INVESTIGATING THE EFFECTS OF POSITIVE AND NEGATIVE IMAGERY CONTENT AND ABILITY ON COGNITIVE, AFFECTIVE, AND BEHAVIOURAL OUTCOMES

By

MARY LOUISE QUINTON

A thesis submitted to University of Birmingham

for the degree of

DOCTOR OF PHILOSOPHY

School of Sport, Exercise, and Rehabilitation Sciences

College of Life and Environmental Sciences

University of Birmingham

September 2017

Abstract

The aim of this thesis was to investigate the effects of positive and negative imagery content and ability on cognitive, affective, and behavioral outcomes. After reviewing the literature in Chapter 1, Chapter 2 examined whether negative image interpretation was influenced by imagery content and skill level. This chapter also investigated the effect of imagery content and skill level on performance, anxiety, and confidence in a golf putting task. Following a similar study design to Chapter 2, Chapter 3 investigated imagery's effectiveness for regulating psychological and cardiovascular responses to competition stress. This chapter also examined whether mastery imagery ability was associated with psychological and cardiovascular outcomes. Following an experimental investigation of mastery and affect imagery ability, Chapter 4 explored these types of imagery ability as mediators between confidence and appraisals and responses to stress. This chapter also explored negative imagery ability's role in these models through a negatively worded version of the Sport Imagery Ability Questionnaire. Overall, this thesis makes novel contributions to imagery literature by adding new relationships to the revised applied model of deliberate imagery use, testing a new measure of negative imagery ability, and highlighting mastery imagery ability's role for protecting against debilitative imagery and regulating stress outcomes.

Dedication

This thesis is dedicated to my Grandad. The determination you showed throughout your life inspired me to "Never Give Up". Thank you.

Acknowledgements

The first thank you has to go to my PhD supervisors Sarah and Jenn. Sarah, thank you for making me feel that I could always come and talk to you and that no question was a stupid question. I don't think you will ever really know just how much our meetings helped to give me focus and clear my head, particularly around the stage when structural equation modelling was introduced! You have made my PhD experience one that I actually enjoyed and I hope that my supervision of others in the future is as valuable as yours was to me.

Jenn, thank you for the potential that you saw in me as a third year undergraduate student on your project all those years ago and for keeping me around ever since! Your guidance has helped me to view things from different perspectives and I've learned more than I ever thought I would. Thank you for providing me with so many exciting opportunities and I look forward to our continued work together in the future.

I'd also like to thank my fellow MST4Life team members Mark, Sam, and Ben. Thank you for always being a listening ear when I've been struggling, for the coffee breaks when I've needed to de-stress, and for many great memories (particularly in the yurt!) that have kept me smiling. Thanks also to my previous office mates Jess and Eva for your advice and continued support. Also a big thanks must go to Jet and Gavin for your support and helping me make sense of the cardiovascular data!

I'd also like to say a big thank you to my hockey team for providing me with such a good distraction from PhD work. The hockey matches (and socials!) helped me make sure I kept a good work life balance and they were a very good form of stress relief! I look forward to celebrating this achievement with you all.

One of the biggest thank you's has to go to my family. To my father, Martin, you always seemed to know when I was struggling and knew exactly the right thing to say to help me overcome any challenges. Thank you for the invaluable advice, being my shoulder to cry on, and my proudest supporter. To my auntie, Sharon, thank you for your unconditional love and support and for always being on the end of the phone when I needed it. To my stepmother, Samantha, thank you for making my trips home some of the most comforting times over my PhD. To my sister, Emily, you had the pleasure of living with me for the majority of my PhD – well done for putting up with me! Thank you for the ways you helped which you probably didn't even realize – with the brunch outings, cake baking, and Grey's watching you definitely knew how to reduce my stress levels, even when I had glandular fever! Also thank you to Joe for your infectious positivity and support (and for taking Emily off my hands!).

Last but by no means least, thank you to my boyfriend, best friend, and my rock, Jamie. Firstly, thank you for encouraging me to pursue a PhD in the first place even though you knew it meant more time apart for us. Thank you for listening to my worries, for your constant reassurance, and for your unwavering belief in me when I couldn't always see it myself. You also weren't afraid to give me some much needed tough love sometimes! You have supported me from the start of my PhD journey and moved your life up to Birmingham towards the end of my PhD journey. Saying thank you just doesn't quite seem enough, I couldn't have done this without you by my side.

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Publications and conference presentations produced during the PhD

Publications which are part of this PhD thesis

1. Quinton, M. L., Cumming, J., Allsop, J., Gray, R., & Williams, S. E. (2016). Imagery meaning and content in golf: Effects on performance, anxiety, and confidence. *International Journal of Sport & Exercise Psychology*. Advanced online publication. doi:10.1080/1612197X.2016.1242150

2. Quinton, M. L., Veldhuijzen van Zanten, J. J. C. S., Trotman, G. P., Cumming, J., & Williams, S. E. (under review). Psychological and cardiovascular stress responses: Influence of challenge, threat, and relaxation imagery. *International Journal of Psychophysiology.*

3. Quinton, M. L., Cumming, J., & Williams, S. E. (2017). Investigating the mediating role of positive and negative mastery imagery ability. *Psychology of Sport & Exercise, 35,* 1-9. doi:10.1016/j.psychsport.2017.10.011.

Publications which are not part of this thesis

Journal Articles

1. Williams, S. E., Veldhuijzen van Zanten, J. J. C. S., Trotman, G. P., Quinton, M. L., & Ginty, A. (2017). Challenge and threat imagery manipulates heart rate and anxiety responses to stress. *International Journal of Psychophysiology, 117,* 111-118. doi:10.1016/j.ijpsycho.2017.04.011

2. Trotman, G. P., Quinton, M. L., Williams, S. E., & Veldhuijzen van Zanten, J. J. C. S. (under review). Challenge and threat states: Examining cardiovascular, cognitive, and affective responses to two distinct laboratory stress tasks. *International Journal of Psychophysiology.*

3. Quinton, M. L., Cumming, J., & Williams, S. E. (in preparation). *A qualitative exploration of elite athletes' facilitative and debilitative imagery experiences.*

4. Cumming, J., Cooley, S. J., Anuar, N., Kosteli, M., Quinton, M. L., Weibull, F., & Williams, S. E. (2016). Developing imagery ability effectively: A guide to layered stimulus response training. *Journal of Sport Psychology in Action, 8,* 23-33. doi: 10.1080/21520704.2016.1205698

5. Quinton, M. L., Cumming, J., Gray, R., Geeson, J. R., Cooper, A., Crowley, H., & Williams, S. E. (2014). A PETTLEP imagery intervention with young athletes. *Journal of Imagery Research in Sport and Physical Activity, 9,* 47-59. doi:10.1515/jirspa-2014-0003

Published Abstracts

1. Cumming, J., Cooper, A., Crowley, H., Geeson, J. R., Quinton, M. L., & Gray, R. (2012). Does PETTLEP imagery improve imagery ability and learning of visuomotor skills in youth athletes? *Journal of Sport and Exercise Psychology, 34,* S61-62.

Conference presentations

1. Quinton, M. L., Cumming, J., & Williams, S. E. (2017). Investigating the mediating role of positive and negative mastery imagery ability. Presented at the Annual Meeting of Research in Imagery and Observation UK (RIO-UK), Roehampton, UK.

2. Quinton, M. L., Cumming, J., Allsop, J., Gray, R., & Williams, S. E. (2015). Individual characteristics influence image meaning: Support for the revised applied model of deliberate imagery use. Presented at the Annual Meeting of Research in Imagery and Observation UK (RIO-UK), Stirling, UK.

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List of Abbreviations

Frequently Used Imagery Terms

CG	Cognitive General
CS	Cognitive Specific
LSRT	Layered Stimulus Response Training
MG-A	Motivational General - Arousal
MG-M	Motivational General - Mastery
MS	Motivational Specific

Questionnaires and Theories

BPS	Biopsychosocial
CAS	Cognitive Appraisal Scale
CTAI-2	Competitive Trait Anxiety Inventory-2
IAMS	Immediate Anxiety Measurement Scale
RAMDIU	Revised Applied Model of Deliberate Imagery Use
SIAQ	Sport Imagery Ability Questionnaire
TCTSA	Theory of Challenge and Threat States in Athletes

Analysis Terms

ANOVA	Analysis of Variance
AVE	Average Variance Extracted
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CR	Composite Reliability
ECVI	Expected Cross Validation Index
MANOVA	Multivariate Analysis of Variance
RMSEA	Root Mean Square Error of Approximation
SRMR	Standardized Root Mean Square Residual

TLI	Tucker Lewis Index

Physiological Measures

BP	Blood Pressure
BPM	Beats per Minute
CO	Cardiac Output
DBP	Diastolic Blood Pressure
ECG	Echo Cardiogram
HR	Heart Rate
mmHg	Millimeter of Mercury
SBP	Systolic Blood Pressure
TPR	Total Peripheral Resistance

Chapter 1

General Introduction

Investigating the effects of positive and negative imagery content and ability on cognitive, affective, and behavioral outcomes

What is Imagery?

The popularity of imagery as a mental technique is widely recognized and is commonly referred to as the “centre pillar” in the field of applied sport psychology (Morris, Spittle, & Perry, 2004, p. 344). The difficulty in selecting one definition of imagery as applicable to a variety of settings has been acknowledged (Cumming & Williams, 2012; Morris, Spittle, & Watt, 2005), but for the purpose of this thesis imagery is defined as White and Hardy’s (1998, p.389) more general conceptualization of imagery:

> “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… it differs from dreams in that we are awake and conscious when we form an image.”

Paivio’s (1985) framework proposed that imagery could be divided into cognitive and motivational functions which could be further subdivided into general and specific levels. Cognitive general (CG) imagery reflected images to improve strategies and game plans while cognitive specific (CS) imagery included images designed to refine particular skills. Motivational general (MG) imagery consisted of mastery and arousal images, whereas motivational specific (MS) imagery reflected images to facilitate achieving one’s goals. At a later date, Hall, Mack, Paivio, and Hausenblas (1998) extended Paivio’s framework and suggested that MG imagery could be further divided into MG-mastery (MG-M; images to enhance confidence and feelings of mastery) and MG-arousal (MG-A; images to regulate affect, feelings, and emotion). This framework proposes to explain how the benefits of imagery transpire.

Research reviewing the role of imagery has identified numerous benefits that fit within the aforementioned framework such as facilitating more effective planning and problem solving (CG), helping to improve skills (CS), enhancing motivation towards one's goals (MS), increasing confidence and self-efficacy (MG-M), and regulating arousal and emotional control (MG-A; Cumming & Williams, 2012; Martin, Moritz, & Hall, 1999; Moran, Campbell, Holmes, & MacIntyre, 2012; Morris et al., 2005; Weinberg, 2008). However, several functions of imagery have been identified outside of Paivio (1985) and Hall et al.'s (1998) framework in a wider range of domains such as, but not limited to, enhancing muscular strength (Slimani, Tod, Chaabene, Miarka, & Chamari, 2016b), increasing exercise intentions in sedentary individuals (Chan & Cameron, 2012), facilitating stroke rehabilitation (Page, 2010), and improving performance in music, acting, and surgery (Cotterill, 2015).

Additional functions of imagery specific to the clinical psychology setting are also evident, such as managing psychosis and increasing positive mood and emotion in bipolar disorder (Holmes, Geddes, Colom, & Goodwin, 2008; Laing, Morland, & Fornells-Ambrojo, 2016). Furthermore, within the clinical setting imagery is recognized as having a more powerful impact than verbal thought on positive and negative emotional outcomes (e.g., anxiety, positive and negative affect; Holmes & Mathews, 2010), emphasizing the importance and effectiveness of imagery for regulating affective outcomes.

Despite imagery's well documented success in serving cognitive and motivational outcomes, imagery is not always effective and if not used effectively it can elicit no benefits or even serve detrimental outcomes (Nordin & Cumming, 2005; Quinton, Cumming, Allsop, Gray, & Williams, 2016; Taylor & Shaw, 2002). However, while research suggests that imagery can cause detrimental effects, there has been no extensive examination in regards to what factors lead to how positive and negative imagery content is interpreted (i.e., facilitative and debilitative imagery). Therefore, there is a need to understand the unhelpful experiences of imagery and this thesis aimed to address this gap and investigate the subsequent effects on cognitive, affective, and behavioral outcomes. Literature from both sport and clinical psychology was drawn upon throughout the thesis to provide a more comprehensive understanding of facilitative and debilitative imagery.

This chapter will first provide an overview of the facilitative and debilitative imagery literature and differentiate between these types of imagery and positive and negative content. Next, models outlining effective imagery use will be introduced, with an emphasis on the revised applied model of deliberate imagery use (RAMDIU; Cumming & Williams, 2013). Then, different frameworks and the associated literature that ensure effective interventions for stress regulation will be discussed. Finally, imagery as a technique for regulating stress will be reviewed, before the aims of the thesis and each chapter are discussed.

Imagery is Not Always Beneficial

If imagery is not used effectively it can result in debilitative outcomes (e.g., increased anxiety, reductions in performance and self-efficacy; Quinton et al., 2016; Short et al., 2002). These outcomes are influenced by imagery meaning, which refers to the perception of an image as either facilitative or debilitative. Research investigating imagery meaning dates back over 40 years, where research supported the notion that positive and negative imagery led only to positive and negative outcomes respectively. For example, imaging oneself successfully performing a task led to better performance, and imaging an unsuccessful performance outcome led to worse performance compared to baseline (Woolfolk, Parrish, & Murphy, 1985b). However, inconsistencies amongst studies were identified (Short, Ross-Stewart, & Monsma, 2006) in terms of the effect of positive and negative imagery had on outcomes. For example, Meyers, Schleser, Cooke, and Cuvillier (1979) found no difference between positive (i.e., mastering a front walkover) and negative (i.e., making a mistake on a front walkover) imagery groups on gymnastic performance, whereas Woolfolk, Murphy, Gottesfeld, and Aitken (1985a) found negative imagery (i.e., missing a putt) decreased golf putting performance, but positive imagery (i.e., successfully executing a putt) did not enhance performance. For the most part, however, this research did not consider how positive and negative imagery was perceived by individuals performing the imagery (i.e., as facilitative or debilitative towards performance and other associated outcomes).

One study that did measure imagery meaning was that by Woolfolk et al. (1985a), who found that although the positive imagery group predominantly believed their imagery helped performance (i.e., was facilitative imagery) and the negative imagery group perceived their imagery hurt performance (i.e., was debilitative imagery), there were also individuals in each group who perceived the opposite (e.g., positive imagery hurt performance and negative imagery helped performance). These findings highlighted the importance of determining imagery meaning to ensure that imagery content was being perceived as intended and indicated important avenues for future research that were addressed in this thesis.

Despite an apparent discrepancy between the concepts of positive and negative imagery and facilitative and debilitative imagery, it was not until 2002 that Short and colleagues (Short et al., 2002) defined facilitative (i.e., helpful) and debilitative (i.e., unhelpful) imagery, and highlighted that positive and negative images are not always synonymous with positive and negative outcomes respectively. Indeed, even when positive image content is acknowledged as debilitative, athletes have still reported using such imagery, for example during injury (Monsma, Mensch, & Farroll, 2009; Ross-Stewart & Short, 2009). Table 1.1 provides Short et al.'s definitions of facilitative and debilitative imagery and examples of positive and negative imagery content from sport (field hockey) and clinical psychology that could be considered facilitative or debilitative in nature. For example, imaging the excitement before an important game (i.e., positive motivational content) might typically be perceived as facilitative (i.e., the image serves the function of increasing arousal and helps the athlete to get “psyched up” for the game). However, for an athlete with a more anxious predisposition, imaging this content might increase outcomes associated with stress (e.g., cognitive and somatic anxiety intensity and perceiving this anxiety as unhelpful towards the upcoming game), and thus the positive image content is perceived as debilitative. Similarly, imaging missing a key tackle (i.e., negative cognitive content) may typically be regarded as a mistake and therefore a debilitative image, however, this content may also serve a motivational function for some athletes to make sure their next tackle is more successful and therefore perceived as facilitative. As research has demonstrated that debilitative images can be more impactful and harmful than facilitative or neutral imagery (Nordin & Cumming, 2005), it is important to distinguish between the content of imagery (e.g., positive and negative) and the interpretation of the image (e.g., facilitative or debilitative) to ensure imagery interventions are effective at eliciting the intended facilitative outcomes.

Table 1.1
Examples of facilitative and debilitative imagery according to positive and negative image content.

		Positive		Negative	
	Definition (Short et al., 2002)	Sport	Clinical	Sport	Clinical
Facilitative	“Imagery designed to have a positive effect on one’s ability to learn and perform, modify important cognitions such as self-efficacy, and regulate arousal and anxiety” (p. 49)	Imaging the successful execution of a penalty corner routine	Imaging meeting up with a friend for a long catch up	Imaging missing a key tackle (but serves as motivating to make the next one)	Imaging being admitted to hospital (but having family there to support you)
Debilitative	“Imagery designed to impede an individual’s ability” to achieve these same results” (p.51)	Imaging the excitement before a key game (but this leads to feeling worried)	Imaging being happy with one’s body image (but currently having an eating disorder)	Imaging the unsuccessful execution of a penalty corner routine	Imaging being told by your boss that you’ve lost your job

The facilitative and debilitative sport imagery literature to date has investigated the effect of imagery meaning on stress related outcomes such as performance and self-efficacy (or confidence). Some studies have reported facilitative and debilitative imagery to increase and decrease performance and self-efficacy respectively (Beilock, Afremow, Rabe, & Carr, 2001; Cumming, Nordin, Horton, & Reynolds, 2006; Short et al., 2002), whereas other studies have found the decrease in performance and confidence from debilitative imagery is not accompanied by a performance and confidence increase from facilitative imagery (Nordin & Cumming, 2005; Taylor & Shaw, 2002). There are evidently inconsistencies across studies, which are likely due to the mixed terminology used (e.g., positive, negative, facilitative, debilitative, or suppressive imagery). Furthermore, these findings highlight the narrow focus within the literature in terms of outcomes investigated. It is surprising that facilitative and debilitative imagery research has not focused on other stress related outcomes such as anxiety, particularly as this construct is mentioned in Short et al.'s (2002) definitions of facilitative and debilitative imagery (Table 1.1). Investigating the effect of facilitative and debilitative imagery on anxiety would provide key findings in regards to regulating this central component of stress (i.e., whether debilitative imagery is more impactful on anxiety than facilitative imagery and therefore whether strategies should target reducing debilitative imagery rather than encouraging facilitative imagery). Therefore, this thesis addressed this gap in the literature.

The concept of differentiating between the effect of positive and negative imagery content on outcomes is also evident within clinical psychology, where an imbalance between positive and negative images has been suggested as a key maintenance factor in mental health conditions such as psychosis, depression, and social anxiety (Brewin, Gregory, Lipton, & Burgess, 2010; Laing et al., 2016; Moscovitch, Gavric, Merrifield, Bielak, & Moscovitch, 2011). However, in contrast to sport psychology literature, the terminology used predominantly includes positive and negative imagery (rather than facilitative and debilitative). This difference between areas of literature might also explain why it is more commonly assumed in the clinical literature that positive imagery content is associated with positive outcomes (e.g., imaging success associated with a happy mood; Sanna, 2000) and negative content with negative outcomes (e.g., imaging being attacked or killed in paranoia; Schulze, Freeman, Green, & Kuipers, 2013), as the focus of terminology is on imagery content (i.e., positive or negative) rather than meaning (i.e., facilitative or debilitative). However, an exception from evidence with psychosis research suggests that similar to sport psychology research, although positive images are experienced (e.g., achieving goals, escaping everyday life), they can be perceived as debilitative and are associated with debilitative emotions such as anxiety (Laing et al., 2016; see Table 1.1 for examples).

Another area within the clinical psychology literature that alludes to the importance of imagery meaning for effective imagery is the inclusion of techniques such as imagery rescripting and cognitive bias modification (e.g., Lang, Blackwell, Harmer, Davison, & Holmes, 2012; Slofstra, Nauta, Holmes, & Bockting, 2016). These techniques are centered upon modifying the interpretation of negative or ambiguous imagery or information processing biases to alter cognitive, behavioral, and affective outcomes. However, measures to assess this interpretation are either worded to assume negative images are perceived as unpleasant (e.g., Slofstra et al., 2016), or fail to assess this interpretation at all (e.g., Lang et al., 2012), suggesting that similar to sport psychology, there is a lack of valid manipulation checks to assess this important component of imagery.

Altogether, reviewing the aforementioned literature clarified the existing gaps of the previous work. First, facilitative and debilitative imagery research in a sport setting has focused predominantly on performance and confidence (or self-efficacy), despite factors such as anxiety being important. The link between negative images and anxiety is particularly apparent from the clinical psychology literature (Holmes & Mathews, 2010; Moscovitch et al., 2011), yet the relationship between anxiety and facilitative and debilitative imagery has not been investigated. Second, research should investigate other factors likely to impact the meaning and effectiveness of facilitative and debilitative imagery. As previously mentioned, skill level is one characteristic that could influence imagery meaning and whether an image is facilitative or debilitative. Another factor that could influence imagery meaning is imagery ability. For example, those who are better able to image positive image content experience more benefits from imagery and thus might perceive it as more facilitative. Collectively, reviewing this literature identified two clear gaps that were addressed in this thesis: investigating the effect of facilitative and debilitative imagery on anxiety, and determining if imagery ability influences imagery meaning and the subsequent effectiveness of imagery.

In summary, both sport and clinical psychology highlights the importance of considering how the content of imagery is perceived (i.e., as facilitative or debilitative) to produce effective imagery. However, determining the importance of imagery meaning for generating effective imagery has not truly been investigated, as research has often neglected to measure imagery meaning (i.e., lack of manipulation checks) and interventions have often lacked a theoretical background. It is important to have a theoretical framework to provide an overarching structure to a body of work (Merriam, 1998), but also to help guide the proposed hypotheses and research questions. Therefore, the next section will focus on theories of effective imagery, including support for determining imagery meaning, and explain how the RAMDIU (Cumming & Williams, 2013) underpins this thesis.

Theories and Models of Effective Imagery

Triple code theory. One theory that highlights the importance of imagery meaning is Ahsen's (1984) triple code theory. Ahsen proposed that an image can serve multiple functions and the function is determined by the individual's interpretation of the image. It was theorized that biases are brought into one's imagery, whether consciously or unconsciously, and therefore different imagery experiences (and interpretations) are present across individuals (Ahsen, 1984). For example, a group of international field hockey players may be provided with the same instructions to image feelings of confidence prior to taking a penalty stroke, but this image might instill the opposite feelings for a player who has recently missed a penalty stroke. However, a main limitation of this theory is a lack of information regarding how the physical characteristics of imagery content (e.g., situational details) contribute to imagery's effectiveness in eliciting positive outcomes. Furthermore, this theory has received little empirical support particularly in sport psychology (Morris et al., 2005), where other models and theories may be more appropriate.

Bioinformational theory. Another relevant theory informing this thesis with regards to explaining imagery meaning and effectiveness is Lang's (1979) bioinformational theory. Initially concerned with fear and emotional imagery, this theory has extensively underpinned clinical and sport psychology interventions and guidelines (e.g., Anuar, Cumming, & Williams, 2016; Cumming et al., 2016; Ji, Heyes, MacLeod, & Holmes, 2016; Martin et al., 1999; Quinton et al., 2016). Providing greater insight into the characteristics of imagery than triple code theory (Ahsen, 1984), Lang proposed that images in the brain are stored as three types of propositional structures: stimulus (e.g., physical and situational details of the scene to be imaged), response (e.g., physiological and emotional situational responses), and meaning propositions (e.g., details on how the image is perceived by the individual). These meaning propositions likely determine whether an image is perceived as facilitative or debilitative (i.e., positive meaning propositions are more likely to lead to facilitative imagery, where negative propositions would lead to debilitative imagery). For example, Williams et al. (2010) found that imagery scripts including stimulus and response propositions alongside low feelings of confidence and control (i.e., negative meaning propositions) led to imagery being perceived as debilitative towards hypothetical performance. It is further proposed that the links between stimulus, response, and meaning propositions are strengthened by physical and mental practice, subsequently leading to more detailed (i.e., more stimulus, response, and meaning information) and effective imagery (Lang, 1979).

Bioinformational theory (Lang, 1979) has been supported in the clinical psychology literature (for a review see Ji et al., 2016). In particular, there has been a link established between the degree of emotional response and one's ability to image, as research has found those with emotional disorders (e.g., depression and anxiety) have a lower ability to image positive content and higher ability to image negative content (Holmes, Lang, Moulds, & Steele, 2008; Morina et al., 2011). Support for Lang's (1979) theory is also evident in the applied sport setting (for a review see Morris et al., 2005), where research has highlighted the importance of including stimulus, response, and meaning propositions when designing effective imagery scripts (Williams, Cooley, Newell, Weibull, & Cumming, 2013) and also for enhancing imagery ability through layered stimulus response training (Cumming et al., 2016), both of which are discussed in Chapters 2 and 3.

Although Lang's (1979) bioinformational theory provides clearer guidance than Ahsen's (1984) triple code theory on what components are required for effective imagery (i.e., stimulus, response, and meaning propositions), both Ahsen's and Lang's theories are limited in that they do not consider contextual factors influencing imagery use (i.e., the situation where imagery occurs), or explain how imagery leads to the resultant outcomes. Furthermore, both theories were specific to the clinical setting so the generalizability of these theories may be somewhat limited. Therefore, although certain strengths of these theories (e.g., considering imagery meaning) informed the present thesis, models more relevant to sport imagery, such as the applied model of imagery use in sport (Martin et al., 1999), also influenced the theoretical underpinning of this thesis.

Applied model of imagery use in sport. The applied model of imagery was designed by Martin et al. (1999) as a framework for researchers and applied practitioners to follow when creating effective imagery. Informed by Ahsen's (1984), Lang's (1979), and Paivio's (1985) theories and frameworks, Martin et al.'s (1999) model proposed that the type (i.e., function) of imagery used determines what outcomes (i.e., cognitive, behavioral, or affective) will be experienced, that certain types of imagery will be more relevant in different sport situations (e.g., training, competition), and that imagery ability will influence how the imagery function leads to the outcome experienced. Although not a component in the model, the authors also acknowledge imagery meaning and state that different images have different meanings to different athletes, which in turn are associated with different outcomes. In sum, there are four key components to consider when determining the effectiveness of athlete's imagery use (sport situation, imagery type, imagery ability, and outcomes experienced; see Figure 1.1 for an overview of the model). For example, according to the applied model, effective imagery would occur if an athlete with high imagery ability levels imaging immediately prior to competition (i.e., situation) to achieve their optimum arousal level (i.e., outcome) used motivational imagery to regulate their arousal (i.e., function).

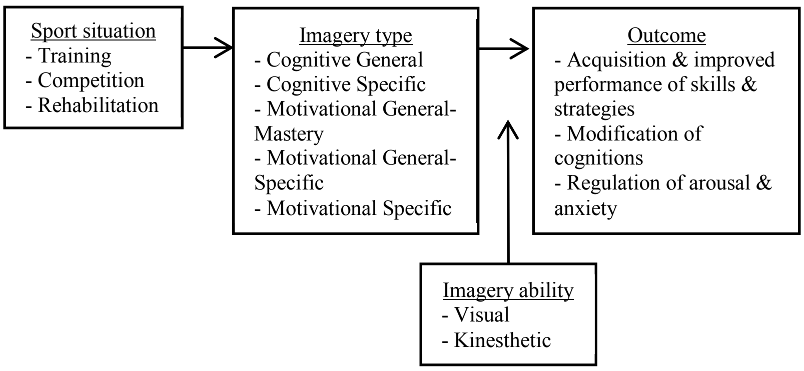


Figure 1.1. The applied model of imagery use. Adapted from "Martin, K.A., Moritz, S.E., & Hall, C. (1999). Imagery use in sport: A literature review and applied model. *The Sport Psychologist, 13,* 245–268."

This model is recognized for the hypothesis of "what you see really is what you get" (Martin et al., 1999, p.260). In other words, the imagery content should match the desired outcomes. There has been ample support in the literature for this concept (see Cumming & Ramsey, 2009 for a review), for example skill based imagery content has enhanced skill related performance (Nordin & Cumming, 2005), affect images have increased anxiety intensity and cardiovascular responses (Cumming et al., 2007), and mastery based images have been associated with confidence and self-efficacy (Abma, Fry, & Relyea, 2002; Beauchamp, Bray, & Albinson, 2002). However, research has also demonstrated that imagery can lead to additional outcomes (e.g., CS imagery improving self-efficacy; Nordin & Cumming, 2005) and imagery's effectiveness depends on the individual interpretation of the image (Cumming & Williams, 2013).

Martin et al. (1999) acknowledged a key limitation in the model is not accounting for individual differences (e.g., skill level). Furthermore, from a facilitative and debilitative imagery point of view, although the model is based on research highlighting the importance of imagery meaning (Ahsen, 1984; Lang, 1979), the model is similar to the older imagery literature in that it does not acknowledge that positive image content could have a debilitative effect and negative image content could have a facilitative effect. Finally, despite acknowledging that athletes can use different imagery for different functions (e.g., Nordin & Cumming, 2005), and that two or more types of imagery can be used simultaneously (e.g., MG-A and MG-M; Cumming et al., 2007), the authors also fail to distinguish between imagery content (i.e., what is imaged) and imagery function (i.e., why it is imaged). Therefore, the next section introduces the RAMDIU (Cumming & Williams, 2013), explaining how the framework expands upon the original applied model and how it is integrated into the research conducted in this thesis.

Revised applied model of deliberate imagery use (RAMDIU). The RAMDIU (Cumming & Williams, 2013) was developed not only to address the aforementioned limitations of the original applied model, but it was also timely to reflect advances in the imagery literature since the former model's conception. The RAMDIU (Figure 1.2) provides a theoretical framework to systematically guide imagery use and expands upon the original model by extending its application to exercise, dance, and rehabilitation settings. Although the focus of the RAMDIU is on deliberate imagery, research has suggested that it can be possible to manipulate spontaneous imagery (see Holmes & Matthews, 2010 for a review), therefore it is likely that some of the models' hypotheses may also apply to spontaneous imagery (e.g., to manipulate spontaneous debilitative images). Furthermore, the RAMDIU acknowledges the distinction between imagery content and function (i.e., what you see is not necessarily what you get) and incorporates key theories (e.g., Ahsen, 1984; Lang, 1979) to include new components such as imagery meaning and individual characteristics, and provides more information on the role of imagery ability, therefore also making the theory more relevant to facilitative and debilitative imagery research. The subsequent sections will outline the different components in the model and will explain how this theoretical framework provides the overarching structure to this thesis.

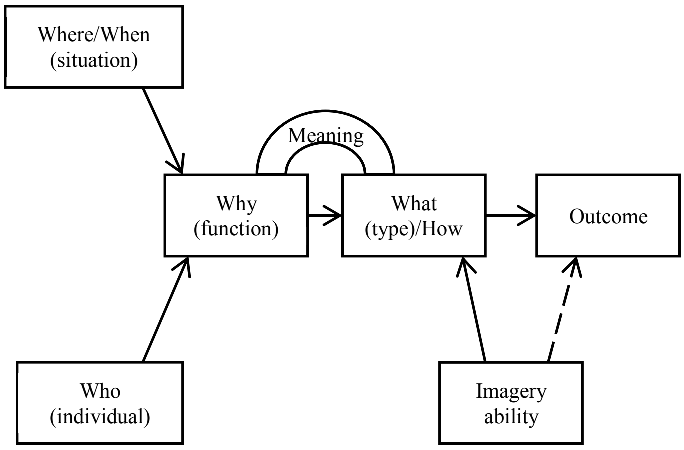


Figure 1.2. The revised applied model of deliberate imagery use. Adapted from "Introducing the revised applied model of deliberate imagery use for sport, dance, exercise, and rehabilitation", by J. Cumming & S. E. Williams, 2013, *Movement & Sport Sciences*, *82*, 69-81. doi:http://dx.doi.org/10.1051/sm/2013098. Copyright 2013 by EDP Sciences. Adapted with permission.

Where (location) and when (situation). This first component of the model proposes that the function of imagery will be influenced by where (i.e., location) the imagery is experienced. For example, the night before a competition a long distance runner might image to rehearse their race plan, but on their journey to the race venue they might be imaging to regulate their arousal levels. The imagery function will also vary according to when (i.e., situation) one images. These propositions are in accordance with the environment and task elements of the PETTLEP[1] model (Holmes & Collins, 2001), which proposes that the individual's surroundings and task nuances should be considered to maximize the effectiveness of an imagery intervention. However, research has not investigated whether different types of imagery are more or less effective for different situations (i.e., when). For example, imagery focusing on refining particular skills (i.e., CS imagery) may be more effective for improving motor skill performance (e.g., golf putting at a competition), whereas imagery focusing on overcoming difficult situations (i.e., MG-M imagery) might be more useful for mastering stress eliciting situations (e.g., during a match). Furthermore, if imagery is not effective for the task then it might be considered as debilitative. This concept is one gap in the literature that was examined in the current thesis and Chapter 3 investigated this hypothesis in the context of a competitive task.

Who (individual characteristics). Playing a similar role to the where and when components, the Who component of the model is concerned with the influence of individuals' trait characteristics on imagery function. Research has demonstrated that numerous individual characteristics can influence the experience of imagery, such as age (Quinton et al., 2014), gender (Cumming, 2008), emotional regulation tendencies (Anuar et al., 2016), perfectionistic tendencies (Nordin-Bates, Cumming, Aways, & Sharp, 2011), and one's meta-imagery (i.e., an individuals' awareness of their own imagery experiences; MacIntyre & Moran, 2010). However, the RAMDIU proposes that these characteristics will influence why one images. For example, someone with low trait confidence levels might image to increase their confidence and regulate their anxiety levels. It can also be argued that imagery ability is

[1] The PETTLEP model suggests seven elements to include for effective imagery interventions: Physical, Environment, Time, Type, Learning, Emotion, and Perspective (for further information see Holmes & Collins, 2001)

another characteristic within this component, but this will be discussed in more detail in the later imagery ability section.

One key characteristic that has been frequently reported to influence individuals' imagery use is skill level (Arvinen-Barrow, Weigand, Thomas, Hemmings, & Walley, 2007; Callow & Hardy, 2001; Shearer, Thomson, Mellalieu, & Shearer, 2007). However, research has not tested this proposition within a theoretical framework such as the RAMDIU (Cumming & Williams, 2013) and has not yet investigated whether individual characteristics can directly influence other components of this model. The RAMDIU is a good theoretical tool to explore whether individual characteristics such as skill level can directly influence imagery meaning and thus whether an image is facilitative or debilitative. For example, experts and novices in the same sport vary in their beliefs about their competencies to perform (i.e., self-efficacy), and as research has shown imagery meaning is linked to self-efficacy and confidence (Nordin & Cumming, 2005; Short et al., 2002), it is likely that experts and novices would perceive imagery differently. Therefore, Chapter 2 addressed this gap in the literature and explored the outcomes of novice and elite golfers' cognitive, affective, and behavioral responses to an imagery intervention (i.e., facilitative and debilitative imagery) and investigated the effect of imagery meaning on skill level and the outcomes experienced.

Why (function). A key strength of the RAMDIU compared to the original applied model is the distinction between why something is imaged (i.e., function) and what is imaged (i.e., content). Cumming and Williams (2012, 2013) proposed that it is the imagery function that should be identified first (as illustrated in Figure 1.2) before considering the appropriate content to serve the function. The imagery function will then influence the outcomes experienced from the imagery via the content (Cumming & Williams, 2013).

