# AN EXAMINATION OF THE RELATIONSHIPS BETWEEN MASTERY IMAGERY ABILITY, APPRAISAL STATES, STRESS AND COPING

by

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# Abstract

The present thesis aimed to explore the associations between mastery imagery ability, challenge and threat appraisal tendencies, perceived stress and proactive coping using a mixture of cross-sectional and experimental research designs. Chapter 2 used a two-study approach (Study 1 in the UK, Study 2 in the US) to assess the relationships between mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, and proactive coping. Results of Chapter 2 demonstrated significant relationships between mastery imagery ability, perceived stress and proactive coping, at least in part due to the mediating role of challenge and threat appraisal tendencies. Based upon the findings of Chapter 2, Chapter 3 was a pilot study that aimed to assess if mastery imagery ability could be increased using an online mastery imagery Layered Stimulus Response Training (LSRT) intervention, and whether increasing mastery imagery ability was accompanied by changes in appraisal tendencies, perceived stress, and proactive coping. Results suggested that the LSRT intervention was effective at increasing mastery imagery ability and challenge appraisal tendencies. This thesis extends the mastery imagery ability literature, demonstrating its importance in stress appraisals and stress and coping. By using a mixed athlete and non-athlete, mixed gender sample, this research also demonstrates the effectiveness of an LSRT intervention in increasing mastery imagery ability in the general population. Furthermore, by using an online delivery format, this research becomes the first of its kind to suggest LSRT can be delivered effectively online.

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## Table of Contents


| | | |
|---|---|---|
| **Chapter 1** | **General Introduction** | **Page** |
| | Stress and Health | 2 |
| | Appraisal States | 5 |
| | Imagery | 7 |
| | Imagery Interventions | 10 |
| **Chapter 2** | **Examining the Mediating Role of Challenge and Threat Appraisal Tendencies on the Relationships Between Mastery Imagery Ability, Perceived Stress and Proactive Coping** | |
| | Introduction | 17 |
| | Study One | 19 |
| | Study Two | 33 |
| | Discussion | 43 |
| **Chapter 3** | **The Effectiveness of an Online Mastery Imagery Intervention in Increasing Mastery Imagery Ability, Challenge and Threat Appraisal Tendencies, Perceived Stress, and Proactive Coping** | |
| | Introduction | 52 |
| | Methods | 57 |
| | Results | 67 |
| | Discussion | 77 |
| **Chapter 4** | **General Discussion** | 85 |
| **References** | | 91 |

# Chapter One

## General Introduction

## General Introduction

Stress can be described as the tension experienced when an event outweighs an individual's ability to cope (Lazarus & Launier, 1978). According to a recent survey conducted by the American Psychological Association, adults have reported an average stress level of five out of ten, with those aged 18-24 reporting the highest stress level (6.1/10) compared to all other age groups. The survey also reported that almost a quarter (23%) of adults would have welcomed a lot more emotional support in the past year, an increase of 35% compared to the previous year (APA, 2020). However, it is not just those in the US experiencing increasing levels of stress and an inability to cope with it. A recent study in the UK showed that almost 3 in every 4 people (74%) reported feeling so stressed in the previous year that they were unable to cope (Mental Health Foundation, 2018). The prevalence of stress has a large impact on society. A review of the economic strain of stress and poor mental health has estimated a cost of between £74 billion and £99 billion per year to the UK economy (Stevenson/Farmer Review, 2017). Beyond the economic burden, it is also important to consider the detrimental effects stress has on both physical and psychological health.

### Stress and Health

Stress can have a negative impact on physical health. To put into context how damaging stress can be, research shows that psychological stress can increase the risk level for developing cardiovascular disease as much as smoking and physical inactivity (Rozanski, 2014). Psychological stress perturbs the cardiovascular system, typically causing increases in cardiovascular reactivity (Chida & Steptoe, 2010; Moore et al., 2012), which is associated with outcomes of cardiovascular disease (Ginty et al., 2017). Across the literature, increased stress levels have been a consistent marker for an increased risk of developing cardiovascular disease (Dimsdale, 2008; Ellins et al., 2008; Gianaros & Jennings, 2018). Stress has also been shown to perturb the immune system causing leukocytosis (Dhabar & McEwen, 1997), as well as result in slower wound healing and a reduced antibody response to vaccination (Ferguson et al., 1995). In addition, increased levels of perceived stress have been associated with an increased chance of developing cold symptoms (Cohen et al., 1991). Collectively this research demonstrates the impact stress has on the cardiovascular and immune systems as well as respiratory health.

Beyond worsening physical health, stress can also be detrimental to psychological health and wellbeing. Studies have shown that increased stress levels are linked to the development of mental health disorders including but not limited to depression, anxiety, and eating disorders (Auerbach et al., 2018; Morina et al., 2011; Schneidermann et al., 2005), with disorders such as depression being associated with an increased risk of all-cause mortality (Sullivan et al., 2012). As well as being linked to a diagnosis of depression, psychological stress has also been linked to developing depressive symptoms in non-diagnosed individuals (Brosschot et al., 2006). Whilst stress has been shown to have a negative impact on psychological health, stress has also been shown to impact health behaviours, with associations being uncovered between increased stress levels and substance abuse, which have been associated with a greater risk of developing bipolar disorders (Sussman & Arnett, 2014). Other research that has examined the impact of anxiety on health shows that trait anxiety is related to an increased risk of hypertension, heart disease and all-cause mortality (Chida & Steptoe, 2009; Denollet & Pedersen, 2009). Taken together, this research demonstrates that the physical and psychological impacts of stress are intertwined and not necessarily experienced in isolation.

Given the prevalence of stress in everyday life, and the impact that it has on physical and psychological health, it is crucial that individuals are equipped with ways to be able to cope with this stress. Described as the actions that one takes to manage the demands of the environment, coping is a method in which an individual can control their responses to a situation following its appraisal as stressful (Lazarus & Folkman, 1984). Research into coping has shown its importance in combating the negative effects of stressors experienced (Baker & Berenbaum, 2007; Chen et al., 2018; Crocker, 1992; Crocker et al., 1998; Ntoumanis & Biddle, 1998). Among the coping methods examined by the aforementioned research, two types of coping are more extant in the literature; problem-focused coping (i.e., attempting to act to alter the perceived stress by solving problems, Carver et al., 1989), and avoidant coping (i.e., mental and behavioural disengagement due to the perceived stress, Carver et al., 1989). Problem-focused coping has been associated with greater social support and improved well-being (Asberg et al., 2008; Chen et al., 2009; Sarid et al., 2004). On the other hand, avoidant coping has been described as using maladaptive behaviours to forget about the stress rather than combat it, characterised by attempting to sleep the stress away (Carver et al., 1989). Whilst problem-focused coping has shown positive associations with adaptive behaviours, it is a coping method that can only occur after one appraises a situation as stressful meaning it is a reactive coping method in which stress must occur before an individual can cope with the situation.

An alternative coping technique, called proactive coping, occurs prior to the initial appraisal of a stressful situation occurring (Aspinwall & Taylor, 1997), allowing an individual to begin subconsciously coping with the stress before this stress occurs. As proactive coping is future-oriented and coping methods such as problem-focused strategies are more reactive (Greenglass & Fiksenbaum, 2009), it can be suggested that proactive coping is the only method that allows an individual to both prevent stress occurring and minimise the intensity of stress. Therefore, it seems prudent that research examines coping methods which are more proactive in the way they deal with potentially stressful situations. Proactive coping occurs at the earliest stage of dealing with stress, therefore those who are better able to proactively cope may experience a reduction in the intensity of stress when a stressful event does occur (Hobfoll, 1989; Straud & McNaughton-Cassill, 2019), meaning proactive coping can not only be used to prevent stress occurring, but also minimise the intensity of stress experienced. Furthermore, individuals who are better at proactive coping typically having a greater tendency to appraise stressful situations as challenges and are less likely to appraise them as threats (Greenglass & Fiksenbaum, 2009). As a result, it can be suggested that an individual's appraisal of stress is crucial to whether they are able to deal with resulting responses to stressful situations.

