IMAGERY ABILITY IN SPORT AND MOVEMENT

By

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Abstract

This thesis investigated how propositions of the Revised Applied Model for Deliberate Imagery Use (RAMDIU) related to imagery ability. Chapter 2 (*N* = 40, *M*age = 23.47) and Chapter 3(*N* = 52, *M*age = 19.60) established that ease and vividness of imaging external visual imagery, internal visual imagery, and kinesthetic imagery of movements can be improved by incorparating elements of the PETTLEP model. Participants perceived the physical and environments elements of the PETTLEP model to be the most helpful for imaging easily and vividly. Chapter 4 investigated the use of these two elements in 151 athletes' (*M*age = 19.94) ease of imaging five different types of sport imagery (i.e., skill, strategy, mastery, goal, and affect). The findings revealed positive associations between the use of physical and environment PETTLEP elements and ease of imaging all five imagery types. The findings of Chapters 2 to 4 suggest that the use of PETTLEP elements – particularly the physical environment elements – will likely result in greater ease of imaging cognitive and motivational imagery content and that the relationship between "What (type) & How" and "Imagery Ability" in the RAMDIU should be bi-directional. Chapter 5 explored the RAMDIU "Who" component by investigating whether emotion regulation (i.e., emotion regulation and emotion suppression) in 648 athletes (*M*age = 20.79) was associated with their sport imagery ability. Results indicated that only emotional reappraisal was positively related with "Imagery Ability". Overall, the thesis extends the literature by establishing that imagery ability can be influenced by the individual's characteristics, as well as how athletes image. Therefore, coaches, and practitioners should consider athletes' characteristics along with how they are going to image to boost imagery ability and maximise the effectiveness of the imagery intervention in achieving the desired outcome(s).

Dedication

This thesis is dedicated to my children as an encouragement for them to continue seeking knowledge

"*Are those who know, equal to those who do not know?*" [39:9].

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I am proud handing in my thesis and wish that my published works are beneficial for future research internationally.

Publication and conference presentations produced during the PhD

This thesis comprises the following four original empirical chapters:

1. *Effects of applying PETTLEP model on vividness and ease of imaging movement*

2. *Comparing PETTLEP Imagery against Observation Imagery on Vividness and Ease of Movement Imagery.*

3. *The Role of Physical and Environment element of PETTLEP Imagery in Priming Sport Imagery Ability.*

4. *Emotion Regulation Predicts Ease of Imaging.*

Publications which are part of this PhD thesis

1. Anuar, N., Cumming, J., & Williams, S. E. (2016). Effects of Applying the PETTLEP Model on Vividness and Ease of Imaging Movement. *Journal of Applied Sport Psychology, 28*(2), 185-198. doi:10.1080/10413200.2015.1099122

2. Anuar, N., Williams, S. E., & Cumming, J. (2016). Comparing PETTLEP imagery against observation imagery on vividness and ease of movement imagery. *International Journal of Sport and Exercise Psychology,* 1-14. doi:10.1080/1612197X.2016.1177104

3. Anuar, N., Cumming, J. & Williams, S.E. (in press). Emotion Regulation Predicts Imagery Ability. *Imagination, Cognition and Personality*.

Publications which are not part of this PhD thesis

Journal Article

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1. Anuar, N., Williams, S. E., & Cumming, J. (2016). Physical And Environment Facilitate Imagery Ability. Presented at the *Annual British Psychological Society's Division of Sport and Exercise Psychology* (DSEP) Conference, Leeds, UK.

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5. Anuar, N., Williams, S. E., & Cumming, J. (2013). The Effect of PETTLEP Imagery on Ease and Vividness. Presented at the *Annual British Psychological Society's Division of Sport and Exercise Psychology* (DSEP) Conference, Manchester, UK.

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List of Abbreviations

Frequently Used Imagery Terms

CG	Cognitive general
CS	Cognitive specific
Env.	Environment
EVI	External visual imagery
IVI	Internal visual imagery
KI	Kinaesthetic imagery
MG-A	Motivational general-arousal
MG-M	Motivational general-mastery
MS	Motivational specific
PETTLEP	Physical, Environment, Task, Time, Learning, Emotion, Perspective
Phys.	Physical
RAMDIU	Revised Applied Model for Deliberate Imagery Use
VI	Visual imagery

Questionnaires

ERQ	Emotion Regulation Questionnaire
IEC	Imagery Evaluation Check
MIAMS	Motivational Imagery Ability Measure for Sport
MIQ	Movement Imagery Questionnaire
MIQ-3	Movement Imagery Questionnaire-3
MIQ-R	Movement Imagery Questionnaire-R
SIAM	Sport Imagery Ability Measure
SIAQ	Sport Imagery Ability Questionnaire
VMIQ-2	Vividness of Movement Imagery Quesitonnaire-2

Analysis Terms

ANOVA	Analysis of variance
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
MANOVA	Multivariate analysis of variance
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equation Modelling
SRMR	Standardized Root Mean Square Residual
TLI	Tucker Lewis Index

Chapter 1

General Introduction

Imagery ability in sport and movement

Of interest to the present thesis was to explore imagery ability as the basis for effective imagery. This introductory chapter will first briefly define and explain the overall concept of imagery. Next, the applied model of mental imagery use (Martin, Moritz, & Hall, 1999) and its revised version (Cumming & Williams, 2012, 2013) are described to highlight the important role played by imagery ability. Techniques to improve imagery ability are then explained after providing background on the nature and measurement of imagery ability. Finally, the general aims and structure of this thesis are outlined.

Imagery

Imagery involves seeing with the mind's eye as well as other sensory experiences (e.g., smell, taste, sound, and feeling) without having to experience the real thing (White & Hardy, 1998). Morris, Spittal, and Watt (2005, p. 19) defined imagery as the:

> Creation or recreation of experiences generated from memorial information, involving quasi-sensorial, quasi perceptual and quasi- affective characteristic, that is under the violation control of the imager and which may occur in absence of the real stimulus antecedents normally associated with the actual experience.

Imagery has been a fundamental technique within sport because it can serve general and specific cognitive and motivational functions (Paivio, 1985). Athletes use imagery for enhancing motivation, increasing self-confidence, improving performance of movements and skills, coping with injury, developing plans and strategies, as well as regulating arousal and anxiety (for reviews, see Cumming & Williams, 2012, 2013). However, better imagers will benefit more from using imagery compared to those who find it more difficult to create and control images (Hall & Martin, 1997). Therefore sport psychologists are interested in ways to improve imagery ability, and after first defining this construct, the specific methods are reviewed in the following sections.

Imagery Ability

As the evidence base in support of athletes' imagery use grows, the ability to image has received considerable attention. Imagery ability has been defined as, "an individual capability of forming a vivid image, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal" (p.60) (Morris et al., 2005). According to Hall (1998), the ability to image depends on a person's capacity to generate, maintain as well as to rotate images in different imagery tasks. Imagery ability therefore includes creating details of the sporting environment, maintaining it for the length of the desired performance, and rotating the viewpoint to see the action occurring from different angles or perspectives.

It is thought that everyone differs in their ability to image, which in turn influences the effectiveness of imagery for achieving its desired functions (Cumming & Williams, 2013; Hall, Mack, Paivio, & Hausenblas, 1998; Isaac & Marks, 1994). In an early study, Issac and Marks (1994) found the most successful athletes to report more vivid images. Martin et al. (1999) later proposed imagery ability as a moderator between the functions of imagery and the affective, behavioural, and cognitive outcomes achieved. More recent evidence further supports the idea that better imagers experience greater benefits from imagery use compared to poorer imagers (Robin et al., 2007). In support of this, McKenzie and Howe (1997) reported that athletes with higher imagery ability improved more in self-efficacy for the task than those with lower imagery ability. Collectively, this evidence has meant that researchers will typically screen participants for their imagery ability and use these values as part of the inclusion criteria for an intervention study (Cumming & Ramsey, 2009). Therefore, it is essential that research investigates imagery ability as a factor influencing imagery effectiveness and in particular, identifies techniques to improve athletes' imagery ability.

Two related models used to explain the role of imagery ability are the *Applied Model of Mental Imagery Used* (Martin et al., 1999) and the *Revised Applied Model for Deliberately*

Imagery Used (RAMDIU; Cumming & Williams, 2012, 2013). Both will now be described in turn.

The Applied Model of Mental Imagery Use in Sport

Over 15 years ago, Martin et al. (1999) proposed the applied model of mental imagery use in sport to guide coaches, athletes, and sports psychologists in creating and administering imagery interventions. The model was developed based on Paivio's (1985) conceptual framework that imagery serves both cognitive and motivational functions that each operate at specific and general levels. Hall et al. (1998) identified five functions within sport through the development of the Sport Imagery Questionnaire (SIQ): cognitive specific (CS; i.e., to improve skills; e.g., tennis serve), cognitive general (CG; i.e., to improve game strategies; e.g., a game plan), motivational specific (MS; i.e., to achieve specific goals; e.g., winning a medal), motivational general-arousal (MG-A; i.e., to manipulate feelings and emotions; e.g., anxiety), and motivational general-mastery (MG-M; i.e., to cope and master challenging situations; e.g., mental toughness). Research has found that athletes report using MG-M imagery functions most frequently followed by CS, but generally supports the existence of these five functions of imagery use (Callow & Hardy, 2001; Cumming & Williams, 2013).

Building on Paivio's conceptual framework, Martin et al. (1999) introduced four components in their applied model as depicted in Figure 1. The "Sports situation" explains that imagery is used by athletes in three main situations: during a training period, immediately before and after competitive events, and during rehabilitation. The "Outcome" component describes the end result of imaging which includes affective (e.g., regulating of arousal), behavioural (e.g., improving skills), and cognitive (e.g., increasing confidence) outcomes. The "Imagery type" component explains the functions of the imagery. Finally, the model highlights "imagery ability" as playing an important role in achieving the outcome by moderating the relationship between the imagery type and the outcomes (Martin et al., 1999). The model initially proposed the idea of "what you see is what you get" as a general rule of thumb for selecting imagery content for an intervention. That is, in a given situation, athletes should image the type of imagery content that most closely matches the desired outcome. For example, if an athlete wants to improve a skill they should image the skill. Similarly, if an athlete wants to increase their confidence, they should image feeling confident. In other words, the applied model proposes that the reasons why an athlete images should be reflected in the content of what they image.

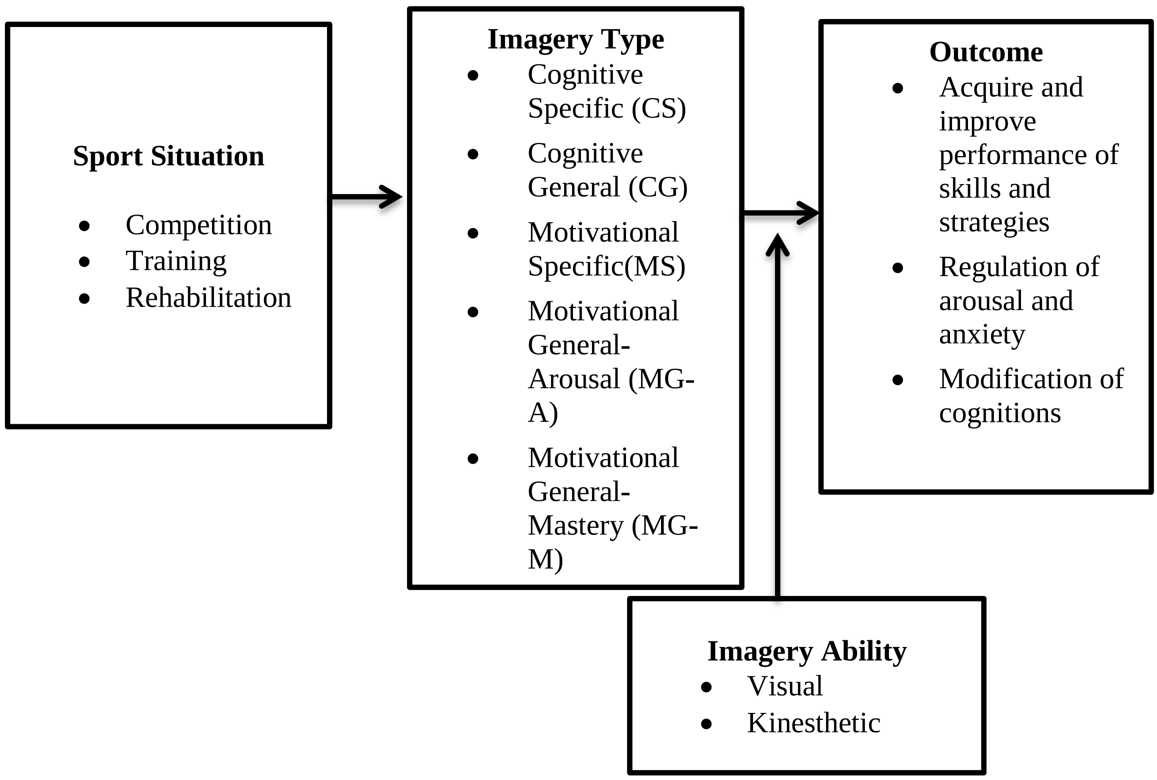

Figure 1. The applied model of mental imagery use in sport.

A number of studies have provided support for the applied model and its predictions (Guillot & Collet, 2008; Jones, Mace, MacRae, & Stockbridge, 2002), indicating the model is beneficial for understanding imagery use among athletes. For example, Beauchamp, Bray, and Albinson (2002) reported pre-competition motivational general-mastery imagery can increase self-efficacy and confidence. Additionally, Abma, Fry, Li, Y, and Relyea (2002) found that high sport confident athletes had higher visual and kinaesthetic imagery ability compared to low confident athletes. However, research also shows that a function of imagery can be served by different types of imagery, and more than one outcome can be obtained by an imagery type (Callow & Hardy, 2001; Nordin & Cumming, 2008). In other words, functions and types of imagery are not equivalent. To clarify this matter, Murphy, Nordin, and Cumming (2008) proposed a distinction between imagery function (i.e., the reasons to image), imagery type (i.e., what is being imaged), and imagery outcome (i.e., the result of the imagery). For example, CS imagery and MG-M imagery are functions of imagery that are performed for different reasons but can be fulfilled by similar content (e.g., perfectly performing a skill), and then similarly impact the performance of that skill (Callow & Hardy, 2001; Nordin & Cumming, 2008). Cumming and Williams (2013) recently revised the applied imagery model to address this matter and distinguish between why (i.e., imagery functions) athletes image from what (i.e., imagery types) they image.

Revised applied model for deliberately imagery use (RAMDIU)

To address the limitations of the original applied model, the revised applied model of deliberate imagery use (RAMDIU; Figure 2) was developed by Cumming and Williams (2012). The original "Sport Situation", "Outcome" and "Imagery Ability" components from the applied model were retained as components in the RAMDIU. The "Sport Situation" component was elaborated to consider both "Where & When" as a component in the RAMDIU. Then, a new component addressing the individual's characteristics was represented by "Who". Both "Where and When" and "Who" are considered to be factors influencing "Why" athletes image (i.e., the functions of their imagery). The "Why" component was proposed to distinguished from "What" (i.e., imagery content) which was originally the "Imagery Type" component. A meaning bridge was added to represent the link between imagery function and content. "How" athletes' image was also included in the

RAMDIU and is considered to be closely linked to "What (type)" athletes image. Finally, "Imagery Ability" is considered by Cumming and Williams (2012, 2013) to operate as both a mediator and moderator. These components will now be explained in turn.

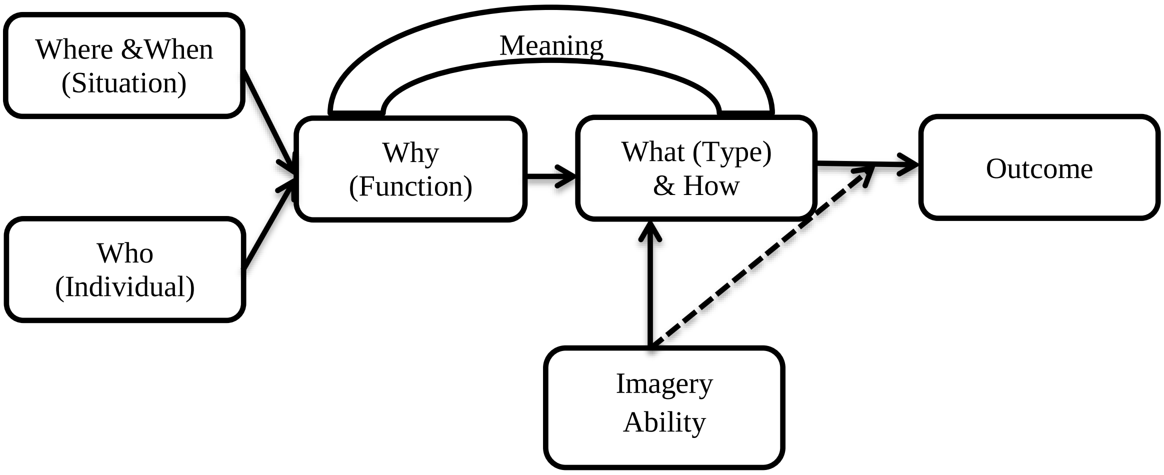

Figure 2. The revised applied model for deliberately imagery use (RAMDIU).

"Where & When"

In agreement with the previous imagery applied model's assertion (Martin et al., 1999), the RAMDIU also proposes that athletes use imagery in different situations but extends this component to represent both location and timeframe of the imagery being performed. As imagery is a simple technique that can be conducted anywhere, athletes can image in a number of different places (Munroe, Giacobbi, Hall, & Weinberg, 2000). This can include at the competition venue, at home, during practice, when travelling, or even during recovery from injury (Munroe et al., 2000). Research suggests that athletes prefer to image at different timeframes depending on the location. For instance, Barr and Hall (1992), and Munroe et al. (2000) indicated that athletes use imagery before competition rather during and after. In contrast, Giacobbi et al. (2000) demonstrated that athletes use imagery during practice. Additionally, the RAMDIU proposes that the "Where & When" component will influence "Why" athletes image. That is, athletes will consider certain places and timeframes when performing different functions of imagery (Cumming & Williams, 2013). For example, athletes will purposely image during practice to learn and improve different physical skills (Cumming & Williams, 2013; Munroe et al. 2000) whereas their imagery during the off-season may aid rest and recovery as well as planning for next season (Cumming & Hall, 2002).

"Who"

Similarly to the "Where & When" component, the RAMDIU proposes that individual characteristics can influence the reason why someone might image. Individual characteristics likely to influence imagery use and imagery outcomes include but are not limited to: gender, competitive level, age, sport type, imagery experiences, as well as personality traits and dispositions. For example, within exercise settings, females have been found to use imagery for health and appearance reasons more frequently than males (Cumming, 2008). Consequently, the RAMDIU emphasises the need to consider the individual characteristics of the imager (e.g., age, experience, gender, competitive level, personality characteristics) when devising effective imagery interventions. Beyond the characteristics mentioned, more recent research further supports the model's prediction that "Who" influences the functions of imagery use (Cumming & Williams, 2013)

In addition to its association with the functions of imagery use, research suggests that individual characteristics are likely to also impact imagery ability. Previously, Isaac and Marks (1994) conducted four studies investigating differences in imagery ability due to individual characteristics. Results found that females imagery vividness earlier at the age of 8 years old to 9 years old than males at the age of 10 years old to11 years old and females reported more vivid movement imagery compared to males. Isaac and Marks (1994) also attempted to compare imagery vividness across different groups. Children ages 7 years old to 15 years old were reported poorer in image movement compare to their control group while physical education students reported more vivid images compare to English and Physics students. Elite athletes reported more vivid imagery compare to the control group as well as air traffic controller, and pilots were found to have more vivid imager than the control group. Hence, there is a pattern of individual difference in imagery ability. Williams and Cumming (2011) reported difference in imagery ability in difference imagery type due to gender and competitive level. The details of the individual differences in imagery ability are explained in more detail in a separate section in this chapter. Despite some evidence suggesting individual characteristics appear to influence imagery ability, the relationship between the "Who" and "Imagery Ability" is not yet represented in the RAMDIU nor has it been extensively examined. As more recent research by Parker, Jones, and Lovell (2016) has demonstrated that experienced athletes scored higher in the vividness of images compare to less experienced athletes, there is a need to investigate the relationship between the "Who" and the "Imagery Ability" components of the RAMDIU.

"Why"

As mentioned above, the RAMDIU uniquely distinguishes between the "Why" and the "What (type) & How" of imagery (Cumming & Williams, 2013). The "Why" component is proposed to reflect the reason athletes use imagery; that is the imagery functions of CS, CG, MS, MG-A, and MG-M. The RAMDIU expands on the original model by proposing that these functions can be used to categorise not only athletes' imagery use but also the imagery use of exercisers, dancers, and patients in rehabilitation settings. For example, an athlete recovering from an injury could use imagery to improve performance of rehabilitation exercises (CS) or, reduce anxiety (MG-A) (Cumming & Williams, 2013). This means, depending on location, timeframe, and individual characteristics, imagery can be performed for different reasons. Therefore, the RAMDIU proposes that the "Where & When" and "Who" directly predicts the "Why". An implication of separating imagery functions from imagery type in the RAMDIU is that imagery functions should first be identified before planning the imagery content (Short & Short, 2005). For this reason, the RAMDIU flows in sequence from “Why” to “What (type) & How”. Gregg and Strachan (2015) recently reported that athletes acquiring sport-specific skills are likely to use goal oriented imagery suggesting that athletes are aware of the reason they perform imagery and this leads them to select imagery content to fulfil this function.

“Meaning”

The RAMDIU addresses a fundamental but previously omitted concept that imagery can mean different things to different individuals (Ahsen, 1984; Lang, 1979). This is represented by a “Meaning bridge” between the “Why” and “What (type) & How” components of the model. It is proposed that imagery can be more effective if it is meaningful to the athletes (Cumming & Williams, 2013). Cumming and Williams (2013) described that meaningful and effective imagery occur when the content and characteristics of the imagery fulfils the reason(s) for why it is being used by the individual in that situation. This means, in order to achieve desired outcomes, based on the “Who” and “Where & When” components, the “Why” component needs to interact with the “What (type) & How” component. An implication is that customising imagery interventions to meet the needs of imagery should involve matching the reasons for the imagery to the desired outcomes

“What (type) & How”

The “What (type) & How” component is developed from the original conceptualisation of imagery type (i.e., what is being imaged) explained by Murphy et al. (2008), but expands on the original model to also denote how the image is performed. Consequently, the “What (type) & How” refers to both the content and characteristics of imagery an individual uses to address the function(s) of imagery use (Cumming & Williams, 2013). As mentioned above, the RAMDIU highlights that what is being imaged can be used to serve the five most common imagery function (i.e., CS, CG, MS, MG-A, and MG-M) with skill images, strategy images, goal images, affect images, and mastery images. But, Cumming and Williams (2013) also expanded on imagery content to include other types of images (e.g., anatomical images, appearance, rehabilitation, role, character of the images and depicted places). Additionally, they also stated that more than one imagery type could be combined to serve a single imagery function as Ribeiro et al. (2015) recently reported that athletes imaging for rehabilitation purpose also aim to maintain their skill and avoid their physical performance from deteriorating. Therefore, imagery should be performed consciously and individuals should be mindful of the intended function and what imagery is most appropriate for achieving the outcome(s).

In regards to "How" to image, Williams and Cumming (2013) described the main characteristics as speed (i.e., real time, slow motion, and fast motion), duration of the image, modality, perspective, and agency (i.e., self or others). The two characteristics that have received the most attention in research are also of most interest to the present thesis: modality and perspective. Modality refers to sensory information that is used to plan actions and regulate performance (Morris et al., 2005). The two most common modalities used when simulating movements are visual imagery (i.e., VI; what is seen in the image; e.g., the body movement during imagery of bending movement) and kinaesthetic imagery (i.e., KI, involves the feeling associated with the movement; e.g., muscle stress on back during imagery of a bending movement) (Callow & Waters, 2005). Perspective is described in regards to visual imagery as being either internal or external visual imagery (Mahoney & Avener, 1977). An internal visual imagery (IVI) perspective is an image performed in the first person perspective; that is, the image or movement is done through the individuals own eyes while performing the imagery (Williams, Cumming, & Edwards, 2011). By contrast, an external visual imagery (EVI) perspective can be described as imagery performed from a third- person perspective and has been defined as “a person (viewing himself) from the perspective of an external observer (much like in home movies)” (Mahoney & Avener, 1977; p. 137). It is important to distinguish between modality and visual perspectives as researchers have highlighted that kinaesthetic sensation can be associated with both external and internal visual perspectives (e.g., Cumming & Ste-Marie, 2001; Hardy & Callow, 1999).

The use of imagery modalities and visual perspectives separately or in combination is known to be beneficial. Researchers demonstrated that more effective imagery occurs when IVI is used in combination with KI (Hardy & Callow, 1999). In regards to the use of visual perspectives, IVI is more beneficial when imaging open skills when timing and perception of information are important (Hardy & Callow, 1999; White & Hardy, 1995). By contrast, EVI is thought to be more beneficial when imaging technical form or body shape, which is important such as when learning how to perform movements (Hardy, 1997). Consequently, to maximise the benefits of imagery, athletes are advised to switch the visual perspective to meet task demands or function of the imagery use (Nordin & Cumming, 2005). However, due to individual capabilities, athletes will often prefer imaging from one visual perspective over another, or switching between the two (Cumming & Ste-Marie, 2001; Ungerleider & Golding, 1991). Therefore, imagery ability is likely to be determined by not only the content but also the characteristics of the imagery.

“Imagery ability”

Similarly to the applied model, the RAMDIU proposes that imagery ability will moderate the relationship between imagery use and the outcomes (Cumming & Williams, 2013). However, the RAMDIU also proposes that the “Imagery Ability” component is likely related to the “What (type) & How” component while being the moderator to the “What (type) & How” and the “Outcome” component. Consequently, it is proposed that imagery ability will also likely mediate the relationship between imagery the content and characteristics, and the imagery outcomes (Cumming & Williams, 2012). The proposed association between imagery ability and what is imaged is based on Paivio`s (1985) initial suggestion that imagery ability can differ based on the content of image. More recently Williams and Cumming (2011) have supported this notion by demonstrating affect images (i.e., feelings and emotions) to be significantly easier to image than skill images, that were in turn significantly easier to image than strategy (e.g., game plan), goal (i.e., winning a medal) and mastery (i.e., mental toughness) imagery in a sample of athletes (Williams & Cumming, 2011).

Additionally, a number of studies have demonstrated a positive relationship between imagery use and imagery ability (Gregg, McGowan, & Hall, 2011; Gregg, Hall, & Nederhof, 2005). Callow and Roberts (2010) support the proposed association between imagery ability and use in terms of how an image is performed (i.e., imagery characteristics) as they found positive correlations between imagery ability and imagery perspectives. Importantly, the relationship between imagery use and imagery ability of particular content seems to be stronger when the imagery content is more closely matched to the imagery function (Cumming & Williams, 2012). Recent evidence, Koehn, Stavrou, Young, and Morris (2015) demonstrated that a moderate to strong relationship existed between imagery ability and imagery use in line with Cumming and Williams's (2012) suggestion that the relationship between "Imagery Ability" and "What (type) & How" could be two-way. Thus, it appears that the "Imagery Ability" proposition in the RAMDIU needs further investigation in regards of the relationship with the "What (type) & How" component. This will therefore be a focus of the thesis. The imagery ability will be discussed in more depth in the next sections

The Nature and Measurement of Imagery Ability

In this section, the nature of imagery ability and its measurement are discussed.

Ability vs. skill

Imagery ability reflects self-capabilities to create and control images, and athletes will differ in this respect (Cumming & Williams, 2012). Individuals vary in their ability to image different content and characteristics (e.g., some are better at movement imagery whereas others are better at emotional imagery). It is has been suggested that imagery ability is partly fixed and adaptable due to maturation and individual`s capacity to generate images (Cumming & Williams, 2012; Hall, 1998). Therefore it is believed that imagery ability is a skill that can be enhanced and developed through practice (Cumming & Ste-Marie, 2001; Williams, Cooley, & Cumming, 2013). Due to imagery's multifaceted nature, differences between people and improvements in imagery ability can be reflected through many different dimensions of imagery ability.

Dimensions of imagery ability

Imagery ability is a multi-dimensional construct reflective of how well someone can image. The imagery process is based on the following stages: (1) generation /formation; (2) inspection; (3) maintenance; and (4) transformation of images (Kosslyn, 1994). Image generation/formation is either recreating previous events or creating new events by joining or adjusting stored perceptual information in different ways. This is based on the assertion that brain stored memories are used in the formation of a mental image (Holmes & Collins, 2001). During the latter stages of the imagery process of inspection, maintenance, and transformation, athletes evaluate the accuracy of the image. Depending on the evaluation, they will manipulate, refresh, and/or maintain the image over a certain period (Kosslyn, 1994). The easiness of forming images and the ability to change (e.g., switch between imagery perspectives or viewing angles and adding or removing details), controllability (e.g., duration), preference (e.g., orientation, perspectives or viewing angles), imagery vividness (e.g., exactness) are dimensions of imagery ability (Denis, 1985; Morris et al., 2005). Consequently, measures of imagery ability should reflect the dimension(s) of interest.

In the sports context, the two dimensions of imagery ability of most interest are: the ease of imaging and vividness of the image. Hence, to reflect the capability to accomplish the imagery process stages (i.e., effort needed to generate, inspect, transform, and maintain the image), ease of imaging is suggested as the standard dimension to measure imagery ability (Richardson, 1988; Roberts et al., 2008; Williams & Cumming, 2012). In contrast, vividness of the images represents the characteristic of the generated image that include clarity, sensory richness, and sharpness of the image (Baddeley & Andrade, 2000; McLean & Richardson, 1994; Murphy & Jowdy, 1992). Therefore, in an attempt to investigate athletes' imagery ability particularly in this thesis, both ease and vividness of imagery were measured.