Short et al. (2006) highlighted that there has been conceptual confusion between imagery function and content, which is evident in previous research (e.g., MacIntyre & Moran, 2007; Martin et al., 1999). However, Short and colleagues referred mainly to the misuse of the Sport Imagery Questionnaire (SIQ; Hall et al., 1998), emphasizing that the SIQ refers to how often athletes use certain types of imagery (which can serve multiple functions; e.g., Nordin & Cumming, 2005; Short, Monsma, & Short, 2004) rather than the frequency with which imagery is used for particular functions. Research since has emphasized the importance of imagery function and strived to make this distinction clearer (e.g., Callow & Hardy, 2001; Cumming & Ramsey, 2009; Murphy, Nordin, & Cumming, 2008; Williams & Cumming, 2011). Therefore, in relation to determining the effect of facilitative and debilitative imagery, the function must be decided before the content to ensure imagery is facilitative. Debilitative imagery could arise if the content is considered first as this content may not be appropriate for the function, but also if the incorrect content is selected to serve a particular function (e.g., an inappropriate image to enhance confidence could be demotivating and therefore debilitative). In accordance with previous research and the RAMDIU, this thesis differentiated between imagery content and function. In particular, Chapter 3 investigated the function of three imagery scripts on responses to a competition task, the content of which will be alluded to in the next section.

What (type) and how. The function of the image determines the imagery content (i.e., what is imaged) and how this content is imaged (i.e., the imagery characteristics; Cumming & Williams, 2013). The imagery characteristics refer to factors such as sensory modalities (e.g., visual, kinaesthetic), visual perspective (internal or external), speed (slow motion, real time, or sped up), duration, or agency (e.g., self or other; Cumming & Williams, 2012) of the image. Although there is a close link between what and how something is imaged, imagery content is the predominant focus of the thesis rather than the imagery characteristics, therefore the remainder of this section will focus on imagery content.

The RAMDIU reflects advances in the literature since Paivio (1985), Hall et al. (1998), and Martin et al.'s (1999) work in that the content of imagery is conceptualized beyond the five categories (CG, CS, MS, MG-M, and MG-A). It is now acknowledged that imagery of differing content can serve multiple functions (Nordin & Cumming, 2005; Short et al., 2004) and different content can also be combined to serve one or multiple functions (Cumming & Williams, 2013; Maddison et al., 2012). For example, an image could focus on refining a particular skill (e.g., a penalty stroke in field hockey) but also include the end goal of winning the match to enhance confidence and arousal simultaneously.

This thesis aimed to enhance understanding of the "what" component of the model by also investigating the impact of positive and negative imagery content on outcomes associated with stress (e.g., confidence, anxiety, and stress appraisals). Although not hypothesized in the RAMDIU, it is conceptually logical that the valence (i.e., positive or negative) of content will influence what outcomes will be experienced. Research has supported the idea that imagery content can impact on outcomes experienced, as positive and negative imagery content have manipulated performance and confidence or self-efficacy (Nordin & Cumming, 2005; Short et al., 2002). Furthermore, Nordin-Bates et al. (2011) reworded the Dance Imagery Questionnaire (Nordin & Cumming, 2006) to include negative imagery content and found that dancers with greater perfectionistic tendencies reported more debilitative imagery, greater cognitive and somatic anxiety intensity, lower self-confidence, and perceived somatic anxiety symptoms as more debilitative than those with lower perfectionistic tendencies.

Although the aforementioned studies investigated the effect of positive and negative imagery content on outcomes, there are three clear gaps in the literature that warrant further investigation. First, imagery meaning (i.e., how imagery was interpreted) was not assessed in the majority of these studies, which is important because positive and negative imagery content is not always perceived as facilitative and debilitative and does not always lead to positive and negative outcomes respectively (Quinton et al., 2016; see next section). Second, as previously mentioned, research has not investigated the impact of positive and negative content on outcomes such as stress appraisals and anxiety. If different imagery content can have an adaptive effect on these factors associated with stress, this would provide important information for how strategies can regulate stress. Third, the effect of imagery ability on positive and negative content has not yet been investigated (see imagery ability section). Therefore, imagery content and its influence on the outcomes experienced was a theme present in all empirical chapters.

Personal meaning. Another new component in the RAMDIU is a meaning bridge between imagery function and content. Informed by Ahsen's (1984) triple code theory and Lang's (1979) bioinformational theory, Cumming and Williams (2013) proposed that the interpretation of an image as facilitative or debilitative influences the relationship between why and what is imaged and defined meaningful imagery as "a match between what is being imaged and its intended function so that the imagery fits both the individual and the situation" (p. 74). Research suggests that when imagery is more personalized and meaningful, for example in a customized imagery script, it results in greater imagery ability and physiological activity and is more effective compared to a predetermined script (Williams et al., 2013; Wilson, Smith, Burden, & Holmes, 2010).

The consideration of imagery meaning in determining whether an image is facilitative or debilitative is important so that imagery interventions can meet the needs of individuals (i.e., ensuring imagery is perceived as facilitative towards the clients' desired goals; Cumming & Williams, 2013). For example, a novice and elite rugby flyhalf imaging a straightforward penalty kick only marginally going through the posts will likely interpret the image differently. For the novice flyhalf, the image would likely be confidence enhancing as they have achieved their goal (i.e., scoring the penalty) and therefore be perceived as facilitative. However, for the elite player, they might be dissatisfied with how close the kick was to being unsuccessful and subsequently perceive the image as debilitative. Altogether, imagery meaning was a key component throughout this thesis.

Imagery ability. Imagery ability has been defined as "an individual's capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal" (Morris, 1997, p. 37). Due to its multidimensional nature, research has reported various different dimensions of imagery ability, such as ease, vividness, controllability, accuracy, and duration (Morris et al., 2005). Additionally, in their model of computational imagery, Kosslyn, Thompson, and Ganis (2006) identified the ability to generate (i.e., create), inspect (i.e., detect details), transform (i.e., modify), and maintain (i.e., engagement) an image. As ease of imaging has been proposed to reflect all the processes of Kosslyn et al.'s (2006) stages and as ease of imagery is also one of the most commonly reported forms of imagery ability (Williams & Cumming, 2011), this was the dimension of imagery ability investigated in this thesis.

Imagery ability likely determines the effectiveness of imagery use. For example, an athlete imaging to regulate their anxiety levels with low imagery ability (e.g., being unable to see themselves composed before a game and unable to incorporate physiological details into their imagery) would not experience as many benefits from their imagery compared to if they had greater imagery ability (e.g., being able to see themselves perform at optimum anxiety levels and feeling their heart rate and breathing increase but being under control). The importance of imagery ability is also demonstrated by the introduction of techniques designed to enhance imagery ability (e.g., layered stimulus response training; Cumming et al., 2016).

Although imagery ability was included in the applied model (Martin et al., 1999), the authors only hypothesized that it would moderate the effects of imagery use on outcomes. In contrast, Cumming and Williams (2013) proposed within the RAMDIU that imagery ability would also serve as a mediator between the imagery content and outcomes experienced, and directly influence the imagery content and how it is imaged (i.e., individuals selecting imagery content that they find easier to image). These proposed roles were informed by research demonstrating that a greater ability to image particular content led to more beneficial outcomes (e.g., higher confidence, better performance; Robin et al., 2007; Williams & Cumming, 2012b) and have since been supported by research reporting imagery ability to be a mediator (Koehn, Stavrou, Young, & Morris, 2016; Slimani, Chamari, Boudhiba, & Chéour, 2016a).

However, the role of different types of imagery ability is yet to be investigated. That is, whether the ability to image certain content can act as stronger mediators or moderators and whether this depends on the particular cognitive, affective, and behavioral outcomes (Cumming & Williams, 2013). These propositions are initially supported by research demonstrating that affect imagery ability is typically easier to image than other types of imagery ability (Koehn et al., 2016; Simonsmeier & Buecker, 2017; Williams & Cumming, 2011). On the other hand, cross-sectional research has shown mastery imagery ability to be a stronger predictor of confidence, stress appraisals, and cognitive anxiety intensity compared to other types of imagery ability (Williams & Cumming, 2012b, 2015), suggesting that although mastery imagery content is more difficult to image than affect imagery content, mastery imagery ability is perhaps more beneficial in terms of serving outcomes associated with stress and anxiety. This gap in the literature was investigated in Chapters 3 and 4.

Although the relationship between imagery ability and content on imagery's effectiveness has been established, the majority of research has only focused on positive imagery content. As negative content can have a bigger impact on outcomes than positive content (e.g., lower confidence and worse performance; Nordin & Cumming, 2005), it is possible that the impact of negative imagery ability will evoke similar outcomes compared to positive imagery ability (i.e., greater impact on outcomes). In turn, the ability to image negative content could influence whether an image is perceived as facilitative or debilitative. For example, in a similar manner to greater imagery ability of facilitative content leading to more facilitative outcomes (e.g., higher confidence; Williams et al., 2012b), greater imagery ability of debilitative content will likely have a greater debilitative impact on the outcomes experienced (e.g., more likely to perceive situations as threatening, more debilitative anxiety interpretations). In the clinical psychology literature, the concept of negative imagery ability (in addition to positive imagery ability) is recognized, whereby those with emotional disorders such as depression and anxiety have lower positive and higher negative imagery ability (Holmes, Lang et al., 2008; Morina et al., 2011). However, the importance of imagery ability with regards to negative imagery has not yet been investigated beyond the clinical setting. Therefore, this thesis also investigated the role of negative imagery ability to contribute to this gap in the facilitative and debilitative imagery literature. Negative imagery ability may also have a greater impact on imagery use compared to positive imagery, which would be an important consideration for clients, researchers, and practitioners.

Outcome. The last component in the RAMDIU is the outcome experienced from the imagery. Although often categorized as cognitive, affective, or behavioral, these outcomes can also be positive or negative. Together with the imagery meaning and function components, the outcomes experienced indicate whether the imagery has been facilitative or debilitative. For example, a challenge imagery script (i.e., positive content) designed to increase anxiety intensity but be perceived as facilitative can lead to positive outcomes such as increased confidence and positive anxiety perceptions (Williams et al., 2010, Williams, Veldhuijzen van Zanten, Trotman, Quinton, & Ginty, 2017). On the other hand, a threat script (i.e., negative content) designed to increase anxiety but be perceived as debilitative can lead to negative outcomes such as lower confidence, negative anxiety perceptions, and worse predicted performance (Nordin & Cumming, 2005; Williams et al., 2010, 2017; Williams & Cumming, 2012a). However, as previously mentioned, the outcomes do not always match up with the content and intended function as unintentional outcomes can be experienced (e.g., Nordin & Cumming, 2005). In other words, what you see is not always what you get (Cumming & Williams, 2013). As this thesis mainly focused on outcomes associated with stress (e.g., anxiety, confidence, stress appraisals), the next section will outline different theoretical frameworks that guide effective interventions for stress regulation.

Theories of Stress

Stress is a multifaceted construct that can elicit various psychological (e.g., increased anxiety) and cardiovascular (e.g., increased heart rate and blood pressure) responses (Moore, Vine, Wilson, & Freeman, 2012; Skinner & Brewer, 2004). Stress is typically a negative experience and excessive stress can be detrimental to physical and psychological health (Schneiderman, Ironson, & Siegel, 2005). Therefore, individuals seek strategies that help modify or reappraise the symptoms associated with stress (Jamieson, Mendes, & Nock, 2012; Meichenbaum & Deffenbacher, 1988). As the cost of work related mental and physical stress is as much as $190 billion per year (Blanding, 2015), it is important to continue investigating effective ways of managing stress, particularly with cost effective techniques such as imagery. However, before presenting the imagery and stress literature, it is important to provide an overview of the different theories of stress that have informed this thesis.

The following four key theories of stress were introduced into the literature for different reasons. Jones' (1995) model of facilitative and debilitative anxiety was timely to reflect then recent advances in anxiety literature that suggested anxiety could also have positive consequences, whereas the biopsychosocial (BPS) model expanded on previous literature to describe the interaction between affective and cognitive processes for determining how individuals appraised stress (Blascovich & Mendes, 2000). Skinner and Brewer's (2004) model of adaptive approaches to competition highlighted the importance of both positive and negative emotions experienced (i.e., not just anxiety) during and prior to competition and explained that the perception of these emotions and ones' coping expectancies determines the extent to which stress is appraised as adaptive. Finally, Jones, Meijen, McCarthy, and Sheffield's (2009) theory of challenge and threat states in athletes (TCTSA) provided a more extensive outline of how psychological constructs interact to determine the mechanism behind whether athletes perceive stress in a positive (i.e., challenging) or negative (i.e., threatening) manner. Although these theories were conceptualized at different times and for different reasons, there are some central components that feature in the majority if not all of them (e.g., the influence of goal orientation, perceived control, and confidence). One key construct that is central to these theories is anxiety.

Increased levels of anxiety (i.e., the intensity experienced) is a frequent response to stress. Lazarus and Lazarus (1994, p. 46) describe anxiety as:

> "… apprehension, unease, concern, and worry… When we are anxious, we are unable to relax. We experience the sense that something wrong in the situation or in our lives. We are uneasy, worry, are troubled with intrusive thoughts that we cannot put to rest, and we want to avoid or escape from upcoming confrontations that are the concrete manifestations of our concern."

Although Lazarus and Lazarus' definition primarily alludes to the cognitive symptoms of anxiety (e.g., worries and intrusive thoughts), anxiety can also be categorized into somatic components (e.g., increased heart rate and sweating; Ree, French, MacLeod, & Locke, 2008). Traditional anxiety research focused on the negative effects of anxiety intensity (e.g., Martens, Burton, Vealey, Bump, & Smith, 1990). This focus on intensity was also reflected in the measures used to assess anxiety such as the competitive state anxiety inventory-2 (CSAI-2), which originally only included an intensity subscale (Martens et al, 1990). However, other models of anxiety suggested that anxiety is not always debilitative and instead of just intensity, the interpretation of anxiety symptoms (i.e., direction; Jones, 1995) should also be considered.

Direction refers to the extent to which individuals interpret the intensity of cognitive and somatic anxiety symptoms as either facilitating or debilitating to performance (Jones, 1995; Mellalieu, Hanton, & O'Brien, 2004). The notion of anxiety direction was first introduced into the competitive anxiety literature by Jones and Swain (1992). These authors modified the CSAI-2 (Martens et al., 1990) to include a direction subscale and found that more competitive athletes perceived anxiety as more facilitative than less competitive athletes, therefore also providing support that anxiety direction differs according to individual differences (Jones & Swain, 1992; Jones, 1995). Since this initial research, anxiety direction has been shown to be a better predictor of performance than anxiety intensity (Chamberlain & Hale, 2007) and therefore Jones' original suggestion that strategies to promote more facilitative anxiety should target both intensity and direction is supported. The next section will now describe Jones' (1995) model in greater detail.

Jones' (1995) model of facilitative and debilitative anxiety. Jones' (1995) model is used to explain how anxiety perceptions transpire. The main premise of Jones' (1995) model is that perception of anxiety symptoms (i.e., as facilitative or debilitative) are dependent on five factors: the type of stressor, individual differences, perceived control, beliefs about coping ability, and expectancies of goal attainment. For example, in a competitive hockey match (stressor), a confident player (individual differences) who believes they have control over the game, can cope with the pressure, and can achieve the goal of winning the match will experience facilitative anxiety perceptions. On the other hand, a less confident player who believes the outcome of the match is outside of their control and cannot cope with the pressure of the game will perceive their anxiety as debilitative. However, this model only focuses on anxiety and does not consider how this construct is associated with other factors (e.g., stress appraisals, physiological responses to stress). Additional research has suggested that perceptions of anxiety are associated with whether stress is perceived in a positive (i.e., challenge) or negative (i.e., threat) manner (Hanin, 2010; Jones et al., 2009). The following sections will introduce more complex theories that consider the appraisals of stress together with responses to stress.

Biopsychosocial (BPS) model and model of adaptive approaches to competition. Challenge and threat appraisals refer to the manner in which individuals respond cognitively, affectively, and physiologically to motivated performance situations where the individual believes they are being evaluated (i.e., by others or themselves; Blascovich & Mendes, 2000). According to the BPS model, one experiences a challenge state when they perceive they have the resources to meet the demands of the situation, whereas a threat state occurs when one believes they have insufficient resources to meet situational demands. The interaction of demand and resource appraisals determines how one responds to a stressful situation (Blascovich & Mendes, 2000). On one hand, demand appraisals are concerned with the characteristics of the situation, such as perceived danger, uncertainty, and the effort required. On the other hand, resource appraisals include the individuals' skills, knowledge, and abilities that help them to cope with the situation, which can also be influenced by trait characteristics (e.g., self-confidence) and available support. The physiological indices of challenge and threat are listed in Table 1.2. Challenge indices are associated with more efficient physiological coping and threat indices with less efficient physiological coping (e.g., vasoconstriction in anticipation of damage or defeat; Jamieson et al., 2012).

Table 1.2
Psychological and physiological antecedents and consequences of challenge and threat states (Blascovich & Mendes, 2000; Jones et al., 2009).

Stress response	Challenge	Threat
	Antecedents	
Psychological	High self-efficacy[a,b]	Low self-efficacy[a,b]
	High perceived control[a,b]	Low perceived control[a,b]
	Approach focused goals[b]	Avoidance focused goals[b]
	Consequences	
Psychological	Positive emotions (typically)[a,b]	Negative emotions (typically)[a,b]
	Sometimes negative emotions (e.g., anxiety)[b]	Emotions perceived as unhelpful[b]
	Emotions perceived as helpful[b]	Cognitive functioning decreased[b]
	Improved decision making[b]	Decreased task engagement[b]
	Cognitive functioning maintained[b]	More resources required to self-regulate[b]
	Increased task engagement[b]	Worse performance[b]
	Less resources required to self-regulate[b]	
	Improved performance[b]	
Physiological	Increased HR, SV, CO[a,b]	Increased HR, SV, CO[a,b]
	Increased SAM activation[a,b]	Increased SAM and PAC activation[a,b]
	Release of epinephrine and norepinephrine[b]	Release of cortisol[b]
	Decreasing TPR[a,b]	Stable or increasing TPR[a,b]

Note. HR represents heart rate, SV represents stroke volume, CO represents cardiac output, SAM represents sympathetic adreno medullary, PAC represents pituitary adreno cortical, and TPR represents total peripheral resistance.
[a] originates from BPS model, [b] originates from TCTSA

Since its conception, the BPS model has greatly contributed towards stress research (Blascovich, Mendes, Tomaka, Saloman, & Seery, 2003) and has also informed research investigating the reappraisal of stress into positive outcomes such as reduced negative affect, more adaptive physiological responses, and better performance (for a review see Jamieson et al., 2012). However, there are limitations of the model including the lack of consideration of what an individual might be striving towards and the effects of appraisals on sporting performance. Skinner and Brewer's (2004) model of adaptive approaches to competition does consider these aspects and proposes that the appraisals are antecedents of positive and negative emotions respectively. In this model, a challenge appraisal includes opportunities to learn and master a situation and experience success, whereas a threat appraisal relates to possible risks to an individual's wellbeing or self-esteem. Skinner and Brewer note that negative emotions (e.g., anxiety) will only result in performance detriments when coping expectancies are low, and that negative emotions can, in some situations, be adaptive (i.e., serving a motivational purpose). However, a key limitation of this model is that it does not consider any physiological characteristics of challenge and threat appraisals.

Theory of Challenge and Threat States in Athletes (TCTSA). The TCTSA (Jones et al., 2009) extends upon the previous three theories of stress and is specific to athletes and competition, therefore this framework contributed to the theoretical foundation of this thesis (see Chapters 3 and 4). The TCTSA extends upon the previously discussed stress theories as it denotes how antecedents interact to determine challenge and threat states (Jones et al., 2009). The theory proposed that self-efficacy, perceptions of control, and goal orientation are three interrelated antecedents that indicate whether a challenge or threat appraisal will be experienced (Jones et al., 2009). For example, a challenge state occurs when one has high levels of self-efficacy (i.e., greater belief in their coping ability for the task) and perceived control, and is associated with approach related goals. On the other hand, a threat state results from low self-efficacy and perceived control, and is associated with avoidance goals. Additional psychological and physiological characteristics of challenge and threat appraisals unique to the TCTSA are noted in Table 1.2. The TCTSA is similar to Skinner and Brewer's (2004) model of adaptive approaches to competition in positing that high intensity negative emotions, such as cognitive and somatic anxiety, can be experienced in a challenge state providing that they have a motivational function (Jones et al., 2009).

A number of predictions hypothesized in the TCTSA (Jones et al., 2009) have been supported in the literature to date. For example, in support of the psychological hypotheses, challenge appraisals have been associated with greater confidence (Williams & Cumming, 2012b), approach goals (Turner et al., 2013), better performance (Moore et al., 2012; Moore, Wilson, Vine, Coussens, & Freeman, 2013; Turner, Jones, Sheffield, Barker, & Coffee, 2014), and more favorable emotions (Howle & Ecklund, 2013; Moore et al., 2012; 2013). In turn, threat appraisals have been associated with lower confidence (Williams & Cumming, 2012b), avoidance goals and lower self-efficacy (Meijen, Jones, McCarthy, Sheffield, & Allen, 2013; Turner et al., 2013), worse performance (Turner et al., 2014; Vine et al., 2015), worse attentional control (Vine et al., 2015), and less favorable emotions (Howle & Ecklund, 2013; Moore et al., 2012; 2013). In support of the physiological hypotheses, research has found that instructions worded to reflect challenge and threat appraisals (in accordance with the TCTSA) have led to cardiovascular reactivity indicative of challenge and threat states respectively (see Table 1.2; Moore et al., 2013; Turner, Jones, Sheffield, & Cross 2012; Turner et al., 2014). However, this literature has not always been consistent as there have been mixed results as to whether the psychological findings relate to the physiological data (e.g., Meijen et al., 2013; Turner et al., 2013). As acknowledged by the original authors as an avenue for future research, the TCTSA mainly focused on state responses to stress and therefore research exploring trait associations (e.g., trait anxiety) with challenge and threat appraisals is warranted (Jones et al., 2009). The next section will focus on research to date investigating the trait associations with these states, including imagery related research and imagery's effectiveness in regulating challenge and threat appraisals and state and trait responses associated with stress (e.g., anxiety).

Imagery and Stress Research

The crossover between imagery and stress research is evident within sport psychology as imagery has been shown to be an effective technique for regulating both appraisals and responses to stress and eliciting facilitative outcomes (Williams et al., 2010, 2017). Individual factors (e.g., trait confidence, appraisals, and anxiety) are also likely to influence imagery and stress experiences. For example, imagery of positive content can protect against negative anxiety symptoms by maintaining high self-confidence (Cumming, Olphin, & Law, 2007). Additionally, imagery scripts describing positive content (i.e., typically perceived as facilitative) such as coping, confidence, and being in control have increased confidence and challenge appraisals and although anxiety levels increased, they were perceived as facilitative (Cumming et al., 2007; Williams et al., 2010; Williams & Cumming, 2012a). It is also the ability to image particular positive imagery content (e.g., MG-A and MG-M) that promotes facilitative responses to stress. Higher levels of imagery ability are associated with greater challenge and lower threat appraisals, more facilitative anxiety interpretations, and higher trait confidence (Abma et al., 2002; Quinton, Veldhuijzen van Zanten, Trotman, Cumming, & Williams, 2017; Williams & Cumming, 2012b, 2015). However, imagery of negative content (i.e., typically perceived as debilitative) can elicit debilitative stress outcomes as scripts containing feelings of anxiety and low levels of confidence and control have led to greater threat appraisals, more debilitative interpretations of high anxiety levels, and a greater cardiovascular response (Williams et al., 2010, 2017; Williams & Cumming, 2012a). This thesis addressed two clear gaps in this literature: investigating the effect of facilitative and debilitative imagery on anxiety and the effects of imagery ability on positive and negative imagery content associated with stress.

Outside of sport psychology, imagery is also effective in regulating stress responses, for example in managing post-traumatic stress disorder symptoms (Casement & Swanson, 2012). Altogether, this collection of literature suggests that imagery interventions that emphasize high efficacy beliefs and perceived control (i.e., two antecedents in the TCTSA; Jones et al., 2009), result in better adaptations to stress (Williams et al., 2017). However, research is yet to investigate whether challenge and threat based imagery is more or less effective for particular stressful tasks, or whether stress appraisals (e.g., challenge and threat) and responses (e.g., anxiety) are associated with the ability to image positive and negative content.

Outline of Research Program

Theoretically informed by the RAMDIU (Cumming & Williams, 2013), the overall aim of this thesis was to investigate the effects of positive and negative imagery content and ability on cognitive, affective, and behavioral outcomes. Specifically, this aim was achieved by (a) determining how different imagery content (e.g., positive and negative), imagery perception (e.g., facilitative or debilitative), and imagery ability influence psychological and cardiovascular responses to non- and stress evoking situations, and (b) exploring whether certain types of imagery ability (e.g., mastery and affect, positive and negative) are associated with responses to a stress evoking situation, and whether certain types of imagery ability are stronger mediators and thus more effective for regulating stress appraisals and responses. The specific research questions for each chapter can be found in Table 1.3.

Table 1.3.
Research questions for empirical thesis chapters.

	Chapter 2	Chapter 3	Chapter 4
Research questions	Does different negative imagery content and participant skill level influence image meaning?	Are different types of positive and negative imagery (challenge, threat, relax) more or less effective for a competition task?	Does positive mastery imagery ability mediate the relationship between confidence and appraisals and responses to stress?
	Does different negative imagery content and participant skill level influence performance, anxiety, and confidence in a golf putting task?	Is mastery imagery ability associated with stress responses to these tasks?	Does negative mastery imagery ability mediate these same relationships?

Although each chapter contains specific research questions, the overarching theme across the three empirical chapters was the investigation of positive and negative imagery content. This content was explored in Chapters 2 and 3 in relation to whether the content was perceived as facilitative or debilitative towards specific outcomes (e.g., performance, anxiety). Chapter 2 first examined positive and negative imagery content from a motor imagery point of view (i.e., imagery focusing on performing a motor action and the outcome achieved). Chapter 3 then further examined the effects of imagery direction but expanded the investigation into motivational imagery content (i.e., imagery focusing on the thoughts and feelings associated with performing rather than an action and subsequent outcome). Despite the differing imagery content between these two chapters, similar outcome measures were assessed and this was extended into chapter 4. Confidence and anxiety were measured in all three empirical chapters and stress appraisals were assessed in Chapters 3 and 4. The consistent inclusion of these outcomes in the thesis addressed the gap of whether positive and negative imagery content influenced outcomes beyond performance and self-efficacy, and whether these outcomes were further influenced by the interpretation of imagery content (i.e., as facilitative or debilitative). Finally, imagery ability was also assessed in all chapters, and the comparison of mastery and affect imagery ability in particular in Chapters 3 and 4 through different methodological approaches ensured the gap of investigating whether different types of imagery ability were more or less beneficial for particular outcomes was addressed. The more detailed aims of each empirical chapter are now discussed.

The aim of Chapter 2 was to examine whether the interpretation (i.e., image meaning) of a negative image was influenced by the specific imagery content and individual characteristics (i.e., participant skill level). Another aim was to determine the effect of the imagery content and skill level on performance, anxiety, and confidence in a golf putting task. These aims were achieved using an experimental approach whereby novice and expert golfers were randomly allocated to an imagery script that described a golf putt missing a target by either 20cm or 40cm. A repeated measures design allowed for comparisons on the variables before and after the imagery intervention.

Next, as perceptions of stress responses can determine the ability to cope with certain situations, Chapter 3 investigated imagery as a strategy to effectively regulate psychological (confidence and anxiety) and cardiovascular (blood pressure and heart rate) responses to stress by examining the effect of three different imagery types on stress responses to an actual competition task. Extending on previous research (Williams et al., 2010, 2017), the challenge (typically perceived as facilitative) and threat scripts (typically perceived as debilitative) included resource and demand appraisals from the BPS model (Blascovich & Mendes, 2000), together with antecedents from the TCTSA (Jones et al., 2009). Despite the challenge and threat scripts including stimulus and response propositions that would typically be considered negative imagery content, the meaning propositions were manipulated to alter the perception of imagery as facilitative or debilitative. The relaxing script included details about cognitions, body position, and physiological responses. Again, a repeated measures experimental approach allowed for comparisons before and after the imagery intervention. Another aim of this chapter was to examine whether the ability to image mastery content (e.g., overcoming difficult situations), in comparison to affective content (e.g., experiencing positive emotions), was associated with certain psychological and cardiovascular outcomes.

Following the investigation of mastery and affect imagery ability in an experimental approach, Chapter 4 further explored these types of imagery ability but as a mediator in a cross-sectional study design via structural equation modelling. Using a two-phase approach, the aim of this chapter was to determine the importance of mastery imagery ability in the relationship between confidence and appraisals and responses to stress by again comparing it to affect imagery ability, which is typically easiest to image (Williams & Cumming, 2011). Furthermore, although research suggests that mastery is the most effective imagery ability for regulating confidence and stress appraisals and responses, only positive imagery ability has been investigated to date. Therefore, another aim of this chapter was to explore the role of negative mastery and affect imagery ability in these same models through a revised negatively worded version of the SIAQ (Williams & Cumming, 2011). This chapter will consequently also investigate whether there is a direct link between imagery ability and the “who” component (e.g., trait confidence, appraisals, and anxiety) of the RAMDIU (Cumming & Williams, 2013).

The chapters in this thesis are presented in the same order, layout, and formatting in which they were submitted for publication with three exceptions. First, tables and figures have been inserted into the text of each chapter to allow for easier comparisons. Second, use of the word chapter in this thesis was replaced with the word study for publication versions. Third, all references are located after Chapter 5 rather than after each chapter.

Chapter 2

Imagery meaning and content in golf: effects on performance, anxiety, and confidence

A version of this chapter has been published under the following reference:

Quinton, M. L., Cumming, J., Allsop, J., Gray, R., & Williams, S. E. (2016). Imagery meaning and content in golf: Effects on performance, anxiety, and confidence. *International Journal of Sport and Exercise Psychology.* Advanced online publication. doi:10.1080/1612197X.2016.1242150

Imagery meaning and content in golf: effects on performance, anxiety, and confidence

Imagery is a psychological technique used by athletes to improve performance (for reviews see Cumming & Williams, 2012; Moran, Campbell, Holmes, & MacIntyre, 2012). One type of imagery known to affect performance is outcome imagery, described as "the imagery of what happens immediately after an action is completed and not the action itself" (Taylor & Shaw, 2002, p. 607). Outcome imagery content can be either positive or negative. For example, sinking a golf putt can improve novices' performance, whereas imaging missing the hole can reduce novices' golf putting performance (Short et al., 2002).

However, image content (i.e., positive or negative) does not always reflect the outcomes experienced from using the imagery. A positive image is not always helpful and can have no, or an unhelpful effect on performance (Taylor & Shaw, 2002). Facilitative imagery is defined as, "Imagery designed to have a positive effect on one's ability to learn and perform, modify important cognitions such as self-efficacy, and regulate arousal and anxiety" (Short et al., 2002, p.49). By comparison, debilitative imagery is, "Imagery designed to impede an individual's ability" to achieve these same results (Short et al., 2002, p.51). Athletes experience debilitative imagery (Macintyre & Moran, 2007; Van de Braam & Moran, 2011), which has a more powerful and quicker effect on outcomes than facilitative imagery (Nordin & Cumming, 2005). Since imagery is a technique used in sport and rehabilitation settings to optimize performance and other outcomes such as confidence and anxiety, it is important to understand what factors influence the interpretation of an image (i.e., image meaning) and its subsequent impact on cognitive (e.g., confidence), affective (e.g., anxiety), and behavioral (e.g., performance) outcomes.

A lack of clarity in the terminologies used within this area of the literature (i.e., facilitative and debilitative, positive and negative) has made it difficult to compare previous studies. Positive imagery (i.e., positive image content such as serving an ace in tennis) differs from facilitative imagery. For example, a novice player might image themselves serving and narrowly missing the service box (i.e., a negative outcome), but this content may serve to improve performance capabilities and thus the player experiences an increase in performance (i.e., the image serves as a facilitative image). It is necessary to understand the difference between these terms as positive and negative imagery may not always facilitate and debilitate performance respectively (Beilock et al., 2001; Taylor & Shaw, 2002).

To distinguish between the aforementioned terms, researchers need to assess the meaning of the image (Cumming & Williams, 2013; Ramsey, Cumming, & Edwards, 2008). Imagery content may be interpreted differently and elicit different outcomes (e.g., confidence, anxiety) depending on personal and situational factors such as skill level, age, task efficacy, and task experience. Without manipulation checks to consider imagery meaning, caution must be taken when inferring what consists as, and the effects of, facilitative imagery and debilitative imagery. This oversight likely explains some of the inconsistencies between studies in this area (e.g., Short et al., 2002, Beilock et al., 2001).

Image meaning has become an integral part of imagery research (Cumming & Williams, 2013; Nordin & Cumming, 2005). The concept is rooted in Lang's (1979) bioinformational theory that highlights meaning propositions, along with stimulus (i.e., situational details) and response propositions (i.e., emotional and physiological responses to the situation), are essential for enhancing imagery effectiveness. Lang proposed that meaning propositions explain the relationship between stimulus and response propositions, and thus influence the perceived importance and effect of the image. However, image interpretation has often been neglected in previous studies (Beilock et al., 2001; Short et al., 2002). Extensive research has demonstrated the benefits of effective imagery, but it is known that many athletes experience unhelpful images under pressure (Van de Braam & Moran, 2011), which can be associated with other detrimental outcomes (e.g., lower confidence; Nordin &

Cumming, 2005). Therefore, the rationale behind the current study is to investigate how certain characteristics may impact imagery's meaning and its effectiveness on performance outcomes important for sporting success.

The interpretation of imagery content is also likely to depend on individual characteristics (Cumming & Williams, 2013). In their revised applied model of deliberate imagery use (RAMDIU; Figure 1.2), Cumming and Williams (2013) propose that factors such as age, gender, and personality dispositions (i.e., the "who" component) can affect outcomes resulting from imagery use (e.g., confidence, anxiety, performance) by influencing image meaning. These individual characteristics are likely to determine whether an image is facilitative or debilitative on the outcomes being served. For example, a novice golfer imaging narrowly missing a putt may instill feelings of confidence (i.e., facilitative imagery) due to the outcome being outside their current capabilities. The same image may lead to feelings of disappointment for an elite golfer (i.e., debilitative imagery). Despite skill level likely influencing the interpretation of different outcome images, this proposition has yet to be sufficiently tested as studies have predominantly included novices (e.g., Nordin & Cumming, 2005) or not verified image meaning (e.g., Ramsey et al., 2008; Short et al., 2002). Athletes of all skill levels use imagery, so if image meaning is associated with skill level, it then follows that image meaning will have important implications for applied practitioners, coaches, and athletes for how imagery should be delivered.

According to the RAMDIU, the meaning of an image is also likely to be influenced by imagery content (i.e., what is imaged; Cumming & Williams, 2013). For example, imaging missing a long putt by a few centimeters might be facilitative but imaging missing by a greater distance might be debilitative. This interpretation is likely to be further influenced by skill level (Cumming & Williams, 2013). It is important to investigate whether imagery content depicting a similar outcome (e.g., missing a target) can be facilitative or debilitative depending on the specific details of the outcome. Together with how this may differ depending on skill level, such information will help researchers better understand the impact of debilitative imagery.