**Appraisal States**

As discussed, stress can elicit psychophysiological responses that have a damaging impact on physical and mental health. However, it is not only how we cope with stress, but how we appraise it that can diminish the effect of stress or the responses it generates. Specifically, research has shown that altering one's appraisal of a stressful situation could diminish the negative responses experienced, such as increasing self-confidence and perceiving anxiety to be more facilitative (Williams et al., 2017). Two types of appraisal state – a challenge or a threat appraisal – can be described as responses to stress-evoking situations where an individual evaluates the external demands of the situation against their personal resources to cope (Blascovich, 2008; Jones et al., 2009). In the case of a challenge appraisal, this state is experienced by an individual when they perceive themselves to have sufficient (or nearly sufficient) resources to be able to meet the external demands (Blascovich, 2008; Jones et al., 2009). On the contrary, a threat appraisal is experienced when an individual perceives themselves to not have sufficient resources to meet external demands of the situation (Blascovich, 2008 Jones et al., 2009). It is proposed that the appraisal of stress occurs before the physiological and psychological responses to that stress-evoking situation (Blascovich, 2008), meaning that the appraisal state will trigger the subsequent psychophysiological responses experienced relevant to that state.

The theory of challenge and threat states in athletes (TCTSA; Jones et al., 2009) was developed to build on and amalgamate existing challenge and threat theories, in part to explain factors likely to influence a challenge or threat state. The TCTSA suggests that self-efficacy, perceived control, and a focus on approach or avoidance goals act as three antecedents that determine whether individuals believe they can cope with a stress-evoking situation (Jones et al., 2009).Recently, this model was revised and updated, to more comprehensively focus on three aspects; physiological changes, predispositions, and cognitive appraisal (TCTSA-R, Meijen et al., 2020). Stressors and underlying appraisals evoke physiological changes, and it is proposed that the changes in physiological activity relate to whether an individual enters a challenge or threat state. The revised model also incorporates updates to the original theory by including trait challenge and threat, whereby predisposed appraisal types are associated with resulting appraisal states (Meijen et al., 2020). By recognising that challenge and threat states are fluid, the updated TCTSA-R model provides a more in-depth examination of the cognitive processes that occur prior to performance when compared to its predecessor.

Research on appraisal states and responses to stress found that a challenge appraisal was more closely associated with more facilitative interpretations of stress, compared to a threat appraisal which was more closely associated with debilitative interpretations of stress (Jones et al., 2009). As a result of interpreting stress as more facilitative, individuals have displayed lower perceived stress levels (Crum et al., 2013). Other research has shown that increased tendencies to appraise situations as threats can result in increased feelings of anxiety (Jones et al., 2009; Mallorqui-Bague et al., 2016). While challenge appraisal tendencies have been associated with more facilitative interpretations of anxiety and greater self-confidence (Jones et al., 2009; Thomas et al., 2007; Skinner & Brewer, 2004; Swain & Jones, 1996), with threat appraisals linked to lower self-confidence and viewing anxiety as more debilitative (Williams et al., 2010). However, as well as evoking psychological responses to stress, an increased tendency to appraise situations as a challenge has also been associated with a greater stroke volume and greater heart rate in comparison to a threat appraisal which was related to increased vasoconstriction (Blascovich & Mendes, 2000). Using cardiovascular reactivity as an indicator for a challenge or a threat state, research has shown that increased reactivity, indicating a challenge state, predicted greater cognitive and motor performance compared to a threat state indicated by decreased reactivity (Turner et al., 2012). The aforementioned studies demonstrate that appraisal states can not only have an influence on the intensity of stress and anxiety experienced, and on how stress and anxiety is interpreted but also on cardiovascular responses to stress.

In terms of how appraisals influence one's coping with stress, threat appraisal tendencies have been linked to more maladaptive coping, in comparison to a challenge appraisal which is associated with more adaptive coping (Blascovich & Mendes, 2000; Jones et al., 2009; Trotman et al., 2019). Given the evidence to suggest appraising situations as a challenge will have greater benefits for stress, anxiety and coping, it is important that research establishes dispositions associated with more adaptive appraisal states to result in lower stress and more proactive coping.

**Imagery**

Imagery, described as the process whereby an individual internally creates different thoughts and feelings (Cumming & Williams, 2012), is one such technique that could be used to alter one's stress appraisal tendencies. Imagery scripts – descriptions to guide the user in what and how to image the scenario – have been used to elicit different appraisal states within individuals in order to manipulate resultant stress responses. For example, imagery scripts describing feelings of confidence and of being in control resulted in increased self-efficacy and decreased perceived stress (Jones et al., 2002). Using imagery scripts with anxiety symptoms but with feelings of confidence and of being in control, imagery use can result in the anxiety symptoms being perceived as more facilitative for performance (Cumming et al., 2007; Williams et al., 2010; Williams et al., 2012a). In contrast, imaging anxiety symptoms and an increased heart rate but without confidence or feeling in control, can lead to increased threat perceptions and debilitative interpretations of anxiety (Cumming et al., 2007; Williams et al., 2010; Williams et al., 2012a).

More recently, a within-subject design study showed that following an imagery script emphasising thoughts and feelings associated with a threat, participants reported feeling more threatened during a speech preparation task and experienced responses more in line with a threat appraisal (i.e., more debilitative anxiety, lower confidence) and higher heart rate compared to a speech preparation following an imagery script emphasising thoughts and feelings associated with a challenge (Williams et al., 2017). Collectively, these studies show that imagery can be used to influence appraisal states and subsequently induce changes in the intensity and interpretation of psychophysiological responses to stress.

Aside from imagery use, imagery ability has been shown to be a disposition associated with stress appraisals and resultant responses from these appraisals. Imagery ability can be defined as “an individual’s capability to form vivid and controllable images, and retain them for sufficient time to effect the desired imagery rehearsal” (Morris, 1997, p. 37). Imagery ability naturally differs between individuals and can be influenced by the content being imaged (Williams & Cumming, 2011). For example, displaying a higher ability to image content associated with performing movement does not mean the individual will be able to image themselves coping in a stress evoking situation just as easily or vice versa. Importantly, imagery ability is a modifiable disposition that can be improved with practice and other techniques (Cumming & Williams, 2012, pp. 213). This is important given the more adaptive constructs that greater imagery ability seems to be related to.

Specific to stress related constructs, mastery imagery ability – described as the capability of an individual to image mastering challenging situations (e.g., staying positive after a setback) – seems to be of particular importance (Williams & Cumming, 2012b). Initial research in this area was conducted in a sport setting using athlete samples, with studies showing that those with a greater mastery imagery ability displayed greater challenge appraisal tendencies of stress as well as interpreted anxiety as more facilitative (Williams & Cumming, 2012b; 2015), whilst other research has shown that individuals are less likely to have debilitating perceptions of anxiety symptoms (Quinton et al., 2019). More recently, research has examined these relationships in samples of mixed athlete and non-athlete student populations, showing greater mastery imagery ability to be associated with lower levels of perceived stress (Beevor et al., under review; Möller, 2019) as well as lower levels of trait anxiety, and lower and more positive interpretations of state cognitive anxiety (Möller, 2019). Similarly, a recent study showed associations between greater mastery imagery ability and more facilitative interpretations of anxiety as well as mastery imagery ability relating to greater performance in stressful situations (Williams et al., 2021).