Measuring imagery ability

Imagery is a cognitive process that can only be observed by the person performing it, which poses inherent problems for measuring imagery ability (Lang, 1977). Consequently, research has developed a number of objective and subjective assessments. These methods have also been combined (Collet, Guillot, Lebon, MacIntyre, & Moran, 2011). Cumming and Williams (2012) proposed that different methods are likely to tap different aspects of the imagery process. An objective approach involves measuring behavioural and physiological responses during imagery using electroencephalographic (EEG) activity, functional magnetic resonance (fMRI), electromyography (EMG), as well as heart rate and skin conductance (Guillot & Collet, 2005; Guillot et al., 2008; Saimpont, Malouin, Tousignant, & Jackson, 2015). However, objective approaches provide an indirect assessment (i.e., results display natural brain responses on equipment) that is only limited to physiology and brain changes, while the whole imagery process remains unclear and direct measure of the imagery process is needed. One way of direct assessment is subjective approaches. Therefore, this thesis will apply subjective approaches to focus on the ease and vividness of the imagery ability dimensions.

A subjective approach to the assessment of imagery ability is to use of self-report questionnaires. Self-report measure are frequently utilised in field and laboratory settings due to being flexible, cost-effective, easy access, and time efficient. Furthermore, these questionnaires also offers an opportunity to measure a range of imagery characteristics such as perspective and modality (i.e., EVI, IVI and KI), as well as different types of content (e.g., cognitive vs. motivational). The nature of directly asking an individual to image and then evaluate how well they are able to image on a rating scale accompanied by anchors also means that questionnaire responses are more explicit assessments of imagery ability compared to objective measures; that is a more direct assessment of imagery ability is obtained (Williams, Guillot, Di Rienzo, & Cumming, 2015).

There is a diverse range of questionnaires for researchers to choose from when measuring imagery ability. These questionnaires often vary by imagery ability dimension (e.g., ease, vividness) as well as the type of content (e.g., movement, or motivational) and characteristics (e.g., perspectives, modalities) assessed. To measure movement imagery ability, the Movement Imagery Questionnaire (MIQ) is an option. It was first introduced by Hall and Pongrac (1993). It contains 18 items of two subscales that are completed in four phases. The questionnaires requires participants to perform the movements physically before imaging the same tasks. Then, participants rate on a 7-point scale (1; “very easy to picture or feel” to 7; “very difficult to picture or feel") to represent how easy it was to image the movement tasks. However, MIQ was not properly validated until the revised version Movement Imagery Questionnaire-Revised (MIQ-R; Hall & Martin, 1997) was introduced which reduced the number of items and reversed the scoring anchors. The 8-item MIQ-R improved on the MIQ as the correlation between subscales was found to be more acceptable. However, the MIQ-R failed to distinguish between different VI perspectives (Williams et al., 2012). Williams et al. (2012) modified the MIQ-R to address this limitation by seperating the visual perspectives and distinguished ease of imaging EVI and IVI, while retaining the original KI subscale. Termed the MIQ-3, this measure of movement imagery ability has produced valid and reliable scores of EVI, IVI, and KI.

Another questionnaire that is often used to measure imagery ability in movement is the Vividness of Movement Imagery Questionnaire (VMIQ; Isaac, Marks & Russell, 1986). It has 24 items of basic body movements to measure visual and kinesthetic imagery ability. Scores from this questionnaire have demonstrated satisfactory test-retest reliability and concurrent validity; however, this questionnaire has also since been revised to distinguished between visual perspectives (i.e., EVI and IVI). The resulting Visual Movement Imagery Questionnaire-2 (VMIQ-2; Roberts et al., 2008) uses a scale of 1(“perfectly clear”) to 7(“no image at all”) to assesses the vividness of imaging ten different movements (e.g., running, walking, bending to pick up a coin). The scores from the VMIQ-2 are reported to have good reliability and validity, even when reverse scored so that a higher score indicates higher ability (Williams et al., 2012).

This thesis will focus on one questionnaire to measure imagery ability of general movement. Although the MIQ-3 and VMIQ-2 offer separate measure of EVI, IVI and KI, the movements used in the VMIQ-2 were more appropriate for addressing the research questions of this thesis. Additionally, the MIQ-3 requires participants to perform the movements physically prior to the imagery, which means participants must be able to physically perform the task and stay injury free throughout the experiment. For these reasons, the VMIQ-2 is preferred over MIQ-3 in this thesis to measure athletes’ movement imagery ability.

To assess the ability of imaging more than just movement, there are other questionnaires available for research. The Sport Imagery Ability Measure (SIAM; Watt &Morris, 1998) was devised to assess content of a sporting nature. This questionnaire is known as the multimodal, multidimensional, and task-oriented questionnaire in which participants image generic sport-related scenes. In response to their ability to image the scene, they rate their response on a 10 cm line with two anchors (e.g., “no image” and “perfectly clear to image”). The validity and reliability of the questionnaires has been reported to be moderate to very good. However, because this thesis will directly measure ease and vividness, this questionnaire was not applicable to the investigation. Moreover, this questionnaire is rarely used in research, which suggests that it might have further limitations.

Another questionnaire that can be used to measure athletes’ imagery ability is the Motivational Imagery Ability Measure for Sport (MIAMS; Gregg & Hall, 2006). It was developed to assess how well athletes can image motivational sport content. The psychometric properties of the instrument are adequate. However, this questionnaire only measures motivational imagery content. This means that direct comparisons across different types of imagery ability content cannot be examined; therefore, it was not sufficient to measure athletes’ imagery ability in imaging different imagery content in the present thesis.

The Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) was devised to address these aforementioned gaps in the literature regarding imagery ability assessment. This sport-specific measure of imagery ability assesses athletes’ ease of imaging different types of imagery content reflective of that used to serve the five functions of athlete imagery use (Williams & Cumming, 2011). These subscales (three items per subscale) include skill (e.g., “refining a particular skill”), strategy (e.g., “making up new plans/strategies in my head”), goal (e.g., “winning a medal”), affect (e.g., “the excitement associated with performing”), and mastery (e.g., “remaining confident in a difficult situation") imagery content. Ease of imaging each item is rated on a 7-point Likert-type scale ranging from 1 (*very hard to image*) to 7 (*very ease to image*). Compared to the SIAM and the MIAMS, the SIAQ has undergone more extensive validation testing and findings over multiple studies demonstrate the SIAQ to generate valid and reliable scores of sport imagery ability. For this reason, it was chosen as the measurement tool for other type of imagery that is not limited to movement only. However, the SIAQ only distinguishes between different imagery content (e.g., skill vs. mastery) rather than different imagery characteristics (e.g., visual imagery vs. KI). If the latter was of interest, a different questionnaire would be more appropriate.

In sum, there are a number of assessment methods researchers can choose when wanting to assess imagery ability. While no measure is perfect, certain assessment tools may be more appropriate depending on the purpose of the imagery ability assessment. Therefore, to focus on movement imagery ability or specifically wanting to assess the ability to image different imagery modalities and perspectives, a questionnaire such as the MIQ-3 or VMIQ-2 would likely be the most appropriate method to use. By contrast, if interested in a variety of both cognitive and motivational sport specific content, the SIAQ may be more appropriate. Irrespective of the imagery ability questionnaire used, research assessing imagery ability has revealed a number of individual differences that will be reviewed in the following section.

Individual Differences

In the past few years, researchers have increasingly explored differences in imagery ability due to individual factors such as age, gender, competitive level, confidence, and experience (Cumming & Williams, 2012; Murphy et al., 2008). In regards to age, children develop their ability to image from about 5 years old (Kosslyn, Margolis, Barrett, Goldknopf, & Daly, 1990). Children are good in maintaining an image although there are differences in their ability to generate images. The ability to image continues to develop across the lifespan (Cumming & Williams, 2012) and gradually decreases after 50 years of age (Isaac & Marks, 1994; Mulder, Hochstenbach, Van Heuvelen, & Den Otter, 2007).

Apart from age, research has examined differences in imagery ability between males and females. Early studies (Callow & Hardy, 2004; Gregg & Hall, 2006) have reported that there were no significant differences found in imagery ability when comparing male and female athletes. However, recently, Williams and Cumming (2011) found that males are able to image skill imagery more easily compared to females. Another study reported that males significantly differed to females in kinaesthetic imagery ability (Mendes, Marinho, & Petrica, 2015). More recently, Gregg, O, and Hall (2016) reported that female athletes who were classified as lower in task and ego goal orientation reported clearer and vivid internal visual images compare to male athletes with the same goal orientation profile. The discrepancy in findings when comparing imagery ability between males and females does not seem conclusive although researchers have emphasized that males and females differ from each other in imagery ability and cognitive function (see, Ernest, 1997; Richardson, 1991). Therefore, it is vital to consider the roles of gender in investigating athletes' imagery ability.

In regards to competitive level, there is ample evidence in support of differences in imagery ability across the different levels of athletes. Higher competitive athletes display greater movement imagery ability compared to lower level athletes (Roberts et al., 2008). Williams and Cumming (2011) found similar differences in ease of imaging movement based imagery (i.e., skill and strategy imagery ability) as imagery ability of more motivational content (i.e., goal, affect and mastery imagery ability). Recently, Rostami and Rezaie (2013) reported higher level athletes who had participated in various competitions (e.g., league and national level) scored higher in motivational imagery ability compared to lower level athletes. The differences between higher and lower level athletes is thought to be due to the level of experience, imagery use, the understanding of imagery benefits, and athletes' self-efficacy and confidence (Gregg, Hall & Butler, 2008; Gregg, Hall, McGowan, & Hall, 2011; Hall, Rodgers & Barr, 1990; Rodgers, Hall, & Buckolz, 1991; Short, Tenute, & Feltz, 2005). For example, higher level athletes use imagery more frequently compared to lower level athletes, which in turn results in higher imagery ability (Cumming & Hall, 2002). In regards to the different levels of competition, a recent study reported that elite athletes differ in their ability in image skill, strategy and goal imagery compared to non-elite athletes (Ashrafi & Hemayattalab, 2015). More recent research has also suggested differences in imagery ability due to other individual characteristics which are discussed later in this chapter.

In addition to gender and competitive level, other individual characteristics are thought to be associated with differences in imagery ability. While literature has investigated a wide range of athlete characteristic that influence imagery ability, one that has received little attention to date is emotion regulation. Williams and Cumming (2015) have recently reported positive correlations between imagery ability in imaging different content and other individual characteristics (i.e., anxiety, confidence, and challenge and threat appraisal tendencies). This shows that athletes` emotions (e.g., anxiety and stress appraisal) relate to imagery ability. Emotion plays a big role in sports performance and athletes tend to regulate emotion in two primary ways: either they reappraise the emotion where they change how they think about a particular situation to decrease its emotional impact, or they suppress the emotion by trying to inhibit ongoing emotion-expressive behaviour (Gross, 2002; Uphill, Lane, & Jones, 2012). Neuroscience studies (Gross, 2008; Kosslyn, 1994) claim that both reappraisal and suppression impact individual`s memory function – an important factor for imagery ability (Kosslyn et al., 1984; Paivio, 1985).

It is suggested that reappraisal can boost memory function whereas suppression is thought to negatively impact memory function (Gross, 2008; Poldrack, Wagner, Ochsner, &

Gross, 2008). Memory function is thought to impact how well an individual is able to generate, inspect, transform, and maintain and image (Kosslyn, 1994). Therefore, it can be suggested that athletes who tend to reappraise their emotions more frequently, may experience an enhancement in their memory function and thus find it easier to image. Conversely, athletes who suppress their emotions more frequently, may experience a reduction in their memory function and thus, find it more difficult to image. As such imagery ability may be positively associated with emotion reappraisal, and negatively associated with emotion suppression. Studies have attempted to investigate how athletes' emotion regulation impact brain function, which would indirectly influence imagery ability function (D'Argembeau & Van der Linden, 2006; Schacter, Addis, Hassabis, Martin, Spreng, & Szpunar, 2012) and estimated the impact on imaging (Holmes & Matthews, 2005; Gross, 1999; Gross 2013). To the best of my knowledge, evidence of the impact of imagery ability from to emotion regulation can only be found in D'Argembeau and Van der Linden's (2006) study in which they reported that individual who suppress emotions are likely to experience less sensory, contextual and emotional details when imaging. This means, suppression will impact an individual imagery ability to image senses. They also reported that reappraisal will not have any effect in experiencing sensory, emotional details and context of imagery (D'Argembeau & Van der Linden, 2006). However, this study did not specifically examine the ability to image different imagery content. Therefore, there is insufficient data on the relationship between athletes' emotion regulation and their imagery ability. In addition to traits and dispositions relating to imagery ability, imagery ability can also be improved using techniques that are discussed in the next section.

Improving Imagery Ability

As imagery ability is a modifiable skill (Williams & Cumming, 2011), it is thought that athletes can improve their imagery ability. As mentioned above, research has identified a positive relationship between imagery use and imagery ability (Cumming & Hall, 2002; Gregg et al., 2005; Moritz, Hall, Martin, & Vadocz, 1996). This suggests that athletes who use imagery more frequently (thereby gaining more imagery practice) are likely to display higher levels of imagery ability. In support, several studies have discovered ways that can improve imagery ability as a result of mental practice or imagery use during imagery intervention programmes. It is suggested that imagery ability can be modified and strengthened through practice (Cumming & Ste-Marie, 2001; Williams et al., 2013). Rodgers et al. (1991) showed that general kinesthetic imagery ability can be improved through 16 weeks of imagery training in ice skaters. In another study, Cumming and Ste-Marie (2001) found that sport-specific visual and kinaesthetic imagery ability improved following a five-week imagery intervention. This means, similarly to a physical skill, imagery ability can be improved over time with practice. Importantly, it appears that imagery practice does not tend to transfer to other types of imagery ability. For example, the physical practice group in an imagery intervention by Williams et al. (2013) experienced an improvement in their specific imagery ability (i.e., content reflective of that being performed during the intervention). However, improvements did not generalise to other more generic images (Williams et al., 2013).

Beyond imagery use/practice, in more recent years researchers have devised and suggested other methods and techniques to improve imagery ability above and beyond gains achieved through imagery practice. Greater gains in these developed techniques are provided in terms of the magnitude of the improvement, the timeline of the improvement (i.e., experience gains in imagery ability more imminently), and/or the subsequent effectiveness of the imagery resulting from the improvement. In support to this, there is growing interest in improving athletes' imagery ability by manipulating how athletes image (e.g., applied imagery techniques; Cumming et al., 2016; Wright, McCorminck, & Birks, 2014). Two of the more commonly used techniques in the literature which lead to these greater improvements in imagery ability include Layered Stimulus Response Training (LSRT; Williams, Cooley, & Cumming, 2013) and using observation in conjunction with imagery (Holmes & Calmels, 2008). Another imagery technique that is frequently employed in the sport setting due to being highly effective in achieving desired imagery outcomes (e.g., improved performance, skill enhancement) is PETTLEP imagery. As discussed in the next section, PETTLEP imagery's effectiveness could partly be due to enhancements in imagery ability (Cumming & Williams, 2012). However, research is yet to systematically examine this idea. The next three sections discuss the details of these three techniques include the underlying theories behind why they are likely to be effective in improving athletes' imagery ability.

Layered Stimulus Response Training (LSRT)

Layered Stimulus Response Training (LSRT) is a recent technique that has been reported to assist athletes in creating and controlling images to thus improve their imagery ability (Cumming et al., 2016; Williams et al., 2013). LSRT was developed based on Lang's (1979) bioinformational theory. The theory explains that imagery is a product of brain's information processing which involves propositions stored in long-termed memory. These three types of propositional information are; (1) stimulus propositions, which represents the content of the scene to image (e.g., environment or place of the image); (2) responses propositions, which explain the responses to the scene include somatomotor events (e.g., muscle tension), sense organ adjustments (e.g., postural changes), verbal responses (e.g., speak), visceral events (e.g., increased heart rate), and processor characteristics (e.g., disorientated in time); and (3) meaning propositions, which include the interactions between stimulus and response propositions (e.g., the reason to image) (Lang, 1977, 1979).

The LSRT technique is specifically designed to assist individuals who have difficulty in any aspect of the imagery process (i.e., imagery generation, inspection, transformation, and maintenance) and thus either find imagery ineffective or detrimental in the outcomes they experience (Cumming et al., 2016). For example, an athlete may be unable to control her imagery and keep experiencing a negative image which can reduce her confidence and increase her anxiety. Consequently, LSRT is not only beneficial for improving imagery ability, but it is also helps athletes to achieve more adaptive cognitive, behavioural and affective imagery outcomes through imagery use. The LSRT is systematic, but flexible, so that is can be easily customised to meet the needs of the individual receiving the training. Individuals start with a basic image (often characterised by one or two stimulus propositions) and gradually additional propositions are added in a layering approach to build up the image making it more detailed. For example, a dancer could image a dance movement and the dance floor, then she will add on a layer of imagery that contains a response proposition, for example, psychophysiological changes, music and the feelings while moving the body. Next, she will add another imagery layer of meaning propositions which is about the interaction of stimuli and response propositions including the reason for imaging such as increased feelings of self-confidence.

LSRT helps to create more vivid imagery that is easier to generate. By doing so, individuals can better create and control their images. The reflective phase of the LSRT aids the inspection phase of the imagery process, and also promotes a greater awareness of the reasons for imaging and what content would most appropriately meet a particular function. Consequently, athletes are better able to achieve desired outcomes by eliminating undesired images and selecting the most appropriate content and imaging this to the best of their ability

(Cumming & Williams, 2013). Evidence supporting the effectiveness of LSRT has emerged in both research and applied settings when using imagery for different outcomes (Davies, 2015; Williams et al., 2013). Furthermore, Williams et al. (2013) demonstrated that LSRT appears to be more effective than physical practice. For instance, an LSRT intervention led to improvements in golf putting performance and the ability to image the golf putting task (Williams et al., 2013).

However, LSRT will not be considered in this thesis as it requires time to repeat the process to established layer by layer in order to develop imagery ability and needs to be guided by a researcher or practitioner. In this investigation, PETTLEP imagery will be explored as a new technique for improving imagery ability as it can be done in a short time and without needing a guide. Therefore, this thesis will convey the results of a novel investigation into imagery ability based on, PETTLEP imagery, which is more commonly used for creating more effective imagery but its impact on imagery ability has been rarely explored. PETTLEP imagery will be compared to another emerging technique with empirical evidence on the influences on imagery ability, which is observation. Hence, PETTLEP imagery and observation imagery are considered in this thesis' investigation and are discussed accordingly in the next sections.

PETTLEP model

The PETTLEP model is a popular imagery technique for enhancing the effectiveness of imagery. Holmes and Collins (2001) initially proposed that seven different elements (i.e., **P**hysical, **E**nvironment, **T**ask, **T**iming, **L**earning, **E**motions, and **P**erspective) should be addressed and incorporated during imagery. The Physical element suggests physical characteristics of the task should be recreated or adopted by the individual when imaging. For example, athletes can wear their proper attire, hold appropriate equipment, and stand in the correct position for a particular movement (Cumming & Williams, 2012). The Environment element suggests that imagery should be performed in an environment reflective of the scenario being imaged. It can include using video footage and photographs if access to the venue is not possible. The Task element suggests that the imagery content should reflect the physical capabilities of the performer and consider the attentional demands required. The Timing element refers to the speed and duration of the imagery. It is suggested that imagery should be performed in real time. The Learning element refers to making adjustments to the imagery content based on the imager's stage of learning so that the images performed continually reflect the individual's current capabilities. The Perspective element is the visual perspective the imager adopts when viewing the image. It is suggested that the imagery should be performed from a perspective that is preferred by the individual or most appropriate for the task (Gregg et al., 2005).

To illustrate how the seven PETTLEP elements may be incorporated into an image, take the example of a football player who would like to improve his dribbling skills in matches. Wearing his football kit and standing with the ball under a foot (Physical), he could image the dribbling task (Task) while standing on the pitch (Environment). He should image dribbling in real time (Timing) at his current performance standard (Learning), while incorporating the relevant feelings and emotions that would be experienced when under pressure (e.g., anxiety or excitement) and using either EVI or IVI while also experiencing the kinesthetic sensations associated with the task (Perspective).

The effectiveness of PETTLEP imagery was initially explained by functional equivalence (i.e., the image created in mind correspond to the real execution of the task) (Holmes & Collins, 2001). However, more recent research suggest the effectiveness of PETTLEP imagery is explained by behavioural matching as the term "functional equivalence" is also used in EMG patterning and motor similarities studies that explain the broader concept and not focusing on the similarity between imagery and execution. Behavioural matching refers to the degree of similarity/matching between the imagery conditions behaviours with the action preparation and execution, (see, Wakefield, Smith, Moran, & Holmes, 2013). This means, the most effective imagery is due to the higher degree of matching elements between imagery and execution thought to bring about levels of neural activity experienced during the imagery that are more similar to those experienced during the execution of the movement. Consequently, imagery is thought to more effectively prime movement execution. In support of this suggestion, a number of studies demonstrate that imagery incorporating PETTLEP elements will enhance technical skill and performance (Wakefield & Smith, 2009; Wakefield & Smith, 2012), and improve confidence and motivation (Callow, Roberts, & Fawkes, 2006; Ramirez, Smith, & Holmes, 2010) to a greater extent that those not incorporating elements or incorporating less elements.

As previously mentioned, imagery ability plays an important role in the effectiveness of imagery achieving its desired imagery outcomes. Consequently, it can be suggested that the proposed neural similarity between imagery and execution of the same movements (Holmes & Collins, 2001; Murphy et al., 2008; Wakefield et al., 2013) and involvement of multisensory behaviour matching brought about by PETTLEP imagery can improve imagery ability. For example, if an athlete is standing on the pitch in their football kit they are probably more readily able to recall the feelings and sensations associated with dribbling the ball. Consequently, the imagery is probably easier to generate and more vivid and realistic. However, although surprising, research is yet to examine this proposal meaning that a key aim of this thesis is to comprehensively investigate this notion. Similarly to PETTLEP imagery, observation is another technique that has started to receive an attention as a method to create more effective imagery. However, as discussed in the next section researchers have already suggested this to be an effective method to improve imagery ability.

Observation

Observation has been reported as a technique that can enhance the performance of movement and learning of skills (Gatti, Tettamanti, Gough, Riboldi, Marinoni, & Buccino, 2013; Holmes & Calmels, 2008). Gallese and Goldman (1998) provide basic understanding of observation facilitating movements as they suggested that similar areas of the brain activate when a person observes and executes a motor task. It is also suggested that observation activates neural areas active during execution and hence, that neurons control both actions (Buccino et al., 2001; Edwards, Humphreys, & Castielloc, 2003). This means that imagery, observation, and execution share similar neural process (Jeannerod, 1994). As observation is reported to be similar to imagery, neuroscientific studies provide explanation of the similarity and the relationship between the two (see, Jeannerod, 1994; Holmes, Cumming & Edwards, 2010).

Holmes and Calmels (2008) extend the notion that the similarity between observation and imagery encompass imitation, intention, and empathy. By considering observational perspective, behavioural agency, observation instruction and nature of the task, and observation motor cortex, observation can be similarly effective to imagery in regards of enhancing performance and skills learning (Jeannerod, 1994; Gatti et al., 2013). Holmes and Calmels (2008) discussed details of observation and imagery function, and consequently suggested that observation may supplement imagery. Hars and Calmels (2007) reported that gymnasts use observation to help them image for the purpose to improve self-assessment, increase performance, technical execution, as well as to increase visual perceptions.

As observation has been used to help imagery, the relationship between observation and imagery ability have also received attention. It is suggested that observation influence imagery ability in regards of clarity, vividness, image management, and image manipulation (Holmes & Calmels, 2008). This means that athletes use observation to help them image as observation may contribute to increased imagery ability in regards of vividness and similarity of the image. For example, Wright, McCormick, Birks, Loporto, and Holmes (2015) recently reported that observation was similarly effective for generating visual imagery when compared to imagery training. The consistency of these findings in the literature indicates that imagery and observation are related and this association forms the bases for why observation will also likely increase imagery ability.

Through observation, athletes receive information about what and how to image (Gould & Damarjian, 1996; Lang, 1979). In this way, observation prime is beneficial by helping athletes to form accurate representations of what they intend to image. Regardless of whether the observation is of a video modelling or someone in real situation, it can enhance the similarities between the imagery and execution (Cumming & Williams, 2011). Hence, observation can be used to prime imaging. However, it is thought that the visual perspective for displaying the observation must be congruent with the visual perspective adopted for the imagery (Williams, Cumming, & Edwards, 2011). For example, Williams et al. (2011) found that observation enhanced ease of imaging EVI when the video clip was filmed from an external not internal viewpoint. Although observation has been considered as a technique to improve imagery ability, it has not yet been directly compared to other techniques to enhance imagery effectiveness such PETTLEP imagery. The effect of observation prime vs. PETTLEP imagery on athletes' ease and vividness of imaging movement is therefore investigated in the present thesis.

Outline of Research Programme

Based on the importance of imagery ability highlighted by the RAMDIU as well as being extensively supported by research, this thesis will seek to understand the various factors that can lead to greater imagery ability. As outlined in the above literature review, there are gaps in understanding what factors and techniques are most likely to influence imagery ability of different content and characteristics; that is, considering the "What (type) & How", "Who", and "Imagery Ability" components of the RAMDIU.

To address some of these gaps, this thesis specifically aimed to explore : (a) the ways in which individuals perform imagery (i.e., the "What (type) & How" component); and (b) individual characteristics of the imagery (i.e., the "Who" component) can impact imagery ability. To address the first aim, the effect of PETTLEP imagery was initially examined and then compared to observation as techniques to improve ease and vividness of EVI, IVI, and KI of movements. The relationship between athletes' use of physical and environment PETTLEP elements and their ability to image different imagery content was also examined. Based on bioinformational theory, the second aim of the thesis was to examine how emotion regulation was associated with imagery ability of different imagery content. These research questions were designed to contribute to the literature by aiding our understanding of how the RAMDIU components of "What (type) & How" and "Who" (i.e., how athletes image and individual characteristics) related with imagery ability, with implications on the ways to support individuals to improve their imagery ability, which in turn could lead to more effective imagery use.

This thesis is composed of four empirical chapters. In chapter 2 (study 1), an experiment was conducted to investigate the increment in ease and vividness of imagery ability. The VMIQ-2 was used as the measure to capture three different perspectives (EVI, IVI and KI). Imaging the VMIQ-2 movements with the incorporation of PETTLEP elements was compared to imaging the same movements using more traditional imagery. Chapter 3 (study 2) extended the investigation of PETTLEP imagery enhancing imagery ability but compared this to imagery following an observation prime. These two empirical chapters also investigated which PETTLEP elements athletes found to be most helpful in increasing the ease and vividness of the imagery.

Chapter 4 (study 3), investigated whether imagery ability was associated with the frequency with which athletes use the physical and environment PETTLEP elements. To examine this association with imagery ability of different content (i.e., skill, strategy, goal, mastery and affect), this chapter employs the SIAQ. This chapter also highlighted the importance of different individual characteristics (i.e., gender and competitive level) can have on imagery ability. To further examine the extent to which individual characteristics impact imagery ability, Chapter 5 (study 4) examined the extent to which emotion regulation (i.e., emotion reappraisal and emotion suppression) was associated with imagery ability of different content. Again the SIAQ was used to examine the differences in both imagery ability and emotion regulation due to gender and competitive level.

Note: The chapters have been prepared in journal article style apart from the references which are presented in one list following the general discussion. Tables and figures were inserted into the text of each chapter for visual clarity purposes.

Chapter 2

Effects of Applying the PETTLEP Model on Vividness and Ease of Imaging Movement

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Effects of Applying the PETTLEP Model on Vividness and Ease of Imaging Movements

Imagery is a popular technique used by athletes to enhance sporting performance (Cumming & Williams, 2012; Martin, Moritz, & Hall, 1999). It has been described as an experience that reflects actual experience in a variety of senses (e.g., sight, taste, sound) without experiencing the real thing (White & Hardy, 1998). However, the ease with which an athlete is able to image and the vividness of this imagery has been proposed to influence its effectiveness, with better imagery ability leading to more effective improvements in skill acquisition and performance (Hall, 1998). In support, Robin et al. (2007) demonstrated that individuals who image more easily experienced greater improvements in the accuracy of their tennis service return following an intervention combining imagery with physical practice compared with those who found imagery more difficult. McKenzie and Howe (1997) also reported that imagery was effective in enhancing self-efficacy for only those individuals displaying higher ease of imaging. Based on the available evidence, athletes' ability for imaging is considered to be one of the most important factors in determining the extent to which imagery is effective for achieving desired outcomes (for recent reviews, see Cumming & Williams, 2012, 2013).

Imagery ability is defined as "an individual's capability of forming vivid, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal" (Morris, Spittle, & Watt, 2005, p. 60). Hall (1998) explains that everyone has the ability to generate an image but this may differ in terms of vividness, controllability, kinesthetic feelings, ease, and emotional experience. Consequently, the ability to image is multidimensional and can be reflected in a number of ways. The two main dimensions used to assess imagery ability in sport are ease and vividness (Callow & Hardy, 2005; Gregg, Hall, & Nederhof, 2005). In the present study we refer to imagery ability by these dimensions. Ease of imaging can be described as how effortlessly an individual is able to create and control an image (Hall &

Martin, 1997; Williams & Cumming, 2011), whereas vividness describes the clarity and sharpness or sensory richness of an image (Baddeley & Andrade, 2000; Morris et al., 2005). Ease and vividness have a close association in that an individual who finds it easy to image will likely generate a vivid image (Williams & Cumming, 2011). However, ease and vividness are conceptually distinct dimensions of imagery ability when imaging the different modalities experienced during an image (e.g., visual, kinesthetic, olfactory, gustatory, auditory). As such, ease and vividness should be separately measured when assessing how well someone is able to image.

Within sport, the two main modalities of movement imagery athletes use to enhance performance are visual and kinesthetic. Visual imagery involves seeing the movement and can be experienced from two different perspectives. External visual imagery (EVI; third person perspective) involves watching yourself perform the movement as if from another person's point of view whereas internal visual imagery (IVI; first person perspective) involves viewing the movement through your own eyes as if actually performing the movement (Morris et al., 2005). Kinesthetic imagery (KI) refers to imaging the feelings and sensations associated with the movement. Although EVI, IVI, and KI have been identified as separate constructs (Roberts, Callow, Hardy, Markland, & Bringer, 2008; Williams et al., 2012), combining visual and kinesthetic imagery is thought to be most beneficial for enhancing performance, both directly and indirectly through psychological variables such as confidence (Callow & Hardy, 2004). However, few studies have directly examined what specific techniques could be used to develop ease and vividness of EVI, IVI, and KI.