It is important to consider the effectiveness of outcome imagery on other outcomes beyond performance. Debilitative imagery can reduce outcomes such as self-efficacy and confidence (Nordin & Cumming, 2005; Taylor & Shaw, 2002) whereas facilitative imagery can increase these outcomes (Short et al., 2002). However, similar to performance, findings are inconsistent; for example, self-efficacy and confidence did not improve with facilitative imagery in other studies (e.g., Nordin & Cumming, 2005; Taylor & Shaw, 2002). Interestingly, no studies have investigated whether imagery perceived as facilitative or debilitative (i.e., image meaning) is associated with affective outcomes such as anxiety, which is particularly surprising given that Short et al.'s (2002) definitions of facilitative and debilitative imagery refer to imagery impacting other outcomes of imagery use.

According to the RAMDIU, it is logical that a similar principle to the image meaning and confidence relationship would apply for anxiety, particularly given the strong association between anxiety and confidence (Hanton, Mellalieu, & Hall, 2004). Williams, Cumming, and Balanos (2010) demonstrated that imagery content perceived as more helpful (i.e., more facilitative image meaning) to a hypothetical competition was associated with more positive anxiety interpretations, whereas imagery perceived as more hurtful was associated with more negative anxiety interpretations. Therefore, it would be worth investigating whether outcome imagery can have a facilitative or debilitative effect on anxiety, and examine the association between image meaning and anxiety intensity and interpretation of an actual situation. These findings could have applied implications as it could have a direct impact on how practitioners use imagery work with their clients to regulate anxiety.

Aims and Hypotheses

The present study investigated the effects of specific outcome imagery content and skill level on imagery interpretation (i.e., the image meaning), and on golf putting performance, anxiety, and confidence of the putting task. Two outcome images were compared: (a) an image of the ball missing the target by 20 cm (near miss group), and (b) an image of the ball missing the target by 40 cm (far miss group). Expert and novice golfers were compared over both imagery conditions.

Experts and novice athletes likely have different expectations of themselves and performance standards of what is considered acceptable. Therefore, missing a target would likely be deemed as unsuccessful for an expert. However for novice athletes, missing the target by a shorter distance than a typical performance standard (i.e., 20cm) may be considered a successful performance, whereas missing by a further distance than that typically reflected by novices (i.e., 40cm) may be deemed as unsuccessful. Therefore, it was hypothesized that (a) experts would perform better than novices throughout the experiment due to their level of proficiency, and (b) experts would interpret both images (i.e., near and far miss) as more unhelpful towards performance compared with novices who would interpret the near miss image as more helpful towards performance and the far miss image as more unhelpful. It was further hypothesized that (c) novices in the near miss group would experience reduced anxiety, increased confidence, and facilitated performance compared with baseline, whereas novices in the far miss group and all experts would experience increased anxiety, reduced confidence, and debilitated performance compared with baseline. Finally, (d) image meaning would be associated with Block 2 outcome variables (performance, anxiety, and confidence) and the changes in variable scores between blocks.

Method

Participants

The sample (*N* = 79) consisted of 53 male and 26 female right handed participants from 18 to 24 years (*M* = 19.54 years, *SD* = 1.39). Expert golfers (*n* = 39) were defined as those with a handicap of seven or below, or a professional status (*M* playing experience = 8.10 years, *SD* = 3.24). Novice golfers (*n* = 40) were defined as those who had little or no previous golf experience. Expert golfers played golf as their main sport. Novice golfers represented a variety of sports including football (*n* = 14), rugby (*n* = 3), and athletics (*n* = 3).

Equipment

The equipment consisted of an artificial putting surface made from polypropylene grass (Patiograss), a Golden Bear Claw blade putter (35 in.), and 15 Wilson Ultra golf balls. As illustrated in Figure 2.1, the putting surface was 5.5 m long and 1.5 m wide and the putting distance was 2.92 m. The target to aim for was an "X" formed using tape that measured 4.5 by 4.5 cm in diameter. A target was chosen instead of a hole to make the task more difficult and ensure that an accurate putt was less likely due to chance. Two additional targets (different colors for clarity) were placed on the surface throughout the experiment to represent the near miss (red) and far miss (blue) putting conditions. The distances representing the near and far miss conditions were pilot tested with experts and novices and subsequently were 20 cm and 40 cm from the target respectively, both behind and to the left of the target (at 140° from the target).

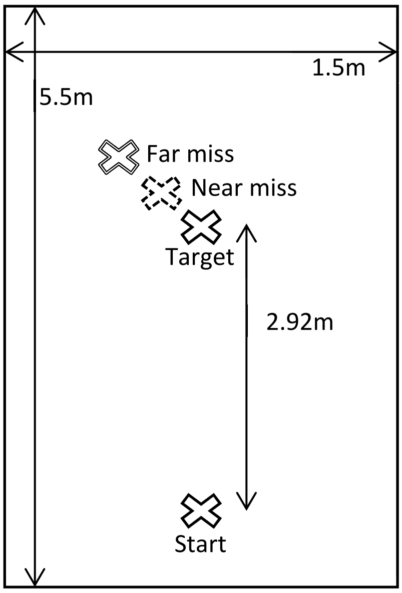


Figure 2.1. Experiment setup.

Measures

Image meaning. After Block 2 participants were asked to rate whether they perceived the imagery they performed as being helpful or unhelpful towards their performance. Responses ranged from 1 (*entirely unhelpful*) to 7 (*entirely helpful*).

Performance. Putting performance was assessed by measuring the distance (cm) the ball ended up from the center of the target. Distance was measured using a tape measure from the target to the part of the ball closest to the target. Higher scores indicated worse performance. Each block consisted of 15 putts with distances averaged for each block.

State anxiety and self-confidence. Cognitive and somatic anxiety and self-confidence were assessed immediately prior to performance using the Immediate Anxiety Measure Scale (IAMS; Thomas, Hanton, & Jones, 2002). Before completing the questionnaire, participants were provided with definitions of the constructs to ensure understanding. Section one asked participants to rate the extent to which they felt cognitively anxious, somatically anxious and self-confident. Ratings for each construct were made on a 7-point scale from 1 (*not at all*) to 7 (*extremely*). Section two asked participants whether they perceived their cognitive anxiety, somatic anxiety, and self-confidence as positive or negative towards their upcoming performance. Ratings were made on a 7-point scale from -3 (*very debilitative/negative*) to +3 (*very facilitative/positive*). The IAMS has been previously recognized as a valid and reliable measure when assessing state cognitive and somatic anxiety, and self-confidence (Thomas et al., 2002).

Imagery ability. Imagery ability was measured using the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). Imagery ability was measured at the start of the experiment to screen for low levels of imagery ability, which may be a potential confounding variable in later analyses. The SIAQ is a 15 item questionnaire assessing how easily participants can image content reflective of athletes' imagery (i.e., skill, strategy, goal, mastery, and affect images). Participants rated how easy it is to image each item on a 7-point Likert-type scale from 1 (*very hard to image*) to 7 (*very easy to image*). Responses for each subscale were averaged to provide separate scores for each imagery ability subscale. The SIAQ is valid and reliable with good psychometric properties (Williams & Cumming, 2011). Cronbach alpha coefficients were all above .70 in the present study for skill (.85), strategy (.86), goal (.86), mastery (.81), and affect (.80) subscales.

Imagery evaluation form. An imagery evaluation form composed of four items was completed immediately after Block 2. Responses for all items were made on a 7-point Likert-type scale. The first item asked participants how frequently they incorporated the imagery during the putting task ranging from 1 (*not at all*) to 7 (*before all putts*). Two separate questions asked participants how easy it was to see and feel the images they just performed ranging from 1 (*very hard to see/feel*) to 7 (*very easy to see/feel*). The final question asked participants to rate how vivid their images were from 1 (*no image at all*) to 7 (*perfectly clear*).

Aiming for target. Following each block, participants rated the extent to which they were aiming to get the ball onto the center of the target. Responses were made on a 7-point

Likert-type scale from 1 (*not at all*) to 7 (*on every putting attempt*). This item was included to assess whether participants might not have performed well due to a lack of motivation.

Demographic information. On arrival at the lab, participants provided information regarding their gender, age, sport played, competitive level, golf experience, and handicap if relevant.

Procedure

Arrival, Block 1, and screening. Following ethical approval from the university where the authors are based, participants were recruited through emails, social media, and lecture announcements. The majority were undergraduate students who received course credit for taking part. On arrival at the lab, potential participants were informed about the nature of the experiment. It was explained that all data provided would be treated confidentially and participants were free to withdraw at any time. All information was provided by pen and paper surveys. Those willing to participate provided written consent and were randomly allocated to the near miss or far miss group according to pre-determined randomly generated lists devised by the experimenters. Separate lists were used to balance the distribution of expert (near miss = 20, far miss = 20) and novice (near miss = 19, far miss = 20) golfers across both groups based on information provided at the point of recruitment.

For an overview of the experiment protocol, see Figure 2.2. Participants had 60 practice putts to become familiar with the putting surface and putter. They were told, "the aim of the putting task is to putt the ball as close to the center of the target as possible. The perfect putt would have the ball stop directly on the X at the end of the mat." Novices were given instructions on how to hold the putter. Participants provided their demographic information half way through the 60 putts to prevent boredom. After the practice putts, participants completed Block 1, consisting of 15 putts (again aiming to putt the ball as close to the X as possible) with the putting distance obtained following each putt. Before performing the block, participants completed the IAMS about how they were feeling about the upcoming block. After the block, participants rated the extent they were aiming for the target.

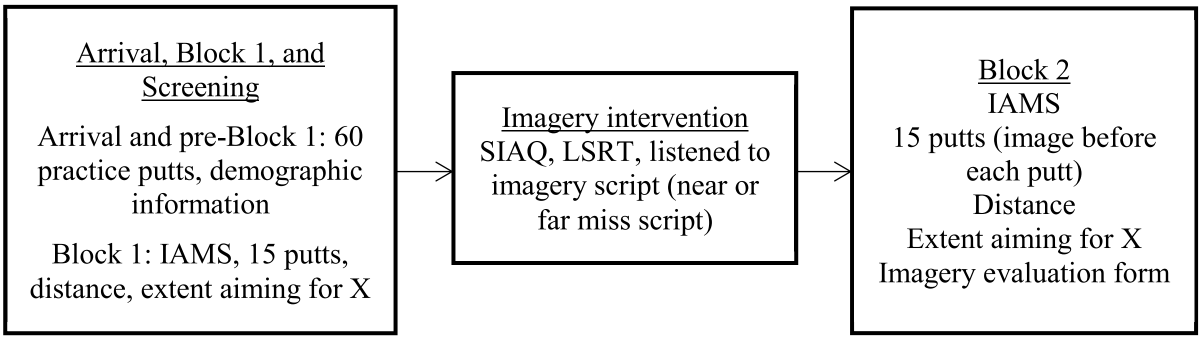


Figure 2.2. Experiment protocol.

Imagery intervention. After Block 1, the experimenter gave participants White and Hardy's (1998) definition of imagery. Then, internal (i.e., seeing through your own eyes) and external (i.e., watching yourself on television) visual imagery perspectives were explained before they completed the SIAQ. Before listening to their assigned imagery script, the experimenter delivered layered stimulus response training (Cumming et al., 2016; Appendix 8) to ensure all participants could produce images as clearly and as vividly as possible. The procedures, similar to those employed by Williams, Cooley, and Cumming (2013), involved building the imagery up in layers, gradually including more details with each attempt. Next, participants were shown a photo of the outcome of their allocated condition; for the near miss group, the ball on the cross 20 cm behind and to the left of the target, and for the far miss group, the ball on the cross 40 cm behind and to the left of the target. This ensured all participants were aware of what they should be imaging. Participants then listened to the near miss or far miss script (see Appendix 9) twice on a mp3 player while standing on the putting mat, assuming the correct stance, and holding the putter. They were told to image as clearly and vividly as possible from their preferred visual perspective. Scripts emphasized both stimulus (e.g., “Look down and see the white golf ball, resting on the green mat”) and response (e.g., “Feel the point of impact when the putter connects with the ball”) propositions (Lang, 1979). Scripts lasted just over 2 min and were identical except for the outcome, where the script described the ball “at the last second miss the target and end up about [20 cm or 40 cm] further behind and to the left of the target.”

Block 2 and debrief. Immediately after the intervention, participants completed Block 2 and filled out the IAMS about how they felt about the upcoming block and then completed the putts. This block was identical to the first except that before each putt participants imaged the scenario they had previously imaged while listening to the script. Immediately after the block, participants completed the imagery evaluation form and rated their image meaning and the extent they were aiming for the hole. Finally, participants were debriefed on the experiment and thanked for their participation. Participants were also informed that potential sources of support were available if the imagery led to feelings of distress. The experiment lasted between 90 and 120 min.

Data Analyses

Data was analyzed using SPSS (version 22). For the preliminary analyses, two MANOVAs examined differences between groups in imagery ability and 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVAs analyzed imagery frequency, ease of imaging (see and feel), and image vividness. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA with repeated measures on the first factor was conducted to analyze the extent to which participants were aiming to get the ball onto the center of the target.

For main analyses, two separate 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVAs with repeated measures on the first factor analyzed performance and confidence scores. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) x 2 Skill level (novice, experts) MANOVA with repeated measures on the first factor analyzed differences in cognitive and somatic anxiety intensity and direction. A 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) factorial ANOVA analyzed image meaning. For MANOVAs, Box's M test was not violated, but Pillai's Trace values were still reported as this is the most robust multivariate significant test (Olson, 1976). For ANOVAs and MANOVAs involving repeated measures, if Mauchly's test of sphericity was violated, Greenhouse Geisser values were reported.

To investigate the imagery meaning outcome relationship, pearson's bivariate correlations were conducted to explore the relationship between image meaning and Block 2 outcomes. Participants were then divided into meaning groups depending on their imagery perception: those who perceived the imagery as unhelpful (i.e., 1-3 on the Likert scale; n = 42) and those who perceived the imagery as helpful (i.e., 5-7 on the Likert scale; n = 29). Participants who scored 4 (*neither helpful nor unhelpful*) were excluded from this analysis (n = 8). Differences between blocks were calculated for performance, confidence, and anxiety intensity and direction by subtracting Block 1 from Block 2 scores. One-way ANOVAs then compared these differences between those interpreting the imagery as helpful and those interpreting it as unhelpful. The probability value threshold for all analyses was set at .05. All significant effects were followed up with bonferroni post hoc pairwise comparisons.

Results

Preliminary Analyses

Imagery ability. Results revealed there were no significant differences in imagery ability according to imagery content, Pillai's Trace = .051, $F(5, 73) = .79$; $p = .559$, $\eta_p^2 = .05$, or skill level, Pillai's Trace = .038, $F(5, 73) = 0.57$; $p = .721$, $\eta_p^2 = .04$.

Imagery evaluation form. There were no significant imagery content or skill level differences for frequency of imaging, ease of visual or kinesthetic imagery, or imagery vividness (*p*'s > .05). There were no significant imagery content by skill level interactions. Means and standard deviations are reported in Table 2.1. Consequently, imagery ability was not considered as a variable to be controlled for in the main analyses.

Table 2.1
Manipulation check means (standard deviation) for imagery content group and skill level

	Imagery content group		Skill level	
Manipulation check	Near miss	Far miss	Experts	Novices
Frequency of imaging	5.87 (1.22)	6.3 (.72)	6.13 (.97)	6.05 (1.07)
Ease of imagery (see)	4.62 (1.48)	4.6 (1.37)	4.73 (1.58)	4.49 (1.23)
Ease of imagery (feel)	4.13 (1.49)	4.03 (1.51)	4.1 (1.66)	4.05 (1.32)
Vividness of imagery	4.23 (1.31)	4.28 (1.32)	4.28 (1.41)	4.23 (1.2)

Aiming for target. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA revealed a significant main effect for block, $F(1,75) = 6.69$, $p = .012$, $\eta_p^2 = .08$, 95% CI [0.08, 0.64]. Participants were aiming for the target significantly more at Block 1 ($M = 6.49$, $SD = 0.97$) than Block 2 ($M = 6.13$, $SD = 1.35$). There were no significant main effects for imagery content or skill level, and no significant block by imagery content, block by skill level, imagery content by skill level, or block by imagery content by skill level interactions.

Main Analyses

Image meaning. A 2 Imagery content (near miss, far miss) × 2 Skill level (novices, experts) factorial ANOVA revealed a significant main effect for skill level, $F(1,75) = 7.88$, $p = .006$, $\eta_p^2 = .10$, 95% CI [-1.67, -0.28]. Novices perceived the imagery to be more helpful ($M = 4.00$, $SD = 1.47$) than experts ($M = 3.03$, $SD = 1.61$; $p = .006$). To give context to these ratings, experts interpreted the imagery as somewhat unhelpful whereas novices perceived the imagery to be neither helpful nor unhelpful. There was no significant main effect for imagery content and no imagery content by skill level interaction.

Performance. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA revealed a significant main effect for block, $F(1,75) = 13.58$, $p < .001$, $\eta_p^2 = .15$, 95% CI [-6.02, -1.8] a significant main effect for skill level, $F(1,75) = 118.23$, $p < .001$, $\eta_p^2 = .61$, 95% CI [-24.14, -16.66] and a significant block by imagery content interaction, $F(1,75) = 9.49$, $p = .003$, $\eta_p^2 = .11$, 95% CI [-10.88, -2.24]. Mean scores indicated that novices ($M = 42.84$, $SD = 12.67$) performed significantly worse than experts ($M = 22.38$, $SD = 5.58$; $p < .001$) irrespective of the block. Post hoc analyses examining the interactions indicated that although there were no differences between the imagery content groups at Block 1, at Block 2 the far miss group performed significantly worse ($M = 37.81$, $SD = 15.53$) than the near miss group ($M = 31.00$, $SD = 13.16$; $p = .003$). The far miss group also performed significantly worse in Block 2 ($M = 37.81$, $SD = 15.53$) than it did in Block 1 ($M = 30.64$, $SD = 13.9$; $p < .001$), but the performance of the near miss group did not change across blocks. Means and standard errors depicting the block by imagery content interaction can be found in Figure 2.3. There was no significant main effect for imagery content, and no significant block by skill level (Figure 2.4), imagery content by skill level, or block by imagery content by skill level interactions (Table 2.2).

Anxiety. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) MANOVA revealed at the multivariate level there was a significant block by imagery content interaction, Pillai's Trace = .159, $F(4, 72) = 3.41$, $p = .013$, $\eta_p^2 = .16$. Univariate analyses revealed this was for cognitive intensity, $F(1,75) = 12.78$, $p = .001$, $\eta_p^2 = .15$, 95% CI [-1.46, -0.37], and somatic intensity, $F(1,75) = 4.03$, $p = .048$, $\eta_p^2 = .05$, 95% CI [-1.11, -0.14]. For cognitive anxiety, post hoc analyses revealed that at Block 2, the far miss group had higher levels of cognitive intensity (M = 3.1, SD = 1.34) than the near miss group (M = 2.18, SD = 1.14; p = .001). There were no differences between imagery content groups at Block 1. In the far miss group, cognitive intensity was higher at Block 2 (M = 3.1, SD = 1.34) than compared with Block 1 (M = 2.3, SD = 1.02; p < .001). For somatic anxiety, the far miss group experienced significantly higher somatic anxiety intensity at Block 2 (M = 2.78, SD = 1.48) compared with Block 1 (M = 2.15, SD = 1.05; p = .013). There were no differences in cognitive or somatic intensity between blocks for the near miss group. Means and standard errors depicting the block by imagery content interactions for cognitive and somatic intensity are displayed in Figure 2.3. There was no significant univariate block by imagery content interaction for cognitive direction or somatic direction (Figure 2.3). At the multivariate level there were no significant main effects for block, skill level, or imagery content, and no significant block by skill level (Figure 2.4), imagery content by skill level, or block by imagery content by skill level interactions.

Confidence. A 2 Block (Block 1, Block 2) × 2 Imagery content (near miss, far miss) × 2 Skill level (novice, experts) ANOVA revealed a significant main effect for skill level, $F(1, 75) = 10.87$, $p = .001$, $\eta_p^2 = .13$, 95% CI [0.28, 1.15], and a significant block by skill level interaction, $F(1,75) = 7.17$, $p = .009$, $\eta_p^2 = .09$, 95% CI [-1.09, -0.02]. Post hoc analyses revealed at Block 1, novices were significantly less confident (M = 3.72, SD = 1.34) than experts (M = 4.95, SD = 1.11; p < .001), but there were no differences between imagery content groups at Block 2. Furthermore, novices were significantly more confident at Block 2 (M = 4.28, SD = 1.38) than they were at Block 1 (M = 3.72, SD = 1.34; p = .04), but experts' confidence did not change over blocks. Means and standard errors depicting the block by skill level interaction are displayed in Figure 2.4. There were no significant main effects for block or imagery content, and no significant block by imagery content (Figure 2.3), imagery content by skill level, or block by imagery content by skill level interactions.

Table 2.2

Means (standard deviation) for performance and psychological variables by block, imagery content group, and skill level

	Block 1			Block 2		
Imagery group	Experts	Novices	Total	Experts	Novices	Total
			Performance			
Near miss	21.14 (5.19)	40.08 (12.52)	30.37 (13.40)	21.66 (4.45)	40.84 (12.06)	31.00 (13.16)
Far miss	20.55 (4.30)	40.72 (12.80)	30.64 (13.90)	26.15 (7.39)	49.47 (12.40)	37.81 (15.53)
Total	20.85 (4.71)	40.41 (12.50)		23.91 (6.44)	45.27 (12.84)	
			Confidence			
Near miss	4.95 (.76)	4.21 (1.18)	4.59 (1.04)	4.65 (1.27)	4.47 (1.17)	4.56 (1.21)
Far miss	4.95 (1.40)	3.25 (1.33)	4.10 (1.60)	4.35 (1.39)	4.10 (1.55)	4.23 (1.46)
Total	4.59 (1.11)	3.72 (1.34)		4.50 (1.32)	4.28 (1.38)	
			Cognitive anxiety intensity			
Near miss	1.95 (1.00)	2.63 (1.38)	2.28 (1.23)	1.85 (1.00)	2.53 (1.21)	2.18 (1.14)
Far miss	2.25 (1.16)	2.35 (.88)	2.30 (1.02)	2.75 (1.37)	3.45 (1.23)	3.10 (1.34)
Total	2.10 (1.08)	2.49 (1.14)		2.30 (1.27)	3.00 (1.30)	
			Cognitive anxiety direction			
Near miss	.45 (1.57)	.47 (1.39)	.46 (1.47)	.55 (1.91)	.16 (1.46)	.36 (1.69)
Far miss	-.25 (1.62)	.20 (1.24)	-.02 (1.44)	-.95 (1.32)	.35 (1.27)	-.30 (1.44)
Total	.10 (1.61)	.33 (1.31)		-.20 (1.79)	.26 (1.35)	
			Somatic anxiety intensity			
Near miss	2.10 (1.21)	2.84 (1.21)	2.46 (1.25)	1.90 (1.02)	2.89 (1.52)	2.38 (1.37)
Far miss	2.00 (1.12)	2.30 (1.00)	2.15 (1.05)	2.65 (1.66)	2.90 (1.29)	2.77 (1.48)
Total	2.05 (1.15)	2.56 (1.12)		2.28 (1.41)	2.90 (1.39)	
			Somatic anxiety direction			
Near miss	.10 (1.71)	-.21 (1.32)	-.05 (1.52)	.25 (2.00)	.05 (1.31)	.15 (1.68)
Far miss	.05 (1.82)	.40 (1.67)	.00 (1.73)	-.55 (1.79)	.40 (1.57)	-.08 (1.73)
Total	.08 (1.75)	-.13 (1.49)		-.15 (1.92)	.23 (1.44)	

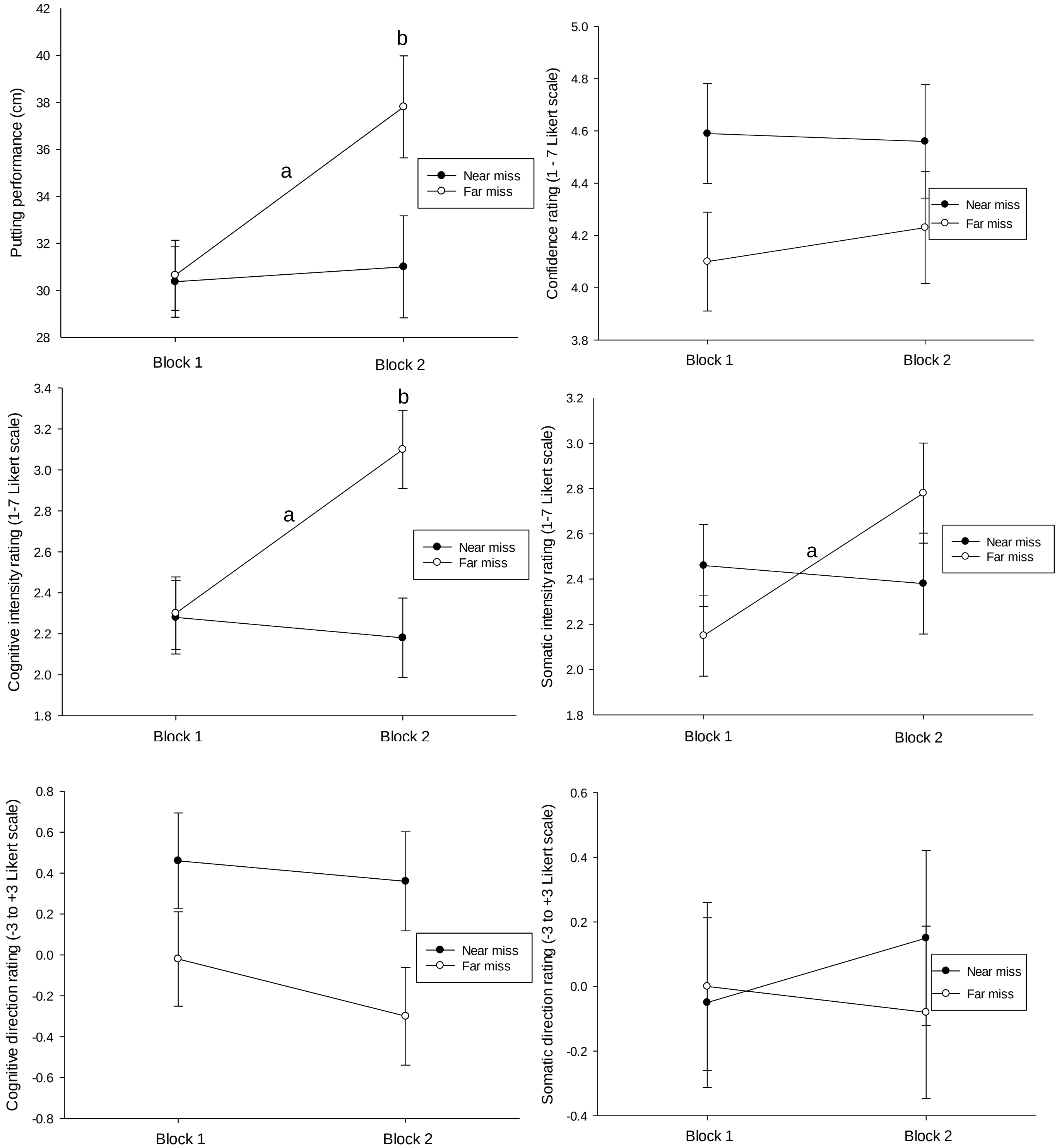


Figure 2.3. Mean and standard errors for imagery content group by block interactions (-●- near miss, -○- far miss). Presented from top left to bottom right across the page are: putting performance, confidence, cognitive anxiety intensity, somatic anxiety intensity, cognitive anxiety direction, and somatic anxiety direction.

Note. [a] Far miss group significantly greater at Block 2 than Block 1. [b] At Block 2, far miss group significantly greater than near miss group.

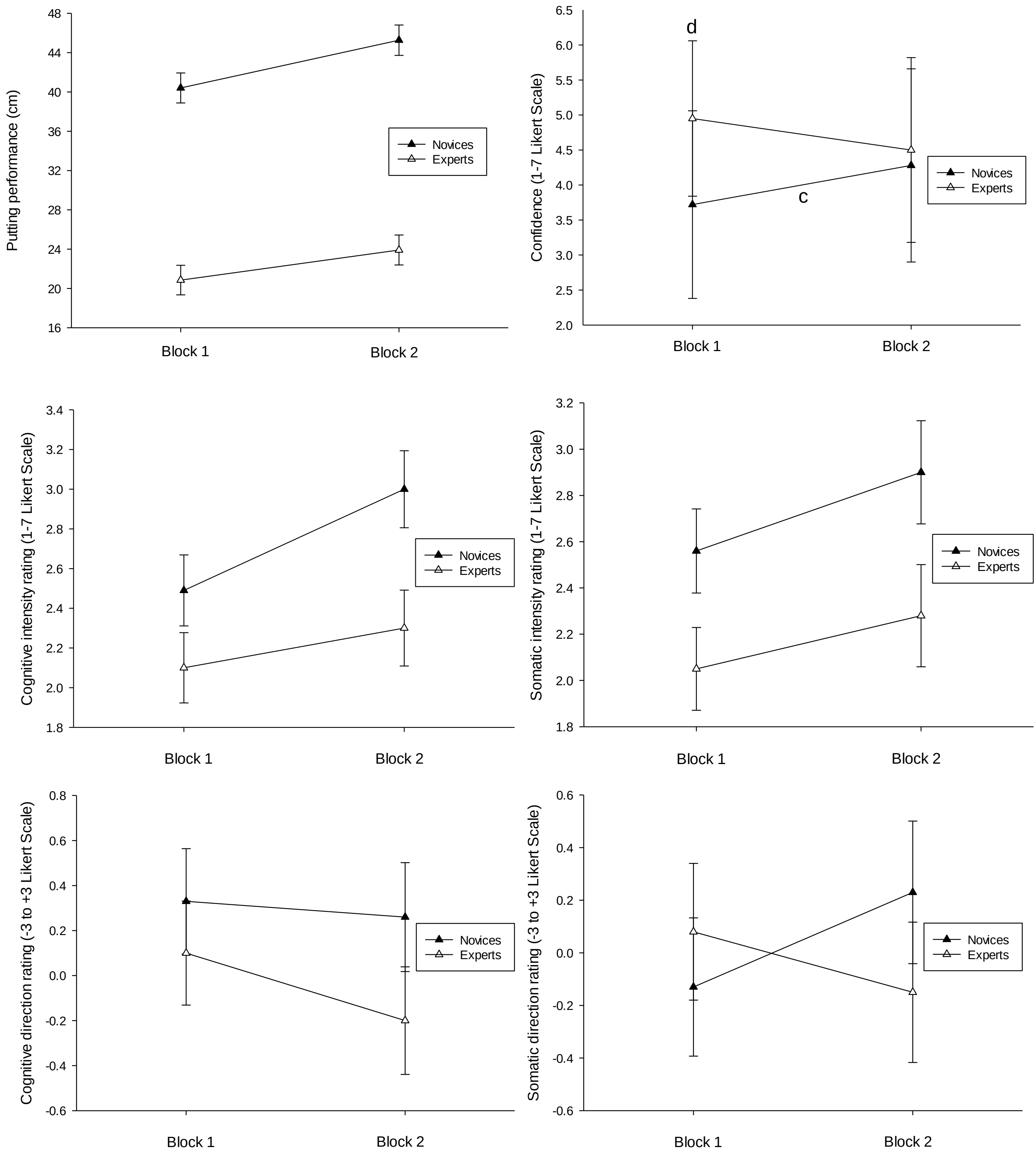


Figure 2.4. Mean and standard errors for skill level by block interactions (-▲- novices, -△- experts). Presented from top left to bottom right across the page are: putting performance, confidence, cognitive anxiety intensity, somatic anxiety intensity, cognitive anxiety direction, and somatic anxiety direction.

Note. [c] Novices significantly greater at Block 2 than Block 1. [d] At Block 1, novices significantly less than experts.

Imagery Meaning Outcome Relationship

There were no significant correlations between image meaning and any Block 2 outcomes (Table 2.3). A one-way ANOVA revealed a significant difference in performance due to meaning group, $F(1, 69) = 7.44$, $p = .008$. The unhelpful group experienced a greater increase in putting error ($M = 6.81$, $SD = 10.18$) than the helpful group ($M = 0.68$, $SD = 7.86$). There were no significant differences in confidence, anxiety intensity, or direction due to meaning group (p's > .05).

Table 2.3
Correlation matrix for image meaning and Block 2 variables

Variable	1.	2.	3.	4.	5.	6.
1. Image meaning						
2. B2 performance	.13					
3. B2 cognitive anxiety intensity	-.05	.41**				
4. B2 somatic anxiety intensity	-.02	.21	.51**			
5. B2 confidence intensity	.04	-.06	-.23*	-.31**		
6. B2 cognitive anxiety direction	.12	.06	-.21	-.14	.12	
7. B2 somatic anxiety direction	.05	.10	-.14	-.21	.07	.69**

Note. B2 represents Block 2.
*p < .05. **p < .01

Discussion

This chapter investigated the effect of skill level (i.e., expert and novice) and imagery content (i.e., near miss and far miss) on image meaning, and on anxiety, confidence, and performance of a golf putting task. Results predominantly confirmed our first hypothesis that experts would perform better than novices throughout the experiment. Similarly, results partly support our second hypothesis that experts would interpret the near and far miss images as more unhelpful than novices, which is likely due to the imagery content not reflecting their performance capabilities. However, contrary to our hypothesis, novices interpreted the imagery as similarly helpful regardless of condition. This is likely due to the image content of missing by 40 cm reflecting the novices' performance capabilities (Block 1 mean novice performance = 40.41 cm). Consequently, the far miss condition is likely to have still been helpful for novices. These interpretations support the task and learning elements of the PETTLEP (Physical, Environment, Task, Time, Learning, Emotion, Perspective) model of imagery (Holmes & Collins, 2001), and highlight the importance of matching the image content to the current performance level. Previous facilitative and debilitative imagery studies considering skill level have neglected to report image meaning (Ramsey et al., 2008). Therefore these findings are the first to demonstrate that individual characteristics, such as skill level, are directly associated with image meaning (Cumming & Williams, 2013).

Although image meaning was related to skill level, it did not differ according to the content of the imagery. According to the RAMDIU (Cumming & Williams, 2013), image meaning bridges the gap between imagery function and content to influence the outcomes experienced. Findings suggest that imagery function likely plays a key role in influencing the relationship between image meaning and content. As image function was not measured in this study, future research investigating image meaning should consider the function and content of the image to comprehensively understand the relationships between these components outlined by RAMDIU. Importantly, however, and supporting our hypotheses, image content did alter the outcomes experienced (e.g., performance and anxiety intensity).

Results for performance and anxiety partially supported our hypotheses. These outcomes seemed to be determined by image content (i.e., near miss or far miss) rather than skill level. Although experts reported the imagery as being more unhelpful than novices, both skill levels in the far miss group experienced a decline in performance. Moreover, experts in the near miss group reported the imagery as being unhelpful to performance, yet they experienced no change in performance across blocks. This is a similar finding to Nordin and Cumming (2005) in which facilitative imagery was interpreted as helpful but did not alter performance or self-efficacy. Together with a lack of significant relationships between image meaning and Block 2 variables, findings suggest a lack of awareness from participants concerning the impact imagery could have on outcomes. Therefore, while it is important to assess individuals' perceptions of imagery, this may not always reflect the pronounced impact it could have.