Aside from examining relationships between mastery imagery ability and stress responses, research has also examined the relationship between mastery imagery ability and appraisal states. Quinton and colleagues (2018) established associations between greater mastery imagery ability, and an increased tendency to appraise stressful situations as a challenge. However, research has found no direct association between increased mastery imagery ability and decreased threat appraisals – with self-confidence acting to facilitate the relationship between these variables (Williams & Cumming, 2012b). These studies suggest that perceiving situations as a challenge does not mean they are perceived as less of a threat (Quinton et al., 2018; Williams & Cumming, 2012b).

Given the inconsistencies in the literature regarding the relationships between challenge and threat appraisals and imagery, it is crucial that research fully explores the different roles that each appraisal state may play in the relationships between imagery ability and stress responses. In addition, research has primarily examined these relationships using athlete specific samples. Given research has demonstrated that athletes can differ to non-athlete samples in dispositions and coping (Mansell, 2021; Calmeiro et al., 2014) it can be theorised that such differences could be present between athletes and non-athletes in mastery imagery ability and appraisal tendencies. As such, it is important that research also examines these relationships among the general population in order to extend our knowledge in this area as well as increase the generalisability of findings. Furthermore, given that research shows imagery ability to be a modifiable disposition (Möller, 2019; Williams & Cumming, 2011; Williams et al., 2013), and higher mastery imagery ability appears to be related to more adaptive responses to stress (Williams et al., 2021), it is important that research examines and establishes ways to improve mastery imagery ability and examines the subsequent effects this has on stress and coping.

**Imagery Interventions**

Previous research has shown that imagery is like a physical skill in that it can be improved with practice (Calmels et al., 2004; Robin et al., 2007; Williams et al., 2013)**.** Initial research using practice methods to improve movement imagery ability (i.e., the internal creation and representation of movements; Guillot & Collet, 2005) showed that imagery practice was effective at increasing movement imagery ability (Cumming & Ste-Marie, 2001; Rodgers et al., 1991). Underlining the importance of such interventions, imagery practice has been shown to improve the capacity of an individual when imaging various scenarios (Calmels et al., 2004; Cumming & Ste-Marie, 2001).

However, more recent research has established to other techniques to bring about greater or more immediate improvements in imagery ability than that achieved through imagery practice alone. One such method is to combine imagery practice and action observation (internal representation of observed movements, Eaves et al., 2016), finding that in isolation both of these experimental groups experienced improvements in skill and strategy imagery ability compared to a control group (Williams, 2019). However, as those in the action observation group experienced spontaneous imagery, it can be suggested that imagery and action observation being used in conjunction may be more effective than using imagery practice in isolation (Eaves et al., 2016; Williams, 2019). Another method is incorporating the 7-elements of the PETTLEP model (for more details see Holmes & Collins, 2001) into the imagery to bring about instantaneous improvements in imagery ability as an alternative to physical practice (Anuar, Cumming, & Williams, 2016). While these two approaches are very effective for improving the ability to image more movement-based content, imagery training using a layered approach seems to be an effective way to improve different types of content beyond just movements (Cumming & Williams, 2012). One such approach is called Layered Stimulus Response Training (LSRT; Cumming et al., 2016).

Layered Stimulus Response Training is a training method that can be used to improve one's imagery ability using a layering approach. Based upon bioinformational theory (Lang, 1977), an image is considered to be made up of three different propositions; (1) stimulus propositions (physical details of the imaged situation; e.g., location, audio), (2) response propositions (the individuals' verbal, movement and physiological responses to the stimulus; e.g., increased heart rate), and (3) meaning propositions (the interpretation of the relationship between the stimulus and response propositions; e.g., fear vs excitement). These different propositions are gradually added into the imagery during the LSRT which includes three separate imagery phases; (1) image, (2) reflect and (3) develop (Cumming et al., 2016). To start with, the individual images the relevant content, then starts reflecting on the imagery and develops this by discussing it with the researcher before adding necessary details. Across the duration of the session, each phase of imagery is repeated numerous times in order to develop the imagery in layers, and gradually increase imagery capacity (Cumming et al., 2016).

Although a relatively new technique for improving imagery ability, previous research using LSRT has supported its effectiveness. The first study examined LSRT's capacity to improve movement imagery ability and the subsequent effect this had on golf putting performance. Participants using LSRT group were able to increase their skill imagery ability, with LSRT being shown to be an effective technique in initiating improvements in complex movement images when compared to standard imagery practice (Williams et al., 2013). As a result, those in the LSRT group experienced increases in their golf putting performance, showing that increasing imagery ability can have a positive effect on outcomes associated with better imagery ability. A second study used LSRT in a group of insufficiently active women to improve imagery ability of experiencing the positive feelings and sensations associated with going for a brisk walk. The results demonstrated that participants who completed one session of LSRT reported significantly higher ease of imaging scores, suggesting that LSRT has beneficial effects for improving imagery ability even after just one session (Weibull et al., 2015). This research shows that LSRT is a more effective technique to use to improve imagery ability in comparison to more traditional methods of improving imagery ability (Williams et al., 2013; Weibull et al., 2015)

Applying the bioinformational theory (Lang, 1979), physiological and psychological changes reported in LSRT research such as those observed by Weibull and colleagues (2015) can be explained based upon the concept of meaning propositions. Through using LSRT, the meaning propositions can be adapted and strengthened, thereby altering an individual's interpretation of specific stimulus and response propositions, changing debilitative interpretations to facilitative interpretations. For instance, by manipulating the meaning propositions by getting the insufficiently active women to view walking more positively, this research shows how LSRT can be used to alter one's interpretation of a situation, and the responses typically experienced (Weibull et al., 2015).

It could be suggested that applying the same principles of LSRT to a stress-evoking situation could result in similarly changing the meaning propositions to result in a more positive appraisal of the situation. For example, confronted with an exam scenario, an individual may image themselves being in an exam hall (i.e., stimulus propositions) and experiencing an increased heart rate and butterflies in the stomach (i.e., response propositions). The LSRT could then be used to change the meaning propositions of these responses to enable the individual to associate these feelings of increased heart rate and butterflies in the stomach as being indicators that they are switched on and ready to perform well rather than feeling afraid. They may also be able to layer in additional feelings such as feeling confident. However, despite research demonstrating that improving imagery ability can have an impact on real-world performance as well as showing LSRT can manipulate the meaning propositions of activities, research has yet to sufficiently examine the effectiveness of LSRT to improve mastery imagery ability and alter appraisal tendencies.

That being said, one such study that has examined the impact of a 2-week mastery imagery LSRT intervention on responses to potentially stressful situations used a mixed athlete and non-athlete, student sample to assess the intervention's impact on anxiety and perceived stress (Möller, 2019). Results showed that a mastery imagery LSRT intervention consisting of four sessions seemed to be effective at improving the mastery imagery ability, decreasing general anxiety, and increasing self-confidence and causing participants to have a more facilitative perception of cognitive anxiety during an acute psychological stress task. By comparison, a control group experienced no changes in these variables, suggesting that a mastery imagery LSRT intervention was effective at regulating responses to stress. However, the sample used was female, limiting the generalisability of findings, and the study investigated responses to acute stress rather than general levels of stress and appraisal tendencies, as well as one's ability to cope with stress.

