should be conducted to examine the ecological validity of the finding of Study 1 for limited-skilled players. It should also be valuable to interview participants, preferably at the end of each phase, to acquire their experiences of using RETI and to obtain their estimate of the effectiveness of the imagery program. The finding of such research would provide further tests for the results attained in Study 1. Future research on the use of the RETI delivery method, especially in real world situations, should provide valuable information.

Looking at the results of Studies 1 and 2, none of the conditions showed significant improvement in their outcomes during the first two sessions. This could be due to the lack of skill at doing imagery as participants had no previous experience of systematic imagery training. Although they received some instructional guidelines with their first imagery script, it seems that participants in all conditions needed time to adjust in some way to imagery as an efficacious method of enhancing their performance during the first two weeks. Therefore, level of experience with imagery could be a mediating factor in terms of the impact of imagery training for performance enhancement, so perhaps participants started to show performance enhancement as their skill in using imagery developed. Thus, research replicating Studies 1 and 2 should allocate several sessions for imagery training familiarization before starting interventions to examine how developing imagery ability prior to delivery of an imagery training program affects the impact of delivery methods.

The issue of imagery dosage is very important to consider and more investigations are required to discover the best intervention length (e.g., short/day, medium/month, prolonged/year), imagery session duration, number of trials in each session, and how many phases required (Morris et al., 2012). Therefore, one of the main paths for future research, is to focus on the dose of imagery to further understand what characteristics of imagery training influence the effectiveness of imagery training delivered in different ways (e.g., RI, PI, RETI). For example, the RI participants showed a notable increase in gain score in the third and fourth week which did not happen for participants in the Control conditions of both Studies 1 and 2 and also the PI condition in Study 1 and RETI condition in Study 2. Perhaps the amount of information given to participants was too much for the length of the imagery training of these studies. Therefore, it is worth examining whether the RI delivery method results in greater improvement outcomes after a longer intervention period. Inasmuch as there was a large increase in scores in the last two phases of RI interventions in Studies 1 and 2, spending more time rehearsing the scripts might result in greater improvement in RI imagery. Such research might provide useful information on the effectiveness of the different imagery delivery methods for performance facilitation.

For all three studies, I chose to ask participants to practice the imagery training program three times per week. I chose three times per week based on the limited literature on imagery dose response. For example, Wakefield and Smith (2009) found that three imagery sessions a week was more advantagous than one or two sessions per week. However, it is still unclear how much imagery is enough and whether there comes a point where adding more sessions is too much, that is, no further benefit is gained from extra time spent repeating the same imagery or there is even a decrement. Therefore, further research needs to establish a dose of imagery training that is not too infrequent, nor overloading the participants (Cooley et al., 2013; Morris et al., 2012). It is even more crucial to determine the correct dose of imagery for imagery conditions where there are multiple phases with a different imagery script in each phase (e.g., PI and RETI). In the current thesis, I chose the same amount and duration of imagery training for all phases across all conditions. Participants might need more or less than 3 sessions in some phases to master the imagery task and get the most out of the imagery training. Therefore, it is important to determine the right time to remove a part of the script in RETI or add more details in PI. For example, in Study 3, some participants' performance declined in high-pressure situations toward the end of the season. One explanation I proposed was that participants undertook high-pressure imagery concurrently with facing high pressure in the final games of the season. Therefore, the time that was allocated to practice imagery under pressure (3 imagery sessions per week) might not been enough to adequately prepare players for the high-pressure situations in actual games. One way to refine the number of sessions of imagery per week is via regular consultations with participants to ask whether they think they are ready for the next phase. The number of sessions participants complete with a particular version of the script before they indicate that they are ready to move to the next phase would be one indication of how many sessions phases should be. From this kind of exercise, it would also be possible to determine whether participants consider that the suitable time to move to a simpler script in RETI or a more complex script in PI is different for different phases of an imagery training program. This would provide a clearer picture of the factors that affect RETI and PI delivery of imagery and demonstrate the role of different types of imagery delivery in performance development.

It is likely that the imagery delivery method is not the only determining factor and the amount of information that is delivered to athletes is important to consider as well. For example, researchers should examine whether all the details of PI or RETI scripts can be delivered more effectively in small and gradual steps or large steps particularly in terms of the impact this has on performance. It is also appropriate to examine the amount of content in RI imagery scripts. For example, the effectiveness of the RI delivery method could be different if the RI script contained more limited details than the rich script used in Studies 1 and 2 of the present thesis. Thus, in research conducted in the future, researchers should consider examining simpler versions of RI as alternative imagery delivery methods. In some studies it would be appropriate to compare different RI scripts. In other studies simpler RI scripts could be compared for effectiveness with other methods examined in the present thesis. This would provide a clearer picture of the factors that affect RETI, RI, and PI delivery of imagery and demonstrate the role of other factors affecting the effectiveness of imagery training programs in sport.

Despite the extensive theoretical and research literature that exists on the application of imagery in motor learning and sports performance, the studies conducted in this thesis have raised a number of important questions about the processes and procedures of how sport psychology practitioners should deliver imagery effectively. These questions open up a number of exciting areas in which systematic research should be conducted.

## Implications for Practice

The findingsreported in this thesis can provide useful information for sport psychology practitioners, specifically on effective procedures for the delivery of imagery training. The current results should assist sport psychologists and coaches to optimize the efficacy of imagery-training programs that they develop. A close relationship between the participants’ skill level and the method of imagery delivery was found in the present thesis. RETI has been found to be suitable for limited-skilled players, while PI has had more impact on high-level athletes. Thus, depending on athletes’ skill level, practitioners and psychologists should choose imagery training methods carefully as all imagery training methods are not equally beneficial for athletes of a certain skill level. The first implication is that RETI and PI would be more advantageous for use with developing athletes and highly-skilled athletes respectively.