There were no significant effects for anxiety direction, which might be more strongly influenced under conditions where performance is more important (e.g., under pressure). This finding can also be explained by self-confidence; that is, imagery can protect against negative anxiety symptoms by maintaining high self-confidence (Cumming, Olphin, & Law, 2007). In support of our hypothesis, novices (who perceived imagery as more helpful than experts) experienced an increase in confidence following imagery. This replicates findings that outcome imagery can alter confidence (Taylor & Shaw, 2002), but suggests this is associated with image meaning which can be related to an individual's characteristics.

Overall results highlight the importance of image meaning; an important component of the RAMDIU (Cumming & Williams, 2013), which is defined here as an individuals' interpretation of an image as helpful or unhelpful, and how this is influenced by individual characteristics (e.g., skill level, confidence, prior performance). The RAMDIU, along with previous theories (e.g., Lang's bioinformational theory, 1979), suggests that the most effective imagery will occur when it is meaningful and personalized to the athlete. This chapter hypothesized that imagery would have either a facilitative or debilitative effect upon various outcomes, but did not hypothesize that there would be no effects (i.e., as for experts' confidence). Based on these theories and models, it may be worth considering that participants are unlikely to experience the intended, if any, effect when imagery is not relevant and meaningful.

Strengths and Limitations

A strength of the study was that only the outcome of the image was manipulated unlike previous studies that have manipulated both outcome and other aspects such as performance execution (Nordin & Cumming, 2005; Taylor & Shaw, 2002). Therefore one can be more confident that results are due to the imagery outcome. Additionally, participants completed 60 practice putts to prevent performance changes due to task acclimatization. Finally, the criterion for expert golfers ensured the comparison with novices of outcome imagery effects was undertaken with truly elite participants.

A possible limitation is that participants aimed for the target significantly more at Block 1 than Block 2. This could be due to the imagery content (i.e., missing the target) making participants despondent and possibly lowering motivation levels. Similarly, Nordin and Cumming (2005) found that individuals imaging hitting the bull's eye aimed significantly more for the bull's eye compared to individuals who imaged missing the bull's eye. This reduction in the present chapter was equal across groups suggesting it did not influence the interactions from the main analyses. Future research should examine the influence outcome imagery has on effort and motivation. Using a target instead of a hole might be another limitation because participants may have responded differently to the task if an actual golf hole was used, which is also more ecologically valid. However, a target was chosen in the present chapter to ensure an accurate putt was less likely due to chance and this procedure has been successfully implemented in previous research (e.g., Gray, Allsop, & Williams, 2013). Future research could compare both methods to investigate potential differences.

Applied Implications and Future Research

Results of this chapter have important implications for applied practice. In support of Williams, Cooley, Newell, Weibull, and Cumming (2013), findings suggest that coaches and applied practitioners should consider athletes' personal characteristics and develop imagery scripts and exercises alongside the athlete to ensure the content is interpreted as intended. Findings emphasize the need for a systematic, theoretical approach when exploring athletes' imagery experiences, providing further support for the RAMDIU (Cumming & Williams,

2013) as a framework for future interventions and applied practice. Future research should investigate the effect of other characteristics (e.g., age, gender, and personality) that might also influence image meaning.

Results also suggest caution should be taken when discussing image meaning with athletes as they are not always accurate about images being helpful or unhelpful. For example, novices said the imagery was not unhelpful but still had a reduction in performance. These individuals may display poorer meta-imagery: the awareness and control an individual has over their own imagery (Moran, 2004). It is possible that people who are more aware of how to use imagery for different benefits might be more accurate in stating whether an image is helpful or unhelpful. Future research should investigate whether certain characteristics (e.g., meta-imagery proficiency, mindfulness) are associated with greater accuracy in whether an image is helpful or unhelpful. Finally, although beyond the scope of this chapter, a worthy avenue for future research to pursue is to investigate how the various components of the RAMDIU relate to each other, for example through structural equation modelling.

In conclusion, this chapter investigated whether skill level (i.e., expert or novice) and imagery content (i.e., missing a target by 20 or 40 cm) impacted image meaning, and outcomes of imagery use (i.e., anxiety, confidence, and performance of a golf putting task). Associations between image meaning and these outcomes were then examined. Findings demonstrated that skill level is associated with how imagery content is interpreted (i.e., image meaning), but also that imagery content (regardless of skill level and image meaning) influenced other outcomes. However, image meaning did not significantly relate to the outcome variables. Findings support the RAMDIU that suggests an individual's characteristics (e.g., skill level) are related to image meaning. However, image meaning does not always reflect the outcomes experienced and thus caution should be taken when trying to obtain information about the image meaning from an athlete. Future research should investigate the effects of different types of imagery on cognitive and affective outcomes but in response to a stress eliciting situation.

Chapter 3

Competition stress: influence of challenge, threat, and relaxation imagery, and imagery ability

A version of this chapter is under review under the following reference:

Quinton, M. L., Veldhuijzen van Zanten, J. J. C. S., Trotman, G. P., Cumming, J., & Williams, S. E. (2017). Competition stress: influence of challenge, threat, and relaxation imagery, and imagery ability. *International Journal of Psychophysiology.*

Competition stress: influence of challenge, threat, and relaxation imagery, and imagery ability

Acute psychological stress is a common occurrence in everyday life, eliciting a range of psychological (e.g., increases in anxiety) and cardiovascular (e.g., increases in heart rate; HR) responses (Moore, Vine, Wilson, & Freeman, 2012; Skinner & Brewer, 2004; Turner, 1994). Excessive stress can be detrimental towards physical and psychological health (Schneiderman, Ironson, & Siegel, 2005), therefore, individuals self-regulate stress responses by modifying the symptoms of stress (e.g., relaxing) or changing the perception of these symptoms (e.g., reappraisal; Meichenbaum & Deffenbacher, 1988). Stress can be appraised as facilitative or debilitative (Crum, Salovey, & Achor, 2013). Facilitative stress responses are characterized by better task performance, greater confidence, helpful anxiety perceptions, and/or a more favorable cardiovascular profile, whereas debilitative responses can consist of poorer performance, lower confidence, hurtful anxiety perceptions, and/or a less favorable cardiovascular profile (Crum et al., 2013; Trotman, Quinton, Williams, & Veldhuijzen van Zanten, 2016; Williams, Cumming, & Balanos, 2010). Consequently, it is important to establish strategies to elicit more facilitative responses to stress.

According to Jones (1995), strategies to elicit more facilitative anxiety responses should target both the intensity of symptoms experienced (i.e., level of anxiety) and the meaning of these symptoms to the individual (e.g., facilitative or debilitative), the latter of which are influenced by perceptions of control (i.e., greater control leads to more facilitative anxiety; Jones, 1995). Anxiety perceptions can be a stronger predictor of success than intensity (Chamberlain & Hale, 2007). However, these perceptions can vary according to anxiety intensities (Lundqvist, Kenttä, & Raglin, 2011). Moreover, different levels of anxiety intensity may be more or less facilitative in certain tasks (e.g., higher anxiety might be more facilitative in competition tasks; Hanton & Jones, 1999).

The magnitude of stress experienced and the nature of the stress response also depends on factors such as self-confidence and situational appraisal (Jones, 1995). The theory of challenge and threat states in athletes (TCTSA; Jones, Meijen, McCarthy, & Sheffield, 2009) posits that a motivated performance situation is characterized as a challenge or a threat. Building on Jones' (1995) model and the biopsychosocial model (Blascovich & Mendes, 2000), greater perceived control and confidence is associated with a challenge appraisal which is characterized by more facilitative anxiety perceptions, better performance, and more efficient cardiovascular responses (Table 1.2). By contrast a threat appraisal (resulting from lower perceived control and less confidence) is associated with more debilitative anxiety perceptions, worse performance, and less efficient cardiovascular responses (Jones et al., 2009; Moore et al., 2012; Williams et al., 2010). Situational factors such as the task may also affect the stress experienced (Jones, 1995). Jones (1995) highlighted that different sports will vary in what characterizes an adaptive response, but this suggestion likely extends beyond sport. Investigating the stress response to certain tasks, such as competitive stress tasks, is important to uncover mechanisms by which individuals cope with stressful situations.

Competition is a type of stress that individuals do not always avoid as readily as other types of stress. For example, 15.74 million people in England engage in sport at least once a week (Sport England, 2016), thus in the sport setting, competition is typically not feared by individuals and is often enjoyed and actively engaged in. Unlike the clinical literature, responses to stress in the form of competition can be more beneficial than experiencing no response (Skinner & Brewer, 2004). Indeed, athletes often report higher anxiety levels and feeling "psyched up" to be helpful for upcoming competition (Hanton, Neil, & Mellalieu, 2008) and therefore do not want to reduce these levels. As previously mentioned, control is a key determinant of facilitative or debilitative anxiety (Jones, 1995). Consequently, competition is likely to elicit more perceived control compared to other tasks where control is less easily self-regulated (e.g., public speaking). Therefore, techniques may be more beneficial if they can elicit challenge appraisals, feelings of control, and responses perceived as more facilitative for success. This information could have wider implications as a greater understanding of strategies' effectiveness could enhance coping with these stressful situations (e.g., prevent athletes choking under pressure).

Imagery is one effective technique for altering the intensity and perceptions of psychophysiological stress responses (Cumming, Olphin, & Law, 2007; Williams et al., 2010). However, previous studies were conducted in either hypothesized competition or low stress evoking situations. Williams, Veldhuijzen van Zanten, Trotman, Quinton, and Ginty (2017) expanded on these studies and investigated the influence of different types of imagery (i.e., challenge, threat, and neutral scripts) on anxiety and HR responses to a public speaking task. Results revealed that imagery successfully manipulated the appraisal and responses experienced during an actual stress task. However, research is needed to replicate and extend this work to determine if imagery can also alter stress responses for coping in actual competition (i.e., rather than hypothesized competition), which would be beneficial for informing effective management of stress in various settings (e.g., sport).

It is important to determine the generalizability of Williams et al.'s (2010, 2017) studies beyond a hypothetical competition and public speaking preparation task to explore how different types of imagery regulate responses to different stress evoking situations (e.g., actual competition). Collectively these studies found that the threat group perceived the task as more stressful and experienced lower confidence and more debilitative anxiety interpretations compared to the challenge and neutral groups, but the challenge and neutral scripts were more similar than originally hypothesized (Williams et al., 2010, 2017). For example, Williams et al. (2017) found that there was no difference in task appraisals or HR responses between these two groups and their confidence levels and anxiety interpretations were both higher (or more facilitative) compared to the threat group. In fact, at times the neutral script was even more adaptive (e.g., significantly more facilitative anxiety interpretations compared to threat script) than the challenge script. These findings were in contrast to Williams et al. (2010), who found that challenge imagery was most helpful for hypothetical competition performance than threat (and neutral) imagery. The difference in these two studies' results is likely first due to the different tasks used (i.e., public speaking and competition), and second due to the use of an actual stress evoking task (i.e., public speaking) in the Williams et al. (2017) study compared to hypothetical stress in the Williams et al. (2010) study. Therefore, when considering the effectiveness of different types of imagery for regulating responses to an actual (i.e., rather than hypothetical) stressful situation such as competition, it would be worthwhile to extend both Williams et al.'s (2010) study and Williams et al.'s (2017) study and examine whether a different type of imagery in a relaxing script (as used in previous research; Cumming et al., 2007) would be more facilitative than a challenge (and threat) script when individuals are faced with a stress evoking, real life situation (i.e., competition).

The notion of effective imagery for different situations is highlighted by the revised applied model of deliberate imagery use (RAMDIU; Cumming & Williams, 2013). The model proposes that imagery will be more effective when the imagery content (i.e., what is imaged) is appropriate for the function (i.e., why it is imaged) it intends to serve, which can also be influenced by the situation (i.e., where or when). It is logical that different tasks (e.g., competition compared to public speaking; Williams et al., 2010, 2017) will vary in what characterizes adaptive stress responses and what is imaged to evoke a facilitative response will likely differ. For example, the effectiveness of a challenge or relaxing script (i.e., content) for encouraging confidence (i.e., function), might be influenced by the task, such as competition (i.e., situation). Therefore, it is possible that the findings of this study may be more in line Williams et al.'s (2010) study due to a similar situation (competition) compared to the Williams et al. (2017) study which used a public speaking task.

Given that imagery is more effective when people can image sufficiently (Williams, Cooley, & Cumming, 2013), imagery ability is another key consideration for effectively regulating stress (Williams et al., 2017). Imagery ability is described as "an individual's capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal" (Morris, 1997, p. 37). Higher levels of imagery ability have been associated with greater benefits (e.g., better performance, higher confidence; Abma, Fry, & Relyea, 2002; Robin et al., 2007). The RAMDIU posits that imagery ability will directly influence the imagery content used (i.e., individuals will likely image content that they find easier to generate), but will also moderate the effectiveness of outcomes experienced (Cumming & Williams, 2013). Mastery imagery ability (i.e., imaging mastering challenging situations) is particularly relevant to investigating how individuals cope with stress. Better mastery imagery ability has been linked to higher challenge appraisals and lower threat appraisals (Williams & Cumming, 2012b). Also, lower and more facilitative anxiety perceptions have been associated with higher mastery imagery ability via greater self-confidence levels (Williams & Cumming, 2015). Therefore, those with higher mastery imagery ability, who are better able to regulate their anxiety through self-confidence, may be less affected by negative (e.g., threat) imagery during a stressful situation. These individuals may also experience greater benefits of imagery associated with coping and being in control of stress (e.g., challenge imagery).

It is also likely that mastery imagery ability could relate to relaxing imagery. Although Cumming et al. (2007) included a relaxing script as a control in comparison to other mastery and affect scripts, they found that both mastery and relaxing scripts were beneficial for being more confidence building compared to an anxiety (i.e., affect) script. Therefore, there could also be similarities between mastery and relaxing imagery in relation to their effectiveness at regulating responses to stress (e.g., confidence). Thus, when investigating the effect of different types of imagery (e.g., challenge, threat, and relax) on stress responses, it is important to investigate the role of mastery imagery ability.

From a bioinformational theory perspective, affect imagery ability (i.e., the ability to image emotions such as excitement) could also relate to the effectiveness of imagery scripts (i.e., emotion based content enhances imagery effectiveness; Lang, 1979). Research has demonstrated an association between affect imagery ability and stress appraisals (Williams & Cumming, 2012b). However, Williams and Cumming (2012b) found that mastery imagery ability was a stronger predictor of challenge appraisals and cognitive anxiety intensity compared to affect imagery ability. Furthermore, affect imagery ability was not associated with confidence or threat appraisals (Williams & Cumming, 2012b), which are arguably two key components associated with stress responses (Blascovich & Mendes, 2000; Jones et al., 2009). Although affect imagery ability is typically easier to image than mastery imagery ability (Simonsmeier & Buecker, 2017; Williams & Cumming, 2011), it is likely that mastery imagery ability is more effective when considering regulating stress responses to competition.

Aims and Hypotheses

The first aim of this chapter was to investigate how different types of imagery can alter psychological (anxiety and confidence) and cardiovascular (HR, blood pressure; BP, cardiac output; CO, total peripheral resistance; TPR) responses to an actual competition task. Participants completed the task twice: once before and once after listening to their randomly allocated imagery script (challenge, threat, relax, or control). The second aim was to determine whether alterations in the responses to the task were associated with greater mastery imagery ability. To determine the extent to which alterations in these responses were unique to mastery imagery ability, responses were also compared to another type of imagery in affect imagery ability. This type of imagery was considered a more relevant comparison than other types of imagery ability as it includes emotions which are also commonly experienced in stress (e.g., nervousness, excitement; Williams & Cumming, 2011).

Assuming the competition task would elicit a stress response, it was hypothesized that (a) the challenge script would elicit the most facilitative stress responses for the competition task, and (b) the threat script would elicit the most debilitative stress responses (e.g., lower self-confidence, more debilitative anxiety interpretations, higher HR, BP, and CO reactivity, stable or increasing TPR) for the task compared to other conditions. In regards to changes over time, it was hypothesized that, (c) anxiety intensity would increase from Session 1 to Session 2 for the challenge and threat groups, but decrease for the relax group, (d) compared to Session 1, anxiety would be perceived as more facilitative for the challenge group and more debilitative for the threat group, (e) confidence would increase from Session 1 for the challenge and relax groups but decrease for the threat group, and (f) HR, BP, CO, and TPR reactivity would decrease from Session 1 for the relax group, but increase for the challenge (except TPR which would decrease for challenge) and threat groups. Finally, (g) challenge and threat groups would experience an increase in HR and CO during the imagery script compared to the relax group, and (h), higher levels of mastery imagery ability, in comparison to affect imagery ability, would be associated with more favorable psychological and cardiovascular outcomes to the task for the challenge and relax groups, but also the threat script would be less detrimental for those with greater mastery imagery ability.

Method

Participants

Seventy-eight male undergraduate students (*M* age = 20.03 years, *SD* = 1.28) participated in the study with the option of gaining course credit. Only males were recruited due to sex differences in responses to stress (Bale & Epperson, 2015). Participants were healthy with no history of epileptic seizures, cardiovascular, immune, metabolic, or kidney disease, and had no current illness or prescribed medication in the last four weeks at the time of the study. Participants were instructed to abstain from heavy exercise and alcohol consumption 24 hours before testing, and from eating and drinking caffeine two hours before testing. Following ethical approval, participants provided informed written consent after being recruited by experimenters over an eight week period through social media, emails, and class announcements at the university where the authors are based.

Cardiovascular Measures

A blood pressure monitor (Omron HEM-705CP) with an occluding cuff placed on the non-dominant arm assessed systolic and diastolic BP (millimeters of mercury; mmHg). Mean arterial pressure (MAP) was calculated using the equation ((2 × DBP) + SBP) / 3. Heart rate (HR; beats per min; bpm) was recorded continuously using the Vrije Universiteit Ambulatory Monitoring System (VU-AMS5fs[2], TD-FPP, Amsterdam, The Netherlands; De Geus, Willemsen, Klaver, & Van Doornen, 1995; Willemsen, De Geus, Klaver, Van Doornen, & Carroll, 1996). The VuAMS5fs used seven Ag/AgCl spot electrodes (Invisatrace, ConMed Corporation), to record electrocardiography (ECG) and impedance cardiography (ICG). The ECG was recorded using three electrodes: below the right collar bone 4 cm to the right of the sternum, between the lower two ribs on the lateral right hand

[2] 9 participants' data were recorded on a previous electrocardiograph system (Vrije Universiteit Ambulatory Monitoring System, VU-AMS), however data was analyzed on both systems and no differences were found.

side and at the apex of the heart on the left lateral margin of the chest. Following automated R-peak detection, the interbeat interval signal was visually inspected and corrected if necessary.

The ICG electrodes were placed at the top of the sternum between the tips of the collar bone, at the xiphoid process of the sternum, and two on the back (3 cm above and 3 cm below the horizontal plane of the upper and lower measuring electrodes respectively). Next, 60 s ensemble ICG complexes were created and scored offline in the VU-DAMS program. Specifically, this included the detection of four key points: (1) the onset of the Q-point in the ECG (start of electromechanical heart cycle), (2) the B-point (start of left ventricular ejection time and aortic valves open), (3) the dz/dt_{min} (maximal blood velocity during systole), and (4) the X-point (aortic valves close and left ventricular ejection ends; Sherwood et al., 1990). The key points of each ensemble were visually inspected before the following measures were produced: Left ventricular ejection time (LVET, ms) was the time between the B and X points; stroke volume (SV, ml) was calculated using the Kubicek formula, $SV = \rho \times (L/Z_0)^2 \times LVET \times dZ/dt_{max}$ (Kubicek et al., 1974); cardiac output (CO; l/min) was calculated by multiplying SV by HR; and total peripheral resistance (TPR; dyne-s/cm^{-5}) was calculated using the formula MAP/CO × 80.

Psychological Measures

State anxiety and self-confidence. The Immediate Anxiety Measurement Scale (IAMS; Thomas, Hanton, & Jones, 2002) assessed cognitive and somatic anxiety and self-confidence in relation to the task. Participants were provided with definitions of these constructs to ensure understanding. Participants rated the extent to which they felt cognitively anxious, somatically anxious, and self-confident on a 7-point Likert type scale from 1 (*not at all*) to 7 (*extremely*) before indicating how they perceived these symptoms from -3 (*very debilitative/negative*) to +3 (*very facilitative/positive*). Validity and reliability evidence has been found in support of IAMS test scores (Thomas et al., 2002).

Challenge and threat appraisals. Challenge and threat appraisals of the task were assessed with six items used previously by Williams et al. (2010). Three items represented the extent to which participants appraised the situation as a challenge (e.g., "I view the task as a challenge") and three items represented a threat appraisal (e.g., "I feel threatened by the situation"). Participants rated the extent to which they agreed with each item a 7-point Likert type scale from 1 (*not at all*) to 7 (*very true*). Each subscale's items were averaged to create separate measures of challenge and threat appraisal. The internal reliability for Session 1 and Session 2 was acceptable for both challenge (Cronbach α's = .86, .94) and threat (Cronbach α's = .93, .98) appraisals respectively.

Task evaluation. Three items assessed the level of task stressfulness, difficulty, and effort experienced. Ratings were made on a 7-point Likert type scale from 1 (*not at all stressful/not at all difficult/did not try at all*) to 7 (*extremely stressful/extremely difficult/tried throughout the whole task*).

Mastery and affect imagery ability. Participants completed the mastery and affect subscales of the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). Participants imaged three items reflecting mastery content (staying positive after a setback, giving 100% effort when things are not going well, and remaining confident in a difficult situation), and three items reflecting affect content (positive emotions felt while doing sport, anticipation and excitement associated with sport, excitement associated with performing) before rating ease of imaging on a 7-point Likert type scale from 1 (*very hard to image*) to 7 (*very easy to image*). The ratings were averaged to give one mastery and one affect imagery ability score. The internal reliability in this study was just below adequate (Cronbach α mastery and affect = .66, .69 respectively). However, validity and reliability evidence has previously been found in support of SIAQ test scores (Williams & Cumming, 2011).

Imagery script evaluation. Six items evaluated the imagery on 7-point or 10-point Likert type scales (Cumming et al., 2007). Two items asked how easily and vividly participants could image the scripts (1 = *very hard/no image at all*, 7 = *very easy/perfectly clear*). One item asked the extent to which participants were engaged when listening to the script (1 = *none of the time*, 10 = *all of the time*). Two items assessed how imagery was perceived to impact confidence and anxiety intensities (1 = *decreased confidence/anxiety symptoms a lot*, 7 = *increased confidence/anxiety symptoms a lot*). The final item assessed how imagery was perceived to influence anxiety symptom interpretation (1 = *anxiety viewed as being much more hurtful*, 7 = *anxiety viewed as being much more helpful*).

Competition Task

The competition task was the car racing computer game Need for Speed: Underground (Electronic Arts Games). The primary objective was to win a car race in the quickest time possible against three computer controlled opponents, while avoiding traffic and other obstacles. Game manipulations allowed the computer opponents to match the ability of the participant to ensure there was never a clear win or loss. To enhance task competitiveness, a leaderboard was displayed in the lab and participants were informed that the fastest time (for each session) at the end of the study would be awarded a £10 voucher. Prerecorded instructions informed participants about the keypad controls, that their race position would be displayed throughout the race, and that they would have one practice lap (Session 1 only) before completing the three lap race. The experimenters provided participants with verbal encouragement throughout (e.g., Veldhuijzen van Zanten et al., 2002). The conditions for both races were pilot tested and similar in difficulty but included a different car and track than Session 1 to ensure the novelty of the task was maintained.

Imagery

The three imagery scripts (challenge, threat, and relax) described the moments prior to the task, including cognitive and physiological responses. Scripts were based on those previously employed (Cumming et al., 2007; Williams et al., 2010) and included stimulus (e.g., "you look around and notice the experimenters watching you"), response (e.g., "your heart is beating faster than usual"), and meaning (e.g., "…but you feel ready") propositions (Lang, 1979). Scripts were pilot tested but no further changes were made. All three scripts were matched in terms of the amount of content and script length and lasted approximately 3 min. The scripts were audio recorded and played on an mp3 player.

Challenge and threat scripts were matched for stimulus and response propositions and described how participants would cope with the task. Altered meaning propositions were attempted through manipulating perceptions of self-efficacy and control, which influence challenge and threat appraisals (Jones et al., 2009). Challenge and threat scripts also included resource and demand appraisals from the biopsychosocial model of challenge and threat (Blascovich & Mendes, 2000), and antecedents from the TCTSA. The relaxing script was developed with the aim of making participants feel calm prior to completing the task. The script included details about cognitions, body position, and physiological responses, and predominantly included response propositions to focus on inducing a state of relaxation[3].

Procedure

Session 1. On arrival at the lab, eligibility criteria were confirmed and all procedures were explained to the participants. Participants were randomly allocated to an intervention group (1, 2, 3, or 4) from a randomly generated list devised by the experimenters; challenge (n = 18), threat (n = 20), relax (n = 19), or control (n = 19).

[3] Scripts can be found in Appendix 17.

Participants were connected to the cardiovascular recording equipment and comfortably seated where they remained throughout the session. A 15 min baseline period then ensued where participants watched a nature documentary to establish resting cardiovascular values. Baseline BP measurements were taken, and ECG and impedance recordings analyzed, in the 9th, 11th, 13th, and 15th minutes. Following baseline, participants were introduced to the task and completed the IAMS and challenge and threat appraisals. Participants then completed the task, whilst cardiovascular measurements were taken at 30 s and 2 min into the task. Participants completed the task evaluation form immediately after the task, had cardiovascular equipment removed, and were reminded about their second session.

Session 2. Session 2 for the control group was identical to Session 1. The protocol was also similar for the imagery groups except that on arrival at the lab, participants were provided with White and Hardy's (1998) definition of imagery. Following baseline, but before participants listened to their allocated imagery script, they received layered stimulus response training (LSRT; Cumming et al., 2016; Appendix 16) from an experimenter trained in the technique to ensure they could image as clearly and vividly as possible. Next, participants received instructions for the task before listening to their allocated imagery script. Participants were instructed to image as clearly and vividly as possible in their preferred visual perspective. Cardiovascular measurements were analyzed for 1 min, 2 min, and 3 min into the script. To prevent participants from being distracted whilst imaging the script, blood pressure was not assessed during the imagery. After listening to the script, participants completed the pretask questionnaires and the task. Finally, participants completed measures of imagery ability, imagery perceptions, and task evaluation before the removal of equipment and being thanked for participation. Each visit lasted between 90 and 120 min.

Data Reduction and Analysis

Baseline measurements were averaged to give an overall baseline score for SBP, DBP, HR, CO and TPR. Task scores were the average of the 30 s and 2 min values. Imagery scores were the average of the 1 min, 2 min, and 3 min values. Reactivity scores were then calculated for HR, BP, CO, and TPR by subtracting the average baseline value from the averaged competition task value (30 s and 2 min). For correlation analyses, change scores were calculated for psychological variables by subtracting Session 1 from Session 2 scores (e.g., a higher change score representing higher, more facilitative anxiety in Session 2).

Data was analyzed using SPSS (version 22). Where dependent variables were correlated, to reduce the likelihood of a Type 1 error, MANOVAs were chosen over ANOVAs (Williams et al., 2010). Pillai's Trace values were reported for all MANOVAs as this multivariate test is most robust (Olson, 1976). For MANOVAs including repeated measures, Greenhouse Geisser values were reported if Mauchly's test of sphericity was violated. The probability value threshold for all analyses was set at .05 and 95% confidence intervals were reported. All significant effects were followed up with bonferroni post hoc pairwise comparisons. One participant (threat group) was excluded from the analysis as a result of univariate and multivariate outlier checks. Upon visual and statistical analysis of outliers for CO and TPR, data were removed for 11 participants.

To verify that a stress response was elicited, three paired sampled t-tests examined differences in HR, SBP, and DBP from baseline to the competition task at Session 1. To investigate if the different scripts influenced the task stress responses, four separate 2 Time (Session 1, Session 2) × 4 Group (challenge, threat, relax, control) MANOVAs with repeated measures on the first factor were conducted to analyze differences in (a) cardiovascular measures (SBP, DBP, HR, CO, and TPR reactivity); (b) IAMS constructs (cognitive and somatic anxiety intensity and direction and confidence); (c) challenge and threat appraisals;

and (d) task stressfulness, difficulty, and effort. A 2 Time (baseline, imagery) x 3 Group (challenge, threat, relax) MANOVA with repeated measures on the first factor was conducted to analyze differences in HR and CO during the script from baseline.

To examine the extent to which mastery and affect imagery ability impacted the effects of the scripts, Pearson's bivariate correlations were conducted for each imagery group to investigate the relationships between mastery and affect imagery ability with psychological change scores and cardiovascular reactivity. To evaluate how well participants imaged the scripts and the perceived effect on certain outcomes, a one-way ANOVA analyzed imagery script engagement, and two one-way MANOVAs analyzed ease and vividness of imaging the script, and the effect of the script on confidence, anxiety intensity, and anxiety perception.

Results

Stress Response

See Table 3.1 for means and standard deviations. Paired sampled t-tests revealed the competition task elicited significant responses from baseline for HR, SBP, and DBP (p's < .001). This data is further supported by self-report task stressfulness ratings.

Table 3.1
Means (standard deviation) and statistical statements for cardiovascular stress responses to the task at Session 1

	Baseline	Competition	Statistical statement
HR (bpm)	70.73 (9.75)	86.16 (15.05)	t (70) = -11.46***
SBP (mmHg)	120.75 (10.04)	140.66 (16.74)	t (76) = -13.22***
DBP (mmHg)	66.07 (7.50)	79.44 (9.17)	t (76) = -15.28***

Note. *** p < .001.

Cardiovascular Reactivity

All means and standard deviations of absolute values during the task are reported in Table 3.2. A 2 Time (Session 1, Session 2) × 4 Group (challenge, threat, relax, control)

MANOVA revealed a significant multivariate main effect for time, Pillai's Trace = .34, $F(5, 40) = 4.15$, $p = .004$. Univariate analyses revealed this effect was for SBP, $F(1, 44) = 14.97$, $p < .001$, $\eta_p^2 = .25$, 95% CI [-11.75, -3.70], and for DBP, $F(1, 44) = 5.03$, $p = .030$, $\eta_p^2 = .10$, 95% CI [-6.39, -.34]. Participants had lower reactivity levels for SBP ($M = 11.79$, $SD = 12.37$) and DBP ($M = 9.02$, $SD = 11.29$) at Session 2 compared to Session 1 (SBP $M = 19.51$, $SD = 13.63$; DBP $M = 12.38$, $SD = 7.56$). There was no significant multivariate main effect for group, no time by group interaction, and no univariate effects for HR, CO, and TPR.

Table 3.2
Means (standard deviation) for psychological and cardiovascular variables by session and intervention group

Imagery group	Session 1	Session 2
	Systolic blood pressure (mmHg)	
Challenge	136.55 (20.44)	132.25 (10.65)
Threat	142.00 (14.46)	133.92 (13.92)
Relax	144.23 (16.34)	130.03 (24.29)
Control	139.66 (15.48)	136.21 (15.63)
Total	140.66 (16.74)	133.11 (16.77)[a]***
	Diastolic blood pressure (mmHg)	
Challenge	80.37 (11.45)	72.18 (10.70)
Threat	79.24 (8.21)	74.74 (10.88)
Relax	79.93 (8.86)	78.11 (11.02)
Control	78.18 (8.42)	76.29 (9.88)
Total	79.44 (9.17)	76.65 (10.49)[a]*
	Heart rate (bpm)	
Challenge	85.06 (16.94)	83.92 (20.71)
Threat	83.47 (14.24)	84.15 (22.92)
Relax	89.25 (15.13)	84.82 (15.89)
Control	86.24 (14.34)	79.28 (9.86)
Total	86.16 (15.05)	83.13 (17.61)
	Cardiac output (l/min)	
Challenge	10.47 (5.27)	11.86 (4.17)
Threat	13.03 (5.64)	14.42 (7.23)
Relax	14.82 (5.41)	11.45 (6.06)
Control	13.38 (6.10)	14.34 (5.23)
Total	13.03 (5.71)	12.93 (5.85)
	Total peripheral resistance (dyne-s/cm^{-5})	
Challenge	742.55 (291.72)	704.32 (258.74)
Threat	726.91 (301.67)	624.02 (241.70)
Relax	599.98 (219.34)	726.95 (247.21)
Control	600.25 (159.97)	582.73 (124.36)
Total	665.25 (252.07)	664.66 (229.79)
	Cognitive anxiety intensity	
Challenge	2.94 (1.16)	3.72 (1.74)
Threat	2.47 (1.22)	3.89 (1.82)
Relax	3.15 (1.57)	3.60 (1.93)
Control	3.37 (1.30)	3.42 (1.47)
Total	2.99 (1.34)	3.66 (1.73)[a]**
	Cognitive anxiety direction	
Challenge	.06 (1.59)	.11 (1.64)
Threat	-.21 (1.58)	-.74 (1.41)

Imagery group	Session 1	Session 2
Relax	.20 (1.51)	-.45 (1.64)
Control	.42 (1.58)	-.53 (1.07)
Total	.12 (1.55)	-.41 (1.46)[a]**
	Somatic anxiety intensity	
Challenge	2.67 (1.28)	3.44 (1.76)[a]*
Threat	2.42 (1.12)	3.42 (1.54)[a]*
Relax	3.15 (1.46)	2.95 (1.54)
Control	3.37 (1.17)	3.11 (1.45)
Total	2.91 (1.30)	3.22 (1.55)
	Somatic anxiety direction	
Challenge	.67 (1.41)	.06 (1.55)
Threat	-.21 (1.51)	-.68 (1.16)
Relax	-.45 (1.57)	-.30 (1.46)
Control	.58 (1.35)	-.37 (1.07)
Total	.13 (1.52)	-.33 (1.32)
	Self-confidence	
Challenge	4.17 (1.65)	4.44 (1.20)
Threat	4.11 (1.20)	3.79 (1.08)
Relax	4.55 (.95)	4.35 (1.31)
Control	4.68 (1.38)	3.89 (.99)
Total	4.38 (1.31)	4.12 (1.17)
	Challenge	
Challenge	5.00 (1.23)	4.93 (1.18)
Threat	5.02 (1.22)	4.96 (1.26)
Relax	5.52 (.86)	5.32 (1.35)
Control	5.35 (1.21)	5.04 (1.22)
Total	5.23 (1.13)	5.07 (1.24)
	Threat	
Challenge	2.17 (1.16)	2.65 (1.82)
Threat	2.32 (1.11)	3.44 (1.63)
Relax	2.23 (1.29)	2.12 (1.44)
Control	1.54 (.68)	2.24 (1.48)
Total	2.07 (1.11)	2.61 (1.65)[a]**
	Task stressfulness	
Challenge	3.44 (1.46)	3.44 (1.58)
Threat	3.53 (1.02)	4.32 (1.11)
Relax	3.70 (1.26)	4.10 (1.25)
Control	3.17 (1.51)	3.78 (1.31)
Total	3.47 (1.31)	3.92 (1.33)[a]**
	Task difficulty	
Challenge	3.72 (1.36)	3.78 (1.59)
Threat	4.32 (1.16)	4.32 (1.06)
Relax	4.05 (1.00)	4.25 (1.48)
Control	3.56 (1.42)	3.89 (1.13)
Total	3.92 (1.25)	4.07 (1.33)
	Task effort	
Challenge	5.61 (1.50)	5.67 (1.28)
Threat	5.89 (1.10)	5.68 (1.25)
Relax	6.40 (1.05)	5.80 (1.80)
Control	6.28 (.96)	5.67 (1.28)
Total	6.05 (1.18)	5.71 (1.40)[a]*

Note. [a] Significantly different than Session 1.
* $p < .05$. ** $p < .01$. *** $p < .001$.