Given the negative effects of stress on physical and mental health (Schneidermann et al., 2005), and increased challenge appraisals have been associated with more adaptive stress responses (Jones et al., 2009; Trotman et al., 2018), it is important that research examines if improving mastery imagery ability using LSRT is also able to positively impact stress appraisals and coping with stress. As mastery imagery ability is a modifiable disposition (Williams & Cumming, 2011), it can be improved with practice, and if found to have a positive effect on stress and coping, it has the potential to be a cost-effective way to elicit challenge appraisals thus helping different populations better appraise and cope with stress experienced in day to day life.

Based upon the aforementioned gaps in the literature, the present thesis aimed to examine the associations between mastery imagery ability, stress appraisals, and perceived stress, and coping with stress, as well as examine the effect of increasing mastery imagery ability on these variables. This was done by conducting three studies which are presented in Chapter 2 and Chapter 3 of this thesis. Using a cross-sectional questionnaire design, the first study explored the mediating role that stress appraisal (i.e., challenge and threat) tendencies have on the relationships between mastery imagery ability and perceived stress and proactive coping (Chapter 2). The second study (also Chapter 2), aimed to replicate the findings of study one in order to test the rigour of such findings between samples from the United Kingdom and United States. The third study (Chapter 3) furthered the work of Chapter 2 and employed an experimental design to conduct a pilot study examining the effectiveness of a 2-week LSRT intervention to improve mastery imagery ability and any associated changes in appraisal tendencies, perceived stress, and proactive coping. The aims and hypotheses of each study are addressed in the subsequent chapters.

# Chapter Two

## Examining the Mediating Role of Challenge and Threat Appraisal Tendencies on the Relationships Between Mastery Imagery Ability, Perceived Stress and Proactive Coping

A copy of Chapter 2 will be submitted for publication at *Anxiety, Stress and Coping*

**Examining the Mediating Role of Challenge and Threat Appraisal Tendencies on the Relationships Between Mastery Imagery Ability, Perceived Stress and Proactive Coping**

Psychological stress has become increasingly prevalent in modern life and can have a detrimental effect on health and wellbeing (Chida & Steptoe, 2010; Moore et al., 2012). Evidence suggests that greater perceived psychological stress is a risk factor for developing mental health problems such as increased anxiety (Racic et al., 2017) and depression (Morina et al., 2011). As well as this, studies have shown that higher perceived stress is associated with poorer executive function (Korten et al., 2017). Given the negative effects of perceived stress on mental and physical health (Schneiderman et al., 2005), it is crucial to identify traits and dispositions which are associated with lower levels of perceived stress or more proactive ways of coping with stress.

One technique which has been used to regulate stress is imagery, a disposition where one would internally create thoughts and feelings (Cumming & Williams, 2012, pp. 213). Imagery use is an established technique to regulate stress by reducing stress and anxiety experienced or reducing the debilitative interpretation of these responses (Charalambous et al., 2015; Cumming et al., 2007; Williams et al., 2017). Beyond using imagery, research has demonstrated that imagery ability (i.e., “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), may be important in stress regulation, even in the absence of imagery use.

Specifically, mastery imagery ability, described as the ease at which one can image mastering challenging or difficult situations (e.g., imaging remaining confident during a sporting situation; Quinton et al., 2019), has been shown to protect against the negative effects of stress and be associated with individuals perceiving greater control over stress (Quinton et al., 2019). Higher mastery imagery ability has been associated with: greater challenge appraisal tendency (Quinton et al., 2018; Williams & Cumming, 2012b), lower threat appraisal tendency (Williams & Cumming, 2012b) and lower levels and more positive interpretations of general anxiety (Williams & Cumming, 2015). However, the aforementioned studies have used athlete populations to examine anxiety and stress appraisals in relation to sport specific contexts. More recent research has looked at mastery imagery ability in non-athlete populations and how it relates to appraisals and responses to stress in a non-sport setting. Two studies conducted in young adult populations, one in the United States and one in the United Kingdom, demonstrated that higher levels of mastery imagery ability were associated with lower levels of perceived stress (Beevor et al., under review; Möller, 2019). However, research has yet to examine the potential mechanisms underlying the relationship between higher levels of mastery imagery ability and lower levels of perceived stress.

One such factor which could explain the relationship between mastery imagery ability and perceived stress is how the stress is appraised. Two common types of appraisal tendencies are challenge and threat appraisals (Jones et al., 2009). Challenge and threat can be described as "emotional, cognitive and physiological states…that involve positive and negative feelings and emotions" (Blascovich & Mendes, 2000, p. 60), with threat states identified as those in which maladaptive coping tendencies are predominant whereas challenge states are identified as those where adaptive coping methods are utilised (Jones et al., 2009). Challenge appraisals are experienced when individuals feel efficacious and in control of stressful situations, and have a focus on approach goals (Jones et al., 2009). Given that those with a higher mastery imagery ability are more easily able to image content such as remaining confident when faced with difficult situations, these individuals are more likely to feel that they possess the resources to meet the demands of stress-evoking situations and are therefore more likely to appraise stressful situations as a challenge rather than as a threat. In support of this idea, research has shown that athletes with higher mastery imagery ability are more likely to appraise stressful situations in their sport as a challenge appraisal and less likely to appraise them as a threat (Quinton et al., 2018; Williams & Cumming, 2011; Williams & Cumming, 2012b). It can be suggested that a similar relationship may exist in non-athletes and their appraisal of stress encountered in non-sport settings.

Greater challenge appraisals of stress have been linked to interpreting stress as more facilitative (Jones et al., 2009), and those that view stress as more facilitative report lower perceived stress levels (Crum et al., 2013). Only those who perceive stress as more facilitative have displayed lower perceived stress levels (Crum et al., 2013), with more debilitative perceptions of stress associated with greater threat appraisal tendencies (Jones et al., 2009). Therefore, it could be argued that those who perceive stress as more of a threat are likely to display higher perceived stress levels. However, the associations between challenge and threat appraisal tendencies and perceived stress have not been fully investigated. Should challenge and threat appraisal be related to perceived stress as expected, it can be theorised that challenge and threat appraisals of stress may mediate the relationship between mastery imagery ability and perceived stress.

Whilst research has examined to some extent how mastery imagery ability relates to stress levels and stress appraisals, research has yet to examine whether mastery imagery ability relates to how individuals cope with stress, despite the likely association. One such method for coping with stress is proactive coping, which involves efforts carried out ahead of a potentially stress-evoking event either to prevent it occurring or to modify its form before it occurs (Aspinwall & Taylor, 1997). As both mastery imagery and proactive coping are typified by feeling in control and confident of possible stress-evoking situations (Greenglass & Fiksenbaum, 2009; Quinton et al., 2019), it could be suggested that being able to image oneself coping with difficult and challenging situations could lead to more adaptive behaviours, such as proactive coping, when confronted with difficult situations in reality.

Individuals who have a greater ability to proactively cope will perceive demanding situations as challenges rather than as threats, with proactive coping something that an individual can take part in prior to the stress occurring (Greenglass & Fiksenbaum, 2009). As proactive coping takes place following the appraisal of stress, challenge and threat appraisal tendencies could play a key role in an individual's tendency to proactively cope. As increased mastery imagery ability has been linked with more challenge appraisal states and lower threat appraisal states (Quinton et al., 2018; Williams & Cumming, 2011, Williams & Cumming, 2012b), it could be suggested that challenge and threat appraisal tendencies could mediate the relationship between mastery imagery ability and proactive coping, but research has yet to examine this.