Informal discussion with participants in Study 1 revealed that one aspect of the content, in particular, was not meaningful to those participants. This was imagining being watched by a large audience. This was confirmed by my experience of watching games at this level, which are played in front of very few spectators. This content was added to the script to include emotions that could be experienced during competitive situations and then to guide participants to imagine coping well with the impact of an audience. It had meaning in that the participants in Study 1 could understand the instruction to imagine an audience and why this would be useful to higher level players, but their lack of experience of playing in front of audiences meant they had no basis for generating that imagery, especially the emotions associated with audience presence and reactions. That is, it had meaning at the level of the instruction, but not at the level of activating the emotions associated with the audience due to the experience gained at the competition level of participants in Study 1. This leads to the implication for developing imagery scripts that the content of imagery scripts throughout interventions should be prepared according to the skill level of imagers and considering the meaningfulness of the content to the athletes who will use it in order for imagery to be effective. Therefore, considering that athletes are different and the same approach may not work equally well for athletes at all levels, individual difference factors, especially athletes' sport abilities and needs and their competition experiences are important to contemplate prior to and during the development of imagery training programs (Weinberg, 2008). In addition, information and feedback should be elicited from athletes during the intervention that could be used to modify the content, including the meaningfulness of the script to the athletes, and the dosage of the imagery intervention, including the duration of the imagery intervention, the duration of each session, and the number of sessions for which participants rehearse each script.

In this thesis, I found that both limited-skill and highly-skilled athletes benefitted from the imagery intervention using different methods of imagery delivery. In the literature regarding the construct of imagery in sport, there is debate about which skill level benefits more from imagery training (Noel, 1980; Suinn, 1983; Wrisberg & Ragsdale, 1979). Based on the results reported in this thesis, in which I compared three different imagery training methods in two different skill level basketball players, it can be suggested that imagery training can be employed effectively with all skill level performers provided that the delivery method of the imagery scripts is tailored to the needs of the performers who will use them. Therefore, the level of proficiency of athletes in the task should be determined first to be able to prescribe an imagery delivery method to suit those athletes best.

Another implication that is evident from Study 1 is that athletes with at least moderate imagery ability can enhance their sporting performance by the use of imagery provided that the delivery of the imagery is appropriate. Based on an initial assessment of imagery ability, athletes who were selected for the study had at least moderate ability to imagine what they were assigned to do. The results showed that RETI training was beneficial to increase their performance in sport. Therefore, athletes with at least moderate imagery ability should be encouraged to more frequently engage in a systematic process of using imagery.

In conclusion, the information provided by the research in this thesis reflected that one factor that could affect imagery effectiveness is the method by which imagery is delivered to athletes. Athletes' skill level was a key factor in determining the most suitable imagery delivery method within thecurrent research; thereby PI and RETI can be replaced with traditional methods of delivering imagery for highly- skilled and limited-skill athletes respectively. This thesis presents the promising results of three of the first research projects to compare the impact of different imagery delivery methods, continuing research regarding themost effective ways to deliver imagery to sports performers could extend this new knowledge and provide further guidance to practitioners.

The PI delivery method was found to significantly enhance highly- skilled players' performance and self-efficacy in actual games across a whole league competition season in Study 3. This was reflected in participants' reports that PI was well structured and very easy to understand and gave a clear visual picture of what they were supposed to imagine. These findings are useful for sport psychologists and coaches in assisting them to develop imagery-training programs using the PI method. The way the imagery content was structured in Study 3 can be used as one of the first examples that sport psychologist and practitioners can refer to when designing PI training for their athletes. However, individual differences, especially athletes' sport abilities and needs, and their experiences in the sport, are important to consider (Munroe-Chandler & Morris, 2011; Weinberg, 2008). The importance of considering individual differences was evident from the Study 3 interview comments. For example, the interview analysis illustrates that the PI affected each participant differently in a number of ways. Thus, coaches and psychologists should design imagery training programs programs incorporating individualised imagery to provide practical benefitsto athletes.

## Concluding Remarks

The purpose of this thesis was to examine the effectiveness of the traditional (RI) and alternative methods of delivering imagery in sport. Three methods of delivering imagery, RI, PI , and RETI, were compared with each other and a control condition among limited-skilled participants in Study 1 and highly-skilled participants in Study 2. The results indicated that different forms of the imagery delivery might be more effective for different skill levels; RETI was found to be the most effective method of delivery for limited-skilled participants, whereas PI was the most efficacious for highly-skilled athletes. Based on the results of the first two studies, it seemed like the best way to deliver imagery depends on the level of development of athletes' skills. Thus, results of Studies 1 and 2 showed that it is not simply the case that one kind of imagery training program is the best for all athletes. In Study 3, the effectiveness of PI of FT shooting performance of highly skilled players was examined in the real world competition situation. Results illustrated that PI enhanced performance in the competition setting in highly-skilled players. This thesis provides insights into a range of possible directions for further research in finding the most effective ways to deliver imagery training, which would lead to greater understanding of how to increase imagery effectiveness in sport.The research in the thesis raised additional questions that need to be examined and I hopecan serveas a stimulus to other researchers interested in pursuing this topic further.

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Appendix A
Demographic Questionnaire

1. Name: ____________________

2. Age: ___________

3. Gender: Male Female

4. Contact details

Phone Number: ________________ Email: ________________

5. What was your highest level of basketball participation?

Domestic Big V Div 2 Big V Div 1 State championship

SEABL League NBL National International

6. Do you currently play in any basketball competition?

Competition name: _______________________________________________

Team name: _____________________________________________________

7. Years of Basketball Experience: ___________

8. How many hours per week are you involved in basketball training? _____hours/week

9. Approximate free throw percentage during your previous season: _____________

10. Have you ever participated in any of the listed sport psychology training program?

Imagery ___________ Goal Setting ___________

Relaxation ___________ Positive Self-Talk ___________

Stress Management ___________

Appendix B

VICTORIA UNIVERSITY MELBOURNE AUSTRALIA

Sport Imagery Ability Measure (SIAM)

**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

**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

**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

**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

**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 C
Free Throw Score Sheet

Name: Code:
Session: Date

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| Total + :<br>Total score: | | Total X :<br>Total score: | | Total - :<br>Total score: | | Total score | | | |

Session: Date

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| Total + :<br>Total score: | | Total X :<br>Total score: | | Total - :<br>Total score: | | Total score | | | |

Session: Date

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| Total + :<br>Total score: | | Total X :<br>Total score: | | Total - :<br>Total score: | | Total score | | | |

Session: Date

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| Total + :<br>Total score: | | Total X :<br>Total score: | | Total - :<br>Total score: | | Total score | | | |

Session: Date

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | | | | | | | | | |
| Total + :<br>Total score: | | Total X :<br>Total score: | | Total - :<br>Total score: | | Total score | | | |

\+ Swish baskets X Hit the rim and make _ Hit the rim and miss

Appendix D
Free Throw Self-Efficacy Scale

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Participants Code:

Session: Date:

You are about to take part in the Free Throw Test. You need to shoot 20 free throws. Please answer the following questions by circling the appropriate number.