State Anxiety and Self-Confidence

All means and standard deviations are reported in Table 3.2. A 2 Time (Session 1, Session 2) × 4 Group (challenge, threat, relax, control) MANOVA revealed a significant multivariate main effect for time, Pillai's Trace = .26, $F(5, 67) = 3.82$, $p = .002$, and a significant time by group interaction, Pillai's Trace = .43, $F(3, 72) = 1.93$, $p = .015$. Univariate analyses revealed the main effect was for cognitive intensity, $F(1, 72) = 12.87$, $p = .001$, $\eta_p^2 = .15$, 95% CI [.30, 1.05], and for cognitive direction, $F(1, 72) = 9.54$, $p = .003$, $\eta_p^2 = .12$, 95% CI [-.85, -.18]. Participants had higher cognitive anxiety levels and perceived them as more debilitative at Session 2 compared to Session 1.

For the time by group interaction, univariate analyses revealed this effect was for somatic intensity, $F(3, 72) = 3.45$, $p = .021$, $\eta_p^2 = .13$, and approached significance for somatic direction, $F(3, 72) = 2.55$, $p = .063$, $\eta_p^2 = .10$. Participants in the challenge, $p = .036$, 95% CI [.06, 1.50], and threat, $p = .011$, 95% CI [.30, 1.70], groups had higher somatic intensity levels at Session 2 than at Session 1. For somatic direction, there was a trend for the challenge and control groups to perceive their symptoms as more debilitative at Session 2 compared to Session 1. At the multivariate level, there was no main effect for group and no time by group interaction for confidence intensity, cognitive intensity, or cognitive direction.

Challenge and Threat Appraisals

All means and standard deviations are reported in Table 3.2. A 2 Time (Session 1, Session 2) × 4 Group (challenge, threat, relax, control) MANOVA revealed a significant multivariate main effect for time, Pillai's Trace = .20, $F(2, 70) = 8.53$, $p < .001$. Univariate analyses revealed this effect was for threat appraisal, $F(1, 71) = 11.87$, $p = .001$, $\eta_p^2 = .14$, 95% CI [.23, .87]. Participants appraised the competition task as significantly more threatening at Session 2 compared to Session 1. There was no significant multivariate main effect for group or time by group interaction for challenge or threat appraisals. There was also no significant univariate time effect for challenge appraisal.

Task Evaluation

All means and standard deviations are reported in Table 3.2. A 2 Time (Session 1, Session 2) × 4 Group (challenge, threat, relax, control) MANOVA revealed a significant multivariate main effect for time, Pillai's Trace = .18, $F(3, 69) = 4.63$, $p = .004$. Univariate analyses revealed this effect was for task stressfulness, $F(1, 71) = 7.57$, $p = .008$, $\eta_p^2 = .10$, 95% CI [.12, .78], and task effort, $F(1, 71) = 4.80$, $p = .032$, $\eta_p^2 = .06$, 95% CI [-.65, -.03], but not for difficulty. Participants found Session 2 significantly more stressful, but put in significantly less effort compared to Session 1. There was no significant multivariate main effect for group, or time by group interaction.

Imagery

Cardiovascular script responses. Means and standard deviations are shown in Table 3.3. A 2 Time (baseline, imagery script) x 3 Group (challenge, threat, relax) MANOVA revealed a significant multivariate main effect for time, Pillai's Trace = .21, $F(2, 38) = 5.08$, $p = .011$. Univariate analyses revealed this effect was for CO, $F(1, 39) = 6.10$, $p = .018$, $\eta_p^2 = .14$, 95% CI [.13, 1.35]. CO decreased during the imagery ($M = 11.98$, $SD = 4.22$) from baseline ($M = 12.72$, $SD = 4.58$). There was also a significant multivariate main effect for condition, Pillai's Trace = .24, $F(4, 78) = 2.60$, $p = .043$. Univariate analysis revealed this was for CO, $F(2, 39) = 5.84$, $p = .006$, $\eta_p^2 = .23$, 95% CI [1.31, 8.43]. The threat group had higher CO ($M = 14.87$, $SD = 4.82$) than the relax group ($M = 10.01$, $SD = 3.38$). There was no significant multivariate time by group interaction or univariate main effects for HR.

Table 3.3
Means (standard deviation) for heart rate and cardiac output at baseline and during imagery scripts

Variable	Baseline	During imagery script
	Heart rate (bpm)	
Challenge	71.29 (9.79)	71.14 (8.95)
Threat	72.81 (10.88)	75.54 (9.57)
Relax	69.21 (8.66)	68.87 (7.99)
Total	70.92 (9.59)	71.58 (9.02)
	Cardiac output (l/min)	
Challenge	12.72 (3.81)	11.64 (3.34)
Threat	15.37 (5.51)	14.38 (4.82)*[b]
Relax	10.08 (2.84)	9.94 (3.38)
Total	12.47 (4.58)	11.80 (4.22)*[a]

Note. [a] Significantly different than baseline. [b] Significantly different from relax group.
* $p < .05$.

Mastery imagery ability. All correlations are shown in Table 3.4. There were significant relationships between mastery imagery ability and cognitive and somatic anxiety direction for the threat and relax groups, and challenge and threat appraisals for the challenge group. Better imagery ability was associated with more facilitative anxiety symptom perceptions in Session 2 compared with Session 1 for the threat group, whereas for the relax group, it was associated with more debilitative anxiety perceptions. A higher level of mastery imagery ability was also associated with lower challenge and threat appraisals in Session 2 compared to Session 1 for the challenge group.

Affect imagery ability. All correlations are shown in Table 3.4. There were no significant relationships between affect imagery ability and psychological or cardiovascular variables.

Table 3.4
Mastery and affect imagery ability correlations by imagery group for psychological change scores and cardiovascular reactivity

Variable	Challenge	Threat	Relax
		Mastery IA	
SBP reactivity	-.193	-.272	-.169
DBP reactivity	.203	.177	.204
HR reactivity	.132	-.327	-.398
CO reactivity	-.167	-.093	-.454
TPR reactivity	.428	.146	.335
Cognitive intensity	-.373	.094	.056
Cognitive direction	.321	.502*	-.474*
Somatic intensity	-.244	.118	-.090
Somatic direction	.127	.472*	-.504*
Challenge appraisal	-.534*	-.234	-.040
Threat appraisal	-.539*	-.054	-.073
		Affect IA	
SBP reactivity	-.172	.182	-.304
DBP reactivity	-.091	.119	.209
HR reactivity	.222	-.056	-.322
CO reactivity	-.156	-.119	-.351
TPR reactivity	.244	.097	-.221
Cognitive intensity	-.215	-.090	-.237
Cognitive direction	.025	.138	.017
Somatic intensity	-.091	-.038	-.230
Somatic direction	-.328	.396	-.174
Challenge appraisal	.106	.067	.043
Threat appraisal	.008	-.128	-.118

Note. SBP, DBP, HR, CO, and TPR represent systolic blood pressure, diastolic blood pressure, heart rate, cardiac output, and total peripheral resistance respectively. IA represents imagery ability.
* $p < .05$.

Table 3.5
Means (standard deviations) for imagery evaluation items according to intervention group

	Imagery script		
Imagery item	Challenge	Threat	Relax
Imagery script engagement (1 = none of the time, 10 = all of the time)	7.29 (1.31)[a]*	5.95 (1.47)	7.85 (1.23)[a]***
Ease of imaging script (1 = very hard, 7 = very easy)	5.29 (1.11)	4.45 (1.32)	5.25 (.85)
Vividness of imaging script (1 = no image at all, 7 = perfectly clear)	5.18 (.95)[a]**	4.16 (1.11)	4.60 (.75)
Effect on confidence (1 = decreased confidence a lot, 7 = increased confidence a lot)	5.00 (.61)[a]**	4.05 (1.13)	5.20 (.89)[a]**
Effect on anxiety intensity (1 = decreased anxiety symptoms a lot, 7 = increased anxiety symptoms a lot)	3.76 (1.15)[b]**	4.37 (.90)[b]***	2.70 (1.03)
Effect on anxiety direction (1 = anxiety viewed as being much more hurtful, 7 = anxiety viewed as being much more helpful)	4.88 (1.22)[a]*	3.53 (1.26)	4.20 (1.44)

Note. [a] Significantly greater than the threat script. [b] Significantly greater than the relax script.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Imagery script evaluation. Means and standard deviations are reported in Table 3.5. For script ease and vividness, there was a significant main effect for group at the multivariate level, Pillai's Trace = .21, $F(2, 53) = 3.09$, $p = .019$. At the univariate level, significant group differences were for vividness, $F(2, 53) = 5.17$, $p = .009$, $\eta_p^2 = .16$, but not ease ($p = .079$). Post hoc analyses showed the challenge group imaged their scripts significantly more vividly than the threat group ($p = .007$). For script engagement, there was a significant difference between groups, $F(2, 53) = 10.29$, $p < .001$, $\eta_p^2 = .28$. The challenge and relax groups were significantly more engaged than the threat group ($p = .011$, $p < .001$ respectively). For the scripts' effect on confidence, overall anxiety, and anxiety direction for both tasks, results of the one-way MANOVA revealed there was a significant main effect for group, Pillai's Trace = .52, $F(2, 53) = 6.15$, $p < .001$. At the univariate level, there were significant group differences for confidence, $F(2, 53) = 8.62$, $p = .001$, $\eta_p^2 = .25$, anxiety, $F(2, 53) = 13.27$, $p < .001$, $\eta_p^2 = .33$, and anxiety direction, $F(2, 53) = 4.77$, $p = .012$, $\eta_p^2 = .15$. The challenge and relax scripts elicited a greater effect on confidence than the threat script ($p = .009$; $p = .001$, respectively). The challenge and threat scripts were more anxiogenic than the relax script (p

= .008, $p < .001$), and the challenge script was perceived as more helpful for anxiety symptoms than the threat script ($p = .010$).

Discussion

This chapter explored how different types of imagery (challenge, threat, and relaxing) influenced the physiological (HR, BP, CO, and TPR) and psychological (anxiety and confidence) responses to a competition task. The task elicited a stress response in accordance with previous literature (Veldhuijzen van Zanten et al., 2002). Also, when considering heart rate reactivity and manipulation checks, the mean values support that participants appeared motivated and engaged in the task.

In accordance with our hypotheses and similar to previous research (Williams et al., 2010, 2017), the challenge and threat imagery groups reported higher cognitive and somatic anxiety levels for the (competition) task. However, in contrast to our hypothesis, there was a trend for anxiety to be perceived as more debilitative for the challenge and control groups, and not the threat group. These results were unexpected and also in contrast to research where participants who imaged challenge, neutral, or coping based content perceived anxiety symptoms as facilitative (Cumming et al., 2007; Williams et al., 2010, 2017) and those who imaged threat based content perceived anxiety as debilitative (Cumming et al., 2007; Williams et al., 2010). Although some of these studies included hypothetical competitions or low stress evoking situations, the scripts provided stimulus propositions based on personal experiences, which likely contributed to an increased meaning, and therefore effectiveness, of the imagery (Lang, 1979). In this study, it is possible that the unexpected results were due to the imagery of the task being less familiar compared to previous studies, and subsequently less meaningful and effective for participants. This notion is supported by the RAMDIU (Cumming & Williams, 2013) which posits that the meaning of an image influences what function (e.g., anxiety producing) the image content (e.g., challenge) serves. Importantly, when using challenge imagery, practitioners should ensure imagery is meaningful and that it has the intended facilitative effect for actual performance scenarios.

Interestingly, additional results were also in contrast to our hypotheses and previous research. For example, according to the TCTSA (Jones et al., 2009), challenge appraisals are associated with increased CO and decreased TPR, whereas threat appraisals are associated with increased CO and stable or decreased TPR. No change in CO or TPR was found in response to stress, and no group by time interaction effects were found. The lack of change in CO responses to stress has been observed in previous studies (e.g., Veldhuijzen van Zanten, Kitas, Carroll, & Ring, 2008) and some research has also failed to support the cardiovascular hypotheses of the TCTSA (e.g., Meijen, Jones, McCarthy, Sheffield, & Allen, 2013; Turner et al., 2013). In regards to during the imagery, although the threat group had higher CO than the relax group, this increase was not experienced by the challenge group. Also, the decrease in CO from baseline to imagery is in contrast to previous research reporting CO to increase during imagery (Williams et al., 2010). These differences in findings are likely due to measurement (i.e., ultrasound or impedance) and postural (i.e., sitting up or lying down) variations. It is also noteworthy that it was not possible to analyze TPR during the imagery as blood pressure was not assessed due to the risk of distracting participants from their imagery. Therefore, future research assessing cardiovascular responses to challenge and threat imagery should be consistent in the measurement and postural approaches undertaken and also investigate avenues to assess TPR during imagery without interference to more comprehensively test these hypotheses.

There were also no significant group differences for confidence, stress appraisals, or CV responses to the competition task. These findings are dissimilar to both of Williams et al.'s (2010, 2017) studies, whereby following imagery, the threat group felt less confident, perceived the task as more threatening, experienced an increase in CO (same for challenge group), and for the 2017 study, experienced an increased heart rate compared to the challenge and neutral groups. Furthermore, although Williams et al. (2017) found that the neutral script was occasionally more facilitative than the challenge script, this was not the case for the relaxing script in the present study. An explanation for these results could be due to the variation between imagery groups in the vividness and engagement of the scripts. Although there were no group differences in ease of imaging (i.e., one indicator of imagery ability), the challenge group imaged their scripts significantly more vividly than the threat group, and the challenge and relax groups were significantly more engaged in their scripts than the threat group. These findings suggest that participants found it easier to image the positive content of the scripts compared to negative content in the threat script, which could have influenced the effect of the imagery on task responses. Therefore, researchers and practitioners conducting imagery interventions should ensure adherence to imagery scripts and verify during the intervention (i.e., rather than after) whether participants can sufficiently image all aspects of the scripts, providing extra training where necessary (e.g., LSRT; Cumming et al., 2016).

In support of our hypotheses, results suggest that the effectiveness of the imagery was determined by individuals' ability to image. Mastery imagery ability tended to be associated with a lower increase in anxiety intensities and stress appraisals of the challenge script. Williams and Cumming (2015) found that mastery imagery ability directly predicted cognitive intensity in a sport setting. This study expands on these results and demonstrates the relationship when using imagery in a competitive stress task. Furthermore, a higher level of mastery imagery ability in the task was associated with a lower reduction in anxiety direction (i.e., less likely to perceive anxiety symptoms as debilitative). Those in the threat group with poorer imagery ability were more greatly impacted by their provided imagery, suggesting that mastery imagery ability acts as a buffer against imagery eliciting debilitative stress responses (e.g., higher anxiety). These findings highlight the importance of imagery ability impacting upon the effectiveness of imagery use, and in line with Jones' (1995) framework, suggest that individual factors such as imagery ability are important to consider when investigating responses to stress and how they are perceived and appraised.

Spontaneous negative images can be experienced in stressful scenarios (Van de Braam & Moran, 2011). The present results allude to the importance of mastery imagery ability in protecting against the debilitative effects of negative images. The importance of mastery imagery ability was further emphasized by the lack of any significant results with affect imagery ability. Although research shows that the ability to image intervention content can influence imagery's effectiveness (McKenzie & Howe, 1997), this study highlights the importance of more generic imagery ability, specifically mastery imagery ability, by demonstrating that the ability to image this content can determine the effectiveness of a particular imagery intervention. Therefore, mastery imagery ability, not just the content used in the imagery intervention, is a key component to consider in imagery interventions.

Another type of imagery ability in the present study, although employed as a manipulation check, could be imagery script engagement. Supported by the computational theory of imagery (Kosslyn, Thompson, & Ganis, 2006), the ability to remain engaged in a script could reflect the maintenance stage of image generation. As previously mentioned, the threat group was less engaged in their script, which could imply lower script engagement acts as a protective factor against debilitative imagery. It is possible that higher engagement with facilitative imagery could elicit more positive responses. Although imagery engagement is crucial for imagery effectiveness in clinical settings (Steenbergen, Craje, Nilsen, & Gordon, 2009), scarce research has explored engagement within other settings (e.g., stress tasks). As debilitative imagery can be more powerful than facilitative imagery (Nordin & Cumming, 2005), it is important to understand this relationship and what strategies (e.g., imagery rescripting) may be most effective to prevent debilitative stress responses and poor performance.

Results support the RAMDIU as a stress eliciting situation influenced the effectiveness of the imagery and the function, which together with imagery ability, influenced the outcomes experienced (Cumming & Williams, 2013). This study expands on Williams et al.'s (2010, 2017) studies and highlights the importance of considering the situation associated with the imagery (i.e., public speaking or competition, hypothetical or real). The results of this study support that responses to an actual competition task are different to a speech preparation task (Williams et al., 2017) and hypothetical competition (Williams et al., 2010). Specifically, the collective results from these studies may demonstrate that imagery scripts (challenge, threat, or relax) might not be as effective for an actual stressful task where stimuli are constantly presented (i.e., car racing competitive game) and performance was evaluated, in comparison to a hypothetical task, or a task which involves greater internal concentration (i.e., public speaking preparation task). Thus, the content (e.g., imagery script), situation (e.g., stress task, hypothetical or real), and who components (e.g., mastery imagery ability) appear crucial to consider when implementing imagery interventions for stressful situations (Cumming & Williams, 2013). Along with Williams et al. (2010, 2017), these are the only studies to explore the influence of different imagery content on stress responses and whether a particular imagery function determines which imagery is more effective for different stress evoking tasks.

Although this study provides some important contributions to the literature, it is not without limitations. Task novelty may have been influenced by previous task experiences, thus future research should test this consideration as a confounding variable. As previously mentioned, the threat group being significantly less engaged in their script could have influenced imagery's effectiveness, but the mean score (5.75) suggests that they were still engaged. Also, the competition task differed in stressfulness across sessions. Although these tasks could have been counterbalanced (e.g., race track) to rule out the order being a confounding variable, the nature of the imagery intervention meant that participants had to be exposed to the task twice and therefore it was likely that the novelty (and stress response) would be reduced. Stress research makes the issue of novelty difficult to control, as the unique aspect of stress is that it is often associated with fear of the unknown. Therefore, undertaking a task twice is likely to yield differences in the stress response. This difference could also be viewed as a strength as completing a task twice often results in a loss of stressfulness of the task, but in this case the task was more stressful the second time. Future research should expand on combining imagery interventions in repeated exposures to stress tasks and the subsequent influence on the stress response experienced.

In conclusion, this study extended Williams et al.'s (2010, 2017) studies by determining if different types of imagery can also alter stress responses for coping in actual competition. An additional novel aspect of this study was to demonstrate the importance of mastery imagery ability for a competition task. In contrast to Williams et al. (2010, 2017), results suggest the imagery type used may not be more/less beneficial for this particular stress task, which may be due to the different nature of hypothetical or real public speaking and competition experiences. Findings demonstrate that mastery imagery ability can determine the effectiveness of imagery's use and play a key role in using imagery to promote adaptive stress responses. In accordance with the RAMDIU (Cumming & Williams, 2013), mastery imagery ability varied across individuals (i.e., who), which together with the situation (e.g., competition task) likely influenced what function (e.g., anxiogenic) the image content (e.g., challenge) served, and the outcomes experienced (e.g., debilitative anxiety interpretations). Anxiety evoking imagery should be used cautiously, and mastery imagery ability should be developed to reduce the impact of debilitative imagery and maladaptive responses to stress.

Chapter 4

Investigating the mediating role of positive and negative mastery imagery ability

A version of this chapter has been published under the following reference:

Quinton, M. L., Cumming, J., & Williams, S. E. (2017). Investigating the mediating role of positive and negative mastery imagery ability. *Psychology of Sport & Exercise, 35,* 1-9. doi:10.1016/j.psychsport.2017.10.011.

Investigating the mediating role of positive and negative mastery imagery ability

Although stress is necessary to cope with potentially harmful situations (Nordqvist, 2015), excessive stress can be detrimental to physical and psychological health (Schneiderman, Ironson, & Siegel, 2005). As factors associated with stress (e.g., low self-confidence, unwanted anxiety, and negative perceptions of events) are the hallmarks of various mental health conditions such as post-traumatic stress disorder and depression (Morina, Deeprose, Pusowski, Schmid, & Holmes, 2011; World Health Organization, 2016), investigating strategies to help alleviate stress symptoms and cope with stress could have important implications for managing mental and physical illnesses.

When considering the effectiveness of strategies for stress regulation (both in terms of the appraisal of stress and the stress response), theoretical frameworks provide a structure to help our understanding (Anfara & Mertz, 2006). This chapter was underpinned by the theory of challenge and threat states in athletes (TCTSA; Jones, Meijen, McCarthy, & Sheffield, 2009), which helps our understanding of the mechanisms of stress by explaining the interactions between antecedents and responses to challenge and threat states (i.e., stress appraisals). The TCTSA proposes that confidence, or its situational specific disposition, self-efficacy, is a key antecedent that impacts both the appraisal of stress and the response to stress (Blascovich & Mendes, 2000; Jones et al. 2009; Skinner & Brewer, 2004). A confident individual is more likely to perceive stress as challenging and less threatening, which could in turn enhance their performance in that situation (Blascovich & Mendes, 2000; Skinner & Brewer, 2004; Williams & Cumming, 2012b). Confidence may also buffer against negative responses to stress such as anxiety (Jones et al., 2009). As confidence is a vital antecedent to both stress appraisals and stress responses, it will likely play an important role when investigating the effectiveness of strategies for regulating stress appraisals and responses.

In addition to antecedents that influence individuals' appraisal of stress as a challenge or threat, the TCTSA explains how antecedents and appraisals influence the stress responses experienced (Jones et al., 2009). Anxiety is a multidimensional construct (Jones, 1995) frequently experienced in response to stress. Anxiety intensity is the level of cognitive (e.g., worries and intrusive thoughts) and/or somatic (e.g., increased heart rate and sweating) symptoms experienced, whereas direction is how the intensity of the symptoms are perceived (e.g., as helpful or hurtful). Jones' (1995) model of facilitative and debilitative anxiety proposes that how anxiety is perceived is influenced by individual factors, such as trait confidence, with higher confidence being associated with more facilitative interpretations of anxiety (Mellalieu, Neil, & Hanton, 2006). As anxiety perceptions may be a stronger predictor of performance than intensity (Chamberlain & Hale, 2007), when determining how strategies alleviate responses to stress, the relationship between confidence and anxiety intensity and symptom interpretation is important to consider.

Imagery is a key technique recognized as effective for regulating confidence, stress appraisals, and stress responses (Cumming, Olphin, & Law, 2007; Holmes & Mathews, 2010; Williams, Cumming, & Balanos, 2010; Williams, Veldhuijzen van Zanten, Trotman, Quinton, & Ginty, 2017). However, imagery is typically more effective for individuals displaying greater imagery ability (Quinton, Veldhuijzen van Zanten, Trotman, Cumming, & Williams, 2017) and less effective for individuals with low imagery ability (Williams, Cooley, & Cumming, 2013). Imagery ability is "an individual's capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal" (Morris, 1997, p. 37). Imagery ability is partly modifiable, thus it has potential to be changed through intervention (Williams & Cumming, 2011).

The importance of imagery ability is highlighted by its inclusion in theoretical models and frameworks in sport and clinical psychology (e.g., Lang, 1979; Martin, Moritz, & Hall, 1999). One such model is the revised applied model of deliberate imagery use (RAMDIU; Cumming & Williams, 2013), which proposes that imagery ability will directly influence image content (i.e., what is imaged), and mediate the relationship between image content and the resultant outcomes (e.g., stress appraisals, anxiety; Cumming & Williams, 2013). Initial research has recognized motivational imagery ability as a mediator, but this work has predominantly focused on imagery ability's role in the relationship between imagery use and performance outcomes (e.g., flow, sport performance; Koehn, Stavrou, Young, & Morris, 2016; Slimani, Chamari, Boudhiba, & Chéour, 2016). Within the stress setting, higher imagery ability is related to greater confidence, more frequent challenge appraisals, fewer threat appraisals, lower anxiety, and a greater tendency to perceive symptoms as facilitative (Abma, Fry, & Relyea, 2002; Quinton et al., 2017; Williams & Cumming, 2012b; 2015). It is important for applied sport psychology to clarify imagery ability's role as a mediator for determining imagery's effectiveness for eliciting facilitative outcomes. The recent development of standardized measures to assess different imagery ability (i.e., cognitive and motivational; Williams & Cumming, 2011) means that the RAMDIU's hypothesis of imagery ability as a mediator can now be rigorously tested.

Imagery ability's relationship with confidence and stress appraisals and responses suggests it as a possible mediator. This proposition is drawn from Bandura (1997), who proposed high levels of self-efficacy evoke more positive imagery scenarios. More confident athletes will likely experience more recent success that is retained in long term memory and more easily retrieved. These retrieved memories enable more confident athletes to draw on specific details of their previous successes more readily for easier image generation (Lang, 1979). Imaging positive scenarios (e.g., performing well) more easily and vividly will, in turn, lead to more resources at individuals' disposal. These more readily available images could then be used to better meet situational demands, and result in greater challenge and lower threat appraisals and more facilitative anxiety perceptions (Bandura, 1997; Jones et al., 2009; Williams & Cumming, 2012b). However, research is yet to examine whether imagery ability is a mediator in the relationship between confidence and stress appraisals and responses.

While conceptually it is likely that imagery ability mediates the relationship between confidence and responses and appraisals to stress, researchers have not yet investigated whether different imagery abilities (e.g., cognitive or motivational) may be stronger mediators for particular outcomes. Williams and Cumming (2012b; 2015) found that mastery imagery ability was the strongest predictor of confidence, challenge and threat appraisals, and cognitive anxiety intensity, whereas most other types of imagery ability did not relate to confidence or other stress appraisal and anxiety variables. Research has also highlighted mastery imagery's role as a mediator in the relationship between a more specific type of confidence and performance (Beauchamp, Bray, & Albinson, 2002). This research provides a strong rationale for mastery imagery ability as the key mediator between confidence and the appraisals and responses to stress. If supported, this relationship would contribute empirical support to the RAMDIU (Cumming & Williams, 2013), and inform guidelines on which types of imagery ability to develop for favorable stress outcomes.

Although mastery imagery ability is likely most effective for regulating confidence and stress appraisals and anxiety, to date only positive forms of this ability have been investigated. Individuals can experience both positive and negative imagery content (Quinton, Cumming, Allsop, Gray, & Williams, 2016), but how content is perceived determines whether the imagery is facilitative (i.e., has a positive effect on outcomes) or debilitative (i.e., has a negative effect on outcomes; Short et al., 2002). Use of negative mastery imagery content has led to greater threat appraisals, more debilitative anxiety perceptions, and lower perceived control in a dart throwing task (Williams & Cumming, 2012a). This evidence suggests that negative mastery imagery ability will likely be associated with debilitative outcomes (e.g., greater threat appraisals, more debilitative anxiety).

It is feasible that, and mirroring the relationship between high confidence and positive imagery (Bandura, 1997), athletes with lower confidence would be able to image negative content more easily. In turn, negative images such as being defeated by a setback would likely make athletes perceive they have fewer resources to meet situational demands (Jones et al., 2009) and experience lower challenge and greater threat appraisals. The link between negative images and appraisals is supported in the clinical psychology literature, where negative appraisals of intrusive images are one of the strongest predictors of depression (Williams & Moulds, 2008). In this same literature, anxiety is associated with higher vividness of negative prospective images and poorer vividness of positive prospective images (Morina et al., 2011). Whether negative imagery ability is associated with stress appraisals and anxiety intensity and direction, however, is unclear. Moreover, imagery ability as a mediator in the relationship between confidence and stress appraisals, and confidence and stress responses has not yet been investigated.

Overall Aims and Research Questions

Testing RAMDIU's hypothesis that imagery ability is a mediator, the first aim of this cross-sectional multi-phase chapter was to investigate the role played by positive and negative mastery imagery ability in the relationship between confidence and stress appraisals (Phase 1) and responses (Phase 2). Negative imagery ability was examined by modifying the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011). To determine the importance of mastery imagery ability's role in the relationship between confidence and stress appraisals and responses, the second aim was to investigate whether another type of imagery ability, affect imagery ability, mediated these same relationships. Affect imagery ability was chosen as the comparison because typically, it is the easiest content to image (Williams & Cumming, 2011, 2012a) and is also related to confidence and stress appraisals (Cumming et al., 2007; Williams & Cumming, 2012b).

Hypotheses

Phase 1. The hypothesized models for both phases can be seen in Figures 4.1 and 4.2. It was hypothesized that (a) confidence would positively predict positive mastery and affect imagery ability (Williams & Cumming, 2012b; 2015) and negatively predict negative mastery and affect imagery ability (Cumming et al., 2007; Williams & Cumming, 2012b; 2015), and (b) positive and negative mastery imagery ability would be stronger predictors of stress appraisals than positive and negative affect imagery ability (Williams & Cumming, 2012b). In Models 1 and 2, (c) confidence would negatively predict threat appraisal and positively predict challenge appraisal (Jones et al., 2009; Williams & Cumming, 2012b), and (d) both positive and negative mastery and affect imagery ability would directly predict both challenge and threat appraisals due to individuals believing they have sufficient (challenge) or insufficient (threat) resources to meet situational demands (Jones et al., 2009; Williams & Cumming, 2012b; Williams & Moulds, 2008). However, (e) only mastery imagery ability would mediate the relationships with confidence due to being a stronger predictor than affect (Williams & Cumming, 2012b, 2015).

Phase 2. In Models 3 and 4, it was hypothesized that (a) confidence would positively predict positive mastery and affect imagery ability (Williams & Cumming, 2012b; 2015) and negatively predict negative mastery and affect imagery ability (Cumming et al., 2007; Williams & Cumming, 2012b; 2015), (b) confidence would negatively predict cognitive and somatic anxiety intensity, but would positively predict anxiety direction (Hanton, Mellalieu, & Hall, 2004), and (c) both positive and negative mastery and affect imagery ability would directly predict both anxiety intensities and direction (Morina et al., 2011; Quinton et al., 2017; Williams & Cumming, 2015), but (d) only mastery imagery ability would mediate the relationships with confidence due to being a stronger predictor than affect imagery ability (Cumming & Williams, 2013; Williams & Cumming, 2012b, 2015).

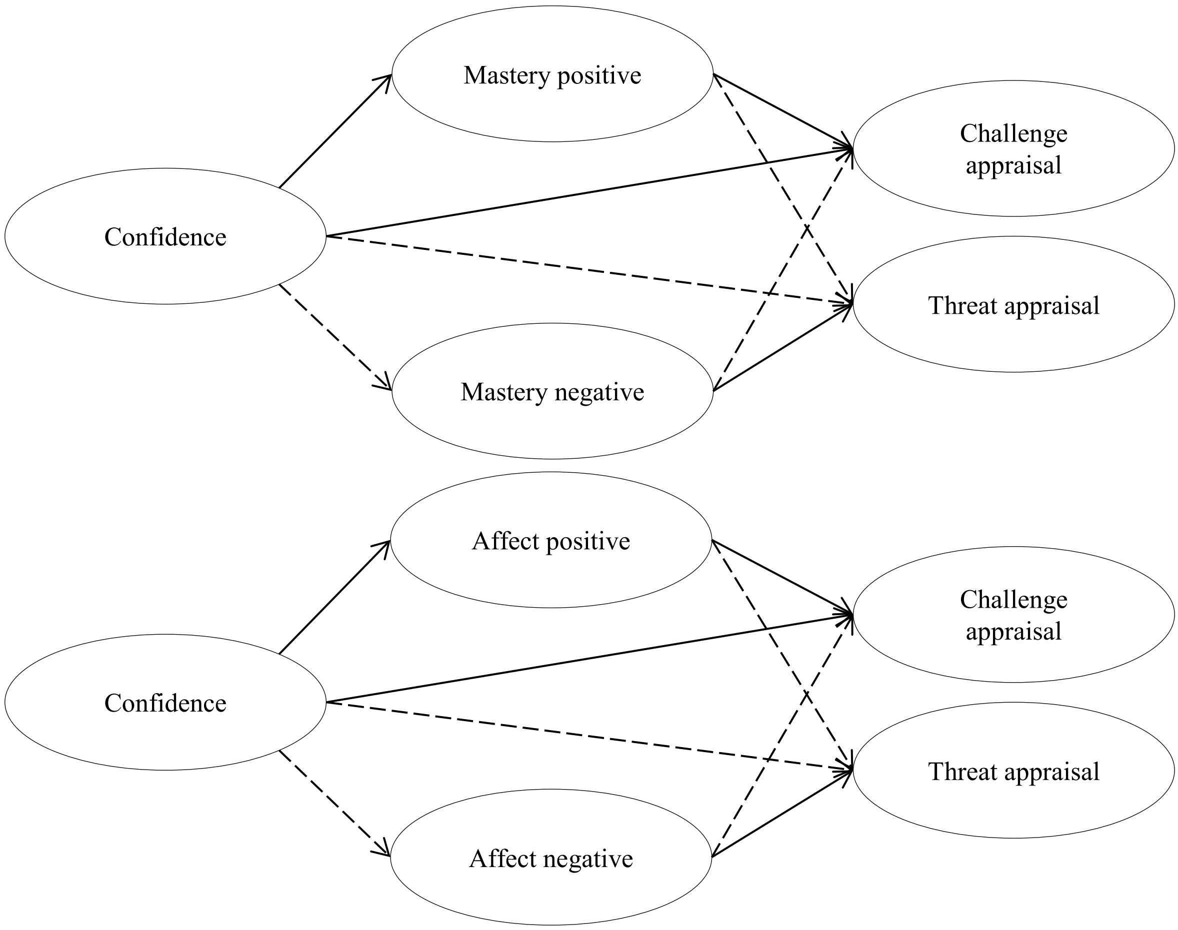
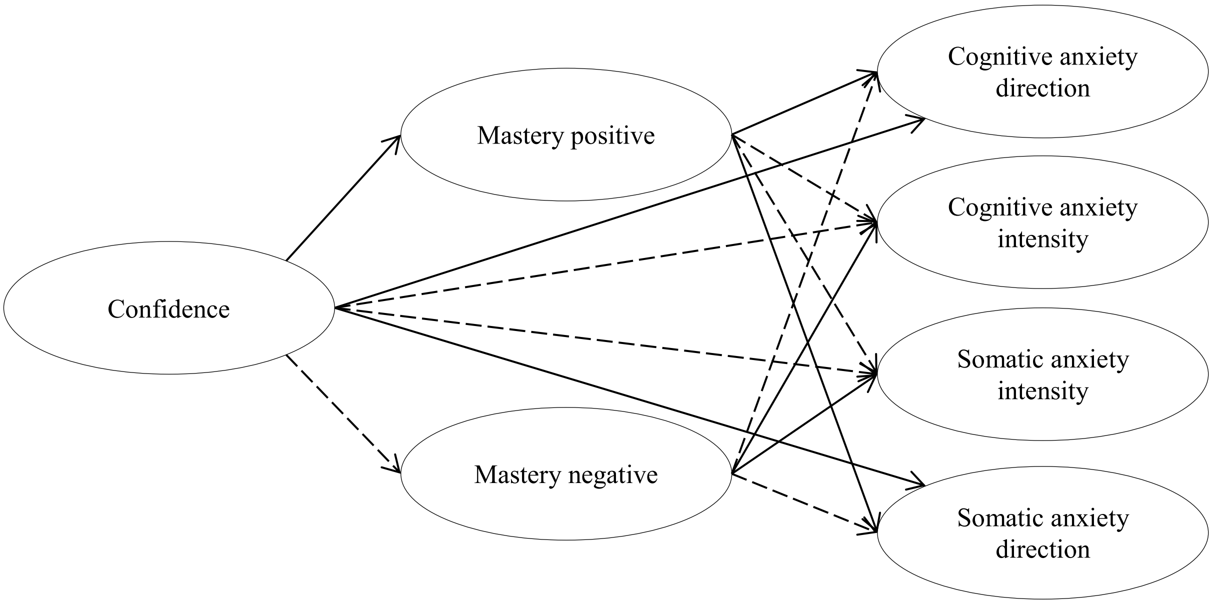


Figure 4.1. Hypothesized Models 1 and 2. For visual simplicity, variances are not presented but are hypothesized as significant.