Within those studies examining how imagery's ease and vividness can be improved, a handful of different techniques have been suggested. Based on Lang's (1979) bioinformational theory, one approach has been to include response propositions into an image as a way to making the experience more vivid (Lang, Kozak, Miller, Levin, &

McLean, 1980). Another approach described by Calmels, Holmes, Berthoumieux, and Singer (2004) is to add more details to the imagery in layers, which has been effective at producing more vivid images during an intervention. A more recent combination of both of these techniques is known as Layered Stimulus Response Training (Williams, Cooley, & Cumming, 2013), and is effective for increasing ease and vividness of both visual and kinesthetic imagery. This technique introduces stimulus, response, and meaning propositions in stages to produce more vivid imagery that is easier to generate. Taking a fourth approach, imagery ability has also been shown to improve with practice only interventions using performance based (Rodgers, Hall, & Buckolz, 1991; Williams et al., 2013) or motivation general-mastery based (Hammond, Gregg, Hrycaiko, Mactavish, & Leslie-Toogood, 2012) imagery.

Another possible technique for improving the ease and vividness of someone's imagery can be found in the PETTLEP model (Holmes & Collins, 2001; Wakefield, Smith, Moran, & Holmes, 2013). Holmes and Collins (2001) originally proposed that incorporating seven different elements (i.e., physical, environment, task, timing, learning, emotions, and perspective) into an image can lead to more effective imagery. For example, if a male soccer player is imaging to improve his dribbling, he could wear his soccer attire, position the ball underneath his foot, and stand in the correct position (physical), while imaging on the field or in the stadium (environment). He could image dribbling in a competitive match situation (task) at his current performance standard (learning) in real time (timing), and with the relevant feelings and emotions that he would experience during the actual situation (e.g., anxiety or excitement). Finally, perspective refers to the visual perspective adopted by the individual, which should ideally match the demands of the task being imaged and/or the preferences of the individual (also see Hardy, 1997).

To date, investigations of the PETTLEP model within sport have found that incorporating more elements leads to greater performance (e.g., Smith et al., 2007; Wakefield & Smith, 2009), as well as improvements in confidence (e.g., Callow, Roberts, & Fawkes, 2006) and motivation (e.g., Ramirez et al., 2010). For example, Smith et al. (2007) found that combining the physical and environment elements together was more effective for improving field hockey penalty flicks compared to both a physical element only condition, and a traditional imagery condition. PETTLEP imagery combined with physical practice is also more effective compared to traditional imagery or physical practice alone (Smith, Wright, & Cantwell, 2008).

Within Smith et al.'s (2008) study and others (e.g., Smith, Wright, Allsopp, & Westhead, 2007), the traditional imagery condition was performed by individuals sitting quietly in a room located away from the performance environment, and sometimes preceded by relaxation exercises to focus the mind. Traditional imagery also does involve certain PETTLEP elements that are common to all imagery interventions, such as task, perspective, and emotion. Based on findings comparing PETTLEP imagery to traditional imagery, Wakefield et al. (2013) have suggested the physical and environment to be the key elements which add value over and above the more traditional elements.

Underpinning the effectiveness of the PETTLEP imagery is the notion that there is some shared neural activity between motor imagery and execution (Holmes & Collins, 2001; Wakefield et al., 2013). Imagery of a movement is thought to elicit similar but not completely identical neural processes to that experienced during execution of the same movement (Jeannerod, 2001). The elements of the PETTLEP model promote behavioral matching between imagery and actual movement, which in turn will hypothetically lead to more efficient shared neural activity between these cognitive processes (Wakefield et al., 2013). Wakefield et al. (2013) proposed that imagery's effectiveness depends on the similarity at the neural level with the actual movement. Regular activation of the neural pathways involved in movement execution through imagery is thought to strengthen neural connections involved in execution and result in improved performance (Jeannerod, 1999). Evidence to directly support this claim is not yet available, however as outlined above, there is considerable behavioral evidence in support of the PETTLEP model. Separate to this research is also the accumulating literature demonstrating similar activation of neural areas involved with both movement imagery and execution (Holmes & Calmels, 2008).

The concept of behavior matching proposed by Wakefield et al. (2013) is also relatively new and research has yet to specifically explain why increased behavioral matching leads to greater improvements in performance than more traditional imagery. A possibility that has not been extensively considered is whether these benefits are due to parallel increases in imagery ability. As stated previously, better imagery ability can lead to more effective imagery interventions. Researchers have already suggested that certain PETTLEP elements may be particularly helpful for improving imagery ability. Gould and Damarjian (1996) proposed that more vivid imagery may occur when an individual holds a relevant piece of sporting equipment and makes movements reflective of the task (i.e., physical). In support, Callow et al. (2006) investigated the vividness of static and dynamic imagery of a skiing task. Participants in the dynamic group incorporated the physical and environmental elements of PETTLEP imagery by wearing their skiing equipment, imaging on the snow, and moving their body side to side. The static group completed the imagery while sitting on a chair away from the snow. Results revealed that participants in the dynamic group reported higher levels of vividness compared to participants in the static group. Although these findings suggest incorporating PETTLEP elements such as physical and environment may increase imagery ability, these studies only measured vividness and did not assess other key dimensions of imagery ability including ease of imaging. Furthermore, they did not separately investigate the effects of PETTLEP imagery on the different imagery perspectives and modalities commonly used in sport (i.e., EVI, IVI, and KI).

Therefore, the purpose of this study was to extensively compare the effect of PETTLEP imagery against traditional imagery on the ease and vividness of EVI, IVI and KI of movement ability. Based on Callow et al.'s (2006) study, we predicted that incorporating the physical and environment elements of the PETTLEP model would elicit more vivid and easier to generate images regardless of the visual perspective or modality compared with more traditional imagery.

Method

Participants

Forty participants (9 males, 31 females; *M* age = 23.47 years, *SD* = 4.11) were involved in the study. Most participants engaged in mild physical activity at least once a week and had no formal experience using imagery. The majority of participants had not received any imagery training (*n* = 34). The other six had received information about imagery in a university lecture.

Measures

Demographic information. Participants provided demographic details such as their age, gender, physical activity level, and if they had received any imagery training.

Vividness of movement imagery questionnaire-2 (VMIQ-2). The VMIQ-2 (Roberts et al., 2008) is a 36-item questionnaire that measures the vividness of imaging 12 movements (e.g., walking, running, throwing a stone) in visual and kinesthetic modalities. The VMIQ-2 was thought to be the most appropriate measure as the movements lent themselves well to being applied to the PETTLEP model. Participants read a description of the movement and are then instructed to image it as clearly and vividly as possibly with their eyes closed. The movements are first imaged from an EVI perspective before imagining them from an internal visual imagery perspective, and finally from a kinesthetic modality. Ratings are made on a 5-point Likert type scale ranging from 1 *(perfectly clear and as vivid as normal/feel of movement)* to 5 *(no image at all, you only know that you are thinking of the skill)*. The scale was reversed in the current study to make it more intuitive for participants (i.e., a higher rating = more clear/vivid image). The VMIQ-2 has demonstrated good validity and is regarded as an acceptable measure of movement imagery vividness. For the present study, an additional 5-point Likert type rating scale was added for each item to measure ease of imaging *(1 = very hard to see/feel, to 5 = very easy to see/feel)*. In the current study the VMIQ-2 demonstrated good reliability with Cronbach alphas of .87 or above. Cronbach alpha coefficients, reflecting the internal reliability of all three subscales for vividness and ease during the PETTLEP imagery condition and traditional imagery condition are reported in Table 1.

Imagery evaluation check. After completing the VMIQ-2 participants completed a single item indicating the extent to which they understood the imagery instructions and different modalities and visual perspectives. Responses were made on a 7-point Likert type scale ranging from 1 *(did not understand at all)* to 7 *(completely understood).*

PETTLEP evaluation form. At the end of the PETTLEP imagery condition, participants completed an evaluation form to determine how helpful the PETTLEP elements were in creating clearer and more vivid images that were easier to generate. This form was comprised of the following items: 1) imaging while adopting the physical positions and having the props reflective of the movements you imaged; 2) performing the imagery in the environment reflective of where the movements would be physically performed; 3) imaging the movements at a standard reflective of your movement capabilities; 4) imaging the movements in real time; and 5) incorporating the relevant feelings and emotions into the imagery. Participants first rated how helpful the items were for creating clearer and more vivid images, and then rated how helpful the items were in making the imagery easier to perform. All ratings were made on a 7-point Likert type scale ranging from 1 *(not at all helpful)* to 7 *(very helpful)*.

Procedures

After receiving ethical committee approval for the study, participants were given an information letter explaining the nature of the study and were informed that their participation was voluntary and they could withdraw at any point. Those who agreed to participate signed the consent form at the beginning of their first visit and were asked to provide demographic information. Participants were then given the following imagery definition:

> Imagery is an experience that mimics real experience. We can be aware of "seeing" an image, feeling movements as an image, or experiencing an image of smell, tastes, or sounds without actually experiencing the real thing. Sometimes people find that it helps to close their eyes. It differs from dreams in that we are awake and conscious when we form an image (White & Hardy, 1998, pp. 389)

Next, participants were educated about the different perspectives and modalities (external visual imagery, internal visual imagery, and kinesthetic imagery) and verbally confirmed they understood the difference between the three imagery types. The participants were then randomly assigned to the counterbalanced order in which they completed the VMIQ-2 under two different conditions 24-48 hours apart. The conditions were PETTLEP imagery and traditional imagery.

During the PETTLEP imagery condition, participants were instructed to incorporate all of the PETTLEP elements when imaging each movement of the VMIQ-2 except for perspective. For the perspective element, participants were told to follow the instructions given in the VMIQ-2 instructions (i.e., image all items using EVI, followed by IVI and then KI). The PETTLEP condition instructions asked participants to adopt the physical position related to each movement described in the VMIQ-2 with props/visual aids provided as appropriate. The participants were also asked to image in an environment reflective of where the movement would be physically performed, image in real time, and incorporate any relevant emotions. For example, when imaging running up the stairs (VMIQ-2 item 5), participants would perform the image standing at the bottom of the stairs wearing appropriate attire and shoes for this activity. Similarly, when imaging kicking the ball in the air (VMIQ-2 item 11) participants held a ball while standing outside wearing the appropriate attire. See Table 1 for an explanation of how the PETTLEP elements were incorporated into the imagery.

Table 1
Description of PETTLEP elements in the imagery

PETTLEP elements	Description
Physical	Wearing the appropriate clothes during imagery or as same as the task, and holding any associated props
Environment	Image at the place as similar as possible to the task.
Task	This is related to the content of the imagery at the appropriate skill level (e.g., attentional demands) and the personal preferences.
Timing	Imaging the movement in real time reflective of the actual movement.
Learning	Imagery content should be modified and adapted to reflect any learning or improvement that takes place.
Emotion	Incorporating the feelings and emotions in imagery that are reflective of the actual movement or task.
Perspective	The viewpoint adopted by the imager during imagery

During the traditional imagery condition, the participants completed the VMIQ-2 in the traditional imagery format. This included imaging while sitting on chair in a quiet room away from the environment where the movements would be typically performed. They also had no props or visual aids.

Once the VMIQ-2 was completed, participants assessed their imagery experience using the Imagery Evaluation Check (IEC), and in the case of the PETTLEP imagery condition, participants also completed the PETTLEP evaluation form. Finally, at the end of the second visit participants were debriefed on the nature of the study and thanked for their participation. Both sessions took no longer than one hour.

Data Analyses

Data were first inspected for missing values. Descriptive means and standard deviations, as well as the internal reliabilities of each of the VMIQ-2 subscale across the two conditions were calculated. A paired samples t-test was conducted to establish that there were no differences between conditions in how well participants understood the instructions. For the main analyses, bivariate correlations were first run to determine the relationship between ease and vividness scores for external visual imagery, internal visual imagery, and kinesthetic imagery. Because the relationships between these dimensions were high for the subscales, repeated measures MANOVAs were used to determine differences when comparing PETTLEP versus traditional imagery.

For these analyses, Pillai's trace was reported because it is the most robust to violations of the homogeneity of the covariance matrix assumption (Olson, 1976). To reflect the meaning of significant difference between conditions, the eta square value were reported based on Cohen (1992) as .2 = small; .14 = medium; .3 = large effect. Mauchly's test of Sphericity was reported to demonstrate the equality of the within subject variance. When this test was significant, the Greenhouse-Geisser correction was applied to reduce the degrees of freedom (Greenhouse & Geisser, 1959). Pairwise comparisons were made using LSD post hoc analyses and Bonferroni adjustment to the VMIQ-2 subscales to control Type 1 errors when using multiple comparisons. Effect size and observed power were reported for all main effects.

Results

Preliminary Analysis

The data was first examined for any missing values. As the pattern of missing data was completely at random, these values were replaced with the mean. Internal reliability, means, and standard deviations for each VMIQ-2 subscale during both conditions are presented in Table 3.

Imagery evaluation check. To ensure that participants understood the instructions and different modalities and visual perspectives equally in both conditions, a paired sampled t-test was conducted. Analysis revealed that all participants understood the instructions they were given in both the PETTLEP (*M* = 5.65, *SD* = 1.31) and traditional imagery condition (*M* = 5.17, *SD* = 1.24) and no significant differences existed between conditions (t = -.22, p = .83).

Ease and vividness correlations. Bivariate correlations revealed significant strong positive relationships between ease and vividness ratings for each of the VMIQ-2 subscales during both visits (Table 2). Due to the high correlations, repeated measures MANOVAs were run on subsequent main analyses of the VMIQ-2 ease and vividness ratings (Maxwell, 2001).

Table 2
Correlations between Vividness and Easiness in both conditions

PETTLEP condition	**EVI Easiness**	**IVI Easiness**	**KI Easiness**
EVI Vividness	**.87****	.64**	.51*
IVI Vividness	.54**	**.80****	.53**
KI Vividness	.37*	.59**	**.88****
Traditional condition	EVI Easiness	IVI Easiness	KI Easiness
EVI Vividness	**.87****	.73**	.54*
IVI Vividness	.64**	**.95****	.64**
KI Vividness	.56**	.67**	**.77****

Note. * p = .001, ** p < .001.

Main Analysis

External visual imagery. A repeated measures MANOVA revealed that there was no significant multivariate effect between the PETTLEP imagery condition and traditional imagery condition, Pillai's trace = .07, $F(2, 38) = 1.49$, $p = .239$, $\eta_p^2 = .07$, observed power = 30%. The finding demonstrates a moderate effect size and a low observed power.

Internal visual imagery. Results of the repeated measures MANOVA revealed a significant multivariate effect with a large effect size Pillai's trace = .44, $F(2, 38) = 14.90$, $p < .001$, $\eta_p^2 = .44$, observed power = 100%. At the univariate level results indicated a significant difference between PETTLEP imagery and traditional imagery for vividness, $F(1, 39) = 24.76$, $p < .001$, $\eta_p^2 = .39$, observed power = 100% and for ease $F(1, 39) = 5.22$, $p = .028$, $\eta_p^2 = .12$, observed power = 61%. Ease and vividness ratings were higher during the PETTLEP condition compared with the traditional condition. The means and standard deviations for both conditions are reported in Table 3.

Kinesthetic imagery. A repeated measures MANOVA revealed a significant difference at the multivariate level with a small effect size, Pillai's trace = .21, $F(2, 38) = 4.97$, $p = .012$, $\eta_p^2 = .21$, observed power = 78%. Findings at the univariate level demonstrated significant differences with a small effect size between the PETTLEP imagery and the traditional imagery for vividness, $F(1, 39) = 8.71$, $p = .005$ $\eta_p^2 = .18$, observed power = 82% and ease, $F(1, 39) = 9.67$, $p = .003$, $\eta_p^2 = .20$, observed power = 86%. Ease and vividness ratings were higher during the PETTLEP condition compared with the traditional condition. Means and standard deviations can be found in Table 3.

Table 3

Internal reliability, mean and standard deviation of EVI, IVI and KI for vividness and easiness of PETTLEP and traditional imagery conditions

	PETTLEP imagery						**Traditional imagery**					
	Vividness			*Ease*			*Vividness*			*Ease*		
	α	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*
EVI	.89	3.94	.68	.89	3.98	.69	.92	3.78	.74	.93	3.75	.81
IVI	.91	4.00*	.70	.88	4.00*	.64	.91	3.74	.69	.91	3.68	.75
KI	.87	3.83*	.71	.89	4.00*	.70	.95	3.48	.85	.95	3.56	.88

Note. * = significantly higher than traditional imagery at $p < .05$

PETTLEP evaluation. Two separate repeated measures ANOVAs were conducted to compare the perceived helpfulness of the different PETTLEP elements in creating clearer and more vivid imagery that was easier to generate.

The analysis for clear and vivid imagery revealed a significant difference between the elements, $F(3.06, 119) = 4.61$ $p = .004$, $\eta_p^2 = .11$, observed power = 89%. Post hoc analyses revealed that participants found adopting the physical characteristics of the task significantly more helpful ($p < .01$) than any other PETTLEP elements (i.e., imaging in the environment, the reflective movement capabilities, in real time, and including the feelings and emotions relevant for the task). However, there were no differences between any of the other PETTLEP element in their perceived helpfulness.

The analysis for ease of imaging showed a significant difference, $F(4, 156) = 3.68$, $p = .007$, $\eta_p^2 = .09$, observed power = 87%. Post hoc analyses revealed that participants found adopting the physical characteristics of the task and imaging in the appropriate environment to be significantly more helpful ($p < .05$) than using the other elements described above.

Means and standard deviations of how helpful all elements were for vividness and ease are reported in Table 4.

Table 4

Means and standard deviations of perceived helpfulness of PETTLEP elements

Items	Vividness		Easiness	
	M	*SD*	*M*	*SD*
Imaging while adopting the physical positions and having the props	6.07*	1.04	6.00*	.88
Performing the imagery in the environment reflective	5.48	1.22	6.03*	1.40
Imaging the movements at a standard reflective of your movement capabilities	5.42	.71	5.57	.99
Imaging the movements in real time	5.35	1.19	5.45	1.10
Incorporating the relevant feelings and emotions into the imagery	5.27	1.24	5.5	1.10

Note. Items completed one of two possible stems: "How helpful were the following things in creating clearer and more vivid images…" or "How helpful were the following things in making the imagery easier to perform…"

*$p < .05$ = significantly more helpful than the other elements.

Discussion

The present study investigated the effects of applying elements of the PETTLEP model (Holmes & Collins, 2001) on ease and vividness of EVI, IVI, and KI. It was hypothesized that imagery incorporating PETTLEP elements would increase participants' ease and vividness of imaging movements using EVI, IVI and KI. Preliminary analysis demonstrated participants' understanding of the instructions and the differences between EVI, IVI, and KI. Therefore, we can be confident that ease and vividness ratings represent the influence of PETTLEP on these types of imagery.

Overall findings mostly supported the hypotheses. Incorporating more PETTLEP elements resulted in greater ease and vividness of IVI and KI compared to traditional imagery. This data provides empirical support for Callow et al.'s (2006) and Gould and Damarjian's (1996) assertion that imagery carried out whilst dressed in the proper attire, holding relevant equipment, and standing in the environment (i.e., incorporating the physical and environment elements of the PETTLEP model) leads to a more vivid image. The present study also provided evidence that PETTLEP imagery also leads to easier to generate IVI and KI.

Previous studies (Calmels et al., 2004; Hammond et al., 2012; Rodgers et al., 1991; Williams et al., 2013) have reported the effectiveness of different imagery interventions for improving vividness and ease of image generation by drawing attention to response propositions and building images in layers. Our findings also give insight into how PETTLEP imagery can increase the effectiveness of imagery interventions and could be compared to these techniques in future research. As the ease of image generation and vividness of the image are well known factors augmenting the benefits of using imagery, it is proposed that a mechanism through which PETTLEP imagery operates is by enabling individuals to improve these dimensions of imagery ability (Cumming & Williams, 2012, 2013). The addition of PETTLEP elements during imagery is believed to enhance the shared neural activity between imagery and physical execution. As explained by Wakefield et al. (2013), any changes in neural activity due to the behavioral matching occurring from PETTLEP imagery has not yet been directly established, but the extant behavioral evidence is supportive of this idea.

Participants in previous studies demonstrating PETTLEP imagery to be effective (e.g., Smith et al., 2007; Wakefield & Smith, 2009) may have also experienced a boost in the ease of image generation and vividness from the addition of PETTLEP elements over and above what would be expected from traditional imagery alone. However, these dimensions have rarely been assessed during or after a PETTLEP imagery intervention has been completed. We urge researchers to monitor changes in these dimensions in future PETTLEP imagery interventions to determine if the increases in ease and vividness found in the current study could produce more long-lasting effects throughout a PETTLEP intervention. This information would also help to better determine the specific role played by imagery ability in determining the effectiveness of an intervention (e.g., as a mediator or moderator; see Cumming & Williams, 2013). As well, such research would also provide further evidence that PETTLEP imagery can be used as a specific technique to enhance a participant's ability to more easily generate and control, vivid and clear IVI and KI images reflective of the task.

Although there was a trend in the predicted direction, PETTLEP imagery did not lead to significantly higher ease or vividness of EVI over traditional imagery. To our knowledge, researchers have yet to separately examine the effects of PETTLEP imagery on IVI and EVI. The majority of PETTLEP studies thus far have either instructed participants to use a combination of IVI and KI (e.g., Smith et al., 2008; Wakefield, & Smith; 2009, Wright, Hogard, Ellis, Smith, & Kelly, 2008) or did not specify which visual perspective the athletes should adopt (e.g., Wright & Smith, 2009). The lack of a significant difference between conditions when using EVI might be due to the nature of the task being imaged (Hardy, 1997), participants' preferences for using a particular visual perspective (Callow & Roberts, 2010), or the sample size. Regardless, it is also important for future research to determine whether other techniques may be effective for enhancing EVI. Action observation is particularly relevant to consider given that this cognitive process also activates similar neural activity to both imagery and observation (Clark, Tremblay, & Ste-Marie, 2004). Action observation has also been shown to improve ease of imaging EVI (Williams, Cumming, & Edwards, 2011; Wright, McCormick, Birks, Loporto, & Holmes, 2015), and athletes who use observational learning more tend to display higher levels of imagery ability (Williams & Cumming, 2012).

It is noteworthy that the present study also explored participants' perceptions of the helpfulness of the different PETTLEP elements for generating more vivid movement images. All of the elements were perceived to be helpful to some extent, which therefore supports the suggestion for individuals to combine multiple PETTLEP elements within the same intervention (Holmes & Collins, 2001). However, we were also interested to learn whether certain elements were considered to be more helpful than others. Aligned with the available research findings (e.g., Smith et al., 2007), participants in the present study perceived the physical and environment elements as the two most helpful for creating vivid images that are easier to generate. For example, the sport-specific group (i.e., participants imaging with the physical and environment elements as well as the other PETTLEP elements) in Smith et al.'s study experienced greater performance gains compared with the clothing group who did not image in the environment (i.e., included the physical but not the environment element). This previous finding suggests that greater similarity of the imagery to the real life physical and environmental details would help the imager to generate more vivid imagery. Adding to the emerging evidence demonstrating the importance of the physical and environment elements, our findings also indicate these have a role to play in increasing the ease of image generation and vividness of the image. It also suggests that individuals are aware of the elements or techniques that may lead to longer term improvements in these dimensions of imagery ability. Future research might also explore whether the physical and environment elements lead to greater imagery ability and outcomes compared to other elements, and whether these effects depend on the content and/or function of the imagery.

From an applied perspective, athletes should be encouraged to incorporate both the physical and environment elements of the PETTLEP model into their imagery as much as possible (for detailed advice, please see Wakefield & Smith, 2012). For physical, this could be as simple as incorporating kinesthetic sensations akin to the real life situation as well as the tactile sensations of wearing the appropriate sporting attire and touching the relevant equipment (e.g., a swimmer dressed in a bathing suit and goggles whilst standing on the starting block). For environment, the imagery would ideally take place in the location where performance will occur. However, if this is not possible, the stimulus information from the environment can be provided via photographs, video and audio recordings, and maps (e.g., an orienteer who studies topographic maps and weather reports to understand the geographical conditions of their next competition before previewing it through imagery).

To address the research question posed in the present study, the VMIQ-2 was modified to include dimensions of both vividness and ease. Although conceptually distinct, ease and vividness ratings were highly correlated with each other (> .70) and the effectiveness of PETTLEP imagery on IVI and KI ability compared with more traditional imagery was similar for both dimensions. In this particular study, the high correlation between ease and vividness could be due to the imagining the same task. Another potential reason for the high correlation between these dimensions is that athletes might find it easier to generate an image could actually confidence that the image generated is a vivid and clear image. Together, these findings suggest that participants do not distinguish between vividness and ease dimensions when completing measures such as the VMIQ-2. This issue has been previously pointed out by Williams and Cumming (2011), and highlights the importance for future research to establish whether these dimensions indeed reflect different aspects of an individual's imagery ability, and if so, whether these can be tapped by the same imagery ability instrument.

A further limitation of the study is that participants may have spontaneously engaged in certain PETTLEP elements beyond what they were instructed to do within the traditional imagery condition. For example, participants in the traditional imagery condition were not told to image in real time (timing) and with the appropriate attentional demands required (task). However, it is possible for participants to have carried out their imagery in this manner without the researchers being aware due to the covert nature of the experience. This issue is not unique to the present study but is problematic with all research comparing PETTLEP imagery to more traditional imagery. Another limitation to note is the measurement of imagery ability and helpfulness of the PETTLEP elements were self-report. Although questionnaires are the most common way to assess movement imagery ability, other complementary techniques have been employed including chronometric and brain imaging techniques (e.g., Guillot et al., 2008; Malouin, Richards, Durand, & Doyon, 2008). Rather than just rely on self-report measures, we encourage future researches to combine a range of indices to provide a more comprehensive measure of imagery ability (also see Collet, Guillot, Lebon, MacIntyre, & Moran, 2011).

In conclusion, the present study demonstrated that PETTLEP imagery's effectiveness is likely to be explained through increasing both the ease and vividness of IVI and KI. However, PETTLEP imagery did not significantly increase EVI compared with more traditional imagery. Therefore, coaches and athletes should be encouraged to apply PETTLEP imagery during an imagery session when using IVI and KI imagery. Although there were no significant differences for EVI ease and vividness during PETTLEP and traditional imagery, it is unknown whether for EVI, PETTLEP imagery is more beneficial than traditional imagery through other mechanisms. Future research should compare other techniques thought to improve imagery ability such as action observation to investigate whether PETTLEP imagery or action observation is more effective at improving ease and vividness of athlete EVI, IVI, and KI.

Chapter 3

Comparing PETTLEP Imagery against Observation Imagery on Vividness and Ease of Movement Imagery

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Comparing PETTLEP Imagery against Observation Imagery on Vividness and Ease of Movement Imagery

Imagery is a process that reflects a real experience in that different senses (e.g., visual, smell, taste, sounds) are experienced in the mind without actually experiencing the real thing (White & Hardy, 1998). This mental technique is widely used in sport, exercise, dance, and rehabilitation settings to serve a number of outcomes such as enhancing motivation and self-efficacy, improving skills and strategies, regulating arousal and anxiety, and facilitating recovery (Cumming & Williams, 2013; Guillot & Collet, 2008). The effectiveness of imagery interventions to achieve these outcomes is influenced by an individual's imagery ability (Gregg, Hall, & Butler, 2010; Robin et al., 2007). For example, Robin et al. (2007) found that following an imagery intervention, better imagers experienced a greater improvement in accuracy tennis service return compared to poorer imagers. As the ability to image plays an important role in the extent to which imagery use is effective in achieving its desired outcomes, an important issue for sport psychology is how to improve imagery's effectiveness (for recent reviews, see Cumming & Williams, 2012, 2013).

Imagery ability can be defined as "an individual's capability of forming vivid, controllable images and retaining them for sufficient time to effect the desired imagery rehearsal" (Morris, Spittle, & Watt, 2005; p. 60). When trying to assess imagery ability, it is important to consider its multidimensional nature (Morris, 2010), with ease and vividness being the two most commonly assessed dimensions in the sport domain (Gregg & Hall, 2006a; Hall & Martin, 1997; Kosslyn, 1994). Ease of imaging is an individual's capacity to create and control vivid images (Cumming & Williams, 2012; Hall & Martin, 1997) whereas vividness relates to an image's clarity and sharpness or sensory richness (Baddeley & Andrade, 2000; Morris et al., 2005). Williams and Cumming (2011) explained that these dimensions are conceptually distinct and it is possible for athletes to vary in how easily they can generate a vivid image. However, ease and vividness ratings are difficult to empirically distinguish and often highly correlated (Anuar, Cumming, & Williams, 2016; Williams & Cumming, 2011). Nevertheless, higher levels of both ease and vividness appear to directly impact the results of imagery interventions (Callow, Roberts, & Fawkes, 2006; Williams, Cooley, & Cumming, 2013). Consequently, it is important to establish which techniques can improve both dimensions of imagery ability as this may contribute to improved effectiveness of imagery interventions.

One such technique is the PETTLEP model (Holmes & Collins, 2001; Wakefield, Smith, Moran, & Holmes, 2013), which proposes that more effective imagery will be experienced if seven different elements (i.e., physical, environment, task, timing, learning, emotions, and perspective) are incorporated into an image (Holmes & Collins, 2001). Incorporation of these elements includes a combination of adjusting both the mental image experienced (e.g., imaging in real time and experiencing relevant emotions) as well as the conditions in which the person is imaging (e.g., imaging while adopting a stance reflective of the movement being imaged in a similar environment to where the movement would be performed). Increasing the phenomenological similarities between the movement and how/what is imaged has been termed behavioral matching by Wakefield et al. (2013), and is the proposed mechanism underlying the benefits of PETTLEP imagery. Indeed, numerous studies have demonstrated that PETTLEP imagery can be more effective than traditional imagery in achieving improvements to skill performance, and increasing self-efficacy and motivation (Smith, Wright, Allsopp, & Westhead, 2007; Wakefield & Smith, 2009; Wright, Hogard, Ellis, Smith, & Kelly, 2008). In addition, incorporating more PETTLEP elements into an image can further its efficacy (Smith et al., 2007; Wakefield & Smith, 2009).

It has also been suggested that the effectiveness of PETTLEP imagery is partly due to increases in ease and/or vividness of the imagery experience (Cumming & Williams, 2012).