How certain are you of making 1 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 2 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 3 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 4 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 5 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 6 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 7 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 8 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 9 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain

How certain are you of making 10 clean baskets out of 10?
Uncertain 0% 10 20 30 40 50 60 70 80 90 100% Very Certain %

Appendix E

Imagery Manipulation Check

Participant's Code: Date:

What time did you practice your imagery script?

Where were you when you practiced your imagery script?

| | Not At All | Somewhat | Moderately So | Very Much So |
|---|---|---|---|---|
| 1. Rate how well you saw yourself in these situations. | 1 | 2 | 3 | 4 |
| 2. Rate how well you heard the sounds in these situations. | 1 | 2 | 3 | 4 |
| 3. Rate how well you "felt" making the movements. | 1 | 2 | 3 | 4 |
| 4. Rate how well you felt the emotions in the situations. | 1 | 2 | 3 | 4 |
| 5. Did you image from inside your body? If so, rate how well you were able to see the image from inside your body. | 1 | 2 | 3 | 4 |
| 6. Did you image from outside your body? If so, rate how well you were able to see the image from outside your body. | 1 | 2 | 3 | 4 |
| 7. Rate how well you controlled the image. | 1 | 2 | 3 | 4 |

Appendix F

Imagery Script for Routine Imagery Condition

**General instructions**

Now you are asked to undertake imagery training, which is when you imagine a scene, skill, or performance in your mind. For this activity you need to generate images of one common performance situation in basketball competition, free throw performance. This script can be used as a guide to generate images, which you can use in preparation for your training sessions, competition, and during competition breaks, e.g., half times. You should do three imagery sessions per week for a period of four consecutive weeks. On each day, you can choose the time that suits you best to do the imagery training. You need to repeat the script 5 times each session which will take approximately 10 minutes. If you feel there is not enough time to imagine each part of the scenario, feel free to pause your listening device, fully picture the scene and then press play to resume listening. After completion of each imagery session use the adherence log to make notes of your experiences. When you imagine the skill, try to experience all the senses associated with that skill or situation, such as the sounds, sights, smell, touch and feelings in your muscles. Try to imagine the images as vividly, clearly and realistically as you can. Also imagine yourself performing the skills successfully.

Routine imagery script

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then let it go slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely. Close your eyes and imagine yourself playing in a championship competition. Take a deep breath. Scan the whole court, noticing the people on your team, and the team you are playing against, as well as the officials. Observe the spectators. Notice that some people, including your parents and your friends, have come to see your performance today. Imagine yourself being fouled and 2 free throws are awarded to you. You immediately look at the scoreboard and check the score and the time. 1 second left and you are down by one point. Winning the game depends on your free throw performance. Take a deep breath. Look around you, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket at which you will be shooting your free throws. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the free throw shots. You know no matter how challenging the situation is you stay calm, focused, and confident about your free throw shots. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You recognize the feeling of the ball when you release it for a bounce and when you catch it again. Take some time now to experience this with all of your senses. Now you are ready to shoot. Place your shooting hand on the center of the ball and your off-hand just to the side. Your elbows are in tight next to your body in the correct shooting form. Like watching videotape, you can see the position you are in when you are about to shoot the ball. Now you look up at the basket and focus your eyes on the target. In one fluid motion, bend your knees and fully extend your knees and your shooting arm upon the release of the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. You see the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. The score is tied and winning of the game depends on your second free throw.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last FT in this stressful situation. Picture yourself back behind the FT line, go through your routine, bounce the ball, hold it, bend your knees and focus. Everyone is quite. See yourself remaining confident and in control. Shoot the ball as you extend your knees. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it. You made all your teammates and your coach happy by winning this game and you feel good about it. Well done.

It is time for the trophy now. See yourself bend forward to receive the gold medal and feel the medal placed around your neck. Picture and feel the huge smile that is across your face and the pride you feel, having been the player to give your team the championship win.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths.

Now go back and repeat the whole script from the beginning.

Appendix G
Imagery Script for Progressive Imagery Condition

**General instructions**
Now you are asked to undertake imagery training, which is when you imagine a scene, skill, or performance in your mind. For this activity you need to generate images of one common performance situation in basketball competition, free throw performance. This script can be used as a guide to generate images, which you can use in preparation for your training sessions, competition, and during competition breaks, e.g., half times. You should do three imagery sessions per week for a period of four consecutive weeks. On each day, you can choose the time that suits you best to do the imagery training. You need to repeat the script 5 times each session which will take approximately 10 minutes. If you feel there is not enough time to imagine each part of the scenario, feel free to pause your listening device, fully picture the scene and then press play to resume listening. After completion of each imagery session use the adherence log to make notes of your experiences. When you imagine the skill, try to experience all the senses associated with that skill or situation, such as the sounds, sights, smell, touch and feelings in your muscles. Try to imagine the images as vividly, clearly and realistically as you can. Also imagine yourself performing the skills successfully.

Script 1

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself at the foul line, ready to shoot two free throws. Take a deep breath. As you get ready for the first shot, feel the smooth, pebbled, leather surface, and the weight of the ball in your hand. Now you look up at the basket and focus your eyes on the target. In one fluid motion, shoot the ball. See the ball travel through the air with a perfect arc and fall through the middle of the basket. You feel good about making the shot. You are ready to shoot the next free throw. Ball is in your hand for the second shot. Look up and focus. Shoot the ball and see the ball travel up and over until it falls through the middle of the basket. Yes, you made the second too. That makes you happy and more confident.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 2

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself on the basketball court. Take a deep breath. Scan the lines of the court, your teammates, and the team you are playing against. Imagine yourself being fouled and 2 free throws are awarded to you. Look around yourself, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings and the basket you will be shooting your free throws. The referee in black and white uniform is lining everyone up around the key. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and weight of the ball in your hands. Place your shooting hand on the centre of the ball and your off-hand just to the side. Your elbows are in tight next to your body in correct shooting form. Now you look up at the basket and focus your eyes on the target. In a fluid motion, bend your knees and then fully extend your knees and your shooting arm upon the release of the ball. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with a perfect arc. Feel confident that the shot is going in. See the ball fall through the middle of the basket. You feel good about making the shot and you get ready for the next shot.