Note. Full lines and dashed lines represent positive and negative predictions respectively.



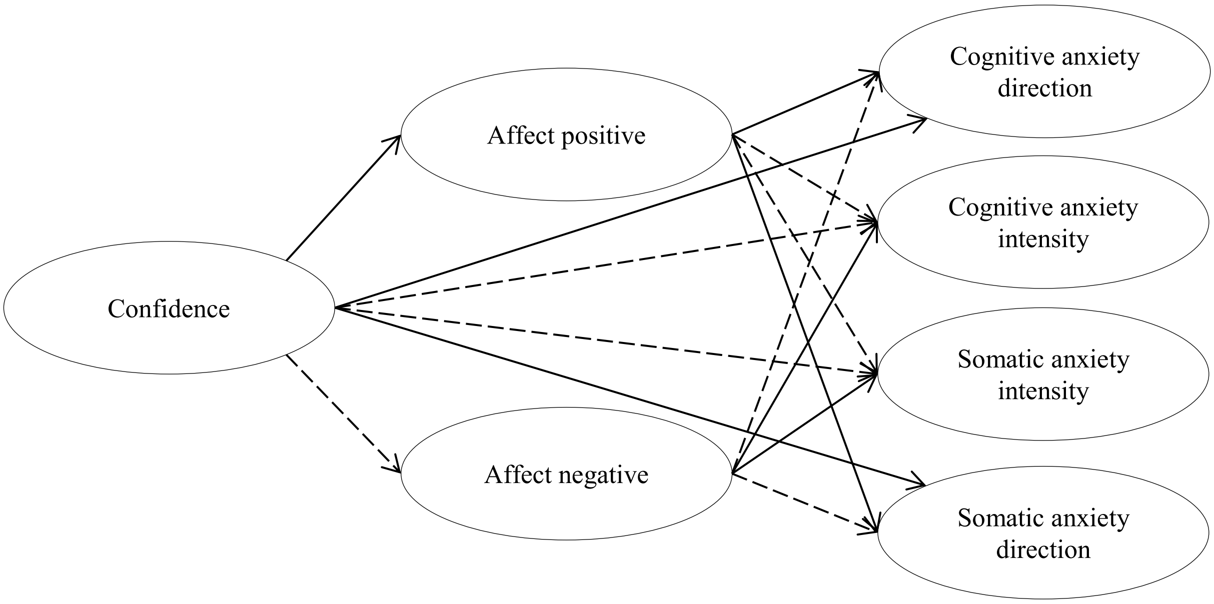


Figure 4.2. Hypothesized Models 3 and 4. For visual simplicity, variances are not presented but are hypothesized as significant.

Note. Full lines and dashed lines represent positive and negative predictions respectively.

Method

Participants

Three hundred and thirty five male (*n* = 142) and female (*n* = 193) athletes with a mean age of 20.80 years (*SD* = 5.09) participated in the study. The sample consisted of team (*n* = 238), individual (*n* = 64), and both team and individual (*n* = 33) sports, with the majority coming from field hockey (*n* = 104), soccer (*n* = 48), and netball (*n* = 29). Athletes ranged in competitive levels including elite (*n* = 73), regional (*n* = 72), club (*n* = 164), and recreational (*n* = 26), and had been participating in their sport for an average of 10.49 years (*SD* = 5.34). To be eligible to take part in the study, participants needed to take part in a sport and be between 18 and 50 years old.

Measures

Demographic information. Participants completed information regarding their age, gender, sport type, sport played, competitive level, and years of playing experience.

Mastery imagery ability. The mastery subscale of the SIAQ (Williams & Cumming, 2011) assessed participants' ability to image positive mastery imagery content. The three items include "remaining confident in a difficult situation", "staying positive after a setback", and "giving 100% effort when things are not going well". Three additional items were developed to assess participants' ability to image negative mastery imagery content. In a similar manner to Nordin-Bates, Cumming, Aways, and Sharp (2011) rewording the Dance Imagery Questionnaire (DIQ; Nordin & Cumming, 2006) to reflect negative content, these new items were based on the original SIAQ mastery items and were pilot tested with undergraduates and imagery experts. The resulting three items are reported in Table 4.1. Participants imaged and then rated each of the six items on a 7-point Likert type scale from 1 (*very hard to image*) to 7 (*very easy to image*). The scores were averaged for each subscale to give one positive and one negative mastery imagery ability score with higher scores representing a greater ease of imaging. Positive and negative mastery imagery ability were not highly correlated ($r = -.27$, $p < .001$), supporting that they are different constructs and important to consider as separate variables. Validity and reliability evidence has been found in support of SIAQ scores (Williams & Cumming, 2011).

Table 4.1
Imagery ability items and factor loadings

Imagery ability items	Factor loading
Mastery positive	
Giving 100% effort when things are not going well	**.48**
Staying positive after a setback	**.69**
Remaining confident in a difficult situation	**.67**
Mastery negative	
Giving up when things are not going well	**.56**
Being defeated by a setback	**.67**
Losing confidence in a difficult situation	**.63**
Affect positive	
The positive emotions I feel while doing my sport	**.58**
The anticipation and excitement associated with my sport	**.76**
The excitement associated with performing	**.76**
Affect negative	
The negative emotions I feel while doing my sport	.29
The nervousness and worry associated with my sport	.30
Performing when negative feelings are not under my control	**.39**
Not feeling psyched up enough for the upcoming performance	**.72**
Being in the "wrong zone" mentally to perform	.88
Being in the incorrect frame of mind for the upcoming performance	**.86**

Note. Factor loadings of items retained are shown in bold.

Affect imagery ability. The affect subscale of the SIAQ assessed participants' ability to image positive affect content. The three items include "the positive emotions I feel while doing my sport", "the anticipation and excitement associated with my sport", and "the excitement associated with performing". To reflect negative affect content, six items were either created or reworded from the original items (see Table 4.1). After pilot testing with undergraduates and imagery experts, all six items were included to be refined through further analysis. Participants imaged and then rated each item on a 7-point Likert type scale from 1 (*very hard to image*) to 7 (*very easy to image*). Each subscale was averaged to give a positive and a negative affect imagery ability score with higher scores representing a greater ease of imaging. Positive and negative affect imagery ability were not highly correlated (r = .032, p = .563), supporting that they are different constructs and important to consider as separate variables.

Challenge and threat appraisals. The Cognitive Appraisal Scale (CAS; Skinner & Brewer, 2002) assessed challenge and threat appraisal tendencies. Eight items assessed the likelihood of participants perceiving situations as a challenge (e.g., "I tend to focus on the positive aspects of any situation") and ten items reflected appraising situations as a threat (e.g., "I worry that I will say or do the wrong things"). In relation to their sport, participants read each item and rated on a 6-point Likert type scale the extent to which they agreed or disagreed from 1 (*strongly disagree*) to 6 (*strongly agree*). The scores were averaged for each subscale to give one average challenge and one average threat score. Validity and reliability evidence has been found in support of CAS challenge and threat scores (Williams & Cumming, 2012b).

Self-confidence and anxiety. The Competitive Trait Anxiety Inventory-2 (CTAI-2; Albrecht & Feltz, 1987) assessed trait levels of cognitive and somatic anxiety intensity and direction, and self-confidence. The CTAI-2 consisted of 27 items; nine assessing cognitive anxiety intensity (e.g., "I am usually concerned"), nine assessing somatic anxiety intensity (e.g., "I feel nervous"), and nine assessing self-confidence (e.g., "I feel self-confident"). Participants read the statement in relation to how they usually feel prior to competition and then rated the intensity on a 4-point Likert type scale from 1 (*not at all*) to 4 (*very much so*). Also for each item, participants rated whether the intensity rating was perceived as facilitative or debilitative on a 7-point Likert type scale from -3 (*very negative/debilitative*) to +3 (*very positive/facilitative*). Due to the high correlations between confidence intensity and direction, the direction subscale is not reported here as in previous research (Williams & Cumming, 2015). Validity and reliability evidence has been found in support of CTAI-2 scores for confidence and anxiety intensity and direction (Mellalieu, Hanton, & O'Brien, 2004).

Procedures

Following ethical approval from the university where the authors are based, participants were recruited over six months through a variety of local and university sports clubs, social media, and notices in undergraduate sport and exercise sciences lectures (for which participants could receive course credit by taking part). Potential participants were provided with an information sheet, including details regarding data confidentiality and the ability to withdraw at any time. After being given the opportunity to ask any questions, those wanting to take part in the study provided written informed consent and completed the demographic information and questionnaire pack either in hard copy or online, which took no longer than 20 min. Upon completion, participants were thanked for their participation.

Data Analyses

Following recommendations by Tabachnick and Fidell (2013), data were screened for data entry errors, missing data, and univariate and multivariate outliers for the entire sample. This process revealed one duplicate entry and inspection of the Mahalanobis distance at $p < .001$ identified 13 multivariate outliers. Therefore, 14 cases were deleted leaving a final sample of 321 (male n = 136, female n = 185). The percentage of missing data was less than 5% so the expectation maximization technique was implemented to impute missing data (Tabachnick & Fidell, 2013).

Data were analyzed using AMOS 22 (Arbuckle, 2013) with maximum likelihood estimations. Due to factor structure problems previously identified with the CAS and CTAI-2 (Williams & Cumming, 2012b; 2015), the two-step process advocated by Kline (2010) was used to first inspect the factor structure of each questionnaire (i.e., measurement model) prior to testing the structural and alternative models through structural equation modelling. Although absolute model fit was tested by investigating the χ^2 statistic, the sole use of this statistic for measuring model goodness of fit is associated with various limitations (e.g., dependent on sample size; Tabachnick & Fidell, 2013). Therefore, other descriptive fit indices were also examined to assess overall model fit (Hu & Bentler, 1999). The root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR) were selected as additional indices of absolute model fit, where criteria of $\leq .05$ and $\leq .08$

reflected excellent and adequate model fit respectively (Byrne, 2010; Hu & Bentler, 1999). The comparative fit index (CFI) and the Tucker-Lewis index (TLI) were also employed as measures of incremental fit, with values of $\geq .95$ and $\geq .90$ indicating excellent and adequate model fit respectively (Hu & Bentler, 1999).

Upon inspecting the factor structure of the questionnaires, any problematic items were removed through investigation of factor loadings and modification indices and the model was respecified (Byrne, 2010). After problematic items were removed from the CTAI-2 and CAS, parceling was undertaken on remaining items to improve the parameter to construct ratio, resulting in a better fitting, more parsimonious model (Little, Cunningham, Shahar, & Widaman, 2002). Like previous research (Williams & Cumming, 2015), the subscale item with the highest factor loading was parceled with the lowest factor loading item. This process continued until all items were parceled (Little et al., 2002). The final measurement models were then tested and checks undertaken for multivariate normality (Mardia's coefficient < 5; Bentler, 2005), multicollinearity (< .70; Tabachnick & Fidell, 2013) and discriminant and convergent validity (average variance extracted > 0.5; AVE; composite reliability > 0.7; CR; Fornell & Larcker, 1981).

Mediation analysis was employed using AMOS 22 (Arbuckle, 2013) by testing for indirect effects (Hayes, 2013) separately for each mediator to determine if positive or negative mastery imagery ability (i.e., mediators) mediated the relationship between confidence (i.e., predictor) and anxiety intensity or direction (i.e., outcomes). The same relationship was then tested using affect imagery ability to determine the extent to which results were specific to mastery content. Standardized regressions and 90% confidence intervals, generated from bootstrapping of 2000 samples, were reported.

Phase 1 Results

Measurement Models

Following the removal of problematic items and, where appropriate, parceling of the retained items (Table 4.2), there were good model fits for the positive and negative mastery SIAQ subscale, χ^2 (8) = 18.10, p = .020, CFI = .96, TLI = .93, SRMR = .04, RMSEA = .06 (90% CI = 0.02-0.10), positive and negative affect SIAQ subscale, χ^2 (8) = 13.21, p = .105, CFI = .99, TLI = .98, SRMR = .04, RMSEA = .05 (90% CI = 0.00-0.09), the CAS, χ^2 (19) = 49.01, p < .001, CFI = .98, TLI = .97, SRMR = .04, RMSEA = .07 (90% CI = 0.05-0.10), and the CTAI-2 confidence subscale , χ^2 (5) = 14.10, p = .015, CFI = .98, TLI = .97, SRMR = .03, RMSEA = .08 (90% CI = 0.03-0.12).

Table 4.2
Process of measurement model adjustment

Step	χ^2 (df) value, p value	CFI	TLI	SRMR	RMSEA	90% CI	Action taken
			SIAQ mastery				
1	χ^2 (8) = 18.10, p = .020	.96	.93	.04	.06	.02-.10	None. Model fit of retained model
			SIAQ affect				
1	χ^2 (26) = 83.04, p < .001	.93	.91	.07	.08	.06-.10	Remove negative items 1, 2 (low factor loadings), and 5 (pilot feedback)
2	χ^2 (8) = 13.21, p = .105	.99	.98	.04	.05	.00-.09	None. Model fit of retained model
			CAS				
1	χ^2 (134) = 475.60, p < .001	.87	.85	.10	.09	.08-.10	Remove low factor loadings for challenge (2, 3) and threat (10)
2	χ^2 (86) = 218.93, p < .001	.94	.93	.07	.07	.06-.08	Parcel remaining items
3	χ^2 (19) = 49.01, p < .001	.98	.97	.04	.07	.05-.10	None. Model fit of retained model
			CTAI-2 confidence				
1	χ^2 (25) = 57.42, p < .001	.95	.96	.05	.06	.04-.09	Parcel remaining items
2	χ^2 (5) = 14.10, p = .015	.98	.97	.03	.08	.03-.12	None. Model fit of retained model
			CTAI-2 anxiety				
1	χ^2 (935) = 2232.02, p < .001	.75	.73	.08	.07	.06-.07	Remove low factor loadings for cognitive (7, 9) and somatic (1, 5, 6) intensity and

Step	χ^2 (df) value, *p* value	CFI	TLI	SRMR	RMSEA	90% CI	Action taken
							direction subscales
2	χ^2 (549) = 982.22, *p* < .001	.88	.87	.06	.05	.05-.06	Parcel remaining items
3	χ^2 (142) = 257.07, *p* < .001	.95	.94	.05	.05	.04-.06	None. Model fit of retained model

Note. SIAQ represents Sport Imagery Ability Questionnaire, CAS represents Cognitive Appraisal Scale, and CTAI-2 represents Competitive Trait Anxiety Inventory-2.

Descriptive Characteristics and Internal Reliability

Means and standard deviations are presented in Table 4.3 for all subscales. The CR values for all subscales were acceptable (Table 4.3). The AVE values for both mastery subscales, negative affect imagery ability, and challenge appraisal were slightly low, but from the CFAs were considered valid. There was no evidence of multicollinearity. Examination of the Mardia's coefficient revealed the data exceeded multivariate normality, therefore bootstrapping was implemented for all further analyses.

Table 4.3

Means (standard deviations) and internal reliability of the SIAQ, CTAI-2, and CAS subscales

	Mean (SD)	Average variance extracted (AVE)	Composite reliability (CR)
SIAQ subscale			
Mastery imagery (positive)	4.77 (.99)	0.38	0.79
Mastery imagery (negative)	3.97 (1.13)	0.39	0.79
Affect imagery (positive)	5.88 (.86)	0.50	0.74
Affect imagery (negative)	4.01 (1.25)	0.48	0.72
CTAI-2 subscale			
Cognitive anxiety intensity	2.39 (.58)	0.50	0.80
Somatic anxiety intensity	2.13 (.57)	0.52	0.84
Self-confidence intensity	2.39 (.50)	0.51	0.84
Cognitive anxiety direction	-.88 (.87)	0.49	0.79
Somatic anxiety direction	-.74 (.91)	0.65	0.85
CAS subscale			
Challenge	4.47 (.67)	0.35	0.75
Threat	3.50 (.99)	0.55	0.91

Note. Affect negative subscale included three items. SIAQ represents Sport Imagery Ability Questionnaire. CTAI-2 represents Competitive Trait Anxiety Inventory 2. CAS represents Cognitive Appraisal Scale.

Mastery Structural Model

In accordance with the hypotheses, regression paths were drawn from confidence to positive and negative mastery imagery ability and challenge and threat appraisals. Paths were also drawn from both imagery abilities to both appraisals (Figure 4.1). The model revealed a good fit to the data, χ^2 (144) = 266.72, $p < .001$, CFI = .95, TLI = .94, SRMR = .05, RMSEA = .05 (90% CI = 0.04-0.06). However, examination of the regression weights revealed the paths from mastery positive to threat ($p = .210$) and mastery negative to challenge ($p = .277$) were not significant and were removed from the model. The resulting model demonstrated a good fit to the data, χ^2 (145) = 258.37, $p < .001$, CFI = .96, TLI = .95, SRMR = .05, RMSEA = .05 (90% CI = 0.04-0.06). As shown in Figure 4.3, results demonstrated that athletes with greater confidence tend to have higher challenge appraisals ($\beta = .52$) and are less likely to perceive situations as a threat ($\beta = -.33$; p's < .001). Also, athletes with greater confidence typically have a greater ability to image positive mastery associated content ($\beta = .56$) and lower negative mastery imagery ability ($\beta = -.52$; p's < .001). In turn, greater positive mastery imagery ability predicted challenge appraisals ($\beta = .23$, $p = .014$), whereas greater negative mastery imagery ability predicted threat appraisal ($\beta = .25$, $p = .002$). The final model provides the better model fit compared to the hypothesized model due to a non-significant χ^2 difference value ($p < .01$) between the nested (i.e., same variables but additional parameters; Schermelleh-Engel, Moosbrugger, & Müller, 2003) hypothesized and final models (Byrne, 2010), and a lower expected cross validation index (ECVI) value for the latter.

Next, to investigate whether mastery imagery ability mediated the relationship between confidence and challenge and threat appraisals, the data was tested for indirect effects (Hayes, 2013). Results showed that positive mastery imagery ability mediated the relationship between confidence and challenge appraisals (B = .15, $p = .025$, 90% CI = 0.04

to 0.29), whereas negative mastery imagery ability mediated the relationship between confidence and threat appraisals (B = -.26, p = .003, 90% CI = -0.47 to -0.12). Athletes with greater confidence tend to have higher challenge and lower threat appraisals, in part through their ability to image positive and negative mastery content respectively.

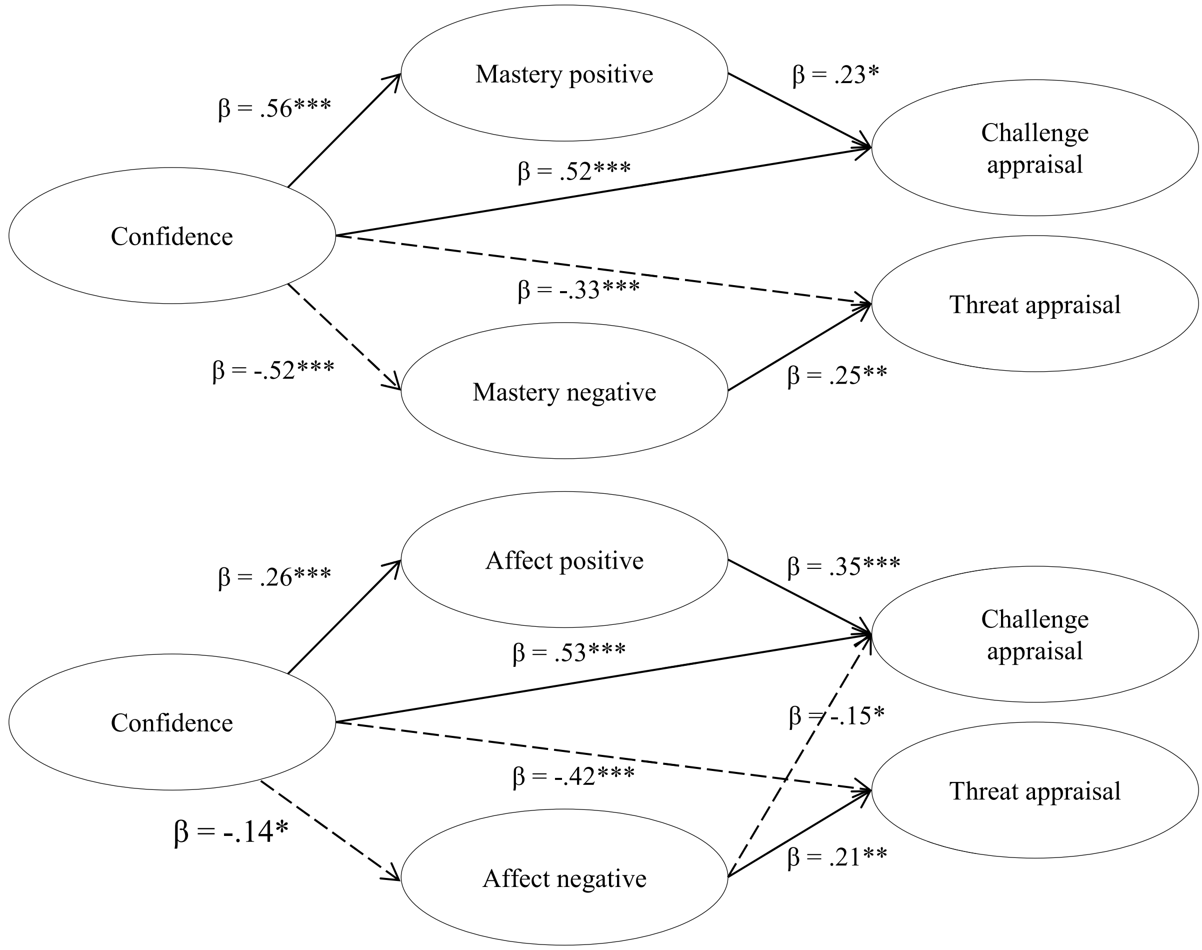


Figure 4.3. Final models predicting imagery ability, challenge and threat appraisals. For visual simplicity, variances are not presented but were all significant (p < .001). Items loading on to the different subscales are also not included for visual simplicity.

Note. All coefficients are standardized. *p < .05, **p < .01, ***p < .001. Full lines and dashed lines represent positive and negative predictions respectively.

Alternative Affect Structural Model

Similar to the mastery structural model, regression paths were drawn from confidence to all variables, and from positive and negative affect imagery ability to both challenge and threat appraisals (Figure 4.1). The model revealed a good fit to the data, χ^2 (143) = 228.15, p < .001, CFI = .97, TLI = .96, SRMR = .05, RMSEA = .04 (90% CI = 0.03-0.05). However, inspection of the regression weights revealed a non-significant path from positive affect imagery ability to threat appraisal (p = .535) and this path was removed from the model. The second model revealed a good fit to the data, χ^2 (144) = 228.54, p < .001, CFI = .97, TLI = .96, SRMR = .05, RMSEA = .04 (90% CI = 0.03-0.05). As shown in Figure 4.3, similarly to the mastery model, athletes with greater confidence have higher challenge appraisals (β = .53) and lower threat appraisals (β = -.42; p's < .001). Higher confidence levels also predicted greater positive affect imagery ability (β = .26; p < .001) and lower negative affect imagery ability (β = -.14, p = .049). In turn, greater positive affect imagery ability predicted a challenge appraisal (β = .35, p < .001), whereas greater negative affect imagery ability predicted both challenge (β = -.15, p = .018) and threat appraisals (β = .21, p = .002). Additionally, positive affect imagery ability was not related to threat appraisal. Finally, a non-significant χ^2 difference value (p < .01) between the hypothesized and final model and a lower ECVI value for the latter indicates a better model fit for the latter than the former (Byrne, 2010).

Next, indirect effects were investigated to determine if affect imagery ability mediated the relationship between confidence and challenge and threat appraisals. Results showed that positive affect imagery ability mediated the relationship between confidence and challenge appraisals (B = .11, p = .001, 90% CI = 0.06-0.19). Negative affect imagery ability mediated the relationship between confidence and challenge appraisals (B = .03, p = .038, 90% CI = 0.01-0.07), and confidence and threat appraisals (B = -.06, p = .029, 90% CI = -0.13 to -0.02). In other words, more confident athletes are more likely to perceive situations as a challenge through their ability to image positive affect content. Additionally, less confident athletes are more likely to perceive situations as a threat and less likely to perceive them as challenging through their ability to image negative affect content.

Phase 1 Discussion

Phase 1 examined whether positive and negative mastery imagery ability mediated the relationship between confidence (predictor) and challenge and threat appraisals (outcome variables). As hypothesized, the ability to image positive mastery and affect content was associated with challenge appraisals. Therefore, athletes who can more easily image mastering difficult situations and the emotions associated with their sport are more likely to perceive stressful situations as a challenge, and may be more confident in their ability to have the resources to meet situational demands (Jones et al., 2009). However, neither positive mastery nor affect imagery ability negatively predicted threat appraisals. As previously found in the literature (Williams & Cumming, 2012b), athletes can be more likely to perceive situations as a challenge but this does not mean they are less likely to perceive situations as a threat. Our finding that positive mastery imagery ability predicted challenge appraisals and negative mastery imagery ability predicted threat appraisals also agrees with previous research suggesting that challenge and threat appraisals are not dichotomous variables and therefore how they relate to different types of imagery ability (i.e., positive and negative) may vary (Seery, 2011; Williams & Cumming, 2012b). These findings are important to note for practitioners, coaches, and researchers as in order to lower threat appraisals, developing positive imagery ability might not be sufficient and an individual's negative imagery ability may also need to be considered.

Results specific to negative imagery ability may be explained by the direction of imagery ability assessed. As suggested by previous research (Williams & Cumming, 2012b) and supported by the relationships in this study, the wording of negative mastery ("losing confidence in a difficult situation") and affect items ("performing when negative feelings are not under my control") is likely more appropriate than their corresponding positive SIAQ counterparts for investigating the relationship of negative imagery ability with threat appraisals. Furthermore, in accordance with the RAMDIU and other research (Cumming & Williams, 2013; Quinton et al., 2016), individual characteristics (e.g., skill level) likely influence how negative content is perceived (i.e., as facilitative or debilitative) as some individuals may find negative images to be motivational (i.e., to overcome image content). To our knowledge, this is the first study to investigate the ability to image negative content and the relationship with stress appraisals. These findings are important for informing future research as specific types of imagery ability (i.e., positive or negative) may be more relevant when investigating challenge and threat appraisals, thus this information should be noted when developing effective interventions for stress appraisals.

Although positive affect imagery ability was a stronger predictor of challenge appraisals than mastery, as hypothesized, positive and negative mastery imagery ability were stronger mediators than affect imagery ability between confidence and stress appraisals. An unexpected finding was the mediating role of positive and negative affect imagery ability for stress appraisals. Although against our hypotheses, these findings are in line with the TCTSA's (Jones et al., 2009) suggestion that stress appraisals are associated with both positive and negative emotions. The present results indicate stress appraisals are also associated with the ability to image such emotional content. The link between threat and negative affect imagery ability in this study demonstrates the importance of assessing negative imagery ability and provides justification for its exploration in future research. Overall, these findings support the RAMDIU's proposition that imagery ability is a mediator (Cumming & Williams, 2013). As this phase determined the mediating role of mastery and affect imagery ability in the relationship between confidence and appraisals of stress (i.e., challenge and threat), results of the second phase examined mastery and affect imagery ability as mediators in the relationship between confidence and responses to stress (i.e., anxiety).

Phase 2 Results

Measurement Models

See Phase 1 for mastery and affect SIAQ subscale CFAs. Following the removal of problematic items and parceling of the retained items (Table 4.2), the CTAI-2 revealed a good fit to the data, χ^2 (142) = 257.07, $p < .001$, CFI = .95, TLI = .94, SRMR = .05, RMSEA = .05 (90% CI = 0.04-0.06).

Descriptive Characteristics and Internal Reliability

Means and standard deviations are presented in Table 4.3. As reported in Table 4.3, the CR values for all subscales were acceptable. The AVE values for both mastery subscales, negative affect imagery ability, cognitive and somatic intensity, and cognitive anxiety direction were slightly low, but were considered valid based on the CFAs. Examination of the Mardia's coefficient revealed the data surpassed multivariate normality, therefore bootstrapping was employed for all further analyses.

Mastery Structural Model

In accordance with our hypotheses, regression paths were drawn from confidence to all mastery imagery ability and anxiety variables (Figure 4.2). Regression paths were also drawn from both positive and negative mastery imagery ability to cognitive and somatic anxiety intensity and direction. The model revealed an inadequate fit to the data, χ^2 (261) = 580.86, $p < .001$, CFI = .88, TLI = .87, SRMR = .09, RMSEA = .06 (90% CI = 0.06-0.07). Non-significant regression weights led to the following paths being deleted: (a) from confidence to cognitive ($p = .162$) and somatic ($p = .300$) anxiety direction, (b) from positive mastery imagery to cognitive ($p = .104$) and somatic ($p = .813$) anxiety direction, (c) from negative mastery imagery to cognitive and somatic direction (p's = .107, .149 respectively), and (d) to somatic intensity from positive (p = .142) and negative (p = .617) mastery imagery.

Following the removal of these paths, the second model revealed a good fit to the data, χ^2 (267) = 422.21, p < .001, CFI = .94, TLI = .94, SRMR = .06, RMSEA = .04 (90% CI = 0.04-0.05) and is depicted in Figure 4.4 with standardized regression weights. Results demonstrated that higher confidence levels directly predicted lower levels of cognitive anxiety intensity (β = -.32, p < .001), and somatic anxiety intensity (β = -.36, p < .001). Higher confidence was also associated with greater positive mastery imagery ability (β = .54, p < .001) and poorer negative mastery imagery ability (β = -.51, p < .001). In turn, greater positive mastery imagery ability (β = -.17, p = .034) is associated with lower levels of cognitive anxiety intensity. Moreover, greater negative mastery imagery ability (β = .20, p = .008) was associated with higher levels of cognitive anxiety intensity. A non-significant χ^2 difference value (p < .01) between the hypothesized and final model and a lower ECVI value for the latter indicates the final model provides the best fit (Byrne, 2010).

Next, indirect effects were examined to investigate whether positive or negative mastery imagery ability mediated the confidence and cognitive anxiety intensity relationship. Results demonstrated that both positive (B = -.09, p = .021, 90% CI = -.019 to -.02) and negative (B = -.10, p = .001, 90% CI = -.19 to -.04) mastery imagery ability mediated this relationship. In other words, athletes who are more confident are likely to be more protected against higher cognitive anxiety levels through their ability to image positive associated mastery content. Additionally, less confident athletes are likely to be less protected against higher cognitive anxiety levels through negative mastery imagery ability.

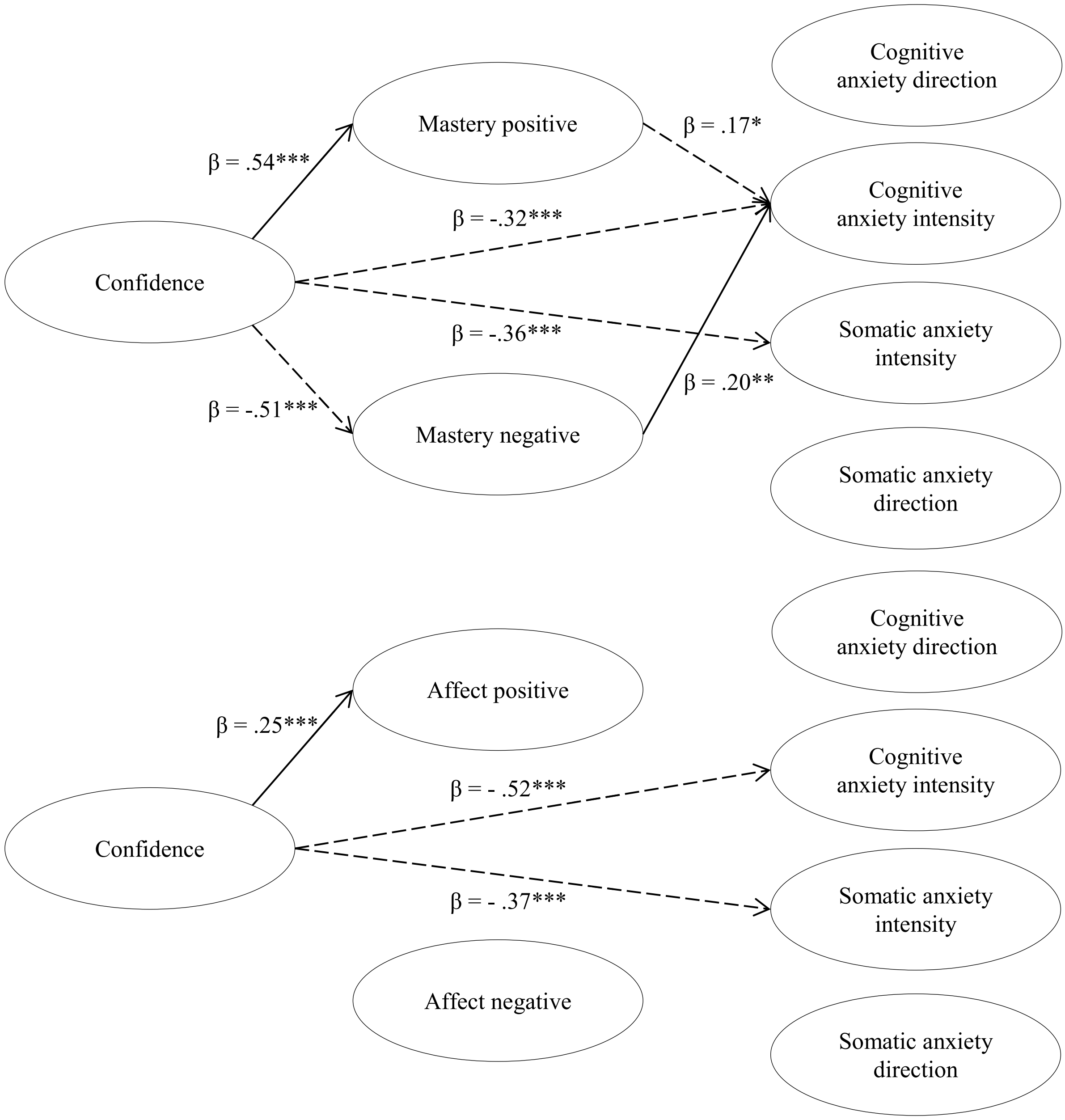


Figure 4.4. Final models predicting imagery ability, and cognitive and somatic anxiety intensity and direction. For visual simplicity, variances are not presented but were all significant (p < .001). Items loading on to the different subscales are also not included for visual simplicity.
Note. All coefficients are standardized. *p < .05, **p < .01, ***p < .001. Full lines and dashed lines represent positive and negative predictions respectively.