Gould and Damarjian (1996) proposed that an individual may experience a more vivid image if he/she holds a relevant piece of sporting equipment and makes movements reflective of the task (i.e., physical PETTLEP element). In support, Callow et al. (2006) found that skiers imaging while incorporating the physical and environment elements reported more vivid imagery than participants imaging in a more traditional format.

More recently, Anuar et al. (2016) investigated the effects of PETTLEP imagery on the ease and vividness of 12 movements from the Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008) such as riding a bike or swinging from a rope. Three different types of imagery were investigated: a) external visual imagery (EVI; i.e., third person); b) internal visual imagery (IVI; first person); and c) kinesthetic imagery (KI; i.e., bodily sensations reflective of the movement). Compared to more traditional imagery, involving imaging in an environment without any senses of actual sport (e.g., in everyday clothing, not in the place of the performance), (Smith, Holmes, Whitemore, Collins, & Devonport, 2001), PETTLEP imagery led to significantly easier image generation and more vivid images when performing IVI and KI but no differences were found for EVI imagery. Participants also reported that the physical and environment were the most helpful of the PETTLEP elements for creating more clear and vivid imagery that was easier to generate. This finding supports a proposal that it is these particular elements which add value over and above the other more "traditional" elements for creating effective imagery (Wakefield et al., 2013). Interestingly, PETTLEP imagery did not show the advantage of also increasing ease and vividness of EVI imagery. It may be that the benefits of PETTLEP imagery in this regard are dependent on the visual modality adopted. However, further research is needed to replicate and extend these findings before any conclusions are made.

Athletes report using both EVI and IVI perspectives and this can depend on the intended function and outcome of the imagery intervention (Callow & Hardy, 2004; Callow & Roberts, 2010). Hardy and Callow (1999) suggested that EVI is more effective for tasks that rely heavily on form for their successful execution such as gymnastic routines whereas IVI is better at facilitating the integration of temporal components of the motor action (the rhythm of the motor execution). As athletes frequently use EVI and IVI, and often switch between the two perspectives (Callow & Hardy, 2004; Callow & Roberts, 2010), it is important to establish techniques for improving both perspectives and compare these techniques to determine whether their effectiveness is dependent on the imagery perspective adopted.

Movement observation is another technique which has been found to increase imagery ability (Williams, Cumming, & Edwards, 2011; Wright, McCormick, Birks, Loporto, & Holmes, 2015). Both movement imagery and observation have some shared neural overlap (Gatti, Tettamanti, Gough, Riboldi, Marinoni, & Buccino, 2013; Munzert, Zentgraf, Stark, & Vaitl, 2008). That is, observing a movement elicits similar brain activity to what we experience when imaging that same movement (Clark, Tremblay & Ste-Marie, 2004; Gallese & Goldman, 1998). This co-activation experienced during movement imagery and observation may help to prime imagery and thus increase ease and vividness of image generation (Williams et al., 2011; Wright et al., 2015). Lang (1979) also proposed that observation facilitates imagery by providing individuals with clear and vivid instructions of what they are imaging. Support for movement observation as a technique for increasing imagery ability also comes from anecdotal evidence in which dancers and gymnasts report observing others to gain images and improve their imagery ability (Hars & Calmels, 2007; Nordin & Cumming, 2005b).

More recently, studies have systematically examined the effects of observation on visual and kinesthetic imagery ability (e.g., Williams et al., 2011; Wright et al., 2015). Williams et al. (2011) tested the effectiveness of observation on EVI, IVI, and KI. Participants first observed the movement to be imaged before subsequently imaging the same movement. Results indicated that movement observation elicited greater ease of imaging compared with no prior observation. However, for visual imagery, observation was only effective when the observation perspective (i.e., first person or third person) was congruent with the imagery perspective being adopted. These findings suggest that observing a movement from a third person perspective could be an alternative technique to PETTLEP imagery to improve EVI. To my knowledge, studies have yet to examine the effect of observation imagery on vividness of EVI, IVI and KI or compare it directly to PETTLEP imagery.

In sum, as it is known that incorporating the PETTLEP elements and prior observation appear to be techniques to increase vividness and ease of imaging movements, research is far from conclusive regarding which imagery dimensions, modalities, and visual perspectives are improved by which technique. Therefore, to continue the investigation from the previous chapter, the aim of the present study is to compare the effects of PETTLEP imagery and observation imagery on ease and vividness of EVI, IVI and KI of movements. These techniques were compared to a traditional imagery group. Based on the findings of Anuar, Cumming and Williams (2016), it was hypothesized that PETTLEP imagery would yield greater ease and vividness scores for IVI and KI compared to the traditional imagery. Based on the findings of Williams et al. (2011), it was also hypothesized that observation imagery would create greater ease and vividness scores for EVI compared traditional imagery. These findings will help contribute to an emerging set of guidelines as to how to improve the quality of an athletes' imagery experience.

Method

Participants

Fifty two athletes (28 female, 24 male, *M*age = 19.60 years, *SD* = 1.59) participated in this study from a mixture of team (*n* = 23), individual (*n* = 28), or combined team and individual (n = 1) sports. In total athletes represented 22 different sports with the majority of participants representing athletics (*n* = 11), football (*n* = 8), and netball (*n* = 4), as well as golf (*n* = 3) and trampolining (*n* = 3). Participant's competitive level of their sport ranged from recreational to international/professional (8 recreational, 25 club, 16 regional, 3 international/professional). Most participants had not received any imagery training (*n* = 47). Five participants had received information about imagery in a university lecture, online, or at a skill based academy.

Procedures

Following ethical approval of the study, participants were recruited via different routes (e.g., poster, email, word of mouth) and given an information letter explaining the nature of the study. Potential participants were informed that their participation was voluntary and they could withdraw if they decided to do so at any point. Those who agreed to participate signed a consent form at the beginning of their first visit. Next, they provided their demographic and sport information. Participants were then given White and Hardy's (1998) definition of imagery and told about the different perspectives and modalities in the present study (i.e., EVI, IVI, and KI). Participants then completed the VMIQ-2 under three different conditions in a random order each 24-48 hours apart. The conditions were: 1) PETTLEP imagery; 2) traditional imagery; and 3) observation imagery. A within-subject design was employed to examine how participant's imagery ability changed as a result of the condition they were exposed to. This also prevented any group differences that may have occurred if using a between-subject design, owing to the expected range of individual differences in imagery ability.

In the PETTLEP imagery condition, participants were instructed to incorporate all of the elements except perspective as this varied according to the VMIQ-2 instructions (Anuar et al., 2016). To incorporate the other elements, participants were asked to adopt the physical position related to each of movement described in the VMIQ-2 with props/visual aids provided as appropriate. Participants also imaged in the environment reflective of where the movement would be performed, imaged in real time performing the movement at an appropriate standard for them, and incorporated any relevant emotions (for more details see Anuar et al., 2016).

The traditional imagery condition involved participants completing the VMIQ-2 while seated in a quiet room; that is, not the environment where the movements would typically be performed. They also had no props and were not told to incorporate any of the other PETTLEP elements (e.g., image in real time).

During the observation imagery condition, participants also completed the VMIQ-2 while seated in a quiet room. Before imaging each movement, an external observation video clip of a model performing the VMIQ-2 movement was played once. After viewing the clip, participants then imaged the same movement before they rated the ease and vividness of the movement.

Once the VMIQ-2 was completed, participants completed the evaluation form of each condition and, in their final visit, they also filled in the post-experiment evaluation form. Finally, participants were debriefed on the nature of the study and thanked for their participation. Each session took no longer than one hour.

Measures

Demographic information. Participants provided details including their age, gender, and sport played as well as their previous imagery experience.

Vividness of movement imagery questionnaire-2 (VMIQ-2). The VMIQ-2 (Roberts et al., 2008) is a 36-item questionnaire that measures an individual's ability to image 12 movements (e.g., walking, running, throwing a stone) in visual and kinesthetic modalities. Participants read the movement items from the questionnaires and then image the movement as clearly and vividly as possibly with their eyes closed. The 12 movements are first imaged from an EVI perspective before being imaged from an IVI perspective, and finally from a KI modality. Ratings are made on a 5 point Likert-type scale ranging from 1 *(perfectly clear and as vivid as normal/feel of movement)* to 5 *(no image at all, you only know that you are thinking of the skill)*. The VMIQ-2 has demonstrated good validity and is regarded as an acceptable measure of assessing the vividness of movement images (Roberts et al., 2008). Similar to Anuar, Williams, and Cumming (2016), the questionnaire was modified in two ways. First, the scale was reversed to make it more intuitive to participants. Therefore, a higher score represented more clear and vivid imagery. Second, ease of imaging was assessed by adding an additional 5 point Likert-type rating scale for each item *(1 = very hard to see/feel, to 5 = very easy to see/feel)*. Unlike previous studies, pictures were also added to each anchor to illustrate and help the participants to understand the different vividness anchors. In the present study the modified VMIQ-2 demonstrated good internal reliability with all Cronbach alpha coefficients being .82 or above for vividness and ease during all three conditions.

PETTLEP evaluation form. After the PETTLEP visit, participants completed the same items used by Anuar, Williams, and Cumming (2016) to measure perceived helpfulness of the PETTLEP elements for creating clearer and more vivid imagery that was easier to generate. This form comprised of the following five items and was completed after each condition: 1) “Imaging while adopting the physical positions and having the props reflective of the movements you imaged”, 2) “Performing the imagery in the environment reflective of where the movements would be physically performed”, 3) ”Imaging the movements at a standard reflective of your movement capabilities”, 4) “Imaging the movement in real time”; and 5) ”Incorporating the relevant feelings and emotions into the imagery”. In Part 1, participants rated how helpful the items were for creating clearer and more vivid images, and in Part 2 participants rated how helpful they were in making the imagery easier to perform. All ratings were made on a 7 point Likert-type scale ranging from 1 *(not at all helpful)* to 7 *(very helpful)*.

Imagery evaluation check. In every visit, participants were given an evaluation form to complete to verify they understood the imagery instructions and explanations of the different modalities and visual perspectives. Responses were made on a 7 point Likert-type scale ranging from 1 (*did not understand at all*) to 7 (c*ompletely understood*).

Observation evaluation form. After completing the observation imagery session, participants were asked two additional questions in relation to the observation clips they observed. The first question asked participants how reflective the clips were of their own movement capabilities and imagery performed, and the second asked participants how similar they perceived themselves to be to the model. Both ratings were made on 7 point Likert-type scale ranging from 1 (*not at all similar*) to 7 (*very similar*).

Post-experimental evaluation form. At the end of the study, all participants were ask to complete an experimental evaluation form that asked them which condition they thought was more beneficial at enhancing their vividness and ease of imaging.

Video Clips

The model was a 28-year old female. The video clips were filmed using an iPhone 4s camera and lasted between three and 11 seconds depending on the movements. The video clips were filmed from an external/third person perspective. Action recognition research has demonstrated that viewing a movement from 180 degrees can produce greater ipsilateral hemisphere activation compared to activation produced when executing the movement (Shmuelof & Zohary, 2008). However, it has been suggested that the switch of viewing perspective occurs at 135 degrees (Waller & Hodgson, 2006; see also Burgess, 2006). Consequently, in a similar approach to Williams et al. (2011), a viewing angle of 140^{o} was used and the camera was positioned 96 cm above the ground, the height of the model's navel. The distance of the model from the camera varied due to the nature of the different movements but the distance for each clip ensured that the model was visible while performing the entire movement. All movements were filmed in the same location from which participants imaged the movements when they completed the VMIQ-2 during the PETTLEP imagery condition. The videos were played to participants on a laptop and projector. The same video clip for a particular movement was played prior to each image from the different VMIQ-2 modalities (i.e., EVI, IVI, and KI).

Data Analyses

Data were first inspected for any missing values. Based on Tabachnick and Fidell (2012), empty cells were replaced with means of the particular variable. The data were also screened for normality as well as univariate and multivariate outliers. Internal reliability, mean and standard deviations were calculated for each subscale of the VMIQ-2 questionnaires for each condition.

In the preliminary analyses, a repeated measures ANOVA was run to check whether participants understood the imagery instructions during each condition. Bivariate correlations were calculated between vividness and ease scores for EVI, IVI, and KI to establish the relationship between these dimensions for each VMIQ-2 subscale. The result of these correlations determined whether the subsequent main analyses required repeated measures MANOVAs.

For the main analyses, when repeated measures MANOVAs were run, the Pillai's trace value was reported as it is the most robust for the multivariate significance test (Olson, 1976). The eta square value (0.2 = small; .14 = medium; .3 = large effect; Cohen, 1992) were reported to reflect the meaning of the significant difference. Mauchly's test of Sphericity was used to examine the equality of the within subject variance. When this was significant (i.e., the assumption of sphericity was violated), the Greenhouse-Geisser correction was applied to reduce the degrees of freedom (Greenhouse & Geisser, 1959). Pairwise comparisons were made using Bonferroni adjustment analyses. A chi square test was also conducted to investigate participants' preferred condition to help them to create vivid imagery that was easy to generate. Two repeated measure MANOVAs were also run with Bonferroni adjusted post hoc analyses for the post-experiment evaluation form of PETTLEP condition to determine which elements were perceived to be most helpful.

Results

Preliminary Analyses

Data screening. Overall only one missing value was found in the data and it was replaced with the mean value of the variable. This option is applicable only when the amount of missing values is extremely low and has minimal influence upon the variance of a variable (Tabachnick & Fidell, 2012). Skewness and kurtosis values met normality assumption based on suggestion (Tabachnick & Fidell, 2012), and no univariate or multivariate outliers were detected in the data.

To examine whether participants understood the instructions and different modalities and visual perspectives equally in all conditions, a repeated measure ANOVA was conducted on the imagery evaluation check. Results indicated that participants similarly understood the instructions and differences between the modalities and visual perspectives in the PETTLEP condition (M = 6.54, SD = 0.73), the observation imagery condition (M = 6.37, SD = 0.79), and the traditional imagery condition (M = 6.50, SD = 0 .70), and this did not significantly differ across conditions (p = .29).

Observation evaluation form. Mean scores for how reflective the observation clips were of participants own imagery (M = 4.48, SD = 1.28) and how similar to the model participants perceived themselves to be (M = 4.44, SD = 1.49) indicated that participants found the observation clips “somewhat” similar to the imagery they performed and the model was “somewhat” similar to them.

Post-experimental evaluation. When trying to create vivid imagery that was easy to generate, 31 participants preferred the PETTLEP imagery condition compared with 10 people who preferred the observation imagery condition, and 1 person preferred the traditional imagery condition. Ten people indicated they had no preference for a particular a condition. A chi-square test indicated these differences were significant, χ^2 (3, n = 52) = 37.39, p <. 001**.**

Relationship between ease and vividness. Bivariate correlations indicating the relationship between ease and vividness of each of the VMIQ-2 subscales in all imagery conditions (i.e.; PETTLEP imagery, observation imagery, and traditional imagery) are presented in Table 5. Results indicate a strong positive association between ease and vividness for each subscale. Consequently, repeated measures MANOVAs were run on subsequent main analyses of the different VMIQ-2 subscales.

Table 5

Correlations between Vividness and Ease in all conditions

PETTLEP imagery condition	**EVI Ease**	**IVI Ease**	**KI Ease**
EVI Vividness	*r* : .90**	*r* : .68**	*r* : .63**
IVI Vividness	*r* : .63**	*r* : .91**	*r* : .59**
KI Vividness	*r* : .48**	*r* : .61**	*r* : .80**
Traditional imagery condition	EVI Ease	IVI Ease	KI Ease
EVI Vividness	*r* : .71**	*r* : .66**	*r* : .65**
IVI Vividness	*r* : .56**	*r* : .87**	*r* : .66**
KI Vividness	*r* : .42**	*r* : .68**	*r* : .88**
Observation condition	EVI Ease	IVI Ease	KI Ease
EVI Vividness	*r* : .90**	*r* : .61**	*r* : .37**
IVI Vividness	*r* : .65**	*r* : .89**	*r* : .57**
KI Vividness	*r* : .58**	*r* : .62**	*r* : .76**

Note. ** p < .001 (two-tailed).

Main Analyses

External visual imagery. A repeated measures MANOVA revealed that there was a significant multivariate effect with a small effect size due to imagery condition, Pillai's trace = .97, $F(2, 48) = 4.98$, $p = .007$, $\eta_p^2 = .02$, observed power = 100%. At the univariate level, results showed a significant difference with a medium and small effect size respectively in vividness, $F(2, 102) = 8.51$, $p < .001$, $\eta_p^2 = .14$, observed power = 96%, and ease, $F(2, 102) = 5.23$, $p = .007$, $\eta_p^2 = .09$, observed power = 82%. Post hoc analysis indicated that participants created significantly more vivid imagery during the PETTLEP imagery ($M = 3.69$, $SD = 0.72$) and observation imagery ($M = 3.61$, $SD = 0.72$) conditions compared to the traditional imagery condition ($M = 3.37$, $SD = 0.66$). For ease of imaging, participants found it significantly easier to image during the PETTLEP imagery condition ($M = 3.77$, $SD = 0.73$) compared with the traditional imagery condition (3.49, $SD = 0.78$). However, there was no significant difference in ease between the observation imagery condition (*M* = 3.66, *SD* = 0.66) and both the PETTLEP and traditional imagery condition.

Internal visual imagery. Results of the repeated measures MANOVA revealed a significant multivariate effect with a large effect size, Pillai's trace = .98, $F(2, 50) = 1207.65$, $p < .001$, $\eta_p^2 = .98$, observed power = 100% on ease. The univariate level revealed a significant difference with a small effect value size for vividness, $F(2, 102) = 19.603$, p < .001, $\eta_p^2 = .28$, observed power = 100%; and ease, $F(2, 102) = 15.26$, $p < .001$, $\eta_p^{2=}$ .23, observed power = 100%. Post hoc analyses revealed that participants reported better vividness and ease during the PETTLEP imagery (vividness: *M* = 4.01, *SD* = 0.68; ease: *M* = 4.07, *SD* = 0.62) compared with observation imagery (vividness: *M* = 3.66, *SD* = 0.63; ease: *M* = 3.73, *SD* = 0.67) and traditional imagery (vividness: *M* = 3.62, *SD* = 0.63; ease: *M* = 3.71, *SD* = 0.61). There were no differences in ease and vividness between observation imagery and traditional imagery.

Kinesthetic imagery. A repeated measures MANOVA revealed a significant difference at the multivariate level with a large effect size, Pillai's trace = .99, $F(2, 50) = 9.26$, $p <.001$, $\eta_p^2 = .99$, observed power = 100%. Findings at the univariate level demonstrated significant differences with a small effect size for vividness, $F(1, 102) = 16.25$, $p < .001$, $\eta_p^2 = .242$, observed power = 100%; and ease, $F(1, 102) = 9.26$, p < .001, $\eta_p^2 = .15$, observed power = 97%. Similar to the post hoc analyses for IVI, participants reported higher vividness and ease in PETTLEP imagery (vividness: *M* = 4.02, *SD* = 0.54; ease: *M* = 4.00, *SD* = 0.62) compared with the observation imagery (vividness: *M* = 3.69, *SD* = 0.47; ease: *M* = 3.78, *SD* = 0.50), and traditional imagery (vividness: *M* = 3.63, *SD* = 0.59; ease: *M* = 3.68, *SD* = 0.63). There were no differences in ease and vividness between observation imagery and traditional imagery. Table 6 provides the information of the differences of ease and vividness between all conditions of EVI, IVI and KI.

Table 6

Internal reliability, mean and standard deviation of EVI, IVI and KI for vividness and ease of all conditions

	PETTLEP imagery						**Observation**						**Traditional imagery**					
	Vividness			*Ease*			*Vividness*			*Ease*			*Vividness*			*Ease*		
	α	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*
EVI	.89	3.69[ab]	0.72	.89	3.77[ab]	0.73	0.92	3.61[b]	0.72	.92	3.66	0.78	.92	3.38	0.66	.93	3.49	0.66
IVI	.91	4.01[ab]	0.68	.88	4.07[ab]	0.62	0.90	3.66	0.63	.90	3.73	0.67	.91	3.62	0.63	.91	3.71	0.61
KI	.87	4.02[ab]	0.54	.89	4.00[ab]	0.62	0.83	3.69	0.47	.82	3.78	0.50	.95	3.66	0.63	.95	3.73	0.67

Note. a = significantly higher than observation and traditional imagery b = significant higher than traditional imagery; p = < .05

PETTLEP evaluation form. Two repeated measures ANOVAs were conducted to investigate whether participants found certain PETTLEP elements more helpful in creating clearer and more vivid imagery that was easier to generate.

The analysis for clear and vivid imagery showed a significant difference between the elements $F(4, 204) = 17.21$, $p < .001$, $\eta_p^2 = .25$, observed power = 100%. Post hoc analyses revealed that no significant difference between participants adopting the physical characteristics ($M = 6.28$, $SD = 1.13$) and environment ($M = 5.75$, $SD = 1.72$) of the task, but physical and environment were significantly more helpful than any of the other elements.

However, the results for ease of imaging also showed a significant difference between the PETTLEP elements, $F(4, 204) = 19.72$, $p < .001$, $\eta_p^2 = .28$, observed power = 100%. Following the same pattern, post hoc analyses revealed that participants found adopting the physical characteristics of the task ($M = 6.39$, $SD = 0.11$) significantly more helpful than any of the other elements. Means and standard deviations of how helpful all elements were for vividness and ease are reported in Table 7.

Table 7
Means and standard deviations of how helpful all elements for vividness and ease

Items	**Vividness**		**Ease**	
	M	*SD*	*M*	*SD*
"Imaging while adopting the physical positions and having the props"	6.17*	1.13	6.39*	0.77
"Performing the imagery in the environment reflective of where the movements would be physically performed"	5.71*	1.30	5.79	1.36
"Imaging the movements at a standard reflective of your movement capabilities"	5.25	1.05	5.29	0.94
"Imaging the movements in real time"	5.46	1.09	5.33	1.17
"Incorporating the relevant feelings and emotions into the imagery"	5.62	1.16	4.77	1.20

Note. *$p < .05$ = significantly more helpful than the other elements.

Discussion

The aim of the present study was to compare the effects of PETTLEP imagery and observation imagery on EVI, IVI and KI ease and vividness of different movements. It was hypothesized that ease and vividness ratings would be higher during PETTLEP imagery for IVI and KI compare to traditional imagery. Conversely, it was hypothesised that for EVI, ease and vividness ratings would be higher during the observation imagery condition compared with the traditional imagery.

Results of the experiment partially supported the first hypothesis. The higher ease and vividness ratings of IVI and KI during PETTLEP imagery compared to more traditional imagery was in accordance with Anuar, Cumming, and Williams (2016). This supports the suggestion that PETTLEP imagery improves the ease and vividness of the image (Callow et al., 2006; Gould & Damarjian, 1996), and in turn, leads to more effective imagery. Contrary to the hypothesis, however, we found that PETTLEP imagery also significantly increased ease and vividness of EVI compared to more traditional imagery. This result was somewhat unexpected as it opposes recent findings by Anuar, Cumming, and Williams (2016) who found no differences in EVI ease and vividness ratings between PETTLEP and traditional imagery conditions. While it had been suggested that PETTLEP imagery might not be able to enhance EVI, findings of the present study suggest that Anuar et al.'s null result may have been due to this previous study being underpowered. That is, the study was more the likelihood of type 2 error (false negative) and had an insufficient sample size to detect a significant result (Cohen, 1992). In contrast, the present study confirms that PETTLEP imagery not only improves ease and vividness of IVI and KI, but also EVI with moderate to large effect sizes (Cohen, 1988). Consequently, PETTLEP imagery appears to help "boost" athletes' ease of imaging and the vividness of imagery, which may in turn explain why these interventions are more effective than traditional imagery (Cumming & Williams, 2012, 2013; Gregg, Hall, & Nederhof, 2005).

Participants' ratings of how helpful they perceived the different PETTLEP elements to be replicated the findings by Anuar, Cumming, and Williams (2016). That is, although all elements were perceived as being helpful (i.e., ratings above the mid-point of the scale), the physical element was rated as the significantly most helpful element of the PETTLEP model followed by the environment element. These findings support a recommendation to combine multiple PETTLEP elements to create more effective images (Holmes & Collins, 2001), and the notion that there are additive benefits of incorporating multiple PETTLEP elements (Smith et al., 2007). Results also add to the growing body of evidence that suggest physical and environment elements could play a more important role in enhancing the movement imagery's effectiveness; in this case, through improving ease and vividness of the imagery (e.g., Smith et al., 2007; Callow et al., 2006). The post-experiment PETTLEP evaluation result also suggests individuals are aware of the extent to which different PETTLEP elements may be more or less effective at improving ease and vividness of their imagery (Anuar, Cumming, & Williams, 2016).

Interestingly, the physical and environment elements are the two PETTLEP elements incorporated by adjusting the external conditions in which the individual is imaging. Incorporating the other elements involves adjusting the internal experience (e.g., imaging in real time and experiencing relevant emotions), and relies on the individual having the capacity to generate and manipulate an image to incorporate and adhere to these details. If individuals are unable to sufficiently perform these mental tasks the corresponding elements will be unlikely to facilitate the imagery process (i.e., task, emotions). Consequently, the straightforward nature of incorporating the physical and environment into an image and these elements being less reliant on an individual's imagery ability may partly explain why individuals find these particular elements most beneficial. Due to the pronounced effects obtained from physical and environment (e.g., Callow et al., 2006; Smith et al., 2007), we urge athletes and coaches to incorporate these elements into their imagery wherever possible.

In partial support of the hypothesis, observation imagery was more effective for priming EVI vividness compared to traditional imagery. However, these differences did not emerge for ease of imaging. Findings for vividness support literature proposing that observation can prime imagery and help enhance imagery ability (Holmes & Calmels, 2008; Lang, 1979; Williams et al., 2011). That is, observing a model perform in the same perspective that is imaged, helps to create a clearer, richer and more lifelike image. Because the observation clips were filmed from a third person perspective, this finding therefore also supports the notion that observation may only prime visual imagery ability when the observation clips are congruent with the imagery perspective (Williams et al., 2011). Unexpectedly, observation imagery did not prime ease of imaging EVI as there were no differences between this imagery condition and traditional imagery. In further contrast to the findings of Williams et al. (2011), observation also did not prime ease or vividness of KI. While the finding for KI has been replicated in other research (Wright et al., 2015), overall the results do not support observation imagery to be as effective at enhancing ease and vividness of imaging as was anticipated.

These equivocal findings could be due to the observation clips not sufficiently matching the content of participants' imagery. Unlike Williams et al. (2011), movements imaged in the present study involved more complex actions that could be performed in different ways (e.g., variations in posture and skill level) by the participants. While participants were able to "somewhat" relate to the observation clips and model used, there are likely characteristics of the clips that would naturally be different to the imagery performed by some participants (e.g., kicking the ball with a different part of the foot, riding a different style of bike). These differences between the observation and imagery may have been sufficient to limit the effects of observation on EVI ease and vividness. A number of factors are known to impact the effects of observational learning including model similarity, viewing angle, speed, and content (for review, see Ste-Marie, Law, Rymal, Hall, & McCullagh, 2012). Future research may wish to further investigate the effects of these factors on the effectiveness of observation priming imagery. For example, to my knowledge, no study has compared the use of self-modeling with other modeling as a technique to prime ease and/or vividness for simple and complex actions.

A second explanation could be that some increases in imagery ability previously attributed to observation imagery may have been a result of including PETTLEP elements within the imagery (see Williams et al., 2011). To the best of my knowledge this is the first study to directly compare the effects of observation and PETTLEP imagery conditions on EVI, IVI, and KI ease and vividness. By comparison, previous research has on occasion combined the two techniques. For example, Williams et al. (2011) asked participants to image the movement previously observed in the same environment where the video clip was performed and while adopting the physical position of the movement (i.e., incorporating the environment and physical PETTLEP elements). Consequently, increases in ease of imaging may have been partly due to incorporating these PETTLEP elements. This explanation is even more convincing when the perceived helpfulness of the physical and environmental elements found in the present study (also see Anuar, Williams, & Cumming, 2016) is also considered, and that PETTLEP imagery was found to be more effective than observation imagery for enhancing KI and IVI ease and vividness, and EVI ease. Future research should compare the conditions used within the present study with a combined PETTLEP and observation imagery condition to further understand the interaction effects that these techniques can have on ease and vividness of movement imagery.

When comparing observation imagery and PETTLEP imagery as techniques to enhance ease and vividness of EVI, IVI, and KI, the present study suggests that PETTLEP imagery may be superior for imaging movements due to its capacity to inflate ease and vividness scores of both visual perspectives and KI. However, it is important to note that certain factors may have meant PETTLEP imagery leant itself better to improving ease and vividness. Other studies have demonstrated that observation can be effective for complex movements that individuals are less proficient at performing (e.g., Wright et al., 2015). Indeed it has been proposed that observation may aid individuals' imagery by providing them with a representation of what to image (Lang, 1979; Nordin & Cumming, 2005). Consequently, observation imagery's effectiveness at enhancing imagery ability may be due to multiple factors including skill level, complexity of the movements, and characteristics of the observation clips (Williams et al., 2011; Wright et al., 2015). It also unknown what effects PETTLEP and observation imagery might have on other types of images commonly experienced by athletes (e.g., strategy, goal, affect, and mastery; Williams et al., 2011).

Despite comparing observation and PETTLEP imagery in the present study, it is important to note that imagery and observation are not mutually exclusive and likely to complement each other (Holmes & Calmels, 2008). Combining both techniques may improve the imagery experience through different processes. For example, incorporation of physical aspects of the image may lead PETTLEP imagery to facilitate kinesthetic imagery, whereas observation provides a visual representation of the movement to be constructed internally (Williams et al., 2011; Wright et al., 2015). We therefore suggest that researchers and applied practitioners combine both techniques when implementing movement imagery interventions for individuals, particularly for those who are new to using imagery or find it harder to generate vivid images.

A limitation of the present study was that the use of self-report measures to assess movement imagery ease and vividness, and the evaluation checks created for the present study have not been previously assessed for validity and reliability. Although self-report measures of imagery ability such as the VMIQ-2 are valid and reliable, it has been suggested that imagery ability should be assessed using a combination of measures (Collet, Guillot, Lebon, MacIntyre, & Moran, 2011; Williams, Guillot, Di Rienzo, & Cumming, 2015). As such, we encourage future research to re-examine the effects of observation and PETTLEP imagery on imagery ability using a range of assessments such as psychophysiological responses, mental chronometry, and qualitative interviews. Furthermore, future research should investigate the test-retest reliability of the evaluation checks used in imagery studies.