Bring up once more a clear, colorful mental picture of your free-throw performance. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head what color your team and the opponents’ singlet is. Take some time now to experience this.

Picture yourself back behind the free-throw line. The referee passes the ball to you. Grab the ball, bounce the ball, hold it, and bend your knees and focus. Everyone is quiet. See yourself remaining confident and in control. Shoot the ball as you extend your knees. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it and you feel good about it. Well done.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 3

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself on the basketball court. Take a deep breath. Scan the lines of the court, your teammates, and the team you are playing against. Many people, including your parents and your close friends have come to see your performance today. This game is being broadcast live and hundreds of people are watching you on TV. Imagine yourself being fouled and 2 free throws are awarded to you. Take a deep breath. Look around yourself, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket you will be shooting your free throws at. Imagine all of this from outside your body like watching yourself on TV or video. Take a deep breath in and out. Wipe your sweaty hands up. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the first free throw shot. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You can feel the ball with your fingers when you release it and when you catch it again.

Place your shooting hand centered on the ball and your off-hand just to the side. Your elbows are in tight next to your body in the correct shooting form. Like watching videotape, you can see the position you are in when you are about to shoot the ball. Now you look up at the basket and focus your eyes on the target. In a fluid motion, bend your knees and fully extend your knees and your shooting arm upon the release of the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. See the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. You feel good about making the shot and you get ready for the next shot.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last free throw in this stressful situation.

Picture yourself back behind the free throw line, go through your routine, bounce the ball, hold it, and bend your knees and focus. Everyone is quiet. See yourself remaining in control confidently. Shoot the ball as you extend your knees. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it and you feel good about it. Well done.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 4

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself playing at a championship competition. Take a deep breath. Scan the whole court, noticing your teammates, and the team you are playing against, as well as the officials. Observe the spectators. Notice that some people, including your parents and your friends, have come to see your performance today. Imagine yourself being fouled and 2 free throws are awarded to you. You immediately look at the scoreboard and check the score and the time. 1 second left and you are down by one point. Winning of the game depends on your free throw performance. Take a deep breath. Look around you, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket at which you will be shooting your free throws. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the free throw shot. You know no matter how challenging the situation is you stay calm, focused, and confident about your free throw shots. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You recognize the feeling of the ball when you release it for a bounce and when you catch it again. Take some time now to experience this with all of your senses. Now you are ready to shoot. Place your shooting hand on the centre of the ball and your off-hand just to the side. Your elbows are in tight next to your body in correct shooting form. Like watching videotape, you can see the position you are in when you are about to shoot the ball.  Now you look up at the basket and focus your eyes on the target. In a fluid motion, bend your knees and fully extend your knees and your shooting arm upon the release of the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. You see the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. The score is tied and winning of the game depends on your second free throw.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last FT in this stressful situation.

Picture yourself back behind the FT line, go through your routine, bounce the ball, hold it, bend your knees and focus. Everyone is quite. See yourself remaining confident and in control. Shoot the ball as you extend your knees.  Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it. You made all your teammates and your coach happy by winning this game and you feel good about it. Well done.

It is time for the trophy now. See yourself bend forward to receive the gold medal and feel the medal placed around your neck. Picture and feel the huge smile that is across your face and the pride you feel, having been the player to give your team the championship win.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

# Appendix H

## Imagery Script for Retrogressive Imagery Condition

**General instructions**

Now you are asked to undertake imagery training, which is when you imagine a scene, skill, or performance in your mind. For this activity you need to generate images of one common performance situation in basketball competition, free throw performance. This script can be used as a guide to generate images, which you can use in preparation for your training sessions, competition, and during competition breaks, e.g., half times. You should do three imagery sessions per week for a period of four consecutive weeks. On each day, you can choose the time that suits you best to do the imagery training. You need to repeat the script 5 times each session which will take approximately 10 minutes. If you feel there is not enough time to imagine each part of the scenario, feel free to pause your listening device, fully picture the scene and then press play to resume listening. After completion of each imagery session use the adherence log to make notes of your experiences. When you imagine the skill, try to experience all the senses associated with that skill or situation, such as the sounds, sights, smell, touch and feelings in your muscles. Try to imagine the images as vividly, clearly and realistically as you can. Also imagine yourself performing the skills successfully.

Script 1

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself playing at a championship competition. Take a deep breath. Scan the whole court, noticing your teammates, and the team you are playing against, as well as the officials. Observe the spectators. Notice that some people, including your parents and your friends, have come to see your performance today. Imagine yourself being fouled and 2 free throws are awarded to you. You immediately look at the scoreboard and check the score and the time. 1 second left and you are down by one point. Winning of the game depends on your free throw performance. Take a deep breath. Look around you, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket at which you will be shooting your free throws. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the free throw shot. You know no matter how challenging the situation is you stay calm, focused, and confident about your free throw shots. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You recognize the feeling of the ball when you release it for a bounce and when you catch it again. Take some time now to experience this with all of your senses. Now you are ready to shoot. Place your shooting hand on the centre of the ball and your off-hand just to the side. Your elbows are in tight next to your body in correct shooting form. Like watching videotape, you can see the position you are in when you are about to shoot the ball.  Now you look up at the basket and focus your eyes on the target. In a fluid motion, bend your knees and fully extend your knees and your shooting arm upon the release of the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. You see the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. The score is tied and winning of the game depends on your second free throw.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last FT in this stressful situation.

Picture yourself back behind the FT line, go through your routine, bounce the ball, hold it, bend your knees and focus. Everyone is quite. See yourself remaining confident and in control. Shoot the ball as you extend your knees.  Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it. You made all your teammates and your coach happy by winning this game and you feel good about it. Well done.

It is time for the trophy now. See yourself bend forward to receive the gold medal and feel the medal placed around your neck. Picture and feel the huge smile that is across your face and the pride you feel, having been the player to give your team the championship win.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 2

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself on the basketball court. Take a deep breath. Scan the lines of the court, your teammates, and the team you are playing against. Many people including your parents and your close friends have come to see your performance today. This game is being broadcast live and hundreds of people are watching you on TV. Imagine yourself being fouled and 2 free throws are awarded to you. Take a deep breath. Look around yourself, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket you will be shooting your free throws at. Imagine all of this from outside your body like watching yourself on TV or video. Take a deep breath in and out. Wipe your sweaty hands up. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the first free throw shot. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You can feel the ball with your fingers when you release it and when you catch it again.