The potential importance of investigating these relationships should not be understated. Evidencing associations between mastery imagery ability, challenge and threat appraisals, and perceived stress would help us understand and identify important dispositions related to lower levels of perceived stress and stronger predictors of perceived stress. Establishing relationships between mastery imagery ability, challenge and threat appraisal, and proactive coping would similarly help us understand the potential impact of mastery imagery ability, and challenge and threat appraisals on the variance of proactive coping. As perceived stress has been shown to result in poorer health (Korten et al., 2017), and proactive coping is associated with better perceived stress (Greenglass & Fiksenbaum, 2009), examining these relationships between mastery imagery ability, stress appraisals, and perceived stress and proactive coping could also identify potential underlying factors thought to contribute to better or poorer psychological and physical health. Only once these relationships are established can researchers and applied practitioners look to intervene and target variables thought to lead to better coping and lower levels of stress.

Therefore, this two-study chapter aimed to examine the associations between mastery imagery ability, challenge and threat appraisal states, and perceived stress and proactive coping, and investigate whether challenge and threat appraisal tendencies mediated the relationship between mastery imagery ability and perceived stress and proactive coping.

## Study 1

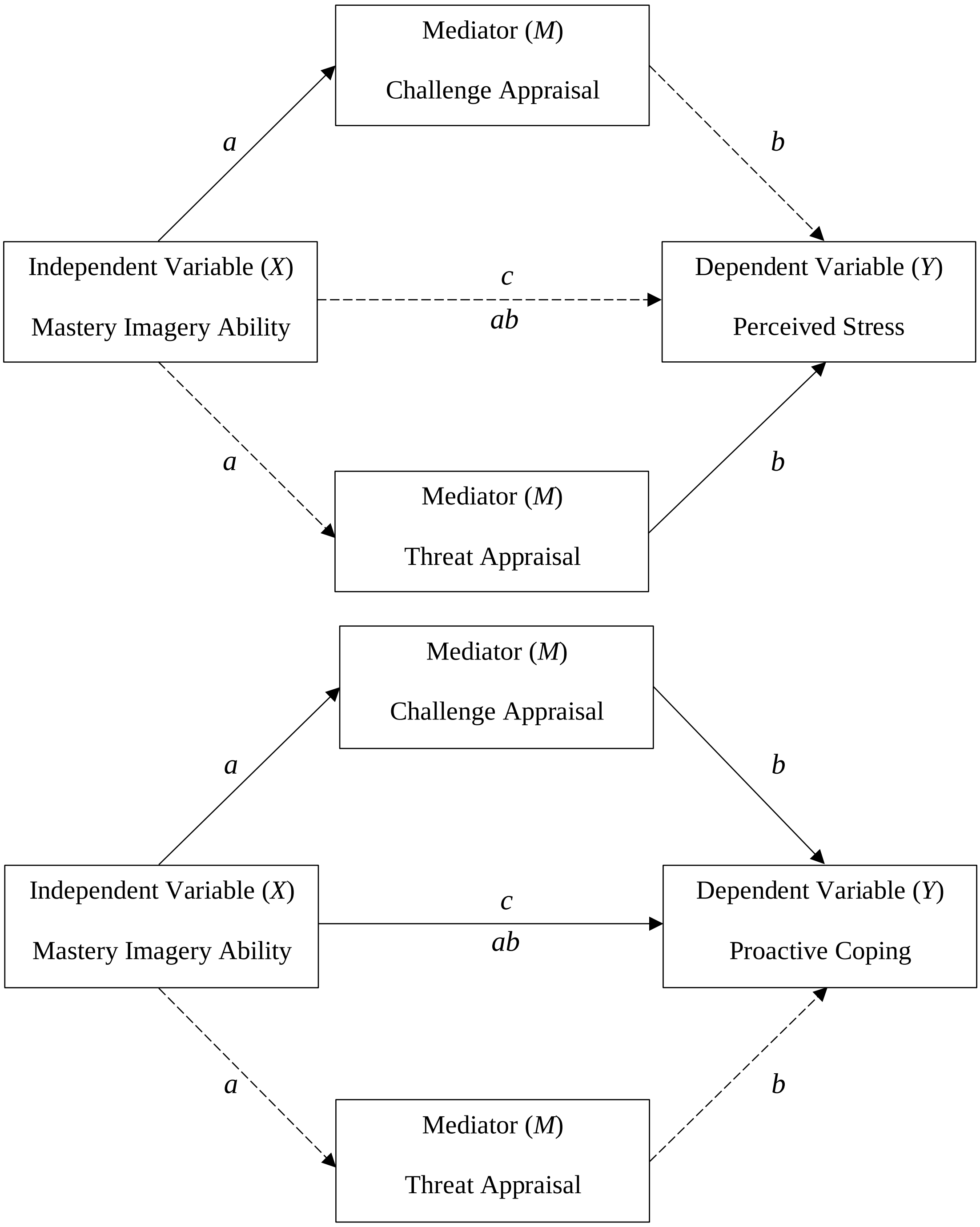
### Aims and Hypotheses

The first aim of Study 1 was to replicate previous research that has identified a relationship between mastery imagery ability and perceived stress and extend this by examining whether this relationship was mediated by challenge and threat appraisal tendencies. Using a UK based student sample, the study investigated whether challenge and threat appraisal tendencies mediated the relationship between mastery imagery ability and perceived stress. The second aim of Study 1 was to investigate whether mastery imagery ability was associated with more proactive coping, and whether this relationship was also mediated through challenge and threat appraisal tendencies. Consequently, two separate mediation models were tested, one with perceived stress as the outcome and one with proactive coping as the outcome.

It was hypothesised that higher mastery imagery ability would be associated with lower levels of perceived stress and greater levels of proactive coping. Furthermore, due to the role that stress appraisal likely has on levels of perceived stress and how individuals cope with the stress, it was hypothesised that the relationship between mastery imagery ability and both perceived stress and proactive coping would be mediated by challenge and threat appraisal tendencies. Specifically, it was predicted that greater mastery imagery ability would be associated with greater challenge appraisal and lower threat appraisal tendencies. Challenge appraisal tendencies were predicted to be negatively associated with perceived stress and positively associated with proactive coping while the opposite was predicted for threat appraisal tendencies. These hypotheses are displayed in Figure 1.

**Figure 1**

*Simple mediation models examining whether challenge and threat appraisals mediated the relationship between mastery imagery ability and perceived stress (top) and proactive coping (bottom)*




*Note.* Solid line between variables indicates hypothesised positive prediction. Dashed line between variables indicates hypothesised negative prediction.

## Methods

### Participants

One hundred and forty-eight participants were recruited for Study 1, aged between 18 and 35 ($M$ = 22.52, $SD$ = 4.36), of which 45 participants were male and 103 participants were female. Of the 148 participants, 104 regularly played sport (62% team sport, 23% individual sport, 15% both team and individual sport) while the other 44 participants did not play a sport. Participants were recruited via email, with emails targeting all areas of the general population, such as to sports clubs, university sports teams, non-sporting societies, large member organisations and other local community clubs from within the UK. If participants were University of Birmingham students they received 1 hr of class research credit for participation in the study. In order to meet the inclusion criteria, individuals had to be between the ages of 18 and 35, be able to read and speak English proficiently, and have no self-reported diagnosed mental health condition at the time of data collection. This study was approved by the University of Birmingham ethics committee and all participants provided informed consent before partaking in the study.