In conclusion, the present study examined the effects of PETTLEP imagery and observation imagery compared with traditional imagery on ease and vividness of EVI, IVI, and KI. Findings demonstrated that PETTLEP imagery was effective in increasing ease and vividness ratings of EVI, IVI, and KI compared with traditional imagery. While observation imagery did not elicit any differences in ease of imaging EVI, the condition resulted in higher vividness scores compared with the traditional imagery. Consequently, findings suggest that while observation may be a technique for improving EVI vividness, PETTLEP imagery appeared, in the present study, to be a more effective technique due to its capacity to improve ease and vividness of all three imagery types (i.e., EVI, IVI, and KI). Although we separately examined the effects of observation imagery and PETTLEP imagery on imagery ability, we propose that both appear beneficial to the imagery process and suggest that researchers and applied practitioners combine observation with PETTLEP imagery to help maximize the effect of the imagery on the desired outcome.

The next chapter will then expand the investigated the association between physical and environment element with the athletes’ imagery ability in imaging other type of imagery.

Chapter 4

The Role of Physical and Environment elements of PETTLEP Imagery in Priming Sport Imagery Ability

The Role of Physical and Environment PETTLEP Elements in Priming Sport Imagery Ability

Imagery is a popular mental technique used by athletes and coaches to improve learning and performance (for a review, see Cumming & Williams, 2012). As the benefits of imagery become more established, there is a growing body of literature recognising its role in achieving cognitive and motivational functions (Paivio, 1985). When developing the Sport Imagery Questionnaire (SIQ), Hall, Mack, Paivio, and Hausenblas (1998) defined five major functions served by imagery in sport: cognitive specific (CS; skills), cognitive general (CG; strategies), motivational specific (MS; goal), motivational general-arousal (MG-A; affect), and motivational general-mastery (MG-M; mastery). These functions form the main reasons why athletes image, and influence both what and how the imagery is carried out to achieve desired affective, behavioural, and cognitive outcomes (Cumming & Williams, 2012).

Why athletes image, what they image, and how they image to achieve different outcomes forms the basic premise of the revised applied model of deliberate imagery use (RAMDIU; Cumming & Williams, 2012, 2013), which builds on its predecessor, the applied model of imagery use developed by Martin, Maritz, and Hall (1999). The RAMDIU encourages researchers and practitioners to consider the individual characteristics of the imager ("Who"), the imagery situation ("Where &When"), the intended imagery function(s) ("Why"), and the imagery content ("What") and characteristics ("How"). The model also outlines the role played by imagery ability in determining whether an imagery intervention will be effective for facilitating desired outcomes by impacting both "What" and "How" individuals image. It is also suggested that by considering the components that RAMDIU proposed, can improve the effectiveness of imagery interventions for achieving outcomes such as skill learning, confidence, and motivation (Callow, Hardy, & Hall, 2001; Cumming & Ramsey, 2008; Mellalieu, Hanton, & Thomas, 2009). As RAMDIU is a recent addition to the imagery literature, few studies have yet to directly examine its propositions (for an exception, see Anuar, Cumming, & Williams, 2016). Of interest to the present study was to further explore the proposed relationship between an individual’s imagery ability and how they image.

It is now well established that athletes differ in their ability to image, and higher imagery ability will lead to more effective imagery outcomes (e.g., Gregg, Hall, & Butler, 2010; Robin et al., 2007). Within the sport domain, imagery ability is typically measured in terms of how easy or difficult it is for athletes to generate images, as well as the quality of these images based on its vividness and lifelikeness (Williams & Cumming, 2011). Cumming and Williams (2012, 2013) have proposed that how well an athlete can image will influence both the content and characteristics of this imagery. Accordingly, athletes will more often image content they find easier to generate (i.e., skill, strategy, goal, affect or mastery) (Williams & Cumming, 2011). They are also more likely image this content with their preferred characteristics including imagery modality, visual perspective, speed, as well as the duration that the image is maintained. For example, a basketball player who finds it easier to image a free throw shot in real time from a third person perspective, will more likely adopt this perspective when imaging.

Of growing interest for researchers is to alter how an individual images based on elements of Holmes and Collins’ (2001) PETTLEP model (Callow, Roberts, & Fawkes, 2006; Wright, Allsopp, & Westhead, 2007). Identifying which of the seven elements (i.e., physical, environment, task, timing, learning, emotions, and perspective) are beneficial for improving imagery ability, may in turn offer ways of further extending the propositions made by RAMDIU. Specifically, demonstrating that how an individual images can impact their imagery ability. To date, robust evidence indicates that behaviourally matching the imagery conditions as closely as possibly to the real life situation by incorporating the PETTLEP elements leads to more effective imagery (for a review, see Wakefield, Smith, Moran, & Holmes, 2013). Two elements in particular, either when used individually or in combination, have been consistently found to produce better performance compared to more traditional imagery: physical and environment (Callow et al., 2006; Smith, Wright, & Cantwell, 2008; Smith, Wright et al., 2007).

The “physical” element refers to the importance of making the imagery experience as physical as possible (Wakefield & Smith, 2012). Wakefield and Smith further described how this approach to imagery interventions could include not only the obvious step of imagining the kinesthetic sensations felt when performing the skill, but also adopting the starting position of the movement, and wearing the same clothes as when performing and holding any associated implements. Incorporating the physical element is proposed to exert its beneficial effects by increasing the shared brain regions and strengthening the memory function as explained by functional equivalence theory (Holmes & Collins, 2001). As also suggested by Gould and Damarjian (1996), dynamic kinesthetic imagery (e.g., holding the relevant sport equipment and make movements related to the images) will result in more vivid imagery because athletes would be able to more clearly recall the associated sensations. According to Lang`s bioinformational theory (1977, 1979), drawing on the relevant response and meaning propositions (i.e., verbal responses, somatomotor events, visceral events, processor characteristics) will help to create more vivid imagery as well as physiological responses similar to the real life situation.

The “environment” element is also based on Lang`s bioinformational theory and relates to the place where the imagery is performed. Response and meaning propositions are more easily activated when stimulus information closely matches the real life situation. These stimulus propositions include multisensory environmental cues to help make the imagery more relevant and personally meaningful to the athletes. These cues can be provided by imaging within the environment where the real life performance takes place and/or supporting image generation with pictures, video clips, and/or sounds relevant to this environment. In turn, the individual can better access response and meaning propositions from long-term memory and generate more effective images. Both Guillot, Collet and Ditmar (2005) and Wakefield and Smith (2012) have similarly suggested that being in the environment while imaging helps the athlete to feel closer to the actual performance.

A number of studies have demonstrated that altering how individuals' image based on elements from Holmes and Collins' (2001) PETTLEP model can lead to greater ease and/or vividness of the image. Compared to a static imagery group, Callow et al. (2006) reported higher vividness of a ski-slalom task for a dynamic imagery group who performed their imagery on the ski slope whilst wearing their ski equipment, adopting a race position, and making small side to side movements as if they were actually skiing. In two recent studies, Anuar and her colleagues (Anuar, Cumming, & Williams, 2016; Anuar, Williams, & Cumming, 2016) demonstrated that incorporating elements of PETTLEP model increased the ease and vividness of imaged movements. Furthermore, in both studies participants consistently perceived the physical and environment elements to be the most helpful in generating easier and more vivid images of movement. Collectively, these findings indicate a need to understand the association of these two particular PETTLEP elements with imagery ability.

The empirical evidence has helped to establish the "physical" and "environment" elements as ways to prime imagery movement skills. However, it is also possible that these elements may be helpful in generating other types of images experienced by athletes, such as those measured by the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). From an applied perspective, it is important to identify potential intervention strategies that will enable athletes to also improve their strategy, goal, affect, and mastery imagery abilities. Because athletes tend to image content they find easier to generate (Williams & Cumming, 2011), improving their ability to image the five main types will also help to maximise their use of imagery as a performance-enhancing technique. Furthermore, investigating whether a direct relationship exists between using the physical and environment elements and the different types of sport imagery ability may lead to further developments of RAMDIU by demonstrating that how one image relates to how well they image.

Therefore, building up from the previous chapter, the main aim of the present study was to create and test the validity of test score from the questionnaire with CFA as evidence of the internal structure and investigate the response to the questionnaire in relation to imagery ability. Drawing from previous research by Anuar and colleagues (Anuar, Cumming , & Williams, 2016 ; Anuar, Cumming, &Williams, 2016), it was hypothesised that incorporating physical and environment elements into imagery more frequently would be associated with greater ease of imaging of skill, strategy, goal, affect, and mastery imagery ability. A further aim was to explore whether any differences existed in the use of physical and environment primes according to gender and competitive level. As this is the first study to assess athletes' use of physical and environment primes, items were developed specifically for the present study. Based on the findings of Williams and Cumming (2011), it was hypothesised that males are higher in imaging mastery imagery ability compare to females' athletes and higher level athletes will score higher in imagery ability than their lower level counterparts.

Method

Participants

Two hundred and ninety participants (151 males, 139 females; *M*age = 19.94 years, *SD* = 2.33) took part in the study. Most of the participants represented team sports (*n* =167), mainly representing football (*n* = 74), rugby (*n* = 23), netball (*n* = 16), and field hockey (*n* = 19), whereas 123 participants identified themselves as individual sport athletes, mainly representing athletics (*n* = 26), road running (*n* = 23), and swimming (*n* = 10). All participants had been involved in their sport for an average of 9.46 years (*SD* = 4.32), with 93 participating recreationally (54 males, 39 females) or at club level, and 197 (97 males, 100 females) representing competitive level athletes from regional to national/international athlete.

Measures

Demographic information. Each participant was asked to provide background information on their age, gender, competitive level, years of experience, and sport played.

Sport imagery ability questionnaire. The Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) was used to measure ease of imaging. It consists of 15 items, with three items tapping each of the five subscales athletes use in relation to their sport (skill, strategy, goal, affect, and mastery imagery). Participants image each item and then rate their ease of imaging each item on a 7-point Likert-type scale whereby 1 represents *"very hard to image"* and 7 represents *"very easy to image"*. The SIAQ has previously derived valid and reliable scores of imagery ability (Williams & Cumming, 2011). In the present study, internal reliability for each subscale was good with the Cronbach alpha coefficients being .71 or above which is presented in Table 9 in result section.

"Physical" and "environment" imagery selected items. Participants completed 10 items as displayed in Table 8 designed specifically for the purposes of the present study to assess how frequently the physical and environment elements were used when imaging. Items were based on descriptions of the physical (e.g., I wear training/competition clothes) and environment (e.g., I image in the real training/competition environment) elements given by Wakefield and Smith (2012), and those items used previously by both of the Anuar and colleagues` studies. Participants were asked to consider the extent to which they incorporate each item into their imagery. Responses were rated on a 7-point Likert-type scale, with 1 representing "*never*", 4 representing "*sometimes*", and 7 representing "*very often*".

Procedures

Following ethical approval, athletes with at least one year of experience in their sport were invited to participate in the study. They were recruited either from contact with local sport teams or from an undergraduate sport sciences class. Potential participants were informed about the voluntary nature of the study. Those agreeing to take part provided written informed consent. They then completed a multi-section questionnaire consisting of demographic information, the SIAQ, and the imagery priming items. This was completed either online or via hardcopy methods. The questionnaire pack took 10 to 15 minutes to complete, and upon completion of the questionnaire pack participants were thanked for their participation.

Data Analysis

The data were first examined using SPSS 22.0 for inaccuracies, missing values, outliers, linearity, univariate and multivariate normality. The psychometric properties of both the SIAQ and the priming items were then checked using AMOS 22.0 software (Arbuckle, 2013) with maximum likelihood (ML) estimation. For the physical and environment imagery priming items, exploratory confirmatory factor analyses (CFA) was used to identify the best fitting model to use in the main analyses. For the more established SIAQ (Williams & Cumming, 2011), a traditional CFA were used. The full measurement model (imagery priming and SIAQ) was then tested using AMOS before structural equation modelling examined the fit of the hypothesized model.

For both types of CFAs, and the subsequent measurement model and main analyses, the models' goodness of fit was tested by the chi-squared likelihood statistic ratio (χ^2; Jöreskog, & Sörbom, 1993). As a non-significant value is rarely found, additional fit indices were employed following the recommendations of Hu and Bentler (1999). The standardized root mean square residual (SRMR; Bentler 1995) and Root Mean Square Error of Approximation (RMSEA) was employed as indicators of the absolute fit, with desired values of < .08 and < .06. The Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) were also reported to reflect incremental fit with values for both of > .95 and > .90 considered to be excellent and good fit respectively (Hu & Bentler, 1999). Although there is still a debate surrounding the appropriate values for demonstrating an appropriate model fit (see Markland, 2007; Marsh, Hau, & Wen, 2004), these values are the most commonly reported and accepted in the literature as indicative of the model fit. Models re-specification in the case of poor model fit was done by following the step-by-step techniques proposed by Byrne (2009), which includes inspection of estimates and modification indices.

Descriptive statistics and internal reliabilities were then calculated for the SIAQ and imagery priming measure based on the items used in the final measurement model. Correlations were used to explore the association between SIAQ subscales to check for issues with multicollinearity. A repeated measures ANOVA was used to explore which imagery type athletes found easier to image. The Cronbach alphas of each factor were also calculated to determine the internal consistency.

Finally, to examine gender and competitive level differences in priming and imagery ability, a two-way gender (male, female) × competitive level (recreational, competitive) ANOVA and MANOVA were conducted respectively. For the MANOVA, Pillai's trace is reported because it is considered the most robust multivariate significance test (Olson, 1976). When significant differences were found, these variables were controlled for in the main analysis.

Results

Preliminary Analyses

Data screening and item characteristics. The data were free from any mistakes, missing values, and univariate and multivariate outliers. The data demonstrated univariate linearity, which allowed it to be examined with SEM technique. Checks for univariate normality showed that the data were normally distributed according to its skewness (< 1) and kurtosis (<1), and it was also free from multicollinearity issue (VIF < 1.53). The Mahalanobis distance statistic revealed no multivariate outliers, but Mardia`s coefficient was 95.47 and the critical ratio was over 1.96, indicating significant multivariate non-normality. Bootstrapping was therefore employed for all subsequent CFA/SEM analysis (Byrne, 2009).

Exploratory Factor Analysis of "imagery priming" items. A two-factor model consisting of five physical and environment items was tested using an EFA. This initial model, displayed in Figure 3, had a poor fit to the data, $\chi^2(34) = 86.13$, $p < .001$, CFI = .91, TLI = .88, SRMR = .5, RMSEA = .07 (90% CI = 0.05 – 0.09). Due to high modification indices (Byrne, 2009), item 2 from the physical subscale and item 7 from the environment subscale were considered problematic and therefore removed from further analysis, $\chi^2(19) = 26.78$, $p = .11$, CFI = .98, TLI = .97, SRMR = .03, RMSEA = .04 (90% CI = 0.00 – 0.07).

The high interfactor correlation between physical and environment ($p < 0.001$) suggested that a one-factor model might more appropriately represent the data (Byrne, 2009). These variables were subsequently merged and a unidimensional variable named "imagery priming" was tested further with the remaining 8 items. The fit of this revised model was adequate, $\chi^2(20) = 29.82$, $p = .073$, CFI = .98, TLI = .97, SRMR = .04, RMSEA = .04 (90% CI = 0.00 – 0.07). However, item 3 and 8 were considered to be problematic due to high modification indices and therefore deleted.

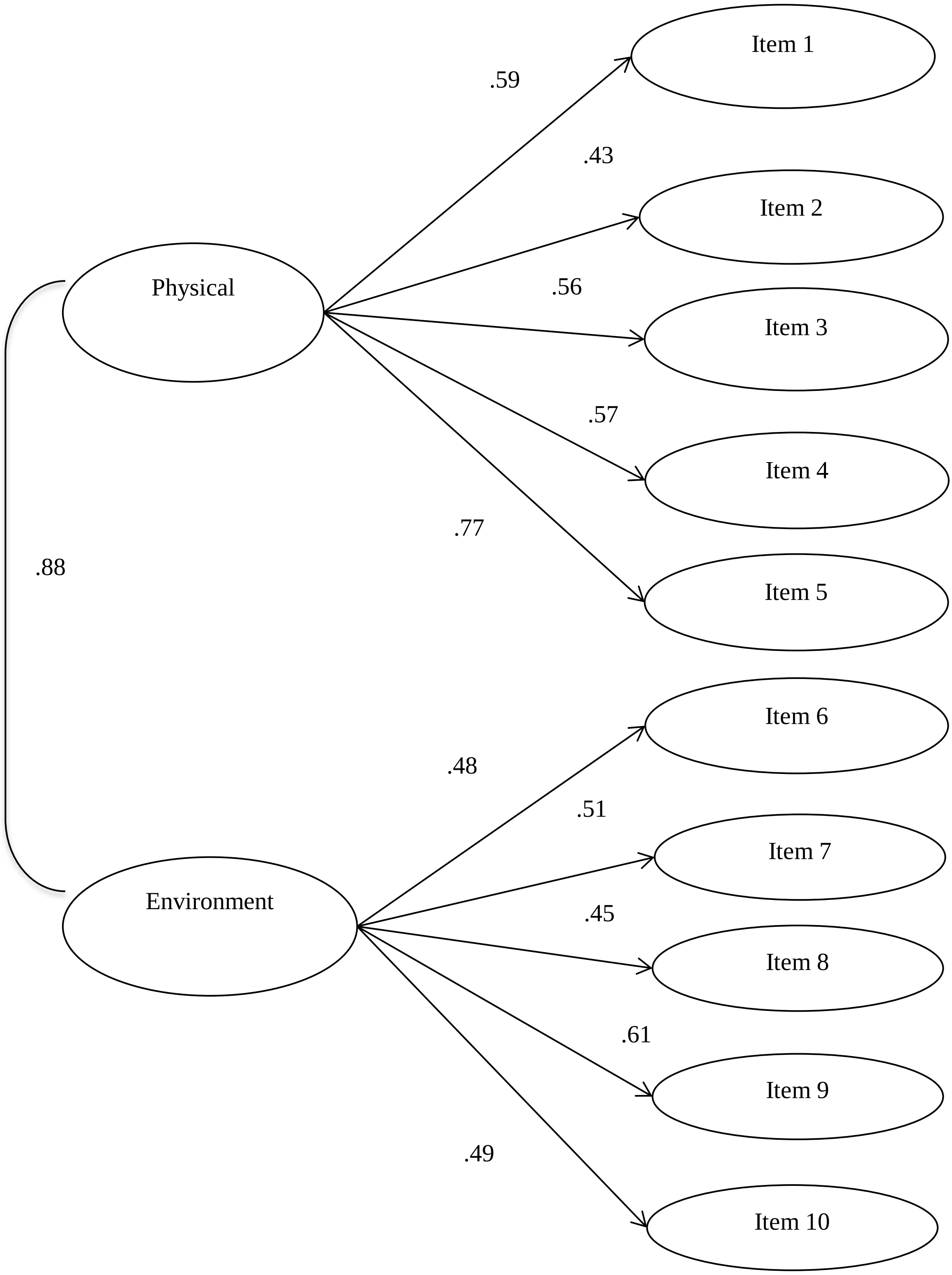

Figure 3. EFA of first model "physical" and "environment" imagery priming items. *Note*: The standardised factor loadings were significant for all items ($p < .001$)

The final model (Figure 4) consisted of six items loading onto the "imagery priming" variable. Three items represented the physical element and three items represented the environment element. Results for the CFA revealed a non-significant chi square, which is desirable but rarely obtained in SEM, and demonstrated good fit across the different indices (Tabanick & Fidell, 2013), χ^2 (9) = 9.75, p = .37, CFI = .99, TLI = .99, SRMR = .03, RMSEA = .05 (90% CI = 0.00 – 0.07). The standardised factor loadings were significant for all items ($p < .001$) and above .40, with item 1 (β = .61); item 4, (β = .55); item 5 (β = .79); item 6 (β = .46), item 9 (β = .56), and item 10 (β = .45). The internal reliability for imagery priming was also adequate (α = 0.75) (Nunnally, 1978). The selected items are listed in Table 8. The items in the final model (highlighted in bold in Table 8) were therefore used in all subsequent analyses.

Table 8
Original imagery selected items and the six retained items following the CFA analysis

Item no	Physical and environment imagery selected items	Element	Means	SD
1	**I make small movements or gestures during the imagery**	**Phys.**	**4.26**	**1.67**
2	**I wear training/competition clothes	Phys.	4.01	1.74
3	** I image while holding or touching kit related to my sport (e.g., hockey stick)	Phys.	3.12	1.93
4	**I perform the movement for real just before I image it**	**Phys.**	**4.64**	**1.82**
5	**I image while standing or adopting a position similar to what I am imaging**	**Phys.**	**4.84**	**1.32**
6	**I watch myself or others perform the movement and/or in that situation, either live or recorded**	**Env.**	**3.36**	**1.79**
7	** I image in the real training/competition environment	Env.	3.73	1.70
8	** I image a situation that I have recently experienced	Env.	2.81	1.75
9	**I use pictures or other visual cues of the environment and/or equipment**	**Env.**	**3.10**	**1.50**
10	**I try to image the same senses (e.g., sight, sound, smell, taste, touch) that I would experience in the real life situation**	**Env.**	**4.39**	**1.78**

Notes. The items in bold font are the 6 retained items for final analysis.
** Items that were removed during EFA analysis.

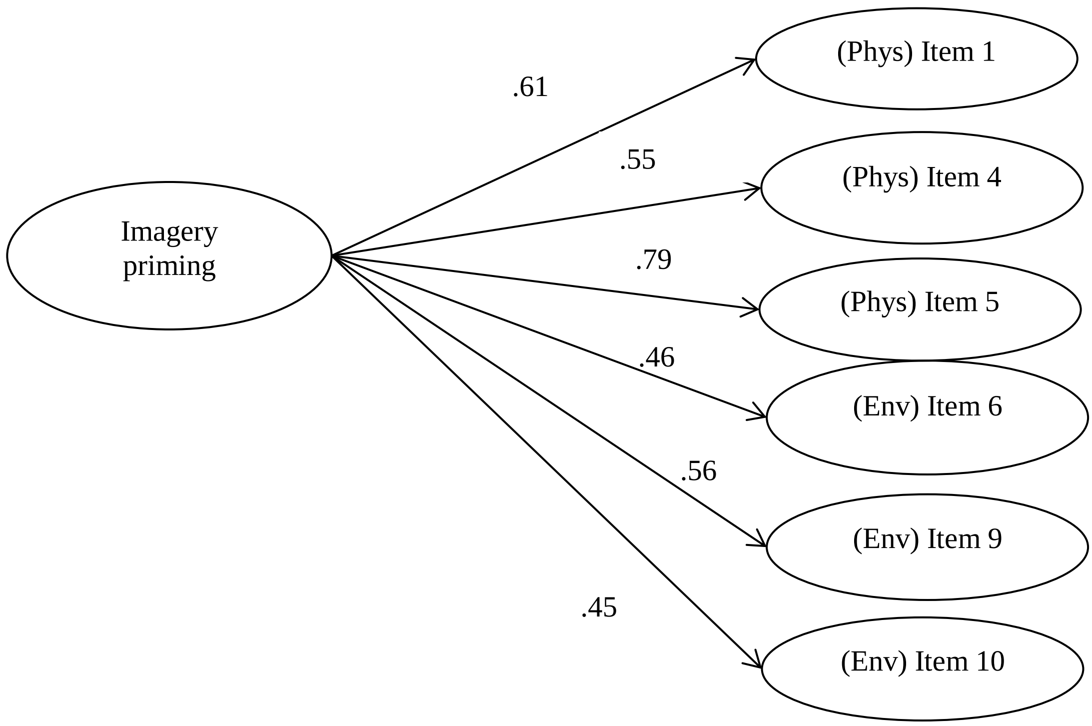

Figure 4. Final model of the EFA of physical and environment selected items
Note: The standardised factor loadings were significant for all items (p < .001)

SIAQ CFA and measurement model. A CFA on the SIAQ revealed a good fit to the data, χ^2 (80) = 127.83, p < .001, CFI = .97, TLI = .96, SRMR = .04, RMSEA = .05 (90% CI = 0.03 – 0.06). The internal reliability was adequate for all subscales with the Cronbach alpha coefficients presented in Table 9. The inter-factor correlations between SIAQ subscales were significant and revealed moderate relationship ranging from 0.4 to 0.5 in magnitude.

The overall measurement model containing both the SIAQ and selected items also had a good fit to the data, χ^2 (180) = 509.44, p < .001, CFI = .84, TLI = .81, SRMR = .11, RMSEA = .08 (90% CI = .07 – .08).

Descriptive statistics and imagery content ease of imaging differences. Means and standard deviations for each factor were calculated for the total sample as well as separately for males and females and the different competitive levels as displayed in Table 9. In general, participants' rated their use of physical and environment imagery priming in relation their sport as between "not very often" to "sometimes" (*M* = 3.49, *SD* = 1.15). They also found it mostly "somewhat easy to image" the five types of ability measured by the SIAQ. A repeated measures ANOVA, $F(4, 286) = 71.47$, $p < .001$, $\eta_p^2 = .50$, indicated that significant differences existed between subscales. Pairwise contrasts using a Bonferonni adjustment to correct for multiple comparisons indicated that participants had significantly better affect imagery ability, compared to skill imagery ability and goal imagery ability which were both in turn significantly easier to image than mastery imagery ability. Mastery imagery ability was then significantly easier to image than strategy imagery ability.

Gender and competitive level differences. A 2 way gender (male, female) × 2 competitive level (recreational, competitive) ANOVA examined differences in imagery priming due to gender and competitive level. There was no significant main effect for gender, $F(1,286) = 1.40$, $p = .30$, $\eta_p^2 = .004$. There was however, a significant main effect for competitive level, $F(1,286) = 7.38$, $p = .007$, $\eta_p^2 = .03$, indicating that competitive athletes (*M* = 3.61, *SD* = 1.17) reported using physical and environmental features to prime their imagery more frequently than recreational athletes (*M* = 3.23, *SD* = 1.07). No significant interaction was found between gender and competitive level, $F(1,286) = .214$, $p = .62$, $\eta_p^2 = .001$.

Table 9

Mean and standard deviations of imagery priming and imagery ability according to gender and competitive level

	α	Total sample		Gender				Competitive Level			
				Female		Male		Recreational		Competitive	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Imagery priming	.74	3.49	1.15	3.44	1.15	3.53	0.98	3.23	1.07	3.61*	1.17
Skill	.81	5.11	1.02	5.11	1.00	5.13	1.04	5.14	0.94	5.11	1.06
Strategy	.83	4.51^{L}	1.14	4.32	1.16	4.68**	1.09	4.28	1.07	4.52	1.17
Goal	.76	5.02^{L}	1.20	4.77	1.16	5.02**	1.18	4.82	1.24	5.11	1.18
Affect	.81	5.53^{H}	1.08	5.47	1.05	5.59	1.10	5.51	1.04	5.54	1.10
Mastery	.71	4.72	1.02	4.53	1.03	4.89**	0.98	4.78	1.05	4.68	1.00

Note.
* = significantly higher than recreational athletes at $p < .05$
** = significantly higher than female at $p < .05$.
H = significantly the most easiest content to image than other imagery content at $p < .01$
L = significantly the harder to image than other imagery content at $p < .01$ and within them there is no significant difference

A 2 way gender (male, female) × 2 competitive level (recreational, competitive) MANOVA examined any differences in the five types of sport imagery ability measured by the SIAQ according to gender or competitive level. A significant multivariate effect was found for gender, Pillai`s Trace = .01, $F(5,282) = 5.00$, $p < .001$, $\eta_p^2 = .08$. Results at the univariate level revealed significant gender differences whereby males found it easier than females to image strategy, $F(1,286) = 8.52$, $p = .004$, $\eta_p^2 = .03$, goal, $F(1, 286) = 14.70$, $p < .001$, $\eta_p^2 = .05$, and mastery, $F(1,286) = 7.23$, $p = .008$, $\eta_p^2 = .03$, images but there was no significance difference for either skill imagery ability, $F(1, 286) = 0.07$, $p = .797$, $\eta_p^2 = .001$, or affect imagery ability, $F(1,286) = 0.57$, $p = .452$, $\eta_p^2 = .002$. No significant multivariate effect was found for competitive level, Pillai`s trace = .27, $F(5,282) = 1.6$, $p = .163$, $\eta_p^2 = .03$, and there was no significant gender by competitive level interaction, Pillai`s trace = .01, $F(5,282) = .80$, $p < .547$, $\eta_p^2 = .01$.

Main Analysis

Due to aforementioned gender differences in imagery ability and competitive level differences in using physical and environment elements, both variables were controlled in the main analysis. The hypothesised model as shown in Figure 5 revealed a good fit to the data, $\chi^2(155) = 231.16$, $p < .001$, CFI = .96, TLI = .95, SRMR =.05, RMSEA = 0.04 (93% CI = 0.03 – 0.05). The standardized factor loadings revealed that "imagery priming" was positively associated with all five SIAQ subscales as shown in the Figure 5.