Place your shooting hand centre on the ball and your off-hand just to the side. Your elbows are in tight next to your body in correct shooting form. Like watching videotape, you can see the position you are in when you are about to shoot the ball. Now you look up at the basket and focus your eyes on the target. In a fluid motion, bend your knees and fully extend your knees and your shooting arm upon the release of the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. See the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. You feel good about making the shot and you get ready for the next shot.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last free throw in this stressful situation.

Picture yourself back behind the free throw line, go through your routine, bounce the ball, hold it, and bend your knees and focus. Everyone is quiet. See yourself remaining in control confidently. Shoot the ball as you extend your knees. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it and you feel good about it. Well done.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 3

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself on the basketball court. Take a deep breath. Scan the lines of the court, your teammates, and the team you are playing against. Imagine yourself being fouled and 2 free throws are awarded to you. Look around yourself, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings and the basket you will be shooting your free throws. The referee in black and white uniform is lining everyone up around the key. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and weight of the ball in your hands. Place your shooting hand on the centre of the ball and your off-hand just to the side. Your elbows are in tight next to your body in correct shooting form. Now you look up at the basket and focus your eyes on the target. In a fluid motion, bend your knees and then fully extend your knees and your shooting arm upon the release of the ball. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with a perfect arc. Feel confident that the shot is going in. See the ball fall through the middle of the basket. You feel good about making the shot and you get ready for the next shot.

Bring up once more a clear, colorful mental picture of your free-throw performance. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head what color your team and the opponents' singlet is. Take some time now to experience this.

Picture yourself back behind the free-throw line. The referee passes the ball to you. Grab the ball, bounce the ball, hold it, and bend your knees and focus. Everyone is quiet. See yourself remaining confident and in control. Shoot the ball as you extend your knees. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it and you feel good about it. Well done.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 4

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself at the foul line, ready to shoot two free throws. Take a deep breath. As you get ready for the first shot, feel the smooth, pebbled, leather surface, and the weight of the ball in your hand. Now you look up at the basket and focus your eyes on the target. In one fluid motion, shoot the ball. See the ball travel through the air with a perfect arc and fall through the middle of the basket. You feel good about making the shot. You are ready to shoot the next free throw. Ball is in your hand for the second shot. Look up and focus. Shoot the ball and see the ball travel up and over until it falls through the middle of the basket. Yes, you made the second too. That makes you happy and more confident.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Appendix I

First Phase Information Sheet

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate in a research project entitled:

The Effects of Imagery Training Program Complexity on Basketball Free Throw Performance

This project is being conducted by a student researcher Fatemeh Fazel as part of a PhD study at Victoria University under the supervision of Professor Tony Morris and Dr Anthony Watt from faculty of Arts, Education and Human Development.

Project explanation

In order to reach the aims of this research project, first phase is to evaluate sport Imagery ability and free throw performance of basketball players. Imagery means creating or recreating scenes, objects, or events and the accompanying emotional reactions by involving all the senses. People use imagery in their daily life activity without being aware of this valuable mental technique. For example if you invited to a job interview, you imagine yourself there before it happens. Moreover, not all people have same ability to imagine and obviously strong imagers generally benefit more from imagery use (Vealey & Greenleaf, 2001).

What will I be asked to do?

I will ask you to complete the Sport Imagery Ability Measure (SIAM), Free Throw Self-efficacy Scale (FTSS) at the first stage. SIAM is a questionnaire that assesses your imagery ability by asking you to imagine four sport scenes. Following each scene, you will be asked to respond to 12 items. Your free throw performance will be tested afterward. I will ask you to do 2 trials of 10 FT with a 15-minute rest between the two trials. To measure the accuracy of your shots more precisely, I will score 3 points for shooting the ball into the basket without hitting the rim, 2 points for shooting into the basket while hitting the rim, 1 point for hitting the rim, but not going in the basket, and 0 for missing completely for each shot. In order to find out how certain you are to make clean basket you will be asked to answer to the FTSS prior to the FT test.

What will I gain from participating?

I will send the result of your tests by email if you wish to. Therefore you will find out how accurate your free throw shot is and what score you gain in your ability to imagine sport scenes.

How will the information I give be used?

The results will be presented in a group format to prevent any individual's data from being made known. The data may also be used to produce a PhD Thesis and academic publications and presentations resulting from this study.

What are the potential risks of participating in this project?

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There are no known risks to participation in this phase of study because data gathered through this study will be kept confidential and only the researchers will have access to the data. Participation in this study is voluntary and you are free to withdraw at any time.

How will this project be conducted?

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After taking part in the study, your imagery ability and your free throw will be tested in a privet session. Data will be compared with other participants to draw a conclusion.

Who is conducting the study?

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Professor Anthony Morris is the Principal supervisor and can be contacted by email - Anthony.Morris@vu.edu.au, or by phone - 99195353

Fatemeh Fazel, is the researcher and can be contacted by email – fatemeh.fazel@live.vu.edu.au, or by phone - 0424889774

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 Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4148.

Appendix J

First Phase Consent Form

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

We would like to invite you to be a part of a study into

The Effects of Imagery Training Program Complexity on Basketball Free Throw

CERTIFICATION BY SUBJECT

I, -------------------------------certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the study: PhD project being conducted at Victoria University by: Professor Tony Morris and Dr Anthony Watt.

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

- Complete Sport Imagery Ability Measure (SIAM)
- Under take the Free Throw (FT) test, and
- Complete Free Throw Self-Efficacy Scale (FTSS)

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 jeopardize 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 Prof. Tony Morris (03 9919 5353) or Dr. Anthony Watt (03 99194119).

If you have any queries or complaints about the way you have been treated, you may contact the Ethics & Biosafety Coordinator, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4148.

Appendix K

Information Sheet for Imagery Condition

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate in a research project entitled

The Effects of Imagery Training Program Complexity on Basketball Free Throw Performance

This project is being conducted by a student researcher Fatemeh Fazel as part of a PhD study at Victoria University under the supervision of Professor Tony Morris and Dr Anthony Watt from faculty of Arts, Education and Human Development.