Alternative Affect Structural Model

Similar to the mastery structural model, regression paths were drawn from confidence to imagery ability and anxiety, and from both types of affect imagery ability (i.e., positive and negative) to cognitive and somatic anxiety intensity and direction (Figure 4.2). The model revealed an inadequate fit to the data, χ^2 (261) = 567.36, $p < .001$, CFI = .89, TLI = .87, SRMR = .09, RMSEA = .06 (90% CI = 0.05-0.07). Non-significant regression weights led to the following paths being deleted: (a) to cognitive anxiety direction from confidence (p = .407), positive affect (p = .807), and negative affect imagery ability (p = .152), (b) to somatic anxiety direction from confidence (p = .643), positive affect (p = .607), and negative affect imagery ability (p = .772), (c) to cognitive and somatic anxiety intensity from affect positive (p's = .196, .999) and negative (p's = .227, .965) imagery ability respectively, and (d) from confidence to negative affect imagery ability (p = .059).

After these paths were removed, the final model revealed a good fit to the data, χ^2 (270) = 414.65, $p < .001$, CFI = .95, TLI = .94, SRMR = .06, RMSEA = .04 (90% CI = 0.03-0.05), which is depicted in Figure 4.4 with standardized regression weights. Similar to the mastery model, athletes with greater confidence levels have lower cognitive (β = -.52, $p <$ .001) and somatic (β = -.37, $p < .001$) anxiety intensity levels. Greater confidence was associated with higher positive affect imagery ability (β = .25, $p < .001$). Unlike the mastery model, there was no relationship between confidence and negative affect imagery ability. Furthermore, positive and negative affect imagery ability was not related to cognitive and somatic anxiety intensity or the direction of these symptoms. A non-significant χ^2 difference value ($p < .01$) between the hypothesized and final model and a lower ECVI value for the latter indicates the final model provides the best model fit (Byrne, 2010). As there were no significant direct effects between confidence and cognitive intensity or between either affect imagery ability and anxiety intensity or direction, it was concluded that neither positive nor negative affect imagery ability served as mediators in this model.

Phase 2 Discussion

The aim of Phase 2 was to build on Phase 1 by comparing positive and negative forms of mastery and affect imagery ability as mediators between confidence and anxiety (i.e., intensity and direction) responses to stress. Similar to Phase 1, positive and negative mastery imagery ability were stronger mediators than affect imagery ability in the relationship between the predictor (i.e., confidence) and outcome (i.e., cognitive anxiety intensity) variables. In contrast to Phase 1, affect imagery ability did not mediate any relationships. Although the link between confidence and anxiety is well established (Hanton et al., 2004; Mellalieu et al., 2006), the present findings show the association between confidence and cognitive anxiety intensity is mediated through an individual's ability to image both positive and negative mastery content. These findings provide further support for the RAMDIU's proposed mediating role of imagery ability.

In contrast to our hypotheses but reported previously (Williams & Cumming, 2015), imagery ability was not associated with somatic anxiety intensity. Research has suggested that the lack of association may be due to using positive imagery ability measures (Williams & Cumming, 2015), but negative mastery imagery ability was only associated with cognitive anxiety intensity in the present phase. One reason for the lack of association between imagery ability and somatic intensity might be due to the dimension of imagery ability assessed. Although ease of imaging is a commonly measured dimension (Williams & Cumming, 2011), research has shown that vividness of negative images is linked to anxiety (Morina et al., 2011). Future research could explore whether imagery vividness is involved in the mechanism by which confidence and anxiety are related.

Another reason for the lack of somatic anxiety findings might be how this type of anxiety is conceptualized. The nature of somatic anxiety, or the physiological responses of anxiety (e.g., increased heart rate, nervousness), might be more reflective of a state measure and could be more difficult to retrospectively recall as a trait measure. There is likely great variation in how one typically feels, dependent on factors such as the competition venue, how well they slept the night before, and even the weather (Bray, Jones, & Owen, 2002; Kroll, 1982). This concept is tentatively supported by imagery ability and confidence being associated with cognitive anxiety intensity and challenge and threat appraisals. These outcome variables are related to cognitions, whereas somatic anxiety is likely more reflective of physiology. As distinguishing between trait and state anxiety is important to accurately predict stress responses (Ree, French, MacLeod, & Locke, 2008), a qualitative exploration of the conceptualization of trait and state somatic anxiety may clarify these issues.

A second contradiction to our hypotheses based on previous research (Quinton et al., 2017; Williams & Cumming, 2015) is that imagery ability did not predict anxiety direction. Williams and Cumming (2015) investigated imagery ability as a predictor of confidence and anxiety direction and although there was no direct relationship found, mastery and goal imagery ability indirectly predicted anxiety direction via confidence. As this study is now the second to find no direct relationship between imagery ability and anxiety direction, the role of imagery ability in the relationship with confidence and anxiety direction is likely that of a predictor rather than mediator.

Another explanation for the lack of significant anxiety direction findings could be that the perception of anxiety symptoms is related to the interpretation of imagery content (e.g., as facilitative or debilitative), rather than the ease or difficulty of image generation. For example, if an individual is predisposed to perceive responses to stress (e.g., anxiety) as facilitative, then it is feasible that imaging content associated with experiencing stress (e.g., mastering difficult situations) may also be perceived as facilitative. Thomas, Hanton, and Maynard (2007) allude to this relationship when reporting that those who perceive anxiety as facilitative (i.e., facilitators) are better able to replace negative images with positive ones compared to their debilitator counterparts. Furthermore, Williams et al. (2010) found in comparison to threat imagery, participants reported challenge and neutral imagery to be significantly more helpful (or facilitative) and experienced more facilitative anxiety interpretations. It would be worthwhile for future research to explore the relationship between anxiety and imagery interpretation as techniques to alter how imagery is viewed (e.g., imagery rescripting; Holmes, Arntz, & Smucker, 2007) could also benefit changing anxiety perceptions.

General Discussion

A key finding from this chapter is the mediating role of mastery imagery ability. It appears that mastery imagery ability is more impactful on cognitive anxiety than affect imagery ability, but both these imagery ability types are important for understanding stress appraisals. The results from both phases make important theoretical contributions. Mastery (and to some extent affect) imagery ability as a mediator, its relationship with outcomes experienced (e.g., stress appraisals, anxiety) and the influence of individual characteristics (e.g., trait confidence) all provide support for the relationships hypothesized in the RAMDIU (Cumming & Williams, 2013). These findings could guide avenues for future RAMDIU research, including investigating whether differences exist for these models according to individual characteristics (i.e., the "who" component in RAMDIU) such as skill level and gender. Future research could investigate other RAMDIU components through quantitative and/or qualitative analyses to test this framework as a whole and further contribute evidence to its importance and validity in the applied setting.

Additionally, the present findings also contribute evidence towards the TCTSA (Jones et al., 2009). Other antecedents alongside confidence such as perceptions of control and goal orientation could also play an important role between imagery ability and stress appraisal. Not only are both antecedents related to challenge and threat appraisals, but research has suggested that perceptions of control may relate to particular types of imagery such as mastery and affect (Williams & Cumming, 2012b). As the present results show that mastery and affect imagery ability are associated with antecedents and outcomes of the TCTSA (e.g., confidence, stress appraisals, and cognitive anxiety), it would be worthwhile to use the RAMDIU to test whether imagery ability could also mediate the relationships examined but using different antecedents to confidence.

A novel methodological contribution of this chapter was the revision of positively worded SIAQ items into negative items. Similar to Nordin-Bates et al. (2011) who reworded positive imagery use content into negative content (Nordin & Cumming, 2006), initial support for negatively worded SIAQ items was provided in this study by demonstrating good model fit over two phases. Identifying athletes' negative imagery ability adds a novel aspect to the imagery ability component of RAMDIU, as only relationships associated with positive imagery ability were hypothesized (Cumming & Williams, 2013). As present findings highlight the importance of positive and negative imagery ability, future research should consider both directions of imagery ability to fully understand relationships proposed by RAMDIU.

Identifying athletes' negative imagery ability could also provide key recommendations for athletes, coaches, researchers, and practitioners with regards to optimizing stress appraisals and cognitive anxiety levels, and developing strategies required to perform successfully (e.g., developing positive imagery to combat negative images). As negative imagery ability was associated with stress appraisals and anxiety, future research should determine whether it is feasible to train athletes how to lower their ability to image negative content (e.g. through LSRT, imagery rescripting; Cumming et al., 2016; Holmes et al., 2007) to lower threat appraisals and cognitive anxiety intensity. Furthermore, adapting the negative SIAQ to a clinical setting and identifying the extent to which individuals are able to image this content could provide a crucial screening tool for a variety of conditions. It is important to note that negative image content is not always perceived as debilitative and positive content is not always facilitative (Quinton et al., 2016), therefore future research should consider the image meaning component of the RAMDIU (Cumming & Williams, 2013) and investigate how the interpretation of positive and negative SIAQ items influences the relationships in the present study.

Although the present research provides some unique contributions to existing literature, there are a few limitations. First, the cross-sectional study design means the results do not imply causation and future research should explore these results in greater depth (e.g., using qualitative methods, imagery interventions, a three wave longitudinal study) to comprehend these relationships. Second, the factor loading of one negative affect item was relatively low but retained due to being above the minimum recommended factor loading (.30; Tabachnick & Fidell, 2013) and the fit indices of the measurement model revealing a good fit to the data. Nonetheless, future research should confirm the validity and reliability of the negative SIAQ.

In conclusion, the present study supports the RAMDIU and demonstrates the role of positive and negative imagery ability as mediators in the relationship between confidence and both appraisals (i.e., challenge and threat) and responses (i.e., cognitive anxiety intensity) to stress. This study was the first to investigate the role of negative imagery ability and demonstrated that negative imagery ability directly predicts stress appraisals and cognitive anxiety intensity. Increasing athletes' positive mastery and affect imagery ability could impact stress appraisals and cognitive anxiety intensity. Adapting the negative SIAQ to a clinical setting to assess negative imagery ability could also be a useful screening tool.

Chapter 5

General Discussion

General Discussion

The overall aim of this thesis was to investigate the effects of positive and negative imagery content and ability on cognitive (e.g., confidence, stress appraisals), affective (e.g., anxiety), and behavioral (e.g., performance) outcomes. This aim was achieved by using a combination of experimental and cross-sectional research to (a) determine how the use of different imagery content (e.g., positive and negative), and the perception of this content (e.g., facilitative or debilitative) could influence psychological and cardiovascular responses and performance to stress evoking and non-stress evoking situations, and (b) explore the role of different types of imagery ability, that is whether certain types of imagery ability (e.g., mastery and affect, positive and negative) were associated with responses to a stress evoking situation and whether they were stronger mediators and thus more beneficial for stress appraisals and responses. The proposed research questions for each chapter are in Table 1.3.

Summary of Results

Chapter 2. Using an experimental repeated measures design, Chapter 2 examined whether the interpretation (i.e., image meaning) of a negative image was influenced by different imagery content and participant skill level. This chapter also investigated the effect of imagery content and skill level on performance, anxiety, and confidence in a golf putting task. After the initial block, novice and expert golfers were randomly allocated to an imagery script that described a putt missing a target by either 20cm (i.e., near miss) or 40cm (i.e., far miss) before completing the task again.

The results of this chapter demonstrated that, in support of the hypotheses, experts perceived the imagery as significantly more debilitative compared to novices, regardless of imagery condition. After receiving the imagery intervention, the far miss group had significantly higher cognitive and somatic anxiety intensity than at Block 1 and performed significantly worse than the near miss group. There were no differences in the perceived helpfulness of the imagery across imagery groups (i.e., near or far miss), but those who perceived imagery as more debilitative performed worse compared to those who perceived imagery as facilitative. Interestingly, experts in the near miss group reported the imagery as being debilitative to performance, yet they experienced no change in performance across blocks, which together with a lack of significant relationships between imagery meaning and outcomes at Block 2 suggests that while it is important to assess imagery meaning, this may not always reflect the pronounced impact the imagery could have on outcomes. Chapter 2 also provided theoretical support for the RAMDIU (Cumming & Williams, 2013), suggesting that imagery function likely plays a key role in influencing the relationship between image meaning and content, but also provided new contributions to the model as individual characteristics (e.g., skill level) were directly associated with imagery meaning.

Chapter 3. Following a similar study design to Chapter 2, the first aim of Chapter 3 was to investigate imagery as a strategy to effectively regulate psychological (confidence and anxiety) and cardiovascular (blood pressure and heart rate) responses to a competitive stress task. After completing the task on their first visit, on their second visit participants were randomly allocated into a challenge, threat, or relax imagery condition (or control group with no imagery) before receiving imagery training, listening to their respective scripts, and completing the task again. Although this has been investigated within a hypothetical competition setting (Williams, Cumming, & Balanos, 2010) and a public speaking task setting (Williams, Veldhuijzen van Zanten, Trotman, Quinton, & Ginty, 2017) where threat imagery had more debilitative psychological and cardiovascular responses to the tasks compared to challenge and neutral imagery, the effects of such imagery had not been investigated in an actual stress evoking competition task, where it is feasible that due to differing task demands, different types of imagery may evoke more facilitative or debilitative responses to the task.

The second aim of this chapter was to explore whether the ability to image general mastery content (e.g., overcoming difficult situations), in comparison to general affect content (e.g., experiencing positive emotions), was associated with changes in the psychological and cardiovascular responses to stress elicited through the imagery scripts. Mastery imagery ability (i.e., imaging mastering challenging situations) is particularly relevant when investigating how individuals cope with stress and was chosen as research has demonstrated it is the strongest predictor of factors associated with stress (e.g., confidence, stress appraisals, anxiety; Williams & Cumming, 2012b, 2015). Affect imagery ability was chosen as it includes emotions which are also commonly experienced in stress (e.g., nervousness, excitement), has been associated with how individuals appraise stress (Williams & Cumming, 2012b), and is typically reported as easiest type of imagery content to image (Williams & Cumming, 2011).

Following the imagery, the challenge and threat groups reported higher somatic anxiety levels to the competition task compared to before the imagery, and the challenge group tended to perceive these symptoms as more debilitative. This finding was in contrast to previous literature (Cumming, Olphin, & Law, 2007; Williams et al., 2010, 2017) and importantly suggests that when using challenge imagery, practitioners should ensure imagery is meaningful and that it has the intended facilitative effect for actual performance scenarios, as in this instance, the imagery content was considered positive (i.e., challenge) but had a debilitative effect (i.e., increased anxiety). Interestingly, greater mastery imagery ability was associated with participants in the threat group being less likely to perceive anxiety symptoms as debilitative, suggesting that greater mastery imagery levels act as a protective factor against debilitative imagery. Affect imagery ability was not significantly associated with any changes in response to competition caused by the imagery. These results highlight the importance of a specific type of general imagery ability (i.e., mastery), which can also determine the effectiveness of an imagery intervention.

Chapter 4. Following the investigation of mastery and affect imagery ability in an experimental approach, the first aim of Chapter 4 was to further explore these types of imagery ability as mediators in a two-phase cross-sectional design. Specifically, this chapter aimed to determine the importance of mastery imagery ability in the relationship between confidence and appraisals (Phase 1) and responses (Phase 2) to stress. These models were then compared to affect mediation imagery ability models. Furthermore, although research highlights mastery imagery ability's effectiveness for regulating confidence and stress appraisals and responses, only positive imagery ability had been investigated to date. Therefore, the second aim of this chapter was to be the first in exploring the mediating role of negative imagery ability in these same models through a revised negatively worded version of the SIAQ (Williams & Cumming, 2011).

Results demonstrated the mediating role of positive and negative mastery imagery ability between confidence and the appraisals and responses to stress. These results highlighted the importance of mastery imagery ability but through a different study design. In contrast to the hypotheses, although mastery imagery ability was a stronger mediator, positive and negative affect imagery ability also mediated the relationship between confidence and stress appraisals. Furthermore, negative mastery imagery ability was a stronger predictor of cognitive anxiety intensity than positive mastery imagery ability, supporting previous research demonstrating negative image content can be more powerful than positive content (e.g., Nordin & Cumming, 2005). The findings from Chapter 3 and Chapter 4 suggest that mastery (compared to affect) imagery ability is more impactful for trait cognitive anxiety intensity and links to actual stressful situations, but mastery and affect imagery ability are both important for influencing trait stress appraisals. This chapter also contributed novel findings to the RAMDIU by demonstrating a direct link between imagery ability and the "who" component (e.g., trait confidence, appraisals, and anxiety) of the model (Cumming & Williams, 2013).

Applied Implications

Specific applied implications of studies are discussed within each chapter and are not repeated here. It is important to emphasize the theoretical contributions of this thesis and highlight how the novel findings could lead to revisions in the models and contributions to the imagery meaning literature. This thesis not only provided support for existing relationships proposed in the RAMDIU (e.g., situation influences function, imagery ability as a mediator, and together with imagery function influences outcomes experienced; Cumming & Williams, 2013), but also contributed original findings to the model which will now be discussed.

First, the original model proposed that individual characteristics (i.e., "who") would influence imagery meaning via imagery function, but Chapter 2 expanded upon this notion and demonstrated a direct link between skill level (i.e., "who") and participants' perception of imagery as facilitative or debilitative (i.e., imagery meaning), which was not illustrated in the original model. This novel finding also contributed to the facilitative and debilitative imagery literature as it conceptualized imagery meaning beyond Short et al.'s (2002) definition by confirming a direct link with individual characteristics (e.g., skill level). This thesis also contributed to the facilitative and debilitative imagery literature through establishing that positive and negative imagery content and ability can influence outcomes such as anxiety and stress appraisals, and noted that imagery function is crucial to ensure that imagery is perceived as facilitative. Furthermore, this thesis differentiated between positive and negative imagery content and facilitative and debilitative perceptions as now recommended in the literature (Quinton, Cumming, Allsop, Gray, & Williams, 2016), to ensure imagery interventions are effective at eliciting the intended outcomes.

Second, the original model proposed that individual characteristics would influence imagery ability via the function, meaning, and content of the imagery, but the findings of Chapter 4 also propose a direct link between the who component (e.g., trait confidence) and imagery ability. Third, Chapter 4 also extended upon the imagery ability component as originally only hypotheses concerning positive imagery were included in the model, whereas the results from Chapter 4 provide support for additionally including negative imagery ability. These new paths and extended components in the model are shown in a revised illustration of the RAMDIU in Figure 5.1.

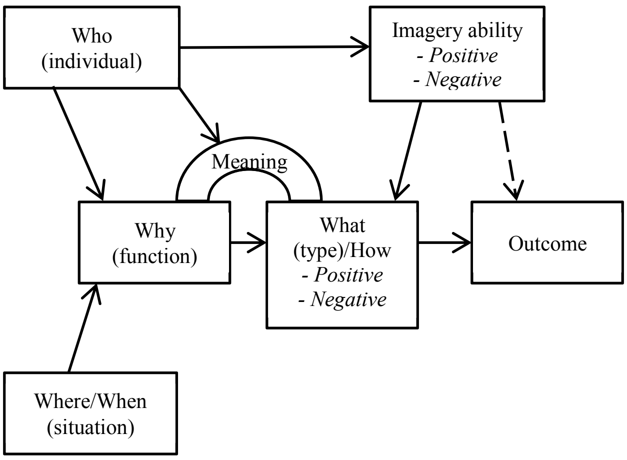


Figure 5.1. Thesis revised version of the revised applied model of deliberate imagery use.

The results from this thesis also provide some discussion points for Jones et al.'s (2009) TCTSA. Resource appraisals as defined within the TCTSA relate to "a person's ability to cope with the demands of a situation and include skills, knowledge, abilities, dispositional factors (e.g., self-esteem, sense of control) and external support available to a person" (Jones et al., 2009; p.163). Within this definition, imagery ability could be characterized as a skill (i.e., it can be practiced and refined), ability, and/or a dispositional factor (i.e., it can vary across individuals), therefore it would be worthwhile for future research to investigate the potential to include imagery ability as another antecedent for challenge and threat appraisals, particularly as research has already demonstrated links with some of the relevant psychological and cardiovascular characteristics (Williams & Cumming, 2012b, 2015; Williams et al., 2017).

The findings from this thesis also provide crucial discussion points for the impact of negative imagery content on performance. Previous research has demonstrated that negative imagery content can be more impactful on performance than positive content (Nordin & Cumming, 2005), but present results suggest that even minor differences in details of negative content (i.e., missing a putt by 20cm or 40cm) can influence performance. In Chapter 2, the content of the far miss imagery script (missing a putt by 40cm) was powerful enough to evoke performance (37.81cm) which reflected the imagery content. This finding could be explained by high adherence to implementing imagery before each putt, which is supported by their mean score of 6.3 (where 7 represented imaging the script content before all putts). The far miss group also experienced increased cognitive and somatic anxiety intensity after the imagery, which may have subsequently impacted performance. These findings should be considered by applied practitioners as even small variations in negative imagery content could have great consequences for athletes' performance.

This thesis also provides a number of additional applied implications regarding negative images and negative imagery ability for sport psychology, with the potential to also inform the clinical psychology literature. An original finding from this thesis was that mastery imagery ability protects against the debilitative effects (i.e., greater anxiety) of threat based imagery, therefore encouraging the use of this particular type of imagery for athletes seeking to combat debilitative imagery. The margins between winning and losing, particularly at elite levels, can be extremely narrow and thus athletes are constantly seeking ways to gain a psychological edge on their opponents. As experiencing negative imagery can be detrimental for performance (Nordin & Cumming, 2005; Quinton et al., 2016), it appears that based on the results of this thesis, developing mastery imagery ability could be the answer to finding that psychological edge necessary for enhancing athletes' optimal performance.

Another unique aspect to this thesis was the revision of positively worded SIAQ items into negative items. The SIAQ is now an established valid and reliable tool for assessing and distinguishing between cognitive and motivational imagery content (Williams & Cumming, 2011), but this thesis extended this questionnaire and demonstrated valid and reliable scores providing initial support for introducing negatively worded SIAQ items. The introduction of this tool could have significant implications for sport psychology. The ability to identify athletes' negative imagery ability could provide key recommendations for athletes, coaches, and practitioners with regards to the strategies required to perform successfully. For example, in a similar manner to greater imagery ability of facilitative content leading to more facilitative outcomes (e.g., higher confidence; Williams et al., 2012b), greater imagery ability of typically debilitative content had a greater debilitative impact on outcomes such as perceiving situations as threatening and experiencing higher cognitive anxiety levels. Therefore, practitioners should focus on strategies to develop positive imagery ability with the specific aim to combat negative images and the associated debilitative outcomes (e.g., through LSRT; Cumming et al., 2016).

In addition to being a useful tool to identify negative imagery ability in sport, the practicality could also extend to the clinical psychology literature. Intrusive, vivid negative images are recognized as a hallmark across many psychological disorders (Holmes, James, Blackwell, & Hales, 2011). Adapting the negative SIAQ to a clinical setting and identifying the extent to which individuals are able to image this content could provide a crucial screening tool for a variety of conditions (e.g., depression). Although there are numerous measures for assessing particular types of negative imagery in clinical psychology (for a review see Pearson, Deeprose, Wallace-Hadrill, Heyes, & Holmes, 2013), the existing measures either do not assess content relevant to coping with negative images and stress (e.g., spontaneous use of imagery scale; Reisberg, Pearson, & Kosslyn, 2003), or rely largely on participant recall and are time consuming to complete (e.g., mental imagery interview; Day, Holmes, & Hackmann, 2004). Therefore, adapting the negative SIAQ to wording appropriate for a clinical setting could allow for a less time demanding measure of negative imagery ability focusing on content related to coping with stress.

The relationship between negative imagery ability and its effect on appraisals and responses to stress would also have important implications for young people, whose brains are still developing (National Institute of Mental Health, 2011) and are more vulnerable to psychiatric disorders linked to negative appraisals (e.g., depression). The research in this thesis suggests that identifying negative imagery ability and developing positive imagery ability (in this case mastery and affect) could be beneficial as a strategy not only in the management of certain mental health issues, but also in their prevention and for maintaining general wellbeing. However, future research should conduct further testing to confirm the validity and reliability of the negative SIAQ.

Additionally, as psychological stress is associated with poor physical health (e.g., hypertension, coronary heart disease; Schnall, Belkić, Landsbergis, & Baker, 2000), the results from Chapters 3 and 4 (i.e., imagery ability's association with stress outcomes) also suggest that developing positive imagery ability might also help manage the physical symptoms of stress. As work related to mental and physical stress costs as much as $190 billion per year (Blanding, 2015), future research should explore this proposition to investigate whether imagery could be introduced as a new cost effective strategy for managing physical and psychological stress.

Results from this thesis also allude to implications for meta-imagery and meta-imagery ability in sport psychology. Beck (1995) explains that not all thoughts are explicit and it is important to develop self-awareness of thoughts through different techniques. For example, an athlete and their coach or practitioner may not realize that stress appraisals and cognitive anxiety intensity are linked to the specific ability to image negative mastery and affect content. Exploring these relationships through different techniques (e.g., guided reflection, think aloud protocols, LSRT; Cumming et al., 2016; Ericsson & Simon, 1993; Johns, 2009) could help develop this self-awareness but also increase an athletes' meta imagery ability (i.e., the extent to which an athlete is aware of their ability to image; MacIntyre & Moran, 2010). A link between meta-imagery ability and imagery meaning is also feasible, as better imagers may be more accurate in determining whether an image is perceived as facilitative or debilitative. Similarly, the concept of mindfulness is also likely relevant as athletes should be aware of what they are imaging in the present moment, particularly if it is debilitative. Regardless, once this awareness is developed and the athlete is aware that cognitions may need to be changed, imagery interventions underpinned by cognitive behavioural therapy (e.g., cognitive bias modification; Telman, Holmes, & Lau, 2013) could be employed within sport psychology to effectively modify cognitive processes and structures (McArdle & Moore, 2012).

Strengths and Limitations

A key strength of this thesis was the strong theoretical foundation upon which it was based. It is important to have a theoretical framework to provide an overarching structure to a body of work (Merriam, 1998), but also to help guide the proposed hypotheses and research questions. This thesis was informed by established theories and frameworks including Paivio's (1985) framework, Lang's (1979) bioinformational theory, and Martin, Moritz, and Hall's (1999) applied model of imagery use. However, the RAMDIU (Cumming &

Williams, 2013) was chosen as a more relevant and recent theory of imagery use and was central to this thesis by underpinning each chapter.

Another main strength of this thesis was the methodological variation across chapters. A combination of experimental and cross-sectional study designs were employed to address the aim of this thesis. Assessments consisted of a combination of self-report and objective data (i.e., cardiovascular responses, performance), which is known as triangulation and served to enhance the methodological rigor of this thesis (Onwuegbuzie & Leech, 2005). Furthermore, the multi-phase approach taken in Chapter 4 allowed for the novel negatively worded SIAQ to be tested over two phases, and for the replication of findings to demonstrate the importance of positive and negative mastery imagery ability in Chapters 3 and 4.

Finally, the inclusion of important manipulation checks in this thesis expanded on previous literature to ensure a more rigorous approach to assessing imagery meaning. With the exception of a few studies (e.g., Cumming, Nordin, Horton, & Reynolds, 2006; Nordin & Cumming, 2005; Woolfolk, Murphy, Gottesfeld, and Aitken, 1985a), typically in the sport psychology literature, studies have neglected to assess imagery meaning (e.g., Beilock, Afremow, Rabe, & Carr, 2001; Short et al., 2002; Taylor & Shaw, 2002). Therefore, one cannot be confident that the results truly reflect differences due to imagery meaning. Similarly, in the clinical literature, studies have either assumed negative images are debilitative or failed to assess imagery meaning (e.g., Lang, Blackwell, Harmer, Davison, & Holmes, 2012; Slofstra, Nauta, Holmes, & Bockting, 2016). This thesis addressed these methodological concerns by including manipulation checks to assess perceptions of imagery meaning and perceptions of the effect of imagery scripts on cognitive and affective outcomes (i.e., as facilitative or debilitative; Chapters 2 and 3). The results in this thesis can be interpreted with greater confidence compared to studies not including such verification.

Although this methodological approach in the thesis was strong, one possible limitation was the reliance on only quantitative methods. Qualitative data could have provided an additional perspective on facilitative and debilitative imagery. For example, interviews could have been implemented to explore athletes' experiences of mastery (in comparison to affect) imagery for regulating appraisals and responses to stress. In support, Kelle (2006) stated that in comparison to a monomethod design, a mixed method approach can validate findings from different perspectives (i.e., triangulation) and provide a better overall picture of the research domain. Although this factor is noted as a limitation, research suggests that in line with a particularistic discourse, the most important consideration should be the choice of appropriate methods to answer the research question (Bryman, Becker, & Sempik, 2008), therefore the strong quantitative methodological design in this thesis was considered apt to address the research questions (e.g., investigating the effect of different types of imagery on task responses through an experimental approach in Chapters 2 and 3).

Another limitation of this thesis could have been how challenge and threat appraisals were conceptualized. In accordance with the TCTSA (Jones, Meijen, McCarthy, & Sheffield, 2009), challenge and threat appraisals were defined as two dichotomous motivated performance states. However, recent research has suggested that rather than two dichotomous states, challenge and threat appraisals should be represented on a single continuum (Seery, 2011; Vine, Moore, & Wilson, 2016), allowing for relative differences to be identified (e.g., greater vs. lesser challenge). Although this proposition is logical in some instances, it also implies that an individual cannot experience both high or low levels in both states, despite research supporting that individuals can experience both in a dual appraisal style (Didymus & Fletcher, 2017; Skinner & Brewer, 2004). Williams and Cumming (2012b) reported that challenge and threat appraisals are not always related, which was supported by findings in Chapter 4 whereby positive mastery imagery ability only predicted challenge appraisals and negative mastery imagery ability only predicted threat appraisals. Therefore, although the conceptualization of challenge and threat states in this thesis was theoretically grounded, it appears that in support of previous research, these two states may not be dichotomous but neither do they appear on a continuum, and careful consideration should be taken when applied practitioners are working with athletes' appraisal styles to ensure the appropriate support is provided.

The final limitation is concerning the population characteristics. First, the thesis mainly comprised of an athlete population. Despite athletes being most appropriate to address the aims of this thesis, the use of this sample means that any implications outside of sport psychology (e.g., clinical psychology as discussed earlier in this chapter) should be interpreted with caution. For example, athletes' competitive anxiety is conceptually different from clinical anxiety and therefore the two types of anxiety should not be considered to overlap without further testing. Second, the sample age was a limited range of 18 to 48 years old, where the majority of participants were of a student age. As a key focus of this thesis was imagery ability, the age of the sample reflected those with the potential for optimum imagery ability levels. Research has suggested that although children younger than 14 can image basic movements (Quinton et al., 2014), they often struggle to image due to their inability to make anticipations (Munroe-Chandler, Hall, Fishburne, O, & Hall, 2007). At the opposite end of the spectrum, imagery ability can decline with age (Campos, Pérez-Fabello, & Gómez-Juncal, 2004). It would be important for future research to investigate whether the key findings and applied implications for mastery imagery ability in this thesis (e.g., protecting against debilitative effects of imagery) also apply to different age ranges.

Future Directions

The broader future directions of this thesis that were not mentioned in previous chapters will now be discussed. First, it is noteworthy to mention the work that this thesis has already informed. Chapter 3 investigated psychophysiological responses to a competition task and investigated the effects of challenge, threat, and relax imagery. The findings of this chapter informed the study design of a similar study, which investigated the effect of challenge, threat, and neutral scripts on anxiety and heart rate responses, but in response to a public speaking task (Williams et al., 2017). Collectively, this research supports that imagery can alter certain cardiovascular and psychological responses to standardized stress tasks. Furthermore, Chapters 3 and 4 led to both cross-sectional and intervention research investigating the importance of mastery imagery ability, whereby this type of imagery ability has now also been shown to be associated with confidence and cognitive anxiety intensity and direction, and predict these variables indirectly through perceived stress scores (Moller, 2017). Altogether, these findings demonstrate the generalizability and replicability of the results in this thesis.

As previously mentioned, future research should investigate the potential for the negative SIAQ within sport and clinical psychology. A novel aspect of this questionnaire that could be introduced in future research is a direction subscale to assess how imagery content is perceived (i.e., imagery meaning). As emphasized throughout this thesis, positive and negative imagery content are not always perceived as facilitative and debilitative respectively (Quinton et al., 2016; Short et al., 2002) and existing measures in sport and clinical psychology do not assess imagery meaning. Including this measure would encourage imagery research to more frequently assess imagery meaning and further contribute to understanding athletes' (and other clients') facilitative and debilitative imagery experiences.

Another area for future research to understand and conceptualize imagery meaning could be investigating whether, similar to challenge and threat appraisals, facilitative and debilitative imagery are two dichotomous types of imagery or whether they are on a single continuum (i.e., one rates their imagery to the extent to which is it facilitative or debilitative on a scale). Research to date within the area of the literature (e.g., Short et al., 2002; Nordin & Cumming, 2005) and the terminology used throughout this thesis is in line with the former dichotomous conceptualization (i.e., as either facilitative or debilitative and that one can experience both simultaneously). However, research is yet to explore the latter conceptualization and this suggestion could be a fruitful area for future research. One way in which research could explore imagery meaning in greater depth could be through a qualitative methodology.

Although this thesis is solely quantitative and in line with a positivist paradigm, there is clear potential for the findings to inform future qualitative work in a sequential mixed methods approach (Kelle, 2006). For example, a deductive approach using the RAMDIU (Cumming & Williams, 2013) as a framework could provide a theoretically informed investigation of imagery meaning to determine if it supports these quantitative findings in how imagery meaning relates to other components in the model. Such information could expand on the quantitative findings in this thesis, for example, determining whether debilitative imagery is more impactful than facilitative imagery on outcomes such as anxiety. Therefore, the findings of this thesis should be used to inform future mixed method work and regardless of methodology, the overall aim should be to enhance knowledge and understanding of imagery meaning.

Conclusion

In conclusion, this thesis aimed to investigate the effects of positive and negative imagery content and ability on cognitive (e.g., confidence, stress appraisals), affective (e.g., anxiety), and behavioral (e.g., performance) outcomes. This aim was achieved through experimental and cross-sectional studies by determining how different imagery content (e.g., positive and negative) and the perception of this content (e.g., facilitative or debilitative) influenced psychological and cardiovascular responses and performance to stress evoking and non-stress evoking situations. Imagery ability was also a key factor and contributed to the aim of the thesis by exploring whether certain types of imagery ability (e.g., mastery and affect, positive and negative) were associated with responses to a stress evoking situation and whether certain types of imagery ability were stronger mediators and more beneficial for stress appraisals and responses. Through this approach, there were a number of novel contributions to the imagery literature. Chapter 2 contributed a new pathway to the RAMDIU (Cumming & Williams, 2013), finding that individual characteristics (e.g., skill level) were directly associated with imagery meaning. Chapter 3 found that challenge imagery is not always helpful, highlighting the importance of ensuring imagery is meaningful to achieve facilitative outcomes. This chapter also found that general mastery imagery ability can protect against debilitative imagery and also determine the effectiveness of an imagery intervention. Finally, Chapter 4 demonstrated the mediating role of both positive and negative mastery and affect imagery ability between confidence and stress appraisals and stress responses. This chapter also contributed a new pathway in the RAMDIU with a direct link between imagery ability and the "who" component (e.g., trait confidence, appraisals, and anxiety). Although more research should be conducted to fully conceptualize imagery meaning, now researchers, athletes, coaches, and applied practitioners should have a better understanding of imagery meaning and the protective and beneficial role of mastery imagery ability in protecting against debilitative imagery.