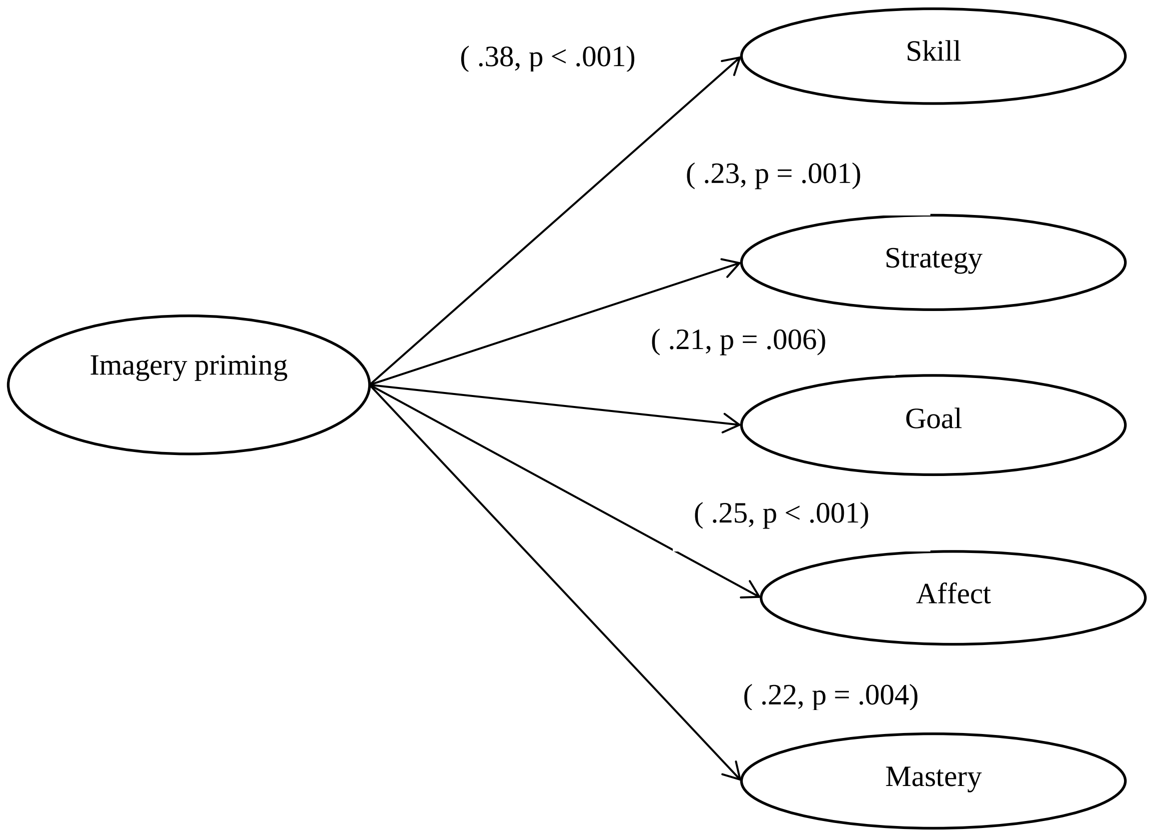

Figure 5. The final SEM model, imagery priming predicting all SIAQ subscales. For visual simplicity, variances between variables and control variables (gender and competitive level) are not presented.

Discussion

The first aim of this study was to examine the relationship between athletes' use of physical and environment imagery primes and their sport imagery ability. Based on previous research (Anuar, Cumming, & Williams, 2016; Anuar, Williams, & Cumming, 2016), the physical and environment imagery priming items were hypothesised to predict greater ease of imaging skill, strategy, goal, affect, and mastery imagery ability. The second aim of the study was to investigate any gender or competitive level differences in imagery ability and the use of imagery priming. It was hypothesised that males would find it easier to image mastery imagery compared to females athletes and higher level athletes would score higher in imagery ability compared to lower level athletes.

Concerning the primary aim of the study, a measure was developed to assess athletes' use of physical and environment imagery primes. Items were written based on the descriptions of the elements of the PETTLEP model (Holmes & Collins, 2001) and included things such as wearing training/competition clothes and imaging in the real training/competition environment. Although physical and environment are distinct elements of the PETTLEP model, the high interfactor correlation in the two-factor model suggested that participant responses to the items representing each variable represented the same underlying construct (Tabachnick & Fidell, 2012). Consequently, data from the present study provided validity and reliability scores for a unidimensional scale consisting of items representing both physical and environment elements. Future research may wish to provide further validity evidence to support using this measure to capture athletes' use of physical and environment primes within natural settings. Another potential use of the measure is to serve as manipulation checks for interventions testing the effectiveness of PETTLEP imagery.

In support of the first hypothesis, the results of the present study showed that the frequency in which athletes incorporated the physical and environment PETTLEP elements into their imagery was positively associated with greater ease of imaging after controlling for gender and competitive level. Building on the previous chapters of this thesis, this finding suggests imagery priming through the incorporation of physical and environmental PETTLEP elements is another way to make it easier for athletes to image different types of images that they use in relation to their sport. Anuar, Cumming, and Williams (2016) previously found that imagery priming helped with movement images. The results support these previous chapters of the thesis that found PETTLEP imagery increases the ease and vividness in imaging movement. However, the present study extends this finding beyond movement images by revealing an association with cognitive and motivational types of imagery ability measured by the SIAQ.

The possible explanation for the physical and environment elements positively predicting athletes' ease of imaging five different types of imagery content, could be attributed to Lang's Bioinformational theory (1979). Bioinformational theory proposal that the incorporation of more relevant response and meaning propositions (e.g., verbal responses, somatomotor events, visceral events, processor characteristics, and sense organ adjustment) results in more vivid imagery. The presence of props (physical) and cues from the real situation (environment) may help to trigger these responses leading to more vivid imagery that is generated more readily. Additionally, Wakefield et al. (2013) suggested that a closer match between the imaged and real life conditions contribute to an increment in imagery ability. Therefore, coaches and practitioners should encourage athletes to use physical and environment primes to help make their images easier to generate.

Interestingly, the relationship between how athletes' image (i.e., use of primes) and imagery ability has implications for RAMDIU, which is a model for guiding effective imagery use (Cumming & Williams, 2013). Research has identified a positive relationship between imagery use and ease of imaging (Gregg, Hall, McGowan & Hall, 2011; Williams & Cumming, 2012). Findings of the present study demonstrate that "What (type) & How" is associated with "Imagery Ability". As such, the relationship between imagery use and imagery ability may influenced by how the imagery is performed. Specific to RAMDIU components the findings of the present study suggest that the "What (type) & How" component is a good predictor of "Imagery Ability". The RAMDIU proposes that "Imagery Ability" will predict the "What (type) & How" component. Consequently, the findings suggest that the relationship between the "What (type) & How" and "Imagery Ability" components could be bi-directional.

In fulfilling the second aim of the study, comparisons between gender and competitive level were made for both imagery ability and imagery priming with a large effect size. In regards to gender differences in imagery ability, it was found that males reported finding it easier to image strategy, goal, and mastery content compared to females. No differences were found between male and female athletes in their ability to image skill and affect content. These findings somewhat differ from previous research. Williams and Cumming (2011) found that males only differed from females in their mastery imagery ability. A possible explanation for the differences between males and females may be due to the difference confidence level. Self-confidence is known to correlate positively with imagery ability (Lirgg, 1991) and males tend to display higher levels self-confidence (Abma et al., 2002). This difference may have elicited differences in strategy, goal and affect imagery ability.

Another difference between the findings of the present study and previous research is related to competitive level differences in imagery ability. The present study reported no significance differences between higher competitive level and lower competitive level on athletes' imagery ability. This is in contrast to previous work which has reported that higher competitive level athletes demonstrated greater imagery ability compared to lower level athletes (Roberts et al., 2008). Additionally, Williams and Cumming (2011) found similar competitive level differences in for skill, strategy, mastery and goal imagery ability. The inconsistency in the present study may be due to the differences in the samples. Williams and Cumming (2011) recruited a number of higher competitive level athletes as they had their competitive level groups (i.e., recreational, club, regional and elite) being a different breakdown to the present study whereas the present study compared recreational and competitive with competitive level athletes mostly consisting of club level athletes. Nevertheless, the mixed findings from both the present and previous studies demonstrate that individual characteristics appear to predict imagery ability.

In regards to the physical and environment elements use, findings suggested that there was no difference due to genders. While the findings did not shown differences in males and females use the imagery priming items, recreational and competitive athletes differed in their use of the physical and environment elements. More competitive athletes incorporated these elements more frequently than less competitive athletes. A possible explanation for this could be due to how deliberate the imagery is. Perhaps competitive athletes use more deliberate imagery and they may likely apply imagery technique (e.g., PETTLEP elements) that relate to greater imagery ability. Recreational athletes tend to image more spontaneously (Cumming & Hall, 2001). However, it could also be due to the imbalance gender in competitive and recreational group of athletes in this study. Nevertheless, the reason for this is not clear, and gender and competitive level differences in athletes' use of physical and environmental primes warrants further investigation.

The key strength of the present study is the results support Lang's (1979) bioinformational theory. The results supported the theory by suggesting that the activation of the response and meaning propositions contributed to the ease of image generation when stimulus information matches the real life situation. A second strength is the focus on athletes' preferred elements (i.e., physical and environment) of the PETTLEP model that have been reported previously by Anuar, Williams and Cumming (2016) to increase imagery ability. Further strengths to note is the implementation of the RAMDIU framework to underpin the research question, and the assessment of physical and environment element use in a more natural setting to compliment previous research that explored the relationship between imagery ability and these PETTLEP elements through manipulating the usage of these elements within an experimental setting.

Despite the strengths of the present study the work is limited by the cross-sectional research design. A logical next step in continuing this line of research would be to explore suggested RAMDIU propositions and test the effects of an intervention to encourage athletes to adopt these elements in naturalistic settings to examine the effects this has on athlete imagery ability. Although initial evidence displayed valid and reliable imagery priming scores, further investigation of this measure is recommended. Future research can also examine any differences in utilising physical and environment elements between males and females or within different competitive level athletes. As this study was the first to measure the use of physical and environment primes to imagery, it is not currently known whether athletes would differ in their use of physical and environment primes according to key demographic variables other than gender and competitive level (e.g., motivational orientation, perfectionism, trait anxiety, emotional regulation). Therefore, it is worth exploring the effects of using physical and environment elements within different groups of athletes (e.g., females, males and higher competitive athletes, lower competitive athletes) to see whether the effect the primes have on imagery ability is influenced by such individual characteristics.

The present study contributed to the literature by giving further insight into the relationship between the “Who”, “What (type) & How”, and “Imagery Ability” components of the RAMDIU. An implication is that athletes of lower competitive levels should be educated and encouraged to use more physical and environment elements during their imagery to help develop their imagery ability likely resulting in greater benefits from this technique. Mean scores of the imagery priming frequency demonstrated moderate use, which suggests that athletes may benefit from using these elements more frequently due to the association with greater imagery ability. When considered with the findings of Anuar Williams and Cumming (2016) those who find it harder to image should be encouraged to use physical and environmental primes. This is potentially a simple way to improve imagery ability of not only movement based imagery, but other types of imagery (e.g., goal, mastery and affect) ability.

In conclusion, this study is the first to explore the relationship between athletes' use of physical and environment PETTLEP elements and their sport imagery ability. Results revealed more frequent use of physical and environment elements positively predicted skill, strategy, goal, affect, and mastery imagery ability. Results also revealed that males reported significantly easier to image strategy, goal, and mastery imagery content compared to females. While competitive levels did not show any differences in imagery ability, more competitive athletes incorporated physical and environment elements of the PETTLEP model more frequently than recreational athletes. These results suggest that the "What (type) & How" and "Who" components of the RAMDIU are likely to influence the "Imagery Ability" component. Future research should be undertaken to investigate the differences in utilising physical and environment PETTLEP elements using different research designs (e.g., qualitative research) for a better understanding of how athletes use these elements to prime their imagery. In Chapter 5, the association between imagery ability and gender and competitive level is re-examined along with another individual characteristic (i.e., emotion regulation) to establish further the extent to which the "Who" component is associated with "Imagery Ability" in the RAMDIU.

Chapter 5

Emotion Regulation Predicts Imagery Ability

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Emotion Regulation Predicts Imagery Ability

Imagery has been described as a cognitive experience that mimics a real experience (White & Hardy 1998). It can serve a number of cognitive and motivational functions in sport, exercise, dance, and rehabilitation which include refining skills, enhancing self-efficacy, and improving motivation (Cumming & Williams, 2012; Hall, 2001; Nordin & Cumming, 2005a). However, a person's imagery ability can determine the effectiveness of an imagery intervention. Specifically, higher imagery ability can lead to greater benefits (e.g., improved performance) resulting from an imagery intervention compared to those who find it more difficult to image (Robin et al., 2007). Thus, imagery ability is an important factor to consider when developing effective imagery interventions.

The revised applied model of imagery use (RAMDIU; Cumming & Williams, 2012) was devised to provide researchers and applied practitioners with a framework for how to develop effective imagery interventions (Cumming & Williams, 2012). Based on the applied model of imagery use (Martin, Moritz, & Hall, 1999), the revised model proposes that for a given situation, athletes should use the type of imagery that will best help them to achieve their desired outcomes (Cumming & Williams, 2012; Martin et al., 1999). Thus the situation, imagery type, and desired outcomes should all be considered when planning imagery interventions (Martin et al., 1999). The model also predicts the moderating factor that imagery ability plays in the relationship between the imagery type and the outcomes obtained (Martin et al., 1999). These proposals have since been supported in the literature (Beauchamp, Bray, & Albinson, 2002; Callow, Hardy, & Hall, 2001; Gregg, Hall, & Nederhof, 2005)

Although research has provided a wealth of support for the model, research following its introduction has highlighted some of the model's limitations. Most notably, recent research has emphasised the need to distinguish between the imagery function (i.e., why the individual is imaging) and the imagery content (i.e., what the individual is imaging) (Martin et al., 1999). To address this more recent work, Cumming and Williams (2013) revised the model (RAMDIU; Revised Applied Model for Deliberate Imagery Used) by separating function and content into "Why" and "What" components respectively (for reviews see Cumming & Williams, 2012; 2013). They also included the "Meaning" proposition of an image (reflecting if the type of imagery fulfils the function of imagery) as a bridge between the "Why" (reflecting the function of imagery) and "What" propositions (reflecting the type of imagery). In addition, the RAMDIU also includes "Who" (i.e., the individual performing the imagery) as a separate component as that is likely to impact upon other aspects of the model.

This specific "Who" component includes but is not limited to characteristics such as gender, competitive level, sport type, as well as traits and dispositions including things like confidence and motivational orientation (Cumming & Williams, 2013). Individual characteristics such as these are likely to impact the effectiveness of an imagery intervention. This is due to an individual's characteristics influencing both the different reasons for imaging (i.e., why image) as well as the imagery content used to achieve these functions (Harwood, Cumming & Fletcher, 2004). For example, in exercise settings, women tend to use imagery more frequently for health and appearance reasons whereas men tend to use imagery more frequently for motivational purposes (Cumming, 2008). Despite research highlighting a relationship between individual characteristics and reasons for imaging, there has been less attention on how these characteristics may impact upon the individual's imagery ability.

A number of studies have shown that athletes of higher competitive level often display greater imagery ability compared with their lower level counterparts (Murphy, Nordin, & Cumming, 2008; Roberts, Callow, Hardy, Markland, & Bringer, 2008; Williams &

Cumming, 2011). Literature has also suggested possible gender differences in imagery ability (Isaac & Marks, 1994; Williams & Cumming, 2011), but these findings have been rather inconsistent across studies (Callow & Hardy, 2004; Gregg & Hall, 2006b). As well as gender and competitive level differences, recent research has highlighted imagery ability tends to be negatively associated with a threat appraisal and anxiety, and positively associated with a challenge appraisal and confidence (Williams & Cumming, 2015). These initial findings suggest that individuals` cognitive and emotional dispositions are likely to relate to their imagery ability. More recently, Williams and Cumming (2015) demonstrated that mastery and goal imagery ability also relate to trait cognitive and somatic anxiety – typically via self-confidence. These initial findings suggest that individual's cognitive and emotional dispositions are likely to relate to their imagery ability. As higher imagery ability can lead to more effective imagery use it is important that studies add to the limited research examining the relationship between different individual characteristics and imagery ability in imaging the five types of imagery (i.e., skill, strategy, mastery, goal, and affect).

The association between emotional dispositions and imagery ability is in line with Lang's bioinformational theory (1977, 1979), which proposes that more emotive images will likely lead to more vivid imagery. Specifically, Lang (1977) proposed that the imagery process involves activating a network of propositionally coded information which is stored in the long-term memory. An emotive image is thought to more readily tap into this memory network (Murphy et al., 2008). Indeed, the inclusion of response propositions including verbal responses (e.g., shouting), somatomotor events (e.g., muscle tension), visceral events (e.g., increased heart rate), processor characteristics (e.g., disorientated in time), and sense organ adjustments (e.g., postural changes) are thought to result in certain physiological responses and higher imagery ability (Lang, 1979; Williams, Cooley & Cumming, 2013).

Extending beyond imagery vividness, the imagery process is believed to consist of image generation, inspection, and transformation (Kosslyn, 1994). Ease of imaging has been proposed to reflect the proficiency in which an individual can perform these different stages of the imagery process and may therefore be a more comprehensive measure of imagery ability (Williams & Cumming, 2011). As found with vividness, research suggests a more emotive image is also associated with greater ease of imaging (Holmes & Mathews, 2005).

Despite the evident relationship between emotions and imagery ability, it may be somewhat surprising that research is yet to examine whether emotion regulation relates to imagery ability. Emotion regulation involves changing the response (i.e., increase, maintain or decrease) of positive or negative emotions (Gross, 1999). Athletes frequently regulate their emotions to assist with their performance. For example, if athletes feel too anxious prior to performance they may alter the way they interpret this anxiety to perceive the feeling as excitement. Indeed, an athlete's ability to regulate emotions is thought to be just as important as any other psychological skill (Gould & Maynard, 2009; Jones, 2003).

Although there are thought to be over 400 strategies used to regulate emotions, the two fundamental strategies are emotion reappraisal and emotion suppression (Uphill, Lane, & Jones, 2012). Reappraisal refers to changing how you think about a particular situation to decrease its emotional impact (Gross, 2002), which occurs before experiencing the emotion (Gross & John, 2003). For example, if athletes feel embarrassed about making mistakes when in training or competition, they may change the embarrassment to a motivational thought by accepting it as a learning experience. Consequently, the feelings associated with embarrassment are experienced as motivation resulting in a reduced emotional impact. Suppression refers to inhibiting ongoing emotion-expressive behaviour. This response comes later in the emotion process, which decreases the behaviour expression but not the emotion experienced (Gross, 2002). For example, in a football penalty situation, a footballer may disagree with the refereeing decision but may forcibly accept it and continue the game while still feeling angry (Jones, 2003). Typically, reappraisal is associated with pleasant emotions whereas suppression is associated with more negative emotion (Jones, 2003). However, in sport, suppression has not been found to be associated with either positive or negative emotions (Uphill, Lane, & Jones, 2012).

It is likely that athletes' emotion regulation is related with their imagery ability due to the associations that both imagery and emotion regulation have with emotions and memory. Previous research established that emotions have a strong association with better imaging (Holmes & Matthews, 2005). Additionally, Hayes et al. (2010) explained that emotion regulation influences an individual`s cognitive function, especially, the encoded memory function. They also suggested that reappraisal will boost memory function whereas suppression impairs memory (Hayes et al., 2010; Gross, 2007). However, research is yet to sufficiently examine the extent to which reappraisal and suppression impact memory function and subsequently relate to an individual's imagery ability.

D'Argembeau and Van der Linden, (2006) were the first to highlight the potential relationship between emotion regulation and imagery ability. They found that the ability to picture past and future events is related to memory function and emotion regulation. They also suggested that individuals who suppress emotions have difficulty accessing memory and would therefore not be able to assemble the encoded memory in constructing and image as readily. Specifically, suppression was thought to result in difficulty accessing the details (e.g., sensory and contextual) associated with images of past and future events. Although picturing past and future events was negatively associated with suppression, there was no association with emotion reappraisal. This study was limited by the measurement of imagery ability to past and future events only, and not on present events. Events and emotion regulation were also not sport specific, an important factor to consider given that athletes are not always reflective of the general population when it comes to using strategies and techniques such as imagery and emotional regulation. This suggests the need to examine the relationship between emotional regulation and sport imagery ability in athletes.

Despite the importance of emotion regulation for sporting performance, research is also yet to sufficiently examine whether there are any gender or competitive level differences in athlete emotion regulation. Shirvani, Barabari, and Afshar, (2015) recently found that semi-professional athletes reported being better able to regulate negative emotion compared to amateur athletes. However, this previous study did not separately examine emotion reappraisal and suppression. Moreover to our knowledge, no study to date has examined whether there are any emotion regulation differences according to gender. This may seem surprising given that research suggests males and females tend to broadly differ in their emotional processing, with males typically needing less effort to regulate their negative emotions cognitively (reappraisal) compared to females who tend to use positive emotions to downgrade the negative emotions that they experience (McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008).

Therefore, building on the previous chapter in this thesis, the primary aim of this chapter was to comprehensively explore whether emotion reappraisal and suppression predicted ease of imaging different sport-related content. Based on previous literature (D'Argembeau & Van der Linden, 2006), it was hypothesised that emotion suppression would negatively predict ease of imaging the five types of imagery content (i.e., skill, strategy, mastery, goal, and affect) measured by the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2012). As bioinformational theory (Lang, 1979), claims that experiencing more emotions when imaging would likely create more vivid images and vivid images highly correlated to the ease of imaging, it was hypothesised that emotion reappraisal would positively predict ease of imaging all five types of imagery content. As this is the first study to examine the relationship, which type of emotion regulation most strongly predicted each type of imagery was also examined. The hypothesised model can be seen in Figure 6. The second aim of this study was, to examine any differences in emotion regulation due to gender or competitive level. Based on previous findings (McRae et al., 2008; Murphy et. al., 2008), it is hypothesised that males would reappraise their emotions more frequently than females. Since very limited literature has reported differences in competitive level for emotion regulation, the only hypotheses was that recreational and competitive level athletes would differ in emotion regulation but the nature of these differences was explored in the present study. A final aim of the study was to re-examine the gender and competitive level differences in sport imagery ability. Based on existing literature (Williams & Cumming, 2011), it was hypothesised that males would score higher in imaging mastery imagery compared to females, and that higher competitive level athletes would display higher imagery ability in all five subscales compared to their lower level counterparts.

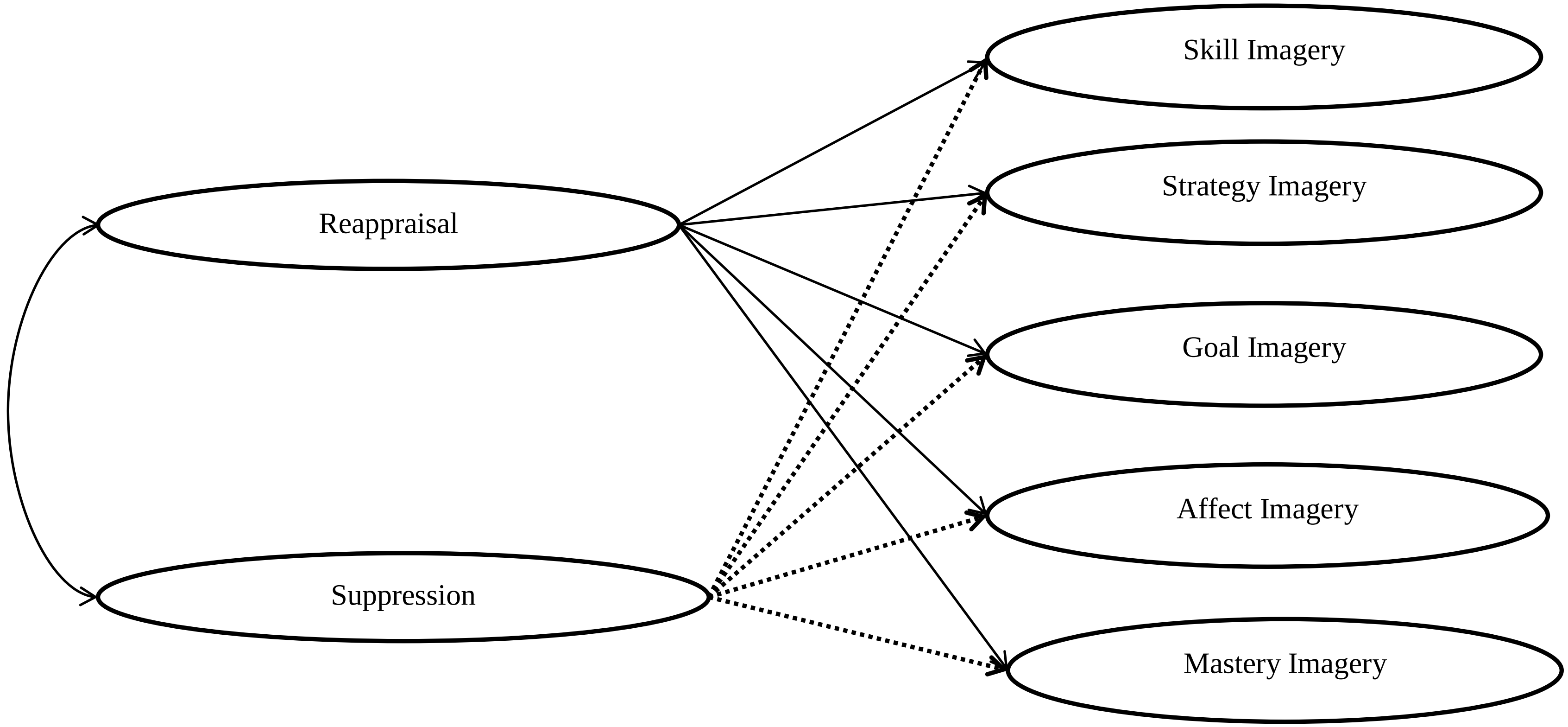

Figure 6. Hypothesised model of emotion regulation, (reappraisal and suppression), predict imagery ability.
Notes. Full lines indicate positively predicted and dashed lines indicate negatively predicted. For visual simplicity, variances between SIAQ subscales and the controlled variable (gender) are not presented.

Method

Participants

Six hundred and forty eight (276 males, 372 females; *M*age = 20.79 years, *SD* = 4.36) athletes participated in the study. The most commonly represented team sports were football (*n* = 197), cheerleading (*n* = 50), basketball (*n* = 35), rugby (*n* = 28), and netball (*n*= 19), and the most commonly represented individual sports were athletics (*n* = 37), swimming (*n* = 27), dance (*n* = 23), road running (*n* = 23), badminton (*n* = 19), and tennis (*n* = 14). All participants had been participating in their sport for an average of 7.67 years (*SD* = 6.50). Participants were either recreational athletes (*n* = 367; 143 males, 224 females) who reported playing their sport for leisure, and competitive athletes (*n* = 281; 133 males, 148 females) who played sport in more competitive setting.

Measures

Individual characteristics. Participants provided information regarding their age, gender, sport played, competitive level, and years of playing experience.

Sport imagery ability questionnaire. The Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) was used to assess athletes' imagery ability specific to their sport. The SIAQ consists of 15 items in which 3 items represent one of the five subscales; skill imagery ability (e.g., "refining particular skill"), strategy imagery ability (e.g., "making up new plan strategy in my head"), goal imagery ability (e.g., "myself winning a medal"), affect imagery ability (e.g., "the excitement associated with performing"), and mastery imagery ability (e.g., "staying positive after the setback"). Participants indicate their ease of imaging each item on a 7-point scale (1 = *very hard to image*, 7 = *very easy to image*). The SIAQ has displayed valid and reliable score of imagery ability (Williams & Cumming, 2011). In the present study, internal reliability was good with the Cronbach alpha coefficient of each subscale being .70 or above (skill = .80, strategy = .82, goal = .84, affect = .75, mastery = .70).

Emotion regulation questionnaire. The Emotion Regulation Questionnaire for Sport (ERQ; Uphill et al., 2012) was used to assess athlete emotion regulation. This measure was developed from the original Emotion Regulation Questionnaire (Gross & John, 2003). Participants indicate the extent to which they generally regulate their emotions when training or competing in their sport. Six items represent an individual's tendency to reappraise emotions (e.g., "I control my emotions by changing the way I think about the situation I am in") and four items represent an individual's tendency to suppress emotions (e.g., "I keep my emotions to myself"). Responses are made on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The ERQ for sport has displayed valid and reliable score of athlete emotion regulation (Uphill et al., 2012). In the present study, the questionnaire demonstrated good internal reliability with Cronbach alpha coefficients of .75 (suppression) and .85 (reappraisal).

Procedures

Participants were recruited following ethical approval for the study from the university where the authors are based. Participants were recruited by contacting local team coaches as well as from an undergraduate sport psychology class who were awarded with a course credit on completion of the study. All potential participants were provided with a questionnaire pack containing an information sheet explaining the nature of the study, a consent form, an individual characteristic form, the SIAQ, and the ERQ. Prior to completion of the questionnaire pack participants were informed that participation was voluntary, they had the right to withdraw at any time, and the information they provided would be confidential. Those who agreed to participate provided written consent and then completed the questionnaire pack which took no longer than 15 minutes.

Data Analyses

Preliminary analyses involved checking the data for accuracy in data entry, missing values, outliers, linearity, and univariate and multivariate normality. Bivariate correlations were used to inspect for multicollinearity between factor and multivariate normality (Mardia`s coefficient) was determined through confirmatory factor analyses performed in the main analyses. The Cronbach alphas of each factor were calculated to inspect the internal consistency of each variable.

To examine the data for gender and competitive level differences, two separate two-way gender (male, female) × competitive level (recreational, competitive) MANOVAs with emotion regulation and imagery ability as the dependent variables were conducted. Pillai's trace value is reported as it is considered the most robust multivariate significance test (Olson, 1976).

For the main analyse, AMOS 22.0 software (Arbuckle, 2013) was used to test the hypothesised model emotion regulation predicted imagery ability. Following the two step approach of structural equation modelling (SEM), maximum likelihood was employed to estimate both the SIAQ and ERQ before exploring the structural model (Kline, 2005). Separate CFAs were first performed on the ERQ and SIAQ questionnaires before the measurement model was examined as a whole. Goodness of fit was tested by the chi-squared likelihood statistic ratio ($\chi 2$; Jöreskog, & Sörbom, 1993). Following the recommendations by Hu and Bentler (1999), additional fit indices were examined and reported. The standardized root mean square residual (SRMR; Bentler, 1995) and Root Mean Square Error of Approximation (RMSEA) were both included as indicators of the absolute fit with values of <.06 and <.08 reflecting a good fit (Hu & Bentler, 1999). The Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) were included to reflect incremental fit with values for both of > .95 and > .90 reflecting an excellent and good fit respectively (Hu & Bentler, 1999).

Nevertheless, Hopwood and Donnellan (2010) suggest a more relaxed cut off value for CFI of > .90 and RAMSEA of < .10. Although there is still a debate surrounding the appropriate values for demonstrating an appropriate model fit (see Markland, 2007; Marsh, Hau, & Wen, 2004), these values are the most commonly acceptable and reported in the literature as indicative of the model fit.