Project explanation

The aim of the present study is to determine the most effective imagery training program. Imagery means creating or recreating scenes, objects, or events and the accompanying emotional reactions by involving all the senses. People use imagery in their daily life activity without being aware of this valuable mental technique. For example if you invited to a job interview, you imagine yourself there before it happens. Moreover, not all people have same ability to imagine and obviously strong imagers generally benefit more from imagery use (Vealey & Greenleaf, 2001). Many experimental investigations generally accepted that sport imagery is advantageous, and can be an effective tool in performance enhancement and psychological skills such as self confidence. Nonetheless, the most effective way to deliver imagery has not been determined. This thesis addresses a key issue related to the delivery of effective imagery in sport, namely whether imagery training programs are more effective if they progress from simple, relatively static imagery to complex, dynamic imagery more closely simulating the real competition environment.

What will I be asked to do?

You will be asked to listen to the imagery script three times a week for duration of four weeks while your FT performance will be retested once a week. At the end of each 2 weeks,I will ask you to complete the FTSE again. I will ask you to do 2 trials of 10 FT with a 15-minute rest between the two trials. To measure the accuracy of your shots more precisely, I will score 3 points for shooting the ball into the basket without hitting the rim, 2 points for shooting into the basket while hitting the rim, 1 point for hitting the rim, but not going in the basket, and 0 for missing completely for each shot. In order to find out how certain you are to make clean basket you will be asked to answer to the FTSS prior to the FT test.

What will I gain from participating?

This study expected to help you improve your FT performance, your FTSS, and your Imagery ability as many research has been established the effectiveness of imagery. A potential benefit is that you may become aware of possible techniques that you can use to improve your performance .Furthermore, your participation in the present study helps to determine the most effective way to deliver imagery in sport. It contributes new knowledge that is important to the understanding of how imagery works.

How will the information I give be used?

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Data gathered through this study will be kept confidential and only the researchers will have access to the data. The results will be presented in a group format to prevent any individual‘s data from being made known. The data may also be used to produce a PhD Thesis and academic publications and presentations resulting from this study.

What are the potential risks of participating in this project?

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You may worry about your scores being known by other team member or your coach. I assure you that any data will be kept confidential and no one other than researchers will have access to them. Your improvement might be less than you expected and this make you feel diffident or disappointed. These issues will be minimized by introducing other mental training technique such as relaxation to you. If you still have concerns Professor Mark Andersen (9919 5413) a registered psychologist has agreed to be involved to speak with you regarding any continuing issues.

How will this project be conducted?

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You will be given imagery script which you should listen to in your preferred time at home, stadium or wherever you feel more relaxed and concentrated. After taking part in the study, your imagery ability and your free throw will be tested in a privet session. Data will be compared with other participants to draw a conclusion.

Who is conducting the study?

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Professor Anthony Morris is the Principal supervisor and can be contacted by email - Anthony.Morris@vu.edu.au, or by phone - 99195353

Fatemeh Fazel, is the researcher and can be contacted by email – fatemeh.fazel@live.vu.edu.au, or by phone - 0424889774

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 Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4148.

**Appendix L**

Information Sheet for Control Condition

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate in a research project entitled

The Effects of Imagery Training Program Complexity on Basketball Free Throw Performance

This project is being conducted by a student researcher Fatemeh Fazel as part of a PhD study at Victoria University under the supervision of Professor Tony Morris and Dr Anthony Watt from faculty of Arts, Education and Human Development.

Project explanation

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Imagery means creating or recreating scenes, objects, or events and the accompanying emotional reactions by involving all the senses. People use imagery in their daily life activity without being aware of this valuable mental technique. For example if you invited to a job interview, you imagine yourself there before it happens. Moreover, not all people have same ability to imagine and obviously strong imagers generally benefit more from imagery use (Vealey & Greenleaf, 2001). In order to reach the aims of this research project, your free throw performance and free throw self efficacy will be tested once a week to monitor your improvement.

What will I be asked to do?

---

You will be asked to undertake free throw performance once a week for four weeks and complete Free Throw Self-efficacy Scale (FTSS) every two weeks. I will ask you to do 2 trials of 10 FT with a 15-minute rest between the two trials. To measure the accuracy of your shots more precisely, I will score 3 points for shooting the ball into the basket without hitting the rim, 2 points for shooting into the basket while hitting the rim, 1 point for hitting the rim, but not going in the basket, and 0 for missing completely for each shot. In order to find out how certain you are to make clean basket you will be asked to answer to the FTSS prior to the FT test.

What will I gain from participating?

---

It is expected that your free throw performance will be improve due to practicing it. You will do 80 free throws in total which helps you enhance your performance and your self-efficacy. The result of your imagery ability, free throw performance and free throw self-efficacy will be also provided to you.

How will the information I give be used?

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Data gathered through this study will be kept confidential and only the researchers will have access to the data. The results will be presented in a group format to prevent any individual's data from being made known. The data may also be used to produce a PhD Thesis and academic publications and presentations resulting from this study.

What are the potential risks of participating in this project?

---

You may worry about your scores being known by other team member or your coach. I assure you that any data will be kept confidential and no one other than researchers will have access to them. Your improvement might be less than you expected and this make you feel diffident or disappointed. These issues will be minimized by introducing other mental training technique such as relaxation to you. If you still have concerns Professor Mark Andersen (9919 5413) a registered psychologist has agreed to be involved to speak with you regarding any continuing issues.

How will this project be conducted?

---

Your imagery ability and your free throw performance and free throe self efficacy will be tested in a privet sessions in your preferred time. Data will be compared with other participants to draw a conclusion.

Who is conducting the study?

---

Professor Anthony Morris is the Principal supervisor and can be contacted by email - Anthony.Morris@vu.edu.au, or by phone - 99195353

Fatemeh Fazel, is the researcher and can be contacted by email – fatemeh.fazel@live.vu.edu.au, or by phone - 0424889774

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 Research Ethics and Biosafety Manager, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 or phone (03) 9919 4148.

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Appendix M

Consent Form for Imagery Conditions

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

We would like to invite you to be a part of a study into

The Effects of Imagery Training Program Complexity on Basketball Free Throw

CERTIFICATION BY SUBJECT

I, ---------------------------certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in a PhD project being conducted at Victoria University by: professor Tony Morris and Dr Anthony Watt. 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 Fatemeh Fazel and that I freely consent to participation involving the below mentioned procedures:

- Listen to a pre recorded imagery script three times a week for four weeks
- Complete imagery log after each imagery session
- Undertake Free Throw (FT) test once a week for four weeks
- Complete Free Throw Self-Efficacy Scale(FTSS) once a week for four weeks

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 jeopardize 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 Prof. Tony Morris (03 9919 5353) or Dr. Anthony Watt (03 99194119).