### Measures

**Mastery imagery ability.** The 15-item Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) was used to assess mastery imagery ability. Of the 15-items within the questionnaire, three items specifically assess mastery imagery ability. Participants are asked to image each of the following three items in relation to the sport they play: “Giving 100% effort even when things are not going well”, “Staying positive after a setback” and “Remaining confident in a difficult situation”. Participants who did not play a sport were asked to image the sport they most recently played. Ratings for each image are made using a 7-point Likert-type scale ranging from 1 (*very hard to image*) to 7 (*very easy to image*). Scores for the three mastery imagery items are then averaged to provide an individual’s mastery imagery ability with a higher score reflecting a better ability to image. The SIAQ has been shown to possess good internal reliability and validity (Williams & Cumming, 2011), with the internal reliability of the scale shown to be a good level in the present study (Cronbach's $\alpha$ = .71). The SIAQ has demonstrated good validity and reliability when previously used in non-athlete populations (Beevor et al., under review).

**Challenge and threat appraisal tendencies.** An individual's tendency to appraise situations as a challenge or as a threat was assessed using the 18-item Cognitive Appraisal Scale (CAS; Skinner & Brewer, 2002). Individuals were asked to indicate their level of agreement with a number of statements in relation to a meaningful situation. Threat appraisal was measured using 10 items (e.g., "I worry that I will say or do the wrong things"), with the other eight items measuring challenge appraisal (e.g., "A challenging situation motivates me to increase my efforts"). Responses for each statement were made on a 6-point Likert-type scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). For each subscale, an average score was calculated, providing participants with a separate threat appraisal score and a challenge appraisal score. For both subscales, a higher score indicated a greater tendency to appraise situations as a challenge or as a threat, relative to each subscale. The CAS is a valid and reliable measure of challenge and threat appraisal tendencies (Skinner & Brewer, 2002), with both the threat and challenge subscales demonstrating a good level of internal reliability in the present study (Cronbach's $\alpha$ = .93 and .76, respectively).

**Perceived stress.** The Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983) was used to assess an individual's perceived stress levels. The PSS is a 10-item questionnaire that asks participants about their thoughts and feelings related to stress experienced over the past month (e.g., "How often have you been able to control irritations in your life?"). Responses to each item are made on a 5-point Likert-type scale from 0 (*never*) to 4 (*very often*). First, the positively worded items are reversed scored before all responses are added together to provide a total perceived stress score whereby a higher score indicates a greater amount of perceived stress. The Perceived Stress Scale has been shown to be a valid measure of stress and has adequate reliability (Cohen, Kamarck, & Mermelstein, 1983), with the internal reliability showing the scale to be comfortably above the 0.7 cut-off in the present study (Cronbach's $\alpha$ = .89).

**Proactive coping.** To measure participant's proactive coping, the Proactive Coping Inventory (PCI; Greenglass et al., 1999) was used. Using the proactive coping subscale of the PCI, participants are presented with 14 statements (e.g., "I am a take charge person") and are asked to indicate how true each of these statements are by responding to each on a 4-point Likert-type scale ranging from 1 (*not at all true*) to 4 (*completely true*). Three of the 14 statements are reversed scored, before scores are totalled so that a higher total score reflects a greater tendency to proactively cope. The 'Proactive Coping Scale' of the Proactive Coping Inventory has been shown to have good validity and acceptable reliability as a measure of proactive coping (Greenglass et al., 1999). In the present study, the internal reliability of this scale was shown to be slightly lower than the ideal 0.7 cut-off (Cronbach's $\alpha$ = .67).

**Procedure**

After being contacted via email, interested participants read the information sheet. Participants were advised of their right to withdraw from the study at any time within two weeks of completing the questionnaire pack and that, should they choose to withdraw, their data will be removed from the study and destroyed. They were also given the opportunity to ask any questions about the study. Those willing to take part clicked the link to an electronic consent form and the questionnaire pack provided via the online platform SmartSurvey. The questionnaire pack included items to obtain demographic information and measured mastery imagery ability, perceived stress, proactive coping, and challenge and threat appraisals using measured described above. The questionnaire pack took approximately 20 to 30 minutes to complete. Data collection for Sample 1 started in November 2020 and stopped at the end of January 2021.

**Data Analysis**

Data were first downloaded into a Microsoft Excel file to be organised and then exported into SPSS (IBM SPSS Version 24.0), before being screened for missing data and outliers. No data were observed to be missing, but a few moderate outliers (data points 1.5 standard deviations removed from the mean; mastery imagery ability = 3 outliers, challenge appraisal = 1 outlier, perceived stress = 3 outliers, proactive coping = 1 outlier) were identified within the data set. Initial data analysis was run with the outliers removed, however as the removal of identified outliers did not impact the significance of the results, identified outliers were retained for the analysis.

Correlation analyses were carried out between mastery imagery ability, challenge appraisal, threat appraisal, perceived stress, and proactive coping to establish where relationships existed between the different variables. Next, one-way ANOVAs were conducted to assess any differences in mastery imagery ability, challenge appraisal, threat appraisal, perceived stress, and proactive coping between gender, and one-way ANOVAs controlling for gender examined whether there were any differences in these same variables between those who played sport and those who did not. Partial eta squared was the effect size reported for all ANOVAs and any differences between different genders and/or those who played sport and those who did not resulted in that particular variable being controlled for in the mediation analyses.

To test the hypothesised models, two independent mediation analyses were conducted using the PROCESS SPSS add-on (Hayes, 2017) with a bootstrap of 95% bias-corrected confidence intervals (CIs) of 5000 samples being used. Both mediation analyses were conducted in line with the simple mediation model proposed by Hayes (2009). As Figure 1 depicts, *X* (the predictor) exerts an effect on *M* (the mediator), with *a* representing this relationship, whilst *M* predicts *Y* (the outcome variable) with *b* representing this relationship. Finally, *c* represents the effect of *X* on *Y*. The model therefore represents both a total effect of *X* on *Y* (i.e., *c*), and an indirect effect of *X* on *Y*, via the mediator (represented by *ab*). The indirect effect of *X* on *Y* differs dependent upon *X*'s relationship with *M*. As displayed in Figure 1, in the present study, mastery imagery ability was the independent variable (*X*), challenge and threat appraisal were the two mediators (*M*), and the dependent variable (*Y*) was either perceived stress or proactive coping. In other terms, the analysis examined the extent to which the relationship between mastery imagery ability and perceived stress, and the relationship between mastery imagery ability and proactive coping were mediated by challenge and threat appraisal tendencies, and whether any indirect effects (*ab*) of mastery imagery ability on either perceived stress or proactive coping occurred via challenge appraisal, threat appraisal, or both. The critical alpha level for all mediation analyses was set at .05 with standardised beta coefficients reported for all regressions.

## Results

### Correlation Analyses

Table 1 displays the Pearson's bivariate correlations that examined the relationships between mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, and proactive coping. Mastery imagery ability significantly positively correlated with challenge appraisal tendency and proactive coping, and significantly negatively correlated with threat appraisal tendency and perceived stress. Challenge appraisal tendency was significantly positively correlated with proactive coping, and significantly negatively correlated with threat appraisal tendency and perceived stress, the latter of which significantly positively correlated with threat appraisal tendency. However, no significant correlation was observed between threat appraisal tendency and proactive coping. Proactive coping significantly negatively correlated with perceived stress.