In order to achieve desired model fit, the present study employed techniques suggested by Byrne (2009) to modify the model based on estimate and modification indices inspection. Furthermore, bootstrapping is a resampling procedure that was applied to the analyses when the data did not meet the assumption of multivariate normality (Byrne, 2009).

Results

Preliminary Analyses

Data screening and item characteristics. There was no data entry mistakes, missing values, or outliers. Linearity was shown in the data, which confirmed that SEM techniques could be applied in the main analyses. At the univariate level, the skewness (< 1) and kurtosis (<1.5) values for all variables showed the data was normally distributed. At the multivariate level, Mahalanobis distance showed the data was free from outliers. No multicollineary issue were found as the VIF values were < 1.5. Inspection of Mardia`s coefficient for the sample was 123.18 and critical ratio was over 1.96 indicating that the data was non-normal at a multivariate level. Bootstrapping was therefore employed for the entire SEM analysis. The inter-factor correlations within SIAQ subscales as well as within ERQ subscales were all significant and moderate in size ranging between 0.07 and 0.45 in magnitude. Mean and standard deviations for all SIAQ and ERQ subscales were also calculated and presented in Table 10.

Table 10
Imagery ability and emotion regulation means and standard deviations for male and female, recreational and competitive athletes.

	Male (n = 276)		**Female (n = 372)**		**Recreational (n = 367)**		**Competitive (n = 281)**	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
SIAQ								
Skill	5.11	1.04	4.97	1.05	4.99	1.05	5.08	1.04
Strategy	4.65**	1.11	4.24	1.20	4.34	1.24	4.51	1.10
Goal	5.07**	1.12	4.46	1.41	4.57	1.46	4.92	1.18
Affect	5.63**	1.01	5.41	1.05	5.49	1.06	5.52	1.02
Mastery	4.81**	0.97	4.51	1.07	4.63	1.05	4.66	1.03
ERQ								
Reappraisal	4.81	0.98	4.95	0.94	4.92	0.98	4.84	0.93
Suppression	4.07	1.06	3.95	1.02	3.96	1.06	4.04	0.99

Note. ** Significantly higher than female $p < .01$.

Gender and competitive level differences.

Emotion regulation. The two-way gender (male, female) and competitive level (recreational, competitive) MANOVA on the ERQ revealed a significant multivariate effect for gender, Pillai`s trace = .01 $F(2,643) = 3.33$, $p < .04$, $\eta_p^2 = .01$. Results at the univariate level revealed no significant differences in suppression, $F(1,644) = 1.70$, $p = .19$, $\eta_p^2 = .003$ or reappraisal, $F(1, 644) = 2.89$, $p = .09$, $\eta_p^2 = .004$. There was also no significant main effect for competitive level, Pillai`s trace = .002, $F(2,643) = 0.60$, $p < .55$, $\eta_p^2 = .002$ and no significant interaction between gender and competitive level Pillai`s Trace = .005, $F(2,643) = 1.72$, $p < .18$, $\eta_p^2 = .005$.

Imagery ability. The two-way gender (male, female) and competitive level (recreational, competitive) MANOVA on the SIAQ indicated a significant multivariate effect for gender, Pillai`s Trace = .06, $F(5, 640) = 8.54$, $p < .001$, $\eta_p^2 = .06$. There was no significant multivariate effect for competitive level, Pillai`s Trace = .01, $F(5,640) = 1.73$, $p < .13$, $\eta_p^2 = .01$, and no significant interaction between gender and competitive level, Pillai`s Trace = .02, $F(5,640) = 2.01$, $p < .08$, $\eta_p^2 = .02$.

Results at the univariate level revealed significant gender differences in strategy, $F(1, 644) = 17.72$, $p < .001$, $\eta_p^2 = .03$, observed power = 99%; goal, $F(1, 644) = 29.92$, $p < .001$, $\eta_p^2 = .04$, observed power = 100%; affect $F(1,644) = 6.68$, $p = .01$, $\eta_p^2 = .01$, observed power = 73%; and mastery imagery, $F(1,644) = 14.46$, $p < .001$, $\eta_p^2 = .02$, observed power = 97%, but no significant difference for skill imagery, $F(1, 644) = 2.28$, $p = .132$, $\eta_p^2 = .004$, observed power = 33%. A comparison of the means as shown in Table 10 revealed that males found it significantly easier to image strategy, goal, affect, and mastery images compared to females. Due to these differences, gender variable was controlled in the main analyses.

Main Analyses

Measurement models. Overall, the separate CFA measurement models revealed a good fit to the data for the ERQ, $\chi^2(68) = 339.68$, $p < .001$, CFI = .94, TLI = .92, SRMR = .05, RMSEA = .06 (90% CI = 0.05 – 0.06), with standardised factor loadings ranging from .53 to .82 for reappraisal and .45 to .83 for suppression. The inter-factor correlation (0.31) was moderate in size.

The SIAQ also had a good fit to the data, $\chi^2(160) = 471.87$, $p < .001$, CFI = .96, TLI = .95, SRMR = .04, RMSEA = .06 (90% CI = 0.04 – 0.04), with the standardised factor loadings being .54 or larger for all. The inter-factor correlation again showed medium-sized relationships between the different factors ranging between 0.30 and 0.44 in magnitude. The internal reliability and standardised factor loadings for the ERQ and SIAQ is reported in Table 11.

The measurement model for the ERQ and SIAQ also revealed a good fit to the data, $\chi^2(264) = 634.71$, $p < .001$, CFI = .94, TLI = .95, SRMR = .08, RMSEA = .05 (90% CI = .04 – .05).

Structural model. To test the hypothesized model presented in Figure 6, factor loadings lines from suppression and reappraisal were drawn to all SIAQ subscales (i.e., skill, strategy, goal, affect, and mastery imagery ability) while controlling for gender. The structural model revealed a less than adequate fit to the data, $\chi^2(264) = 1133.52$, $p < .001$, CFI = .85, TLI = .84, SRMR =.12, RMSEA = 0.07(90% CI = 0.07 – 0.08). Inspection of the factor loadings weights shown insignificant value of suppression predicts all five SIAQ subscales (skill, $p = 0.14$; strategy, $p = 0.17$; goal, $p = 0.96$; affect, $p = 0.55$; mastery, $p = 0.85$), indicating that suppression had no association with ease of imaging and these paths were removed from the model. The second model demonstrated an adequate fit to the data, $\chi^2(287) = 895.38.19$, $p < .001$, CFI = 0.90, TLI = 0.90, SRMR = 0.10 RMSEA = 0.06 (90%

CI = 0.05 – 0.06). Reappraisal was found to positively predicted skill, strategy, goal, affect, and mastery imagery ability at ($p < .001$) value. The final model and standardized factor loadings can be seen in Figure 7.

Table 11
The internal reliability and factor loadings of SIAQ and ERQ subscales

Items	***Α***	***β***
Reappraisal	.83	
Item 1		.62
Item 3		.59
Item 5		.53
Item 7		.82
Item 8		.73
Item 10		.76
Suppression	.75	
Item 2		.70
Item 4		.45
Item 6		.83
Item 9		.66
Skill	.80	
Item 12		.73
Item 8		.79
Item 3		.77
Strategy	.82	
Item 13		.78
Item 6		.84
Item 1		.74
Goal	.84	
Item 14		.81
Item 9		.74
Item 5		.80
Affect	.75	
Item 11		.78
Item 7		.78
Item 4		.63
Mastery	.70	
Item 15		.76
Item 10		.70
Item 2		.54

Note. All items are significant with $p < .001$

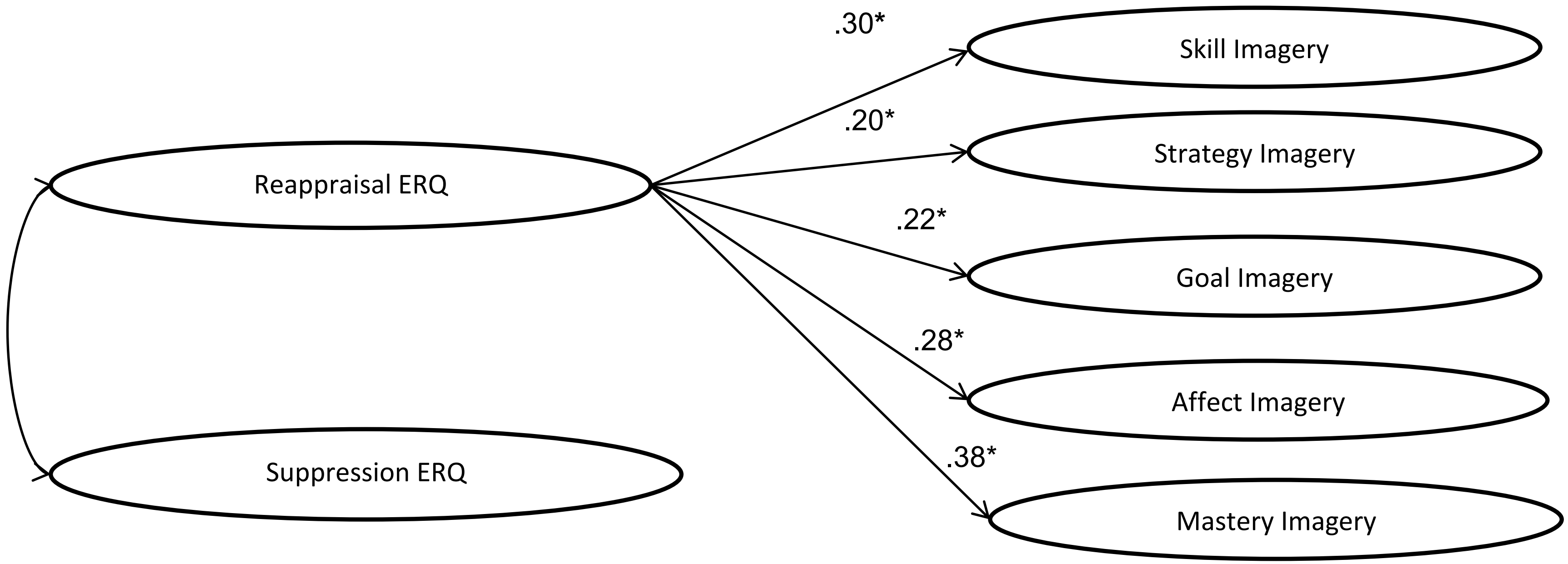

Figure 7. Final model of emotion regulation predicting ease of imaging skill, strategy, goal, affect and mastery.
Note. All coefficients are standardised and positive predictions. * = $p < .001$.
For visual simplicity, variances between SIAQ subscales and the controlled variable (gender) are not presented.

Discussion

The first aim of the present study was to examine the relationship between emotion regulation and imagery ability. Specifically, we investigated whether athlete emotion regulation, (i.e., reappraisal and suppression) predicted ease of imaging skill, strategy, goal, affect, and mastery imagery. It was hypothesised that reappraisal would positively predict and suppression negatively predict these five types of imagery ability. A second aim was to examine whether any differences in emotion regulation and imagery ability exist due to gender and competitive level. It was hypothesised that males would reappraise emotions more frequently than females. It was also predicted that males would score higher ability in mastery imagery ability than females, and more competitive athletes would score higher in ease of imaging of all 5 imagery types.

The findings partially support our hypotheses. As expected, reappraisal positively predicted all five types of imagery ability. That means, athletes who reappraise their emotions more frequently tend to display higher levels of skill, strategy, goal, affect, and mastery imagery ability. Based on the size of the factor loadings, it is interesting to note that reappraisal tendencies most strongly predict mastery imagery ability, closely followed by skill and affect imagery ability.

The strong relationship between reappraisal and mastery imagery ability is unsurprising. Regulating emotions by reappraisal also involves maintaining or decreasing the emotions experienced in a situation. Athletes who are more frequently reappraising their emotions are likely to be more able to image negative or difficult situations more positively. This can be attributed to the motivational reasons for athletes to reappraise, to decrease the emotional impact (Gross, 2002). Therefore, the stronger of the negative emotion and the more difficult situation the athlete is in, the more vivid mastery imagery content can be.

The association between emotion reappraisal and skill imagery as the second strongest prediction is interesting given that the associated imagery content is more cognitive in nature. This is perhaps due to more of the image information being encoded from memory. As, explained by Gross (2002), reappraisal boosts memory function. Similarly, cognitive neuroscience literature demonstrates that reappraisal enhances encoding in memory (Hayes et al., 2010). Therefore, it is possible that athletes who tend to reappraise memories of performing skills more frequently are able to recall these more easily when imaging. This explanation between imagery and memory function may also apply to imagery strategy and goal as results also highlight positive associations between reappraisal and these two subscales.

The third highest relationship with reappraisal is affect imagery ability. This is unsurprising given that when an athlete reappraises emotions, they change the emotion. Being able to call upon various emotions is likely to facilitate an image incorporating positive feelings and emotions. Also, during reappraisal, the emotion proposition is likely tapped during imagery as suggested by Lang`s (1979) bioinformational theory. These results may also be partly explained by Lang's assertion that experiencing more emotions when imaging would likely produce more vivid images (Lang, 1979). Importantly, results of emotion regulation predicting all five types of imagery ability demonstrated that reappraisal is not only related to imagery ability of motivational content, but also the ability to image cognitive content (i.e., skills and strategies).

Contrary to our hypothesis, no relationship was found between suppression and the SIAQ subscales. This finding suggests that suppression as an emotion regulation strategy is not associated with how easily athletes are able to image content in relation to their sport. In contrast, D`Argembeau and Van der Linden (2006) found that suppression negatively predicted imagery of past and future events. They suggested that suppression may affect memory function by diverting attention from encode the details of imaging rather to focus on the emotional responses. In support, studies have documented that suppressing emotions impair memory by blocking the brain pathway involved in retrieval of information, and result in experiencing fewer sensory, contextual and emotional details (D`Argembeau & Van der Linden, 2006; Gross, 2002). However, evidence regarding the suppression that impedes memory encoding (Hayes et al., 2010) does not apply to athletes and sport context. Thus, Uphill et al. (2012) attributed the idea that within the sport context suppression does not tend to be associated with either positive or negative emotions. This is because athletes' suppress emotion if they find it will benefit competition (Gross & Thompson, 2007) meaning it may not be detrimental to memory. Therefore, it is confident to propose that there is no relationship between athletes suppresses emotion and athletes' imagery ability.

A second potential explanation for why suppression was not associated with lower imagery ability is due to the relationship between reappraisal and suppression. Although, previous literature has typically identified no relationship between reappraisal and suppression of emotions (Hayes et al., 2010; Gross & John 2003), the present study demonstrates that there is a moderate positive relationship between these emotion regulation strategies. Similarly, Uphill et al. (2012) found reappraisal and suppression were correlated, suggesting that athletes who suppress their emotions more frequently tend to reappraise their emotions more frequently. Consequently, suppression may not be associated with lower levels of imagery ability because suppression may be overridden by the association between emotion reappraisal and imagery ability. To examine this further, future research could re-examine the relationship between imagery ability and emotion regulation in athletes who display high levels of reappraisal and low levels of suppression, and athletes who display high levels of suppression and low levels of reappraisal.

Contrary to the hypothesis, the present study found no difference between males and females in their emotion regulation tendencies. By comparison, McRae et al. (2008) reported gender differences in emotional processing suggesting that males require less effort in using cognitive regulation due to greater use of automatic emotion regulation compared with females. In contrast, females tend to use more positive emotions when reappraising negative emotions (McRae et al., 2008). Although previous literature has emphasised that females and males regularly use emotion regulation (Nolen-Hoeksema, 2012), the mixed findings may be due to of the focus of this investigation on athletes' emotion regulation in sport. Further research should examine the domain-specific nature of emotional regulation strategies and whether athletes apply these strategies in similar ways in different aspects of their life.

In support of the hypothesis, results revealed gender differences in imagery ability. However, as well as males reporting greater mastery ease of imaging, they also reported higher strategy, goal, and affect imagery ability compared with females. Skill imagery ability was the only SIAQ subscale in which gender differences did not emerge. Traditionally, studies have typically found no self-report differences in imagery ability (e.g., Callow & Hardy, 2004) and gender differences were thought to only exist in spatio-visual imagery tasks (Campos, Pérez-Fabello, & Gómez-Juncal, 2004). However, the majority of studies, (Abma, Fry, Li, & Relyea, 2002; Callow & Hardy, 2004) examining gender differences in self-report imagery ability have used movement based questionnaires such as Vividness of Movement Imagery Questionnaire-2 (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008) and Movement Imagery Questionnaires (MIQ-R; Hall & Martin, 1997). In more recent years, the emergence of the SIAQ which assesses sport content beyond just movements has resulted in gender differences starting to emerge more frequently (Williams & Cumming, 2011). While gender differences were initially reported for males displaying higher mastery imagery ability than females (Williams & Cumming, 2011), the results of the present study and the previous chapter suggest that gender differences in imagery ability may also apply to other imagery content except movement imagery ability (i.e., skill imagery).

It can be suggested that gender differences in motivational imagery content could be due to males typically displaying higher self-confidence (Lirgg, 1991) which has been associated with higher imagery ability (Abma et al., 2002). By feeling more confident in their own sporting ability, males may find it easier to image themselves performing well in difficult situations or when things are not going well for them (i.e., mastery imagery ability). They may also be able to see themselves achieving goals and outcomes more easily (i.e., goal imagery ability) and image the positive emotions associated with performance more easily (i.e., affect imagery ability). No difference in skill imagery ability supports research suggesting no gender differences in movement imagery ability (Callow & Hardy, 2004). However, we encourage future researchers to continue to examine gender differences in SIAQ to provide more insight into whether gender differences in imagery ability of sport related content are in fact a reoccurring finding.

This was the first study to examine whether differences emotion reappraisal and suppression exist for different competitive levels. The findings indicate no differences in reappraisal or suppression for recreational and competitive level athletes. This is inconsistent to Shirvani et al. (2015), as they found semi-professional athletes were better in ability to regulate their emotions compared to amateur athletes. The present study did not support our hypothesis and previous research that higher competitive level athletes would display greater levels of imagery ability (Gregg & Hall, 2006b; Roberts et al., 2008; Williams & Cumming, 2011).

A likely explanation for the similarities in emotion regulation and imagery ability between both competitive level groups is the lack of a more extensive range of competitive levels. While previous research suggesting competitive level differences in emotion regulation compared amateur and semi-professional athletes, the present study compared recreational and competitive athletes. Similarly, studies looking at competitive level differences in imagery ability have included a greater range of standards including recreational, club, county, regional, national, and even international and professional (Roberts et al., 2008). Unfortunately, due to the sample of participants recruited we were not able to categories our participants into a greater range of competitive levels. Therefore, we urge future research to re-examine any competitive level differences in emotion regulation to see whether differences in reappraisal and suppression emerge when comparing more elite and lower level athletes (e.g., international level compared with club and recreational athletes).

The findings of the present study have important implications for future practice. They provide new insight into the potential relationship between the “Who” (i.e., emotion regulation) and “Imagery Ability” components of RAMDIU (Cumming & Williams, 2013). Although a direct relationship is not predicted in the model, the results of the present study indicate that its inclusion is worth considering. That is, the characteristics of individuals appear to impact their ability to image. From an applied perspective, it is worth considering differences in the ways athletes reappraise and suppress emotions when planning imagery interventions.

Key strengths of the present study include the large sample size, comprehensive assessment of both types of emotion regulation and five types of imagery ability and the use of the analytical procedures employed. Although this study provides an important contribution to the literature, it is not without its limitations. The scope of this study was limited by its cross sectional nature. While this study provides important insight into the relationships between emotion regulation and imagery ability, it is important to remember that these relationships do not infer causation. As such, we believe the next logical step in continuing this line of research would be to examine the extent to which emotion reappraisal training is able to alter an individual's imagery ability.

In conclusion, this is the first study to explore the relationship between the "Who" and "Imagery Ability" components of the RAMDIU, specifically athletes' emotion regulation and imagery ability. Results revealed that reappraisal was positively associated with skill, strategy, goal, affect, and mastery imagery ability, whereas suppression had no association with imagery ability. Results also revealed differences in imagery ability due to gender but no differences due to competitive level, and no differences in emotion regulation due to gender or competitive level. These findings suggest that different athlete characteristics are associated with differences in athlete imagery ability. Therefore, it contributes to the growing body of literature in support of the RAMDIU. As mentioned in the previous chapter, the "Who" component of the model appears to be an important determinant in imagery's effectiveness. Future research should explore the extent to which reappraisal training impacts athlete imagery ability.

Chapter 6

General Discussion

Using the revised applied model of deliberate imagery use (RAMDIU), the overall aim of this thesis was to examine how: (a) individual characteristics (i.e., the “Who” component); (b) ways in which individuals perform imagery (i.e., the “What (type) & How” component) can impact imagery ability; as well as (c) to compare different techniques for improving ease and vividness which is two important dimensions of imagery ability. The thesis has made an original and important contribution to our understanding of imagery in sport. Underpinned by functional equivalence theory, the thesis investigated whether incorporating PETTLEP elements and prior observation could facilitate the ease and vividness of movement imagery from different imagery modalities and visual perspectives. The thesis also examined whether skill level, gender, emotion regulation, and a tendency to use physical and environmental PETTLEP elements when imaging was associated with greater ease of imaging different imagery content athletes use in their sport. The next section will begin with a summary of the empirical chapters before discussing the implications, strengths, limitations, and suggestions for future studies.

Summary of Results

The aims of the thesis were achieved by investigated via four empirical studies, each representing a different chapter of the thesis (Chapters 2-5). Each one will now be summarised in turn in the next section.

Chapter 2

The aim of Chapter 2 was to examine the effect of PETTLEP imagery on the ease and vividness of External Visual Imagery (EVI), Internal Visual Imagery (IVI), and Kinaesthetic Imagery (KI) of movements. The ease and vividness of movement imagery incorporating the PETTLEP elements (e.g., imaging while adopting the physical position in the environment in which the movement would be performed) were compared against more traditional imagery (e.g., imaging while seated in a different environment).

Based on previous literature (e.g., Callow et al., 2006), it was hypothesised that regardless of the imagery perspective or modality adopted, incorporating PETTLEP elements into an image would produce more vivid imagery that was easier to generate. Findings supported this hypothesis for IVI and KI: imagery in these modalities was rated as significantly easier and more vivid when performed with PETTLEP elements compared to a more traditional imagery condition. Traditional imagery was defined as imaging while sitting in a quiet room on a chair and not being in the environment where the movements would be typically performed. However, there were no significant differences across conditions for ease and vividness of EVI.

Chapter 2 therefore showed that altering how an individual images by incorporating the PETTLEP elements can enhance ease and vividness of IVI and KI, but not EVI of the different movements used in the Vividness in Movement Imagery Questionnaire-2 (VMIQ-2). It was also investigated which PETTLEP elements athletes' perceived to be the most helpful in improving their imagery ease and vividness. Findings demonstrated, for the first time, that participants perceived the physical and environment elements to be significantly more helpful than the other PETTLEP elements. Altogether, these results are likely to explain why previous studies have found PETTLEP imagery to be more effective than more traditional imagery (Smith et al., 2007). These findings also suggest that behavioural matching of the image to that of the physically performing the movement (i.e., incorporating the physical and environment elements to an image) may be a reason for imagery ability improvements (Wakefield et al., 2013). However, PETTLEP elements did not appear to be effective in improving ease and vividness of EVI of movements which is thought that is due the sample size, or the participants' preferences for using a particular visual perspective

(Callow & Roberts, 2010), or could also because of the nature task being imaged (Hardy, 1997). It was important to re-examine this finding but also investigate whether other technique (i.e., observation) can alter how imagery is performed can improve ease and vividness of EVI of movements. The experiment was replicated and the comparison between observation technique and PETTLEP imagery were discuss in Chapter 3 of this thesis.

Chapter 3

Chapter 3 aimed to replicate and extend the results of Chapter 2. It re-investigated the effects of PETTLEP imagery on ease and vividness of EVI, IVI, and KI, but also compared this to imaging following observation of the movement to be imaged. Observation was selected due to previous research demonstrating that it can elicit similar neural activity to imagery (Clark, Tremblay & Ste-Marie, 2004). In addition, Williams et al. (2011) suggested that observation may only be effective at increasing visual imagery ability when the imagery perspective (i.e., first person or third person) was congruent with the observation perspective. Thus, observation was considered in Chapter 3 as a possible alternative technique to PETTLEP imagery to improve EVI. Chapter 3 also enabled a comparison between PETTLEP imagery and observation to see which technique appeared to be more effective in increasing ease and vividness of EVI, IVI, and KI. As in the previous chapter, Chapter 3 examined which PETTLEP elements athletes' perceived to be the most helpful in improving their imagery ease and vividness. A larger sample of participants compared to Chapter 2 was also recruited to address the potential limitation of sample size in the previous chapter.

Findings of Chapter 3 replicated those of Chapter 2 for IVI and KI. Altering how an individual image by incorporating the PETTLEP elements enhanced ease and vividness of IVI and KI. Furthermore in the larger sample, the results revealed that EVI ease and vividness were also greater during the PETTLEP condition compare to more traditional imagery. Similarly to the previous chapter, the physical and environment PETTLEP elements were perceived as being significantly more helpful than the other PETTLEP elements for enhancing ease and vividness. In regards to observation, although this chapter did not found that observation primed ease of imaging as in previous study (William & Cumming, 2011), it appeared to increase vividness of the image. Consequently, the results suggests that the “What (type) & How” component in RAMDIU are likely to impact athletes’ imagery ability.

The impact of the physical and environment elements on ease and vividness across both studies suggests that deliberately incorporating these PETTLEP elements into imagery practice may be associated with greater imagery ability. Chapter 4 therefore examined this specific issue, and also extended the investigation beyond the simple movement by focussing on the broader imagery content athletes’ use in relation to their sport.

Chapter 4

Chapter 4 explored the relationship between how often athletes incorporate the physical and environment elements of the PETTLEP model and their ease of imaging. The two previous empirical chapters (Chapter 2 and 3) revealed that individuals perceived these two elements to be most helpful in enhancing ease and vividness of simple movements. However, athletes are likely to image a broader range of content. Consequently, the Sport Imagery Ability Questionnaire (SIAQ) was used in Chapter 4 to examine imagery ability five types of imagery content that athletes use in relation to their sport (Williams & Cumming, 2011). As this thesis was also concerned with the role played by the “Who” component of the RAMDIU on “Imagery Ability”, Chapter 4 also examined whether skill level and gender were associated with both the ease of imaging different types of imagery and the frequency with which athletes incorporate the physical and environment elements into their imagery practice.

Results showed that the frequency of incorporating physical and environment elements of the PETTLEP model was associated with greater ease of imaging cognitive based images (i.e., skill and strategy imagery ability) and those containing more motivational imagery content (i.e., mastery, goal, and affect imagery ability). It was found that males image strategy, goal, and mastery much easily than females, but no differences were found compare to females in their ability to image skill and affect. In regards to the utilisation of the physical and environment element, no differences were found between male and female athletes. Therefore, the "Who" component in RAMDIU as reflected by the athletes' gender also appears to influence imagery ability, but it depends on the content being imaged rather than the use of physical and environment elements.

Chapter 5

Building on the initial findings in Chapter 4, Chapter 5 further explored other individual characteristics (i.e., "Who" components of the RAMDIU) that likely to relate to imagery ability. As Lang's bioinformational theory (1977, 1979) proposes that more emotive images will likely lead to more vivid imagery, drawing on and experiencing emotions appear to be important aspects of the imagery process (Murphy, Nordin, & Cumming, 2008). However, research is yet to examine how athletes' emotion regulation is associated with imagery ability. Thus, the final empirical chapter explored the relationship between athletes' emotion regulation and their imagery ability. It was hypothesised that athletes' emotion reappraisal positively predict and suppression negatively predict ease of imaging. Chapter 5 also investigated any gender or competitive levels differences in imagery ability and emotion reappraisal.

There was no significance difference in emotion regulation due to gender or competitive level nor were there any differences in imagery ability due to competitive level. However, the apparent gender differences in imagery ability that emerged in Chapter 4 were replicated in Chapter 5. Results partially supported the hypothesis that reappraisal was positively associated with ease of imaging skill, strategy, goal, affect, and mastery imagery. However, suppression was not related to ease of imaging any of the measured imagery content. Results of Chapter 5 provided further support for the possible yet complex relationship between the "Who" (i.e., emotion regulation, gender) and "Imagery ability" components of RAMDIU (Cumming & Williams, 2013). That is, the relationship likely differs across characteristics of "Who" and what is being measured. Findings from the present thesis provide a number of important implications which are discussed in the next section.

Implications of the Thesis Findings

Although each study provided specific implications which were discussed comprehensively in each empirical chapter, there are a number of more general implications that can be drawn from this body of work. The first implication is the need to reconsider how the different components of RAMDIU are related to one another. The RAMDIU model proposed "Imagery Ability" would influence the content and characteristics of an image (i.e., "What (type) & How" components). For example, the ability to image a particular content (e.g., skill) will likely to increase the use of imagery in particular to image skill imagery (Williams & Cumming, 2012). It was also originally proposed that imagery ability may act as a moderator for the impact that using particular content ("What (type) & How") has on the intended outcome (Martin et al., 1999; Cumming & Williams, 2013). This idea is based on Paivio`s framework which suggested that, athletes' imagery ability differs based on the imagery content and the important roles of imagery ability to achieved the intended imagery outcome (Martin et al., 1999). However, as revealed in Chapter 2 and 3, altering how an image is performed can have a direct impact on imagery ability of such content. This was further supported by the associations in Chapter 4 between the implementation of physical and environment elements and ease of imaging different imagery content. Based on these findings it can be suggested that the relationship between the "What (type) & How" and "Imagery Ability" components of the RAMDIU is two-way as proposed in Figure 8.