If you have any queries or complaints about the way you have been treated, you may contact the Ethics & Biosafety Coordinator, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4148.

VICTORIA UNIVERSITY
MELBOURNE AUSTRALIA

Appendix N

Consent Form for Control Condition

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

We would like to invite you to be a part of a study into

The Effects of Imagery Training Program Complexity on Basketball Free Throw Performance

CERTIFICATION BY SUBJECT

I, --------------------------certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the PhD project being conducted at Victoria University by: Professor Tony Morris and Dr Anthony Watt.

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

- Free Throw Self-Efficacy Scale (FTSS) as my pre test and once every two weeks for 4 weeks,
- Undertake the Free Throw (FT) test once a week for four weeks.

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 jeopardize 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 Prof. Tony Morris (03 9919 5353) or Dr. Anthony Watt (03 99194119).

If you have any queries or complaints about the way you have been treated, you may contact the Ethics & Biosafety Coordinator, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4148.

Appendix O

Social Validation Questionnaire

***Imagery Experience***

How did you find the content of the imagery training?

What kind of images is created in your mind while you practice the imagery?

How do you feel while you are practicing imagery?

How do you think that imagery training affected your free throw performance?

***Performance Enhancement***

How did you feel during the performance?

What were you thinking before and during the performance?

Were there any outside thoughts distracting you?

What was the effect of the intervention?

What were your general beliefs about your performance?

Appendix P

Imagery Script for Study 3

**General instructions**

Now you are asked to undertake imagery training, which is when you imagine a scene, skill, or performance in your mind. For this activity you need to generate images of one common performance situation in basketball competition, free throw performance. This script can be used as a guide to generate images, which you can use in preparation for your training sessions, competition, and during competition breaks, e.g., half times. You should do three imagery sessions per week for a period of three consecutive weeks. On each day, you can choose the time that suits you best to do the imagery training. You need to repeat the script 5 times each session which will take approximately 10 minutes. You can do the imagery training at home or in other comfortable environment. If you feel there is not enough time to imagine each part of the scenario, feel free to pause your listening device, fully picture the scene and then press play to resume listening. After completion of each imagery session use the adherence log to make notes of your experiences. When you imagine the skill, try to experience all the senses associated with that skill or situation, such as the sounds, sights, smell, touch and feelings in your muscles. Try to imagine the images as vividly, clearly and realistically as you can. Also imagine yourself performing the skills successfully.

Script 1

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself on the basketball court. Take a deep breath. Scan the lines of the court, your teammates, and the team you are playing against. Imagine yourself being fouled and 2 free throws are awarded to you. Look around yourself, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings and the basket you will be shooting your free throws. The referee in black and white uniform is lining everyone up around the key. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and weight of the ball in your hands. In a fluid motion release the ball. See the ball travel through the air with a perfect arc. Feel confident that the shot is going in. See the ball fall through the middle of the basket. You feel good about making the shot and you get ready for the next shot.

Bring up once more a clear, colorful mental picture of your free-throw performance. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head what color your team and the opponents' singlet is. Take some time now to experience this.

Picture yourself back behind the free-throw line. The referee passes the ball to you. Grab the ball, bounce the ball, hold it, and focus. Everyone is quiet. See yourself remaining confident and in control. Shoot the ball as you extend your knees. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it and you feel good about it. Well done.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 2

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself on the basketball court. Take a deep breath. Scan the lines of the court, your teammates, and the team you are playing against. Many people, including your parents and your close friends have come to see your performance today. This game is being broadcast live and hundreds of people are watching you on TV. Imagine yourself being fouled and 2 free throws are awarded to you. Take a deep breath. Look around yourself, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket you will be shooting your free throws at. Imagine all of this from outside your body like watching yourself on TV or video. Take a deep breath in and out. Wipe your sweaty hands up. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the first free throw shot. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You can feel the ball with your fingers when you release it and when you catch it again. Now you look up at the basket and focus your eyes on the target. In a fluid motion, release the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. See the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. You feel good about making the shot and you get ready for the next shot.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last free throw in this stressful situation.

Picture yourself back behind the free throw line, go through your routine, bounce the ball, hold it, and focus. Everyone is quiet. See yourself remaining in control confidently. Shoot the ball. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it and you feel good about it. Well done.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Script 3

Get yourself into a nice, comfortable position. Take a few deep breaths. Breathe in through your nose, hold it and then exhale slowly through your mouth (10 secs). If at any time during this exercise you need to adjust your position, do so. Concentrate on your breathing, feel the movement of your body. Allow your mind and muscles to relax. Let any distracting thoughts or sounds enter and exit your mind freely.

Close your eyes and imagine yourself playing at a championship competition. Take a deep breath. Scan the whole court, noticing your teammates, and the team you are playing against, as well as the officials. Observe the spectators. Notice that some people, including your parents and your friends, have come to see your performance today. Imagine yourself being fouled and 2 free throws are awarded to you. You immediately look at the scoreboard and check the score and the time. 1 second left and you are down by one point. Winning of the game depends on your free throw performance. Take a deep breath. Look around you, what do you see? Imagine yourself at the foul line, ready to receive the ball. As you get ready for the shot, notice your surroundings, the fans in the stands, your coach and your teammates on the bench encouraging you, the referee in black and white uniform lining everyone up around the key, and the basket at which you will be shooting your free throws. Take a deep breath in and out. The referee passes the dark orange basketball to you. Feel its smooth, pebbled, leather surface and the weight of the ball in your hands. You can even smell the scent of the ball.

Go through your regular routine before you perform the free throw shot. You know no matter how challenging the situation is you stay calm, focused, and confident about your free throw shots. Now, you are standing behind the line and you can hear the audience and the feeling of your heart beating. Bounce the ball as part of your routine. You can hear every bounce of the ball and the sweat running down your face. You recognize the feeling of the ball when you release it for a bounce and when you catch it again. Take some time now to experience this with all of your senses. Now you are ready to shoot. Now you look up at the basket and focus your eyes on the target. In a fluid motion, release the ball. You can see yourself, your body stretched and your muscles are smooth. You feel the ball spin off your fingertips with just the right push to the shot. See the ball travel through the air with perfect arc. Feel confident that the shot is going in. It does. You see the ball fall through the middle of the goal and you can hear a perfect swish. Many people stand up and applaud and give you hearty cheers. The score is tied and winning of the game depends on your second free throw.