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Appendix 1: Information sheet (Chapter 2)

Investigating Different Types of Imagery on Golf Putting Performance

Dear Participant,

Thank you for considering taking part in this study, which has been approved by the University of Birmingham's Ethical Review Board.

What is our study about?

Imagery refers to an experience you can create or re-create in your mind using your different senses (e.g., seeing yourself going for a walk and how it feels to move your body). It is a popular strategy used to enhance learning and sporting performance, but it can be interpreted by athletes in a number of different ways. Our study aims to compare different images on participants' performance, confidence, and anxiety in a golf putting task.

What will your participation involve?

If you are willing to participate, you will be asked to attend a lab session lasting no longer than 90 minutes. The first part will involve putting on a golf matt and completing some questionnaires. In the second part you will be asked to complete a golf putting task after performing some imagery. The questionnaires will ask you to report on your experience in the experiment. You are free to not answer any question your find distressing. The researcher will also provide you with potential sources of support if answering these questions lead you to feeling distressed in anyway

All your personal data will remain confidential and will be solely used for academic purposes. Consequently, we would be grateful if you were honest in your responses to the questionnaires. In accordance with the Data Protection Act (1998) raw and processed data from this investigation will be kept for a period of ten years following completion of the study. Questionnaires and computer files containing processed data will be kept securely in a locked filing cabinet and will only be accessed by the study investigators. After this time period, all the data collected will be destroyed.

Our overall findings will be used to develop interventions to improve imagery ability in the future, and will be published in an academic journal. You will not be individually identified in any publication.

Do I have to take part?

Please note, your participation in this study is voluntary and you may withdraw at any time up to three months after your lab visit, without explanation or any negative consequences. If you choose to withdraw from the study please contact Mary Quinton (contact details below) to inform us of your decision. Up until the point when the manuscript is submitted for publication your data will be destroyed and not included in the study. A brief summary presenting the results and findings will be available upon request at the end of the study.

Research credit for study participation

First and second year undergraduate students in School of Sport and Exercise Sciences may be eligible for hours of research credit for their participation in the study. Credit hours will be rewarded in recognition for the amount of participation time, with 2 hours given for completing the visit. If you choose to withdraw, you will be awarded the number of hours you spent participating rounded to the nearest half an hour.

If you have any questions now or after the study, or would like any more information about the study please do not hesitate to contact any of us:

Thank you,

Harry Chapple

Matthew Fieldsend

Benjamin Yeomans

Matthew Smith

Mary Quinton

Dr Sarah Williams

School of Sport, Exercise and Rehabilitation Sciences, University of Birmingham, Birmingham, B15 2TT

This letter is for you to keep

Appendix 2: Consent form (Chapter 2)

Investigating Different Types of Imagery on Golf Putting Performance

	Tick to consent
I confirm that I have read and understand the information sheet, and have had the opportunity to ask questions.	
All questions have been answered to my satisfaction	
I understand that my participation is voluntary and that I am free to withdraw at any time up to three months after the lab visit without giving any reason or my rights being affected.	
I give consent for the data that I provide to be used for research purposes.	
I understand that this will be entirely confidential.	
I agree to take part in the above study.	

Print name ....

Signed ....

Date ....

Witness' Name ....

Witness' Signature ....

Appendix 3: Demographics (Chapter 2)

Investigating Different Types of Imagery on Golf Putting Performance

Please provide the following information:

Part 1:
Age _______

Gender Female ☐ Male ☐

Part 2:
If you play a sport please answer the following (if you don't play one please proceed to Part 3).

Sport played________________________

Sport Type: Team ☐ Individual ☐

Competitive level: Recreational ☐ Club ☐ Regional ☐ Elite ☐

Years spent participating in your sport (including this year) _______

Part 3:
Do you have a golf handicap?

Yes ☐ No ☐

If you have a handicap please fill in *section A*, if not please fill in *section B*.

Section A

What is your golf current golf handicap? __________

What is your lowest golf handicap? __________

Years spent playing golf (including this year) __________

Section B

How many rounds of golf have you ever played? __________

When was the last time you played a round of golf? __________

How many times have you played pitch and putt? __________

How many times have you played crazy golf? __________

Have you received any golf instruction before? If yes, indicate number of hours ______

Thank you

Appendix 4: Sport Imagery Ability Questionnaire (Chapters 2, 3, and 4)

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.

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.

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 or hard)	Somewhat easy to image	easy to image	Very easy to image
1. Making up new plans/strategies 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

In relation to my sport, how easy is it for me to image the following…	1 Very hard to image	2 Hard to image	3 Somewhat hard to image	4 Neutral (not easy or hard)	5 Somewhat easy to image	6 easy to image	7 Very easy to image
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

Appendix 5: Imagery Evaluation Form (Chapter 2)

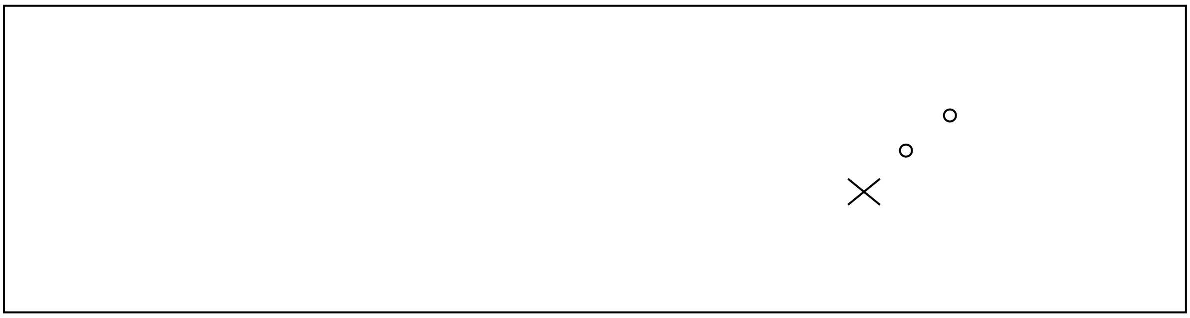
Post Imagery Trial Evaluation

Please answer the following questions in relation to the golf putting task you just completed.

1. How frequently did you incorporate the imagery during the putting task?

1	2	3	4	5	6	7
Not at all			Before half the putts			Before all putts

2. Please indicate on the diagram below where you imaged the ball ending up during the putting task



3. How easy was it for you to see the images you just performed?

1	2	3	4	5	6	7
Very hard			Not hard/ not easy			Very easy

4. How easy was it for you to feel the images you just performed?

1	2	3	4	5	6	7
Very hard			Not hard/ not easy			Very easy

5. How vivid and clear were the images?

1	2	3	4	5	6	7
No image at all			Fairly clear			Perfectly clear

6. Did you perceive the imagery as being helpful or unhelpful to your golf putting performance?

1	2	3	4	5	6	7
Entirely unhelpful	Mostly unhelpful	Somewhat unhelpful	Neither helpful or unhelpful	Somewhat helpful	Mostly helpful	Entirely helpful

7. How did the imagery you were asked to perform influence your <u>confidence</u>?

1	2	3	4	5	6	7
Decreased confidence a lot			Neither increased nor decreased confidence			Increased confidence a lot

8. How did the imagery you were asked to perform influence your <u>anxiety</u>?

1	2	3	4	5	6	7
Decreased symptoms a lot			Neither increased nor decreased symptoms			Increased symptoms a lot

9. To what extent did the imagery you were asked to perform influence your perceptions of anxiety as being <u>helpful</u> or <u>hurtful</u> to performance?

1	2	3	4	5	6	7
Anxiety was viewed as being much more hurtful			Do not influence perceptions of anxiety			Anxiety was viewed as being much more helpful

10. How did the outcome of the imagery compare to your actual putting performance?

1	2	3	4	5	6	7
My putting was much worse than the imagery outcome	My putting was worse than the imagery outcome	My putting was slightly worse than the imagery outcome	My putting was the same standard as the imagery outcome	My putting was slightly better than the imagery outcome	My putting was better than the imagery outcome	My putting was much better than the imagery outcome

Appendix 6: Immediate Anxiety Measurement Scale (Chapters 2 and 3)

Thomas, Hanton, & Jones (2002)

Appendix 7: Aiming for Target (Chapter 2)

Please answer the following questions in relation to the trials you performed today.

1. To what extent were you trying to get the ball onto the centre of the target?

1	2	3	4	5	6	7
Not at all			Half & half			On every putting attempt

2. If your responses were different between trials please indicate how these differed.

____

____

____

____

Appendix 8: Layered Stimulus Response Training (Chapter 2)

****

You are now going to spend the next few minutes performing some imagery. Each time I would like you to image the scenario described to you as clearly and vividly as possible and try to concentrate on making these images as realistic as possible.

When seeing the image, I would like you to use your preferred visual imagery perspective.

Do you remember the two different visual perspectives?

(If they don't remind them)

It doesn't matter which perspective you adopt during the imagery, however I would like you to stick with the same visual perspective throughout the rest of today's session.

You will perform the imagery standing on the golf mat, holding the club with your eyes either open or closed.

Please now take the golf putter and adopt the correct stance on the putting mat.

Remember you are to try and produce imagery which is as realistic as possible. Are there any questions before we go any further?

I would like you to imagine that you are performing the golf putting task.

(Participant images - wait about 10 seconds once you've read out the scenario)

Please describe the content of what you imagined?

I am going to ask you to imagine the scene again. But this time I would like you to incorporate a few more details into your imagery and pay specific attention to these aspects of the scene in order to make the image even more vivid. More specifically, I would like you to focus on using your different senses.

- For example, this time really try to *see* the details of the environment you are putting in (for example the golf matt, walls, the club, the ball, yourself)
- Feel details such as your feet on the mat (what does that feel like?) and the position of your muscles (e.g., your grip of the putter).

I am going to read you the statement again. To make the image as clear and vivid as possible, this time as you try to image the scene think about these different sights and feelings.

**********If participant is struggling to incorporate all senses in one go, break it down by sense and then put it altogether**********.

"Imagine that you are performing the golf putting task".

(Participant images - wait about 10 seconds once you've read out the scenario)

Did you notice any changes in what you imagined? What was different this time about the image?

<u>*Prompts:*</u>

During the imagery, What did you see? What did you hear? What did you feel?

I am going to ask you to imagine the scene for one final time, however this time I would like you to focus on experiencing the physical feelings and emotions that you would experiencing as a result of performing the movement and the outcome of the movement.

- Feel your heart beating before you perform the task
- Feel your muscles contracting as they perform the different stages of the swing
- Feel the club head make contact with the ball
- See the ball roll down the mat and incorporate the feelings and emotions associated with the outcome based on where the ball ends up

**********Again, these feelings can be layered if the athlete is struggling to incorporate all in one go**********.

"Imagine that you are performing the golf putting task".

(Participant images - wait about 10 seconds once you've read out the scenario)

<u>*Prompts:*</u>

During the imagery, What was easy/difficult to see/feel? How did the vividness differ from the first scenario you imaged?

Were there any noticeable changes to how you felt during the imagery and how detailed the image was?

When you listen to the imagery script in a few minutes time I would like you to remember what we have just practised. Remember to incorporate the many characteristics of the imagery you are asked to perform and how these will influence how you are feeling while you experience them.

****

Appendix 9: Imagery Scripts (Chapter 2)

Near Miss Script

Imagine that you are standing on the green putting mat that you were putting on during your last visit....

Feel comfortable and balanced as you get into position. Stand with your feet about 10 inches apart, your knees are somewhat bent...

Look at your feet; see that they are slightly apart, and that your toes are pointing straight ahead...

Look down and see the white golf ball; it is resting on the green mat...

Feel yourself in a comfortable position. Feel your upper body sort of hunched forward so that your eyes are directly over the white golf ball...

Feel your arms slightly bent. Feel the slight tension in your wrists as you firmly grip the putter...

The image should be you, standing square, perfectly lined up with the putter resting on the green mat behind the ball...

Your head is down and over the ball...

Now imagine the line that the ball will follow straight onto the centre of the target. This is the line you are going to putt the ball through....

Now feel yourself bring the putter back, bringing your arms back like a pendulum...

Feel your hands acting as a single unit and your wrists held firm. Feel your head staying down and motionless as your eyes totally concentrate on the ball...

Feel your smooth and consistent back swing the pendulum. Watch the putter move in a straight line towards the white golf ball...

Feel the point of impact when the putter connects with the ball...

Feel your head stay down and motionless and feel yourself finish the stroke, smoothly, effortlessly, a straight and consistent stroke...

See the ball rolling away from you down the mat. Watch it roll along the mat in a nice straight line towards the target...

Follow the ball as it continues to roll closer to the target...

See the ball at the last second miss the target and end up about 20cm further behind and to the left of the target.

Far Miss Script

Imagine that you are standing on the green putting mat that you were putting on during your last visit....

Feel comfortable and balanced as you get into position. Stand with your feet about 10 inches apart, your knees are somewhat bent...

Look at your feet; see that they are slightly apart, and that your toes are pointing straight ahead...

Look down and see the white golf ball; it is resting on the green mat...

Feel yourself in a comfortable position. Feel your upper body sort of hunched forward so that your eyes are directly over the white golf ball...

Feel your arms slightly bent. Feel the slight tension in your wrists as you firmly grip the putter...

The image should be you, standing square, perfectly lined up with the putter resting on the green mat behind the ball...

Your head is down and over the ball...

Now imagine the line that the ball will follow straight onto the centre of the target. This is the line you are going to putt the ball through....

Now feel yourself bring the putter back, bringing your arms back like a pendulum...

Feel your hands acting as a single unit and your wrists held firm. Feel your head staying down and motionless as your eyes totally concentrate on the ball...

Feel your smooth and consistent back swing the pendulum. Watch the putter move in a straight line towards the white golf ball...

Feel the point of impact when the putter connects with the ball...

Feel your head stay down and motionless and feel yourself finish the stroke, smoothly, effortlessly, a straight and consistent stroke...

See the ball rolling away from you down the mat. Watch it roll along the mat in a nice straight line towards the target...

Follow the ball as it continues to roll closer to the target...

See the ball at the last second miss the target and end up about 40cm further behind and to the left of the target.

Appendix 10: Information Sheet (Chapter 3)

STUDY INFORMATION SHEET

Dear Participant,

Thank you for considering taking part in this study, which has been approved by the University of Birmingham's Ethical Review Board.

What is the study about?

This study will assess cardiovascular and psychological responses to a competitive task and a speech task.

Can anyone take part?

Anyone can take part as long you are male, aged between 18-30 years old and meet the following inclusion criteria: no history of epileptic seizures, no immune (e.g., glandular fever), cardiovascular (e.g., hypertension), metabolic, and kidney disease or conditions; no current illness; no prescribed medication in the last 4 weeks (excluding non-steroid asthma treatments). Only males are being recruited for this study due to gender differences in cardiovascular and psychological responses elicited during the tasks completed.

What will your participation involve?

If you are willing to participate, you will be asked to attend two sessions which will each take a maximum of 2 hours. These sessions will take place at least 24 hours apart. When you come into the laboratory, we will be looking at the way your heart and your blood vessels function while you are relaxing and during 2 brief tasks; a computer car racing competition task and a speech task. All of this will be explained in more detail when you arrive in the laboratory. During each visit we will measure your heart activity using 6 small spot electrodes on your chest and back and blood pressure will be taken by a cuff around your upper arm. You are also asked to fill in several questionnaires which are related to things such as competitiveness, motivation, and your perceptions of both tasks.

<u>All your personal data will remain confidential and will be solely used for academic purposes. Consequently, we would be grateful if you were honest in your responses to the questionnaires.</u> In accordance with the Data Protection Act (1998) raw and processed data from this investigation will be kept for a period of ten years following completion of the study. Questionnaires and computer files containing processed data will be kept securely in a locked filing cabinet and will only be accessed by the study investigators. After this time period, all the data collected will be destroyed.

Our overall findings will be used to understand how people respond to different stress tasks. You will not be individually identified in any publication.

Do I have to take part?

Please note, your participation in this study is voluntary and you may withdraw at any time up to two weeks after you complete your second lab visit, without explanation or any negative consequences. If you choose to withdraw from the study please contact Mary

Quinton or Gavin Trotman (contact details provided below) to inform us of your decision. The deadline for withdrawing from the study is 2 weeks after you have completed the second lab visit. If you choose to withdraw before this time, your data will be destroyed and not included in the study. A brief summary presenting the results and findings will be available upon request at the end of the study.

What are the benefits and risks?

In each visit you will be given the opportunity to win a £10 voucher, depending upon your performance in the competition task. If you are a first year or second year student at the School of Sport, Exercise & Rehabilitation Sciences, you will receive 4 Subject Pool hours when you've finished the experiment. The risks of taking part in this study are no more than those of day to day stressors. All information that we collect will be strictly confidential.

Can I change my mind?

If, at any point you wish to withdraw, then you may do so. You do not need to give any reason for this, participation is not compulsory. If you decide to withdraw, the data that we collected from you will be destroyed and will not be used for the study.

Who else is taking part?

We will be recruiting other male students who, like you, fit the inclusion criteria.

Are there any other constraints?

Yes, if you decide to participate you should refrain from exercise and consuming alcohol for 24 hours before the laboratory testing session. Please do not drink any caffeine on the day of the test and refrain from eating and drinking at all for 1 hour before the session.

Do I have to sign anything?

Yes, if you agree to participate we will ask you to sign a Consent Form. This is to show that you have understood what is involved and that you have read the Information Sheet. You can still withdraw at any time without having to give us an explanation.

If you want to find out more about this experiment, feel free to contact us:

Mary Quinton

Gavin Trotman

Dr Jet Veldhuijzen van Zanten

Dr Sarah Williams

Appendix 11: Consent Form (Chapter 3)

	Tick to consent
I confirm that I have read and understand the information sheet, and have had the opportunity to ask questions.	
All questions have been answered to my satisfaction	
I understand that my participation is voluntary and that I am free to withdraw at any time up to two weeks after completing the second lab visit without giving any reason or my rights being affected.	
I give consent for the data that I provide to be used for research purposes.	
I understand that this will be entirely confidential.	
I agree to take part in the above study.	

If you have any more questions about the study please feel free to contact us on the details on the information sheet.

If you would like to receive a summary of the findings please provide your email address.

Email ....

Print name ....

Signed ....

Date ....

Appendix 12: Demographics (Chapter 3)

Please provide the following information:

Ethnicity: White European ☐ White Non-European ☐ Asian ☐

Black Caribbean ☐ Black African ☐ Mixed ☐ Other ☐

Sport played_________________________

Sport Type: Team ☐ Individual ☐ Both ☐

Competitive level: Recreational ☐ Club ☐ Regional ☐ Elite ☐

Years spent participating in your sport (including this year) _______

How often do you play computer games (circle appropriate response)?

Daily Every other day Twice a week Hardly ever Never

Have you ever played Need for Speed Underground: Yes ☐ No ☐

If yes, how do you rate your ability to play this game (circle appropriate response)?

Very good Good Average Fair Poor

Appendix 13: State Measure of Challenge and Threat Appraisals (Chapter 3)

McGregor & Elliot (2002); Williams, Cumming, & Balanos (2010)

Appendix 14: Task Evaluation (Chapter 3)

Please read each statement and circle the number that applies to you in relation to the computer task you just performed.

1. **How difficult did you find the task you just did?**

Not at all difficult	0	1	2	3	4	5	6	Extremely difficult

2. **How competitive did you find the task you just did?**

Not at all competitive	0	1	2	3	4	5	6	Extremely competitive

3. **How stressful did you find the task you just did?**

Not at all stressful	0	1	2	3	4	5	6	Extremely stressful

4. **To what extent were you trying to perform well at the task you just did?**

Did not try at all	0	1	2	3	4	5	6	Tried throughout the whole task

Appendix 15: Imagery Evaluation Form (Chapter 3)

1. When listening to the imagery script, how much of the time were you engaged in the imagery?

1	2	3	4	5	6	7	8	9	10
None of the time									All of the time

2. How easy was it for you to image the scenario described to you?

1	2	3	4	5	6	7
Very hard			Not hard/not easy			Very easy

3. How vivid and clear were the images?

1	2	3	4	5	6	7
No image at all			Fairly clear			Perfectly clear

4. What level of emotion was produced by this imagery script?

1	2	3	4	5	6	7
No emotion						Strong emotion

5. How did the imagery you were asked to perform influence your confidence?

1	2	3	4	5	6	7
Decreased confidence a lot			Neither increased nor decreased confidence			Increased confidence a lot

6. How did the imagery you were asked to perform influence your <u>anxiety</u>?

1	2	3	4	5	6	7
Decreased symptoms a lot			Neither increased nor decreased symptoms			Increased symptoms a lot

7. To what extent did the imagery you were asked to perform influence your perceptions of anxiety as being <u>helpful</u> or <u>hurtful</u> to performance?

1	2	3	4	5	6	7
Anxiety was viewed as being much more hurtful			Do not influence perceptions of anxiety			Anxiety was viewed as being much more helpful

8. How familiar/realistic was the imagery script with regards to your own experiences?

1	2	3	4	5	6	7
Not at all			Somewhat			Extremely

9. How well can you relate to the way you responded as a result of the imagery script events (i.e. you experienced problems so you thought you would not be as successful)?

1	2	3	4	5	6	7
Not at all			Somewhat			Completely

Appendix 16: Layered Stimulus Response Training (Chapter 3)

Provide the participant with the following definition of imagery:

"Imagery is an experience that mimics a real experience. We can be aware of seeing an image, feeling movements as an image, or experiencing an image of smell, taste, or sound without experiencing the real thing. It differs from dreams in that we are awake and conscious when we form an image".

Check whether the participant understands what you mean when you refer to the word imagery (if they don't clarify this and provide examples).

Provide the participant with the following description of imagery:

"When we view images this can be done from different visual perspectives. A first person or internal visual imagery perspective is when you view the image through your own eyes as if you were performing the movement. A third person or external visual perspective is when you view the image from another angle such as from in front. It is like watching yourself on TV or from another person's viewpoint". You can image with your eyes either open or closed, whatever you prefer.

"Along with seeing an image, people can also experience thoughts and feelings during imagery. For example, somebody imagining going for a brisk walk in the sun might imagine feeling their heart rate increase, feeling their leg muscles contracting and their arms pumping. They might also imagine feeling happy to be exercising in such nice weather etc…"

Do you understand how thoughts and feelings might be incorporated into imagery?

(If not, provide a relevant example e.g., to their sport)

You are now going to spend the next few minutes performing some imagery. Each time I would like you to image the scenario described to you as clearly and vividly as possible and try to concentrate on making these images as realistic as possible.

When seeing the image, I would like you to use your preferred visual imagery perspective.

Do you remember the two different visual perspectives?

(If they don't remind them)

You will perform the imagery sat in the chair, with your eyes either open or closed. For the imagery you are about to perform, I would like you to imagine that you are sitting an exam.

Remember you are to try and produce imagery which is as realistic as possible. I will give you 10 seconds to image the scenario and I will tell you when the 10 seconds are up. Are there any questions before we go any further?

So now, I would like you to imagine that you are sitting an exam.

(Participant images - wait about 10 seconds once you've read out the scenario)

Please describe the content of what you imagined?

I am going to ask you to imagine the scene again. But this time I would like you to incorporate a few more details into your imagery and pay specific attention to these aspects of the scene in order to make the image even more vivid. More specifically, I would like you to focus on using your different senses.

- For example, this time really try to *see* the details of the environment you are performing the task in (for example the exam venue, other students and invigilators, yourself, the exam paper)

- Feel details such as the feel of your hands on your pen (what does that feel like?) and the position of your muscles (e.g., how you're sitting in your chair).

I am going to read you the statement again. To make the image as clear and vivid as possible, this time as you try to image the scene I would like you to think about one or two of these different sights and feelings and try and incorporate them into your image.

***********If participant is struggling to incorporate all senses in one go, break it down by sense and then put it altogether***********.

Do you know what specific details you are going to try and incorporate?

Again I will give you 10 seconds to image the scenario and I will tell you when the 10 seconds are up.

"Imagine that you are sitting in an exam".

(Participant images - wait about 10 seconds once you've read out the scenario)

Did you notice any changes in what you imagined? What was different this time about the image?

<u>*Prompts*</u>

During the imagery, What did you see? What did you hear? What did you feel?

I am going to ask you to imagine the scene for one final time, however this time I would like you to focus on experiencing the physical feelings and emotions that you would be experiencing as a result of sitting in an exam.

- Feel your heart beating before you start the exam

- Feel the muscles contracting in your arm and hand as you are writing

- See the exam venue you are sat in and incorporate the feelings and emotions associated with the exam you are sitting

***********Again, these feelings can be layered if the participant is struggling to incorporate all in one go***********.

Do you know what specific details you are going to try and incorporate?

Again I will give you 10 seconds to image the scenario and I will tell you when the 10 seconds are up.

"Imagine that you are sitting in an exam".

(Participant images - wait about 10 seconds once you've read out the scenario)

Prompts:

During the imagery, What was easy/difficult to see/feel? How did the vividness differ from the first scenario you imaged?

Were there any noticeable changes to how you felt during the imagery and how detailed the image was?

When you listen to the imagery script in a few minutes time, instead of imagining sitting an exam, you will image the moments immediately prior to completing the lab tasks. During this imagery, I would like you to remember what we have just practised and apply that to your imagery. Remember to incorporate the different characteristics of the imagery to make it as clear and vivid as possible.

Appendix 17: Imagery Scripts (Chapter 3)

Challenge Script

You are now just a couple of minutes away from the start of the competition race… your heart is beating faster than usual and you are breathing more deeply………… the butterflies in your stomach make you realise the importance of this race……… but you feel ready…….……the positive adrenalin and feelings of confidence you have tell you that you will perform well……… You know that to race quickly you will need to avoid hitting traffic and obstacles during the race…as these would slow you down…however, you have complete control of the car ….……and the equipment is set up to allow you to play the game without complications……you feel in control of this race……you have played the game before…… and because of this, you can feel your confidence in your own ability to perform well in the race.…………you believe that you can win the race you are about to compete in……… your heart is pumping rapidly and you can feel the blood flowing through your body…… ……although this time you will race on a different track, in a different car, you believe that you have the ability to overcome the challenge……you are using the same controls as before… you see them in front of you and you believe that you are capable of operating them effectively to control the car….which will allow you to race as fast as possible………you set yourself the aim of trying to do your best……you think of the task as a challenge…and you know you are someone capable of meeting that challenge…………you know the other cars in the game might have the ability to go faster than you……but you can feel your confidence in your own ability to perform well and race fast…… and you relish the opportunity to compete against them…………you feel the adrenalin rush through your body, reaching all of your muscles…… ……you have never experienced so many intense positive feelings prior to playing a computer game competition ………………… You look around and notice the experimenters watching you about to play the game… and savour the prospect of demonstrating your competence in front of them…………there is real potential for you to win the race in your fastest possible time….and finish with your name at the top of the leader board.

Threat Script

You are now just a couple of minutes away from the start of the competition race… your heart is beating faster than usual and you are breathing more deeply………… the butterflies in your stomach make you realise the importance of this race……… but you do not feel as ready as you would like to be……. you feel your nerves increase as you worry that you will not be able to win……… You know that to race quickly, you will need to avoid hitting traffic and obstacles during the race…as these would slow you down…but this is not under your control….…… you feel you have no control over this race……you have only played the game a few times before in these conditions, and because of this, you obviously can't be sure that you will perform well in the race.…………you are not sure that you can win the race you are about to compete in……… your heart is now pumping rapidly and you can feel the blood flowing through your body…… ……this time you will race on a different track, in a different car, which you are not familiar with…… you believe that you are not able to overcome the challenge…… you see the control pad in front of you…but you now feel worried that you may not be able to control the car effectively…….which will stop you from racing as fast as possible……… you set yourself the aim of not performing poorly……you think of the task as a challenge… and you know you are someone not capable of meeting that challenge…………you know the other cars in the game have the ability to go faster than you……you fret about competing against them……and you cast even more doubt in your own ability to perform well and race fast…………you feel the adrenalin rush through your body, reaching all your muscles…… ……you have never experienced so many intense negative feelings prior to playing a computer game competition ………………… You look around and notice the experimenters watching you about to play the game… and you are concerned about revealing your weaknesses in front of them…………there is real potential to lose this race….and finish with the slowest time in the study.

Relaxing script

You are now just a couple of minutes away from the start of the competition race…………you sit quietly and gather your thoughts before you begin the race…… you feel well prepared… and are relaxed about the upcoming race………… as you rest before the competition, you feel your heart rate begin to slow down ………… you concentrate on your breathing…… and gradually reduce its rate by breathing slowly in…and then out again…………you let all other thoughts go …and focus on your breathing ……. … with each breath you take, you notice yourself becoming more and more relaxed…….feel your body gradually sinking into a state of relaxation……you remain composed…… in a state of calmness…………your body feels comfortable in the position you are sitting in……..and you feel your body continue to relax as all remaining tension gently leaves your muscles ………… your body feels at ease as you continue to become more relaxed……..your heart rate continues to fall…getting slower…and slower…………let go of any other thoughts…and remain in your own world………… your heart rate has gently dropped and your breathing rate has gradually slowed down………… any anxiety you previously experienced has completely evaporated from your body… leaving you in a state of relaxation and contentment............you feel peaceful……. your body is now at a comfortable temperature…………… your muscles are loose…….your hand that will operate the controls is relaxed………and your finger is supple………you are ready to perform the computer task………… you concentrate on your breathing for one final time………you take your time…slowly taking a deep breath in…….then as you gradually breathe out… you are aware of the complete state of relaxation your body has entered……..you feel relaxed, stress-free, and ready to embrace the competition race…

Appendix 18: Information Sheet (Chapter 4)

Dear Participant,

Thank you for considering taking part in this study, which has been approved by the University of Birmingham's Science, Technology, Engineering & Mathematics Ethical Review Committee.

What is our study about?

Imagery refers to an experience you can create or re-create in your mind using your different senses (e.g., seeing yourself going for a walk and how it feels to move your body). It is a popular strategy used to enhance learning and sporting performance, but it can be interpreted by athletes in a number of different ways. Our study aims to investigate how people perceive different images (i.e., helpful or unhelpful) and how this is related to various dispositions and tendencies.

What will your participation involve?

If you are willing to participate, you will be asked to complete a series of questionnaires either online or on paper. This will take no longer than 30 minutes to complete. First and second year students will be credited 0.5 research hours upon completion. The questionnaires will ask you to report on how you perceive different images, your general responses to competition anxiety, how you perceive certain sporting situations and how often you might "dwell" on any mistakes made when competing in your sport. You are free to not answer any question you find distressing. Please contact the researchers on the details at the bottom of this form if answering these questions leads you to feeling distressed in anyway.

All your personal data will remain confidential and will be solely used for academic purposes. Consequently, we would be grateful if you were honest in your responses to the questionnaires. In accordance with the Data Protection Act (1998) raw and processed data from this investigation will be kept for a period of ten years following completion of the study. Questionnaires and computer files containing processed data will be kept securely in a locked filing cabinet and will only be accessed by the study investigators. After this time period, all the data collected will be destroyed. Our overall findings will be used to develop interventions to improve imagery ability and alter negative images in the future, and will be published in an academic journal. You will not be individually identified in any publication.

Do I have to take part?

Please note, your participation in this study is voluntary and you may withdraw at any time up to two weeks after you complete the questionnaire, without explanation or any negative consequences. When providing consent, your own unique participant ID number will be created (from your date of birth and number of siblings). If you choose to withdraw from the study please contact Mary Quinton (contact details below) with your participant ID number to inform us of your decision. If you choose to withdraw, your data will be destroyed and not included in the study. A brief summary presenting the results and findings will be available upon request at the end of the study. You will also be given the opportunity to indicate if you are interested in participating in any future imagery interventions.

If you have any questions now or after the study, or would like any more information about the study please do not hesitate to contact us.

Thank you,

Mary Quinton [redacted]

Dr Jennifer Cumming [redacted]

[redacted]

School of Sport, Exercise & Rehabilitation Sciences, University of Birmingham, B15 2TT

This letter is for you to keep

Appendix 19: Consent Form (Chapter 4)

**** (VERY IMPORTANT) ****
Your date of birth: ____ / ____ / ____   Your number of siblings: _____
D   M   Y   #

	Tick to consent
I confirm that I have read and understand the information sheet, and have had the opportunity to ask questions.	
All questions have been answered to my satisfaction	
I understand that my participation is voluntary and that I am free to withdraw at any time up to two weeks after completing the questionnaire without giving any reason or my rights being affected.	
I give consent for the data that I provide to be used for research purposes.	
I understand that this will be entirely confidential.	
I agree to take part in the above study.	

If you have any more questions about the study please feel free to contact us on the details on the information sheet.

If you would like to receive a summary of the findings and/or are interested in participating in any future interventions, please tick either/both of the boxes below and provide your email address:

Summary of findings ☐   Future imagery interventions ☐

Email ....

Print name ....

Signed ....

Date ....

Witness' Name ....

Witness' Signature ....

Appendix 20: Demographics (Chapter 4)

Please provide the following information:

Part 1:

Age _______

Gender Female ☐ Male ☐

Part 2:

Sport played________________________

Sport Type: Team ☐ Individual ☐ Both ☐

Competitive level: Recreational ☐ Club ☐ Regional ☐ Elite ☐

Years spent participating in your sport (including this year) _______

Thank you

Appendix 21: Negative Sport Imagery Ability Questionnaire (Chapter 4)

Adapted from Williams & Cumming (2011)

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

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.

Ease of Imaging

	SECTION 1						
	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 or hard)	Somewhat easy to image	easy to image	Very easy to image
Performing new plans/strategies poorly	1	2	3	4	5	6	7
Failing to refine a particular skill	1	2	3	4	5	6	7
Failing to win a medal	1	2	3	4	5	6	7
The negative emotions I feel while doing my sport	1	2	3	4	5	6	7
Giving up when things aren't going well	1	2	3	4	5	6	7

In relation to my sport, how easy is it for me to image the following…	SECTION 1						
	1	**2**	**3**	**4**	**5**	**6**	**7**
	Very hard to image	Hard to image	Somewhat hard to image	Neutral (not easy or hard)	Somewhat easy to image	easy to image	Very easy to image
Plans/strategies going wrong	1	2	3	4	5	6	7
Getting worse at a particular skill	1	2	3	4	5	6	7
Being interviewed after performing poorly	1	2	3	4	5	6	7
The nervousness and worry associated with my sport	1	2	3	4	5	6	7
Being defeated by a setback	1	2	3	4	5	6	7
Ineffective game plans	1	2	3	4	5	6	7
Being unable to correct physical skills	1	2	3	4	5	6	7
Myself losing	1	2	3	4	5	6	7
Performing when negative feelings are not under my control	1	2	3	4	5	6	7
Losing confidence in a difficult situation	1	2	3	4	5	6	7
Not feeling psyched up enough for the upcoming performance	1	2	3	4	5	6	7
Being in the “wrong zone” mentally to perform	1	2	3	4	5	6	7
Being in the incorrect frame of mind for the upcoming performance	1	2	3	4	5	6	7

Scoring Guide:

Skill imagery = (Item 2 + Item 7 + Item 12)/3; Strategy imagery = (Item 1 + Item 6 + Item 11)/3; Goal imagery = (Item 3 + Item 8 + Item 13)/3; Affect imagery = (Item 4 + Item 9 + Item 14 + Item 15 + Item 16 + Item 17)/6; Mastery imagery = (Item 5 + Item 10 + Item 15)/3

Appendix 22: Cognitive Appraisal Scale (Chapter 4)

Skinner & Brewer (2002)

Appendix 23: Competitive Trait Anxiety Inventory-2 (Chapter 4)

Albrecht & Feltz (1987)