**Table 1**

*Pearson's bivariate correlations between mastery imagery ability, challenge and threat appraisal, perceived stress, and proactive coping*

| | Mastery Imagery Ability | Challenge Appraisal | Threat Appraisal | Perceived Stress |
|---|---|---|---|---|
| Challenge Appraisal | .662** | -- | -- | -- |
| Threat Appraisal | -.430** | -.440** | -- | -- |
| Perceived Stress | -.374** | -.405** | .525** | -- |
| Proactive Coping | .467** | .608** | -.144 | -.238* |

*Note.* * $p < .05$, ** $p < .001$.

**Participant Characteristics and Gender and Sport Type Differences**

Table 2 displays the means and standard deviations of mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, and proactive coping separately for males and females. One-way ANOVAs showed that compared to females, males reported significantly higher mastery imagery ability ($F[1, 147] = 12.853$, $p < .001$, $\eta_p^2 = .081$) and challenge appraisal ($F[1, 144] = 8.587$, $p = .004$, $\eta_p^2 = .057$), and significantly lower threat appraisal ($F[1, 144] = 14.418$, $p < 0.001$, $\eta_p^2 = .092$) and perceived stress ($F[1, 145] = 4.313$, $p = .040$, $\eta_p^2 = .029$). However, there were no observed gender difference for proactive coping ($F(1, 147) = 0.074$, $p = .786$, $\eta_p^2 < .001$).

**Table 2**

*Male and female means and standard deviations of mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, and proactive coping*

| | Gender | | | |
|---|---|---|---|---|
| | Males | | Females | |
| | M | SD | M | SD |
| Mastery Imagery Ability (1-7) | 5.12** | 1.08 | 4.39 | 1.05 |
| Challenge Appraisal (1-6) | 4.66* | 0.57 | 4.34 | 0.63 |
| Threat Appraisal (1-6) | 3.38** | 1.09 | 4.10 | 1.02 |
| Perceived Stress (0-40) | 17.51* | 5.72 | 20.41 | 7.13 |
| Proactive Coping (14-56) | 39.18 | 5.06 | 38.93 | 4.43 |

*Note.* * $p < .05$, ** $p < .001$, significantly different to females. Numbers within ( ) indicates possible total score for each scale.

As reported in Table 3, results of the one-way ANCOVAs showed there were no differences in mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, or proactive coping due to playing or not playing a sport when controlling for gender ($p$'s > .05, $\eta_p^2 < .03$). Results of the one-way ANOVAs and ANCOVAs resulted in gender being controlled for in the subsequent mediation analyses.

**Table 3**

*Athlete and non-athlete means and standard deviations for mastery imagery ability, challenge appraisal, threat appraisal, perceived stress and proactive coping, and results of one-way ANCOVAs controlling for gender*

| | Athletes (n = 104) | | Non-athletes (n = 44) | | |
|---|---|---|---|---|---|
| | M | SD | M | SD | Analysis Summary |
| Mastery Imagery Ability (1-7) | 4.72 | 1.09 | 4.36 | 1.12 | $F(1, 147) = 1.569$, $p = .212$, $\eta_p^2 = .011$ |
| Challenge Appraisal (1-6) | 4.44 | 0.64 | 4.43 | 0.62 | $F(1, 144) = .200$, $p = .655$, $\eta_p^2 = .001$ |
| Threat Appraisal (1-6) | 3.87 | 1.03 | 3.93 | 1.23 | $F(1, 144) = .085$, $p = .772$, $\eta_p^2 = .001$ |
| Perceived Stress (0-40) | 18.82 | 6.63 | 21.25 | 7.18 | $F(1, 145) = 2.685$, $p = .103$, $\eta_p^2 = .018$ |
| Proactive Coping (14-56) | 39.05 | 4.54 | 38.91 | 4.83 | $F(1, 147) = .014$, $p = .907$, $\eta_p^2 < .001$ |

*Note.* Numbers within ( ) indicates possible total score for each scale.

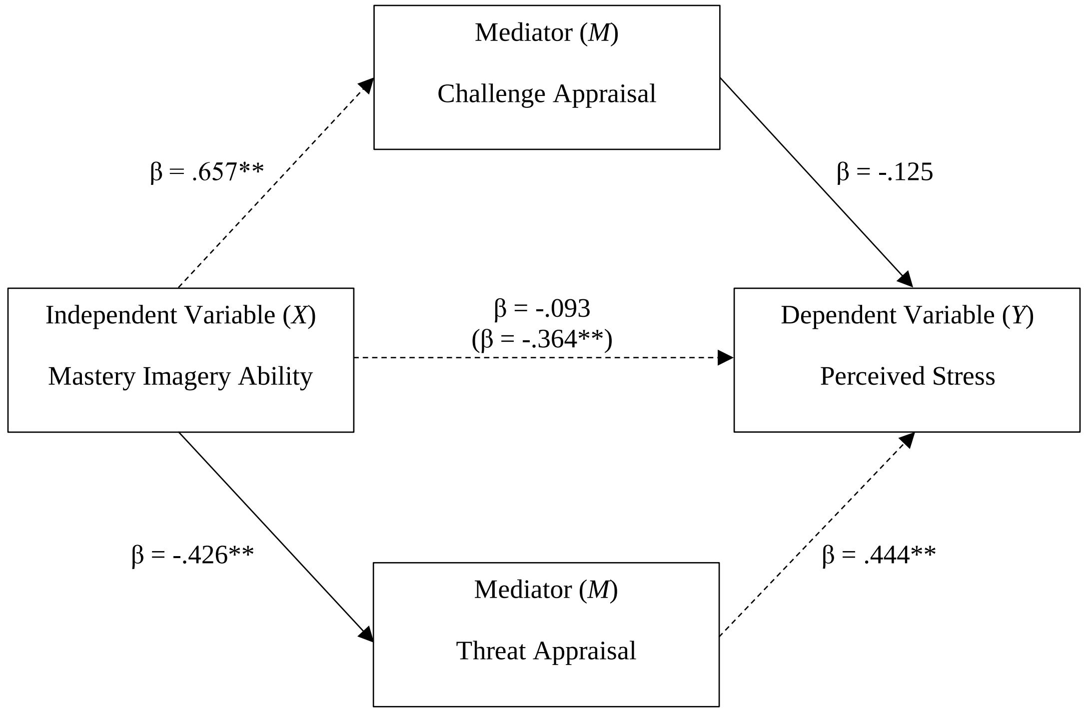
**Mediation Analyses**

For the mediation analysis, two separate models were run whereby mastery imagery ability was the predictor variable (*X)* and challenge appraisal and threat appraisal tendencies were the two mediators (*M*). In Model 1, perceived stress was the outcome variable (*Y*) and in Model 2 proactive coping was the outcome variable (*Y*).

**Perceived stress.** Figure 2 displays the results of the extent to which challenge and threat appraisal tendencies mediate the relationship between mastery imagery ability and perceived stress (controlling for gender). This figure shows that initially, in the absence of challenge and threat appraisal tendencies, mastery imagery ability negatively predicted perceived stress. Once challenge and threat appraisal tendencies were added to the model, mastery imagery ability positively predicted a challenge appraisal and negatively predicted a threat appraisal. However, challenge appraisal did not significantly predict perceived stress, threat appraisal significantly and positively predicted perceived stress. Once challenge and threat appraisal were added to the model as mediators, the relationship between mastery imagery ability and perceived stress became non-significant. This suggests that the relationship between mastery imagery ability and perceived stress was mediated by threat appraisal. This is confirmed by the total indirect effects of *X* (mastery imagery ability) on *Y* (perceived stress) via threat appraisal (β = -1.143, LLCI = -1.769, ULCI = -.606). However, challenge appraisal did not mediate the relationship between mastery imagery ability and perceived stress (β = -.495, LLCI = -1.244, ULCI = .214). Together these results show that individuals with a higher mastery imagery ability tend to be less likely to appraise stressful situations as a threat and this in turn is associated with lower levels of perceived stress.

**Figure 2**

*Mediation analysis depicting the extent to which challenge and threat appraisals mediate the relationship between mastery imagery ability and perceived stress*

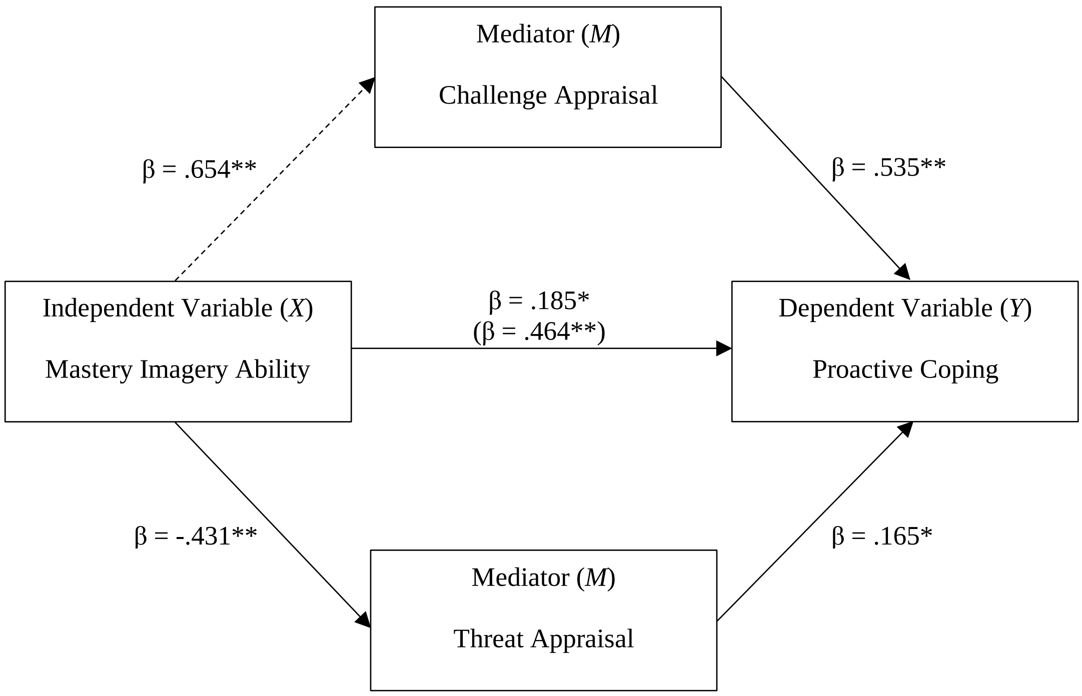



*Note.* * $p$ < .05, ** $p$ < .001. Standardised beta coefficients reported.

**Proactive coping.** Controlling for gender, results of the mediation analyses for proactive coping can be seen in Figure 3. The results show that initially, in the absence of challenge and threat appraisal tendencies, mastery imagery ability positively and significantly predicted proactive coping. Upon adding challenge and threat appraisal tendencies, mastery imagery ability significantly positively predicted challenge appraisal and significantly negatively predicted threat appraisal. Both challenge and threat appraisal significantly positively predicting proactive coping. Once challenge and threat appraisal tendencies were added to the module, the relationship between mastery imagery ability and proactive coping demonstrated mediation but remained significant to a lesser extent than the original direct prediction. The indirect effects of mastery imagery ability on proactive coping shows that challenge appraisal (β = 1.420, LLCI = .945, ULCI = 1.865), and threat appraisal (β = -.288, LLCI = -.607, ULCI = -.038) both mediated the relationship between mastery imagery ability and proactive coping. Collectively, these results demonstrate that those with a higher mastery imagery ability are able to better proactively cope with stress, in part due to their ability to appraise stress as less of a threat and more of a challenge. However, it can be said that due to a much larger beta values, an individual's challenge appraisal plays a bigger role in mediating this relationship.

**Figure 3**

*Mediation analysis depicting the extent to which challenge and threat appraisals mediate the relationship between mastery imagery ability and proactive coping*




*Note.* * $p < .05$, ** $p < .001$. Standardised beta coefficients reported.

**Study 1 Results Summary**

In line with the hypotheses, mastery imagery ability was significantly positively correlated with challenge appraisal and significantly negatively correlated with threat appraisal. Further correlation analyses revealed that mastery imagery ability was also significantly related to perceived stress and proactive coping. When analysing the mediating role of challenge and threat appraisal, the relationship between mastery imagery ability and perceived stress was found to be mediated by threat appraisal. Mediation analyses also demonstrated that challenge and threat appraisal played a role in the relationship between mastery imagery ability and proactive coping. Given that this is the first study to investigate these relationships, it is important to re-examine said relationships using additional samples. Similarly, due to a high proportion of the sample being athletes, further research into these relationships is necessary with a sample which contains a greater proportion of non-athletes.

## Study 2

### Aims and Hypotheses

Study 2 aimed to examine the replicability of Study 1 and re-examine the relationships between mastery imagery ability, challenge and threat appraisal, perceived stress and proactive coping. Similar to Study 1, Study 2 aimed to examine the mediating role of challenge and threat appraisal on the relationships between mastery imagery ability and perceived stress and proactive coping. By utilising a sample from the US, a secondary aim was to examine the similarities and differences between a UK and US sample in order to assess the cross-cultural reliability of the findings. The sample used was made up of predominantly non-athletes, in order to examine the relationships from Study 1 using a largely non-athlete sample.

Based upon the findings of Study 1 and existing research, it was hypothesised that those with a high mastery imagery ability would possess an increased tendency to appraise stressful situations as a challenge and a decreased tendency to appraise stressful situations as a threat. It was also hypothesised that mastery imagery ability would predict decreased perceived stress and increased proactive coping. Furthermore, it was hypothesised that greater challenge and lower threat appraisals would be associated with lower perceived stress and more proactive coping. Given the mediating role displayed by challenge and threat in Study 1, it was hypothesised that challenge and threat appraisal tendencies would play a mediating role in the relationships between mastery imagery ability and perceived stress and proactive coping.

# Methods

## Participants

Three hundred and thirty-eight male (n = 109) and female (n = 229) participants were recruited for this study aged between 18 and 33 (M = 19.26, SD = 1.58). Only forty-six participants indicated that they played a sport while the remaining participants (n = 292) did not play a sport. Participants were approached through Baylor University's online subject pool, SONA, with a link to complete the questionnaire pack. The exclusion criteria used in this study was the same as those employed in Study 1. This study gained approval from Baylor University's ethics committee.

## Measures

The measures used were identical to those used in Study 1.

## Procedure

The procedures used were identical to those used in Study 1, except that Qualtrics was used to collect participant responses rather than SmartSurvey. Study 2 data collection started in February 2021 and stopped at the end of April 2021.

## Data Analysis

Data analysis procedures were identical to those employed in Study 1. Missing data (n = 11) was removed, with outliers identified as data more than 1.5 standard deviations removed the mean (mastery imagery ability = 3 outliers, challenge appraisal = 2 outliers, perceived stress = 11 outliers, proactive coping = 6 outliers). As data analysis revealed that leaving the outliers in the data set did impact the results, identified outliers were removed, leaving a total sample size of 338.

# Results

## Correlation Analyses

Pearson's