Bring up once more a clear, colorful mental picture of yourself, with all of your senses. Take care to notice what clothes you are wearing, who is there with you, and recreate in your head the emotions you feel before the last FT in this stressful situation.

Picture yourself back behind the FT line, go through your routine, bounce the ball, hold it. Everyone is quite. See yourself remaining confident and in control. Shoot the ball. Follow the ball with your eyes and see the ball fall through the middle of the goal and you can hear a perfect swish. You made it. You made all your teammates and your coach happy by winning this game and you feel good about it. Well done.

It is time for the trophy now. See yourself bend forward to receive the gold medal and feel the medal placed around your neck. Picture and feel the huge smile that is across your face and the pride you feel, having been the player to give your team the championship win.

Open your eyes gently, and stretch your arms and legs. Take a couple of quick breaths. Now go back and repeat the whole script from the beginning.

Appendix Q

Consent Form for Participants of Study 3

CONSENT FORM FOR PARTICIPANTS INVOLVED IN RESEARCH

We would like to invite you to be a part of a study into

The Effects of Imagery Training Program Complexity on Basketball Free Throw Performance

CERTIFICATION BY SUBJECT

I, -------------------------certify that I am at least 18 years old* and that I am voluntarily giving my consent to participate in the PhD project being conducted at Victoria University by: Professor Tony Morris and Dr Anthony Watt.

I certify that the objectives of the study, together with any risks and safeguards associated with the procedures listed here under to be carried out in the research, have been fully explained to me by Fatemeh Fazel and that I freely consent to participation involving the below mentioned procedures:

- Listen to a pre recorded imagery script three times a week for four weeks
- Complete imagery log after each imagery session
- FT performance during the game will be collected and used for the research purpose

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 jeopardize 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 Prof. Tony Morris (03 9919 5353) or Dr. Anthony Watt (03 99194119).

If you have any queries or complaints about the way you have been treated, you may contact the Ethics & Biosafety Coordinator, Victoria University Human Research Ethics Committee, Victoria University, PO Box 14428, Melbourne, VIC, 8001 phone (03) 9919 4148.

APPENDIX R

Bar Charts with Error Bars

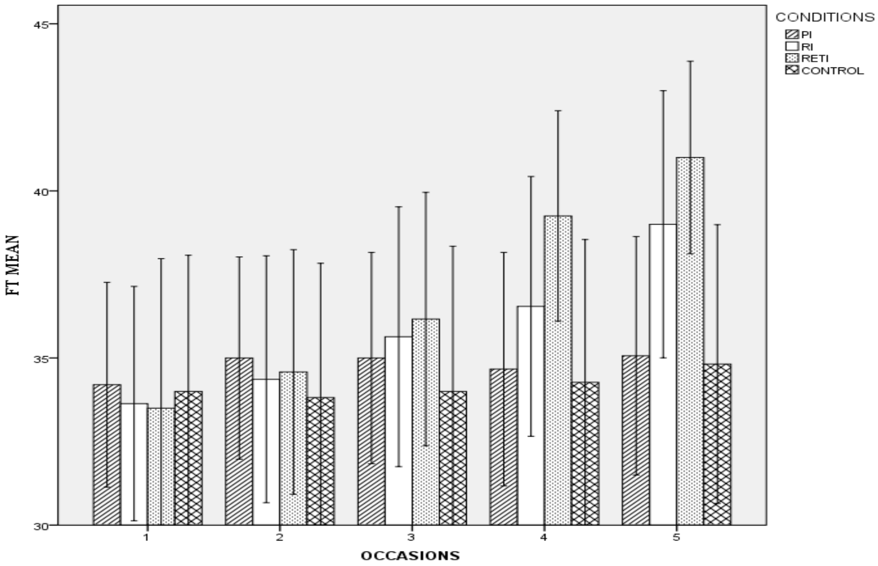


Figure 3.5. Bar Charts with Error Bars of Free Throw Scores

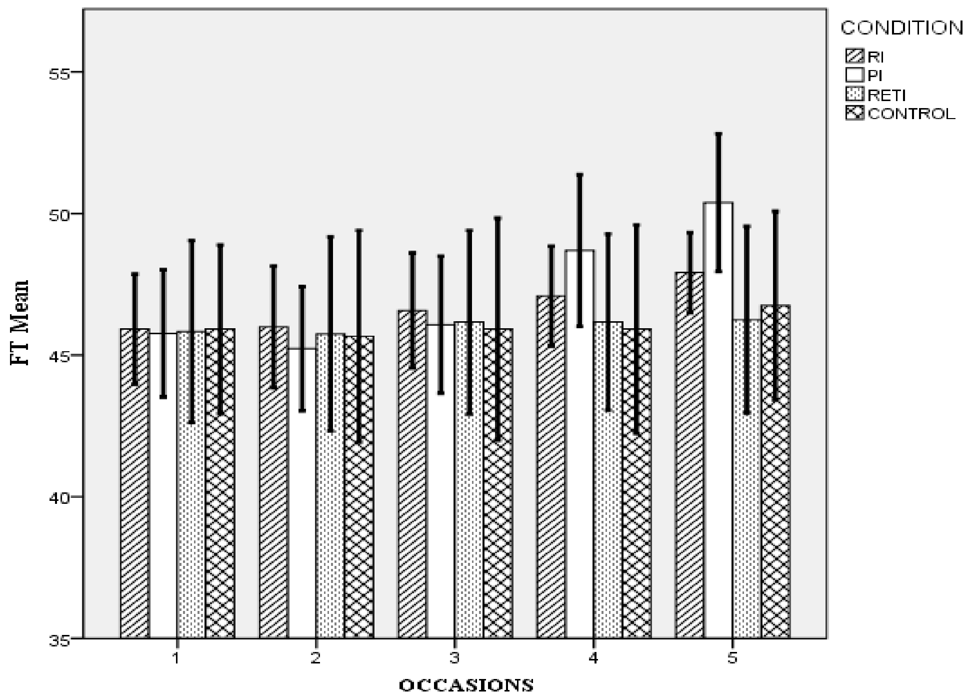


Figure 4.5. Bar Charts with Error Bars of Free Throw Scores