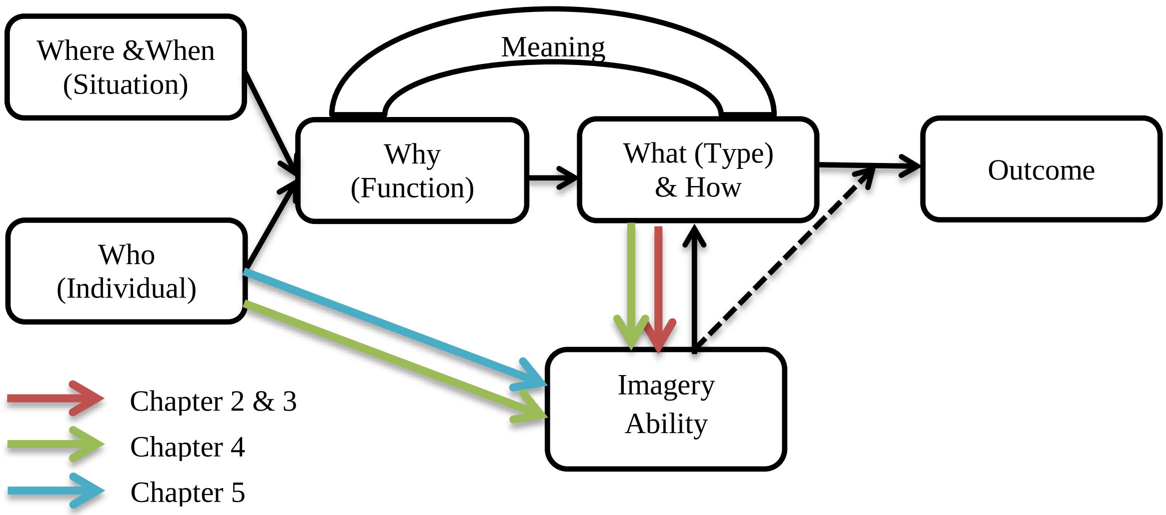

Figure 8. The revised applied model of deliberately imagery use (RAMDIU) based on the findings of the different chapters in this thesis.

The findings from the present thesis also suggest that it is important to acknowledge that the ability to image depends on individual's characteristics. For example, researchers have documented a considerable amount of evidence that imagery ability differs depending on such factors as competitive level, motivation and gender (e.g., Murphy et al., 2008; Roberts et al., 2008; Williams & Cumming, 2011). Chapter 4 and 5 further extended this line of research by revealing greater gender differences in imagery ability than what has been previously assumed. Consequently, whether an athlete taking part in an intervention is male or female may impact upon the ease with which they are able to image the intervention content. Therefore it is worth screening for their imagery ability and there may be a need for providing additional training to assist them form the image such as Layered Stimulus Response Training (LSRT), PETTLEP primes, and observation. Additionally, Chapter 5 revealed that an athlete's tendency to reappraise emotions is also likely to impact upon their ease of imaging. Therefore, as well as influencing the function of imaging, as shown in Figure 8 it can be proposed that an individual's characteristics (i.e., the "Who" component of the RAMDIU) can impact upon an individual's imagery ability.

The overall implication of this thesis is centred on the importance to understanding factors that contribute to the increment of imagery ability. This thesis repeatedly found that athletes have a preference for using the physical and environment elements of the PETTLEP model for making images easier and more vivid. This also points to the role of meta-imagery process as athletes are capable of reflecting on their imagery experience, and controlling the imagery process (MacIntyre & Moran, 2010). The literature has reported the general effectiveness of PETTLEP imagery in different ways (Smith, et al., 2008; Wakefield & Smith, 2009). Importantly, findings suggest that incorporating the PETTLEP elements are likely to be effective for most individuals. However, Ramsey, Cumming, Edwards, Williams, & Brunning (2010) found that the emotion the element might not be as effective as other elements. Overall, the PETTLEP research suggests that different elements differently contribute to the effectiveness of imagery. Athletes should be aware of what elements add towards their effective imagery and try to maximise their imagery use by concentrating on the physical and environment element (Smith et al., 2007).

It has been proposed that every athlete has the capacity to image to a certain extent, but that imagery ability differs amongst individuals. Furthermore, it has been advocated that imagery interventions should be individualised so that they suit each individual rather than applying the same technique to all athletes (Cumming & Ramsey, 2009; Cumming & Williams, 2012). Although it may be appropriate to tailor imagery intervention content to each athlete, the present thesis suggests it would be worth incorporating the PETTLEP elements – particularly the physical and environment elements – to imagery interventions irrespective of its content to try and maximise imagery ability and imagery's subsequent effectiveness.

Strengths and Limitations

A number of strengths and limitations of this body of work have been discussed in each empirical chapter. To avoid repetition, only those strengths and limitations discussed in this section are those that span across the different chapters or have not been discussed previously. The first strength of this thesis is the theoretical approach and use of existing frameworks to underpin the work. This thesis integrated multiple theories. The first theory is the functional equivalence theory that explains the brain process and neural activity during imagery for effective imagery use in learning and performance (Finke, 1980) being as the foundation for why PETTLEP and observation were used as techniques to improve imagery ability in the present thesis. Another influential theory was bioinformational theory (Lang, 1979), which has also received considerable attention and support from the literature. It was initially introduced to address emotional imagery in a clinical setting, which made it appropriate to form the basis of Chapter 5 when proposing the relationship between imagery ability and emotion regulation. In addition to these two theories, the entire thesis was underpinned by RAMDIU (Cumming & Williams, 2012), which is the most recent model for proposing effective imagery use. Consequently, imagery research and interventions frequently employ this model as a guideline. The integration of both these theories and imagery model in this thesis strengthens the research design and quality of the work produced.

The second strength of this thesis is the variation of quantitative research designs, which included a mixture of cross-sectional and experimental research studies across the four empirical chapters. By implementing these various research designs, the findings and conclusions drawn can be analysed to create new theories or in-depth research, comparative analyses, as well as able to verify finding's reliability (Jones, 1997). Re-examining findings from earlier chapters in subsequent chapters (e.g., differences in imagery ability due to gender and incorporating PETTLEP elements) further strengthens the results from this work via replication and extension. Consequently, the findings from the collection of work conducted complement each other well and collectively create a novel suggestions and extensions of the RAMDIU. From these findings for future research to extend the imagery literature can be suggested.

A final strength of the thesis that should be noted is the range in ethnicity of the athletes who participated in the studies. To my knowledge, other published imagery studies typically recruit mostly homogeneous white sample of athletes (e.g., Gregg, McGowan, & Hall, 2011; Rodgers, Hall, & Buckolz, 2008) or do not report the ethnicities of their participants. In contrast, the empirical chapters in the present thesis recruited athletes representing a range of ethnicities. In this way, findings from this thesis are generalizable to a more heterogeneous population.

A potential limitation is the fact that participants are all relatively similar in their experience in imagery use (i.e., around a year of imagery experience), the amount of prior imagery training (i.e., not received imagery training before), and imagery ability (i.e., at least reasonably well, according to VMIQ-2). It would be interesting to re-examine some of the thesis research questions with athletes who vary by these factors (e.g., compare athletes who use imagery more frequently and/or are better at imagery to those with less imagery experience and/or are poorer at imagery). Imagery use is positively related to imagery ability (Gregg, Hall, & Nederhof, 2005), which means the more imagery is used, the easier it is. An interesting research question would be to examine whether poorer imagers respond differently to the PETTLEP and observation primes, or whether they have other preferred

PETTLEP elements that are more strongly associated with imagery ability of different content. Having said that, it should also be noted that labelling good and poor imagers is somewhat challenging as it is still very subjective in terms of what constitutes as a "good" imagery ability score or a "poor" imagery ability score (Cumming & Ramsey, 2009). Furthermore, athletes tend to vary in how well they are able to image different content or from different modalities (Williams & Cumming, 2011). For example, an athlete may be good in imaging EVI but struggle with imaging KI. Alternatively, an athlete may be particularly good in imaging movement imagery but might struggle to image feelings and emotions.

Another limitation to note in this thesis is the use of self-report measures to assess imagery ability. Self-report measures are prone to response bias as Finke (1980) highlighted the possibility that self-report ratings could be based on individuals' confidence rather than how vivid or how easy they are able to image. However, to address this, the thesis provided pictures of vividness scale (refer to appendix 2) to correspond with each vividness anchor to help participants try and understand what may constitute as a clear and vivid imagery compared to a vague and dim image. Additionally, questionnaires with evidence to support the validity and reliability of its scores were used to assess different content and characteristic. Finally, for the experimental chapters, a within-subject design was implemented so that any effects of the PETTLEP and observation on imagery ability were compared to the same participant imaging during the traditional imagery condition.

Nevertheless, a relative change score was more important than an absolute score. Although objective measures (e.g., brain imaging, chronometric assessment) have been used to assess imagery ability (Guillot, 2008; Guillot & Collet, 2005), Williams et al. (2016) found very small/nonexistence relationships between different subjective and objective measures and explained that these measures likely complement each other. However, the majority of these objective measures are used to assess imagery ability. This thesis investigated the imagery ability beyond just movements and nature of the study designs meant that it wouldn't have been feasible to incorporate other measures of imagery ability but this is an area for future research discussed in more detail in the section below. Additional areas for future research are discussed in the next section.

Future Directions

The findings of this thesis can inspire a number of avenues for future research to extend the work in this area. As well as those already discussed in earlier chapters, a potential venture for future research mentioned above is to continue examining how athletes' characteristics can impact upon imagery ability. Previous studies (Cumming, 2008; Nordin & Cumming, 2005a) have undertaken research on different athletes' characteristic on the impact on imagery use, but there is still limited research on imagery ability. It would be worth extending this area of investigation to further clarify what aspects of "who" impact what aspects of imagery ability. These results could be of benefit to not only researchers, but also athletes, coaches, and applied practitioners.

Another potential future direction is to re-examine the research questions posed in the thesis but to incorporate objective methods to measure imagery ability such as mental rotation, brain imaging, mental chronometry, and physiological responses (Collet et al., 2011; Williams, Guillot, Di Rienzo, & Cumming, 2015). It would be interesting to see whether findings are similar when imagery ability is reflected in measures beyond self-report questionnaires and whether certain measures of imagery ability are able to more prominently detect differences in imagery ability due the RAMDIU "Who" and "What (type) & How" components.

It would also be interesting to re-investigate some of the thesis aims using a qualitative research design. Completing questionnaires limits participants' responses because of the nature of the questions and ratings scales. Jones (1997) has suggested that qualitative and mixed method research can support and clarify findings from quantitative research. Implementing a qualitative or mixed method design would therefore offer more details and insights into things such as how PETTLEP and observation may or may not influence ease and vividness that are not tapped by the questionnaires used in the present thesis. Consequently, it also can enhance the suggestions made regarding the proposition in RAMDIU.

Finally, it is important that future research test the modification proposed in this thesis to the RAMDIU by testing the model as a whole. Specifically, there is still a need to examine the extent to which factors identified in the present thesis that increase imagery ability can affect the outcomes associated with imagery use following an intervention (e.g., improvements to performance, confidence, and anxiety management). In sum, the findings of this thesis lay out a number of exciting avenues for future research.

Conclusion

In conclusion, this thesis has provided greater understanding of imagery ability in sport. The overall findings that contributed to further developments of RAMDIU by investigating the "Who" and "What (type) & How" components of the model in relation to imagery ability across four studies. The findings indicate that these factors should be taken into account when developing imagery interventions to ensure the best possible outcomes via increased imagery ability. Moreover, PETTLEP imagery primes (particularly physical and environment) and prior observation could be used increase ease and vividness of imagining simple movements in different modalities and visual perspectives. It is also possible that physical and environment imagery primes may also make it easier to image other types of sport images, due to the associations found in Chapter 4. Additionally, skill level, gender, and emotion regulation are also related to athletes' imagery ability. Consequently, this thesis suggests that both the "Who" and "What (type) & How" components of the RAMDIU are likely to impact on the "Imagery Ability" component. Therefore, athletes, coaches, and practitioners should consider various athlete characteristics along with how the athletes are going to image to boost imagery ability and maximise the effectiveness of the imagery intervention in achieving the desired outcome.

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Appendix 1: Vividness of Movement Imagery Questionnaire-2 (Chapter 2)
(VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008; Reverse scored)

Movement imagery refers to the ability to imagine a movement. The aim of this questionnaire is to determine the vividness and ease of your movement imagery. The items of the questionnaire are designed to bring certain images to your mind.
The first page of the questionnaire is interested in how easily and vividly you are able to image watching yourself performing the movement from an external point of view (External Visual Imagery). The second page of the questionnaire is interested in how easily and vividly you are able to image from an internal point of view, as if you were looking out through your own eyes whilst performing the movement (Internal Visual Imagery). The third page of the questionnaire is interested in how easy and vividly you are able to image feeling yourself do the movement (Kinaesthetic imagery).

1. You are asked to image the movement and then rate the vividness of the image on the 5-point scale below.

Vividness

1	2	3	4	5
No image at all, you only “know” that you are thinking of the skill	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and as vivid as normal vision or feel of movement

2. Then you are asked to rate how easy it was for you to image on the 5-point scale below.

Ease

1	2	3	4	5
Very hard to see/feel	Reasonably hard to see/feel	Neither easy or hard to see/feel	Reasonably easy to see/feel	Very easy to see/feel

Circle the appropriate ratings based on the scales provided. For example, although an athlete may find imaging themselves kicking a football clear and reasonably vivid (and therefore select 4 for vividness), they may find this somewhat hard to image (and therefore select 2 for ease).
Try to do each item separately, independently of how you may have done other items. Complete all items from an external visual perspective before the items from an internal visual perspective, and finally the items for feeling the movement. The ratings for a given item may not in all cases be the same. For all items please have your eyes CLOSED.

Area		The vividness of watching yourself performing the movement (External Visual Imagery)					The ease of watching yourself performing the movement (External Visual Imagery)				
	Item	No image at all, you only know that you are thinking of the skill	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid as normal vision	Very hard to see	Reasonably hard to see	Neither easy or hard to see	Reasonably easy to see	Very easy to see
1	1.Walking	1	2	3	4	5	1	2	3	4	5
	2.Running	1	2	3	4	5	1	2	3	4	5
	3. Throwing a stone into water	1	2	3	4	5	1	2	3	4	5
2	4. Swinging on a rope	1	2	3	4	5	1	2	3	4	5
	5.Running up stairs	1	2	3	4	5	1	2	3	4	5
	6.Jumping sideways	1	2	3	4	5	1	2	3	4	5
3	7. Kicking a stone	1	2	3	4	5	1	2	3	4	5
	8. Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5
	9.Running downhill	1	2	3	4	5	1	2	3	4	5
4	10.Riding a bike	1	2	3	4	5	1	2	3	4	5
	11. Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5
	12.Jumping off a wall	1	2	3	4	5	1	2	3	4	5

Area		The vividness of looking through your own eyes whilst performing the movement (Internal Visual Imagery)					The ease of looking through your own eyes whilst performing the movement (Internal Visual Imagery)				
	Item	No image at all, you only know that you are thinking of the skill	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid as normal vision	Very hard to see	Reasonably hard to see	Neither easy or hard to see	Reasonably easy to see	Very easy to see
1	1.Walking	1	2	3	4	5	1	2	3	4	5
	2.Running	1	2	3	4	5	1	2	3	4	5
	3. Throwing a stone into water	1	2	3	4	5	1	2	3	4	5
2	4. Swinging on a rope	1	2	3	4	5	1	2	3	4	5
	5.Running up stairs	1	2	3	4	5	1	2	3	4	5
	6.Jumping sideways	1	2	3	4	5	1	2	3	4	5
3	7. Kicking a stone	1	2	3	4	5	1	2	3	4	5
	8. Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5
	9.Running downhill	1	2	3	4	5	1	2	3	4	5
4	10.Riding a bike	1	2	3	4	5	1	2	3	4	5
	11. Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5
	12.Jumping off a wall	1	2	3	4	5	1	2	3	4	5

Area	Item	The vividness of feeling yourself do the movement (Kinaesthetic Imagery)					The ease of feeling yourself do the movement (Kinaesthetic Imagery)				
		No image at all, you only know that you are thinking of the skill	Vague and dim	Moderately clear and vivid	Clear and reasonably vivid	Perfectly clear and vivid as normal vision	Very hard to see	Reasonably hard to see	Neither easy or hard to see	Reasonably easy to see	Very easy to see
1	1.Walking	1	2	3	4	5	1	2	3	4	5
	2.Running	1	2	3	4	5	1	2	3	4	5
	3. Throwing a stone into water	1	2	3	4	5	1	2	3	4	5
2	4. Swinging on a rope	1	2	3	4	5	1	2	3	4	5
	5.Running up stairs	1	2	3	4	5	1	2	3	4	5
	6.Jumping sideways	1	2	3	4	5	1	2	3	4	5
3	7. Kicking a stone	1	2	3	4	5	1	2	3	4	5
	8. Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5
	9.Running downhill	1	2	3	4	5	1	2	3	4	5
4	10.Riding a bike	1	2	3	4	5	1	2	3	4	5
	11. Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5
	12.Jumping off a wall	1	2	3	4	5	1	2	3	4	5

Appendix 2: Vividness of Movement Imagery Questionnaire-2 (Chapter 3-with an attempt of adding picture on vividness scale) (VMIQ-2; Roberts, Callow, Hardy, Markland, & Bringer, 2008; Reverse scored)

Movement imagery refers to the ability to imagine a movement. The aim of this questionnaire is to determine the vividness and ease of your movement imagery. The items of the questionnaire are designed to bring certain images to your mind.
The first page of the questionnaire is interested in how easily and vividly you are able to image watching yourself performing the movement from an external point of view (External Visual Imagery). The second page of the questionnaire is interested in how easily and vividly you are able to image from an internal point of view, as if you were looking out through your own eyes whilst performing the movement (Internal Visual Imagery). The third page of the questionnaire is interested in how easy and vividly you are able to image feeling yourself do the movement (Kinaesthetic imagery).

1. You are asked to image the movement and then rate the vividness of the image on the 5-point scale below.

Vividness

1	2	3	4	5
No image at all, you only know that you are thinking of the skill 	Vague and dim 	Moderately clear and vivid 	Clear and reasonably vivid 	Perfectly clear and vivid as normal vision 

2. Then you are asked to rate how easy it was for you to image on the 5-point scale below.

Ease

1	2	3	4	5
Very hard to see/feel	Reasonably hard to see/feel	Neither easy or hard to see/feel	Reasonably easy to see/feel	Very easy to see/feel

Circle the appropriate ratings based on the scales provided. For example, although an athlete may find imaging themselves kicking a football clear and reasonably vivid (and therefore select 4 for vividness), they may find this somewhat hard to image (and therefore select 2 for ease).

Try to do each item separately, independently of how you may have done other items. Complete all items from an external visual perspective before the items from an internal visual perspective, and finally the items for feeling the movement. The ratings for a given item may not in all cases be the same. For all items please have your eyes CLOSED.

Area		The vividness of watching yourself performing the movement (External Visual Imagery)					The ease of watching yourself performing the movement (External Visual Imagery)				
	Item	No image at all, you only know that you are thinking of the skill 	Vague and dim 	Moderately clear and vivid 	Clear and reasonably vivid 	Perfectly clear and vivid as normal vision 	Very hard to see	Reasonably hard to see	Neither easy or hard to see	Reasonably easy to see	Very easy to see
1	1. Riding a bike	1	2	3	4	5	1	2	3	4	5
	2.Running up stairs	1	2	3	4	5	1	2	3	4	5
	3. Throwing a stone into water	1	2	3	4	5	1	2	3	4	5
2	4. Walking	1	2	3	4	5	1	2	3	4	5
	5.Running	1	2	3	4	5	1	2	3	4	5
	6.Jumping sideways	1	2	3	4	5	1	2	3	4	5
3	7. Kicking a stone	1	2	3	4	5	1	2	3	4	5
	8. Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5
	9. Jumping off a wall	1	2	3	4	5	1	2	3	4	5
4	10. Swinging on a rope	1	2	3	4	5	1	2	3	4	5
	11. Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5
	12. Running downhill	1	2	3	4	5	1	2	3	4	5

Area		The vividness of looking through your own eyes whilst performing the movement (Internal Visual Imagery)					The ease of looking through your own eyes whilst performing the movement (Internal Visual Imagery)				
	Item	No image at all, you only know that you are thinking of the skill 	Vague and dim 	Moderately clear and vivid 	Clear and reasonably vivid 	Perfectly clear and vivid as normal vision 	Very hard to see	Reasonably hard to see	Neither easy or hard to see	Reasonably easy to see	Very easy to see
1	1. Riding a bike	1	2	3	4	5	1	2	3	4	5
	2.Running up stairs	1	2	3	4	5	1	2	3	4	5
	3. Throwing a stone into water	1	2	3	4	5	1	2	3	4	5
2	4. Walking	1	2	3	4	5	1	2	3	4	5
	5.Running	1	2	3	4	5	1	2	3	4	5
	6.Jumping sideways	1	2	3	4	5	1	2	3	4	5
3	7. Kicking a stone	1	2	3	4	5	1	2	3	4	5
	8. Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5
	9. Jumping off a wall	1	2	3	4	5	1	2	3	4	5
4	10. Swinging on a rope	1	2	3	4	5	1	2	3	4	5
	11. Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5
	12. Running downhill	1	2	3	4	5	1	2	3	4	5

Area		The vividness of feeling yourself do the movement (Kinaesthetic Imagery)					The ease of feeling yourself do the movement (Kinaesthetic Imagery)				
	Item	No image at all, you only know that you are thinking of the skill 	Vague and dim 	Moderately clear and vivid 	Clear and reasonably vivid 	Perfectly clear and vivid as normal vision 	Very hard to see	Reasonably hard to see	Neither easy or hard to see	Reasonably easy to see	Very easy to see
1	1. Riding a bike	1	2	3	4	5	1	2	3	4	5
	2.Running up stairs	1	2	3	4	5	1	2	3	4	5
	3. Throwing a stone into water	1	2	3	4	5	1	2	3	4	5
2	4. Walking	1	2	3	4	5	1	2	3	4	5
	5.Running	1	2	3	4	5	1	2	3	4	5
	6.Jumping sideways	1	2	3	4	5	1	2	3	4	5
3	7. Kicking a stone	1	2	3	4	5	1	2	3	4	5
	8. Bending to pick up a coin	1	2	3	4	5	1	2	3	4	5
	9. Jumping off a wall	1	2	3	4	5	1	2	3	4	5
4	10. Swinging on a rope	1	2	3	4	5	1	2	3	4	5
	11. Kicking a ball in the air	1	2	3	4	5	1	2	3	4	5
	12. Running downhill	1	2	3	4	5	1	2	3	4	5

Appendix 3 : Imagery Evaluation Check (Chapter 2 and 3)

To what extent did you understand the three different imagery types (i.e., external visual imagery, internal visual imagery, kinaesthetic imagery)?

1	2	3	4	5	6	7
Do not understand			Neutral			Understand

Appendix 4 : PETTLEP Evaluation Form (Chapter 2 and 3)

How helpful were the following things in creating clearer and more vivid images......	Not at all helpful			Neither helpful or unhelpful			Very helpful
Imaging while adopting the physical positions and having the props (e.g., stone, coin, bike, rope) reflective of the movements you imaged	1	2	3	4	5	6	7
Performing the imagery in the environment reflective of the movements	1	2	3	4	5	6	7
Imaging the movements at a standard reflective of your movement capabilities	1	2	3	4	5	6	7
Imaging the movements in real time	1	2	3	4	5	6	7
Incorporating the relevant feelings and emotions into the imagery	1	2	3	4	5	6	7

How helpful were the following things in making the imagery easier to perform......	Not at all helpful			Neither helpful or unhelpful			Very helpful
Imaging while adopting the physical positions and having the props (e.g., stone, coin, bike, rope) reflective of the movements you imaged	1	2	3	4	5	6	7
Performing the imagery in the environment reflective of the movements	1	2	3	4	5	6	7
Imaging the movements at a standard reflective of your movement capabilities	1	2	3	4	5	6	7
Imaging the movements in real time	1	2	3	4	5	6	7
Incorporating the relevant feelings and emotions into the imagery	1	2	3	4	5	6	7

Appendix 5 : Observation Evaluation Form (Chapter 3)

How similar do you perceive the model performing the movements to yourself?

1 2 3 4 5 6 7

Not at all similar — Very similar

To what extent did observing help you to image the movements at a standard reflective of your movement capabilities

1 2 3 4 5 6 7

Not at all similar — Very similar

Appendix 6 : Post-experimental evaluation form (Chapter 3)

Could you please state which approach you think is better and beneficial at enhancing vividness or easiness in imagery in terms of information of the movement and time consuming to create the image?

____

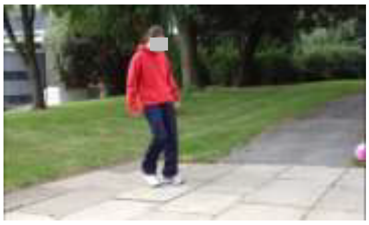
____

Appendix 7 : Example stills of a video clip of 12 movements in VMIQ-2 (Chapter 3)

Riding a Bike

Walking

Kicking a stone



Swinging on a rope

Kicking a ball in the air

Running downhill

Jumping off a wall

Running up Stairs

Bending to pick up a coin

Throwing a stone into a water

Running

Jumping sideways

Appendix 8: Sports Imagery Ability Questionnaires (Chapter 4 and 5) (SIAQ; Williams & Cumming, 2011)

The purpose of this questionnaire is to obtain information about your ability to generate a number of images athletes use in relation to their sport.

The first part of the questionnaire concerns itself with how easy you find being able to image and the second part is how vivid your images are.

Part 1: Ease of imaging

Ease of imaging refers to how easily you are able to create and control images. For each item, bring the image to your mind with your eyes CLOSED. Then rate how easy it is for you to experience the image (1 = very hard, 4 = not easy or hard, 7 = very easy). Circle the appropriate rating based on the scale provided. For example, some athletes may find imaging themselves kicking a football somewhat hard to image and therefore select 3.

Ease of imaging scale

1	2	3	4	5	6	7
Very hard to image	Hard to image	Somewhat hard to image	Neutral (not easy nor hard)	Somewhat easy to image	Easy to image	Very easy to image

Please be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each image. There are no right or wrong answers, because we are simply interested in your response.

Part 1: Ease of Imaging	*1*	*2*	*3*	*4*	*5*	*6*	*7*
In relation to my sport, how easy is it for me to image the following…	Very hard to image	Hard to image	Somewhat hard to image	Neutral (not easy not hard)	Somewhat easy to image	Easy to image	Very hard to image
1.Making up new plan / strategy in my head	1	2	3	4	5	6	7
2. Giving 100% effort even when things are not going well.	1	2	3	4	5	6	7
3. Refining a particular skill.	1	2	3	4	5	6	7
4. The positive emotions I feel while doing my sport.	1	2	3	4	5	6	7
5. Myself winning a medal.	1	2	3	4	5	6	7
6. Alternative plans/strategies.	1	2	3	4	5	6	7
7. The anticipation and excitement associated with my sport.	1	2	3	4	5	6	7
8. Improving a particular skill.	1	2	3	4	5	6	7
9. Being interviewed as a champion.	1	2	3	4	5	6	7
10. Staying positive after a setback.	1	2	3	4	5	6	7
11. The excitement associated with performing.	1	2	3	4	5	6	7
12. Making corrections to physical skills.	1	2	3	4	5	6	7
13. Creating a new event/game plan.	1	2	3	4	5	6	7
14. Myself winning.	1	2	3	4	5	6	7
15. Remaining confident in a difficult situation.	1	2	3	4	5	6	7

Part 3: Perspective

When imaging the items listed above, you may have seen yourself from different perspectives. A first person perspective is an inside view, as if you are actually inside yourself seeing the action through your own eyes, whereas a third person perspective is an outside view, as if watching yourself on video tape. Please fill in the next set of questions by inserting the appropriate response between 1 and 7 in the space provided that best reflects the perspective you adopted when imaging the following items.

What perspective did you adopt when imaging the following...

1	Skill images (e.g., refining a particular skill):	
2	Strategy images (e.g., creating a new event/game plan):	
3	Goal images (e.g., myself winning):	
4	Affect Images: (e.g., the positive emotions I feel while doing my sport):	
5	Mastery Images: (e.g., giving 100% effort even when things are not going well)	

1	2	3	4	5	6	7
Always first person	Mostly first person sometimes third person		Half & Half	Mostly third person sometimes first person		Always third Person

Appendix 9: “Physical” and “Environment imagery priming items (Chapter 4)

Item no		Never	Rarely	Not very often	Sometimes	Fairly often	Often	Very often
1	I make small movements or gestures during the imagery	1	2	3	4	5	6	7
2	I wear training/competition clothes	1	2	3	4	5	6	7
3	I image while holding or touching kit related to my sport (e.g., hockey stick)	1	2	3	4	5	6	7
4	I perform the movement for real just before I image it	1	2	3	4	5	6	7
5	I image while standing or adopting a position similar to what I am imaging	1	2	3	4	5	6	7
6	I watch myself or others perform the movement and/or in that situation, either live or recorded	1	2	3	4	5	6	7
7	I image in the real training/competition environment	1	2	3	4	5	6	7
8	I image a situation that I have recently experienced	1	2	3	4	5	6	7
9	I use pictures or other visual cues of the environment and/or equipment	1	2	3	4	5	6	7
10	I try to image the same senses (e.g., sight, sound, smell, taste, touch) that I would experience in the real life situation	1	2	3	4	5	6	7

Appendix 10: Emotion Regulation Questionnaire (Chapter 5)
(ERQ; Uphill, Lane, & Jones, 2012)

The Emotion Regulation Questionnaire is designed to assess individual differences in the habitual use of two emotion regulation strategies: cognitive reappraisal and expressive suppression.

Instructions and Items
We would like to ask you some questions *in relation to competing and training generally in sport*, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

No	Item	Strongly disagree------------------Neutral------------------Strongly agree						
1	When I want to feel more positive emotion (such as joy or amusement), I change what I'm thinking about.	1	2	3	4	5	6	7
2	I keep my emotions to myself.	1	2	3	4	5	6	7
3	When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.	1	2	3	4	5	6	7
4	When I am feeling positive emotions, I am careful not to express them.	1	2	3	4	5	6	7
5	When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.	1	2	3	4	5	6	7
6	I control my emotions by not expressing them.	1	2	3	4	5	6	7
7	When I want to feel more positive emotion, I change the way I'm thinking about the situation.	1	2	3	4	5	6	7
8	I control my emotions by changing the way I think about the situation I'm in.	1	2	3	4	5	6	7
9	When I am feeling negative emotions, I make sure not to express them.	1	2	3	4	5	6	7
10	When I want to feel less negative emotion, I change the way I'm thinking about the situation.	1	2	3	4	5	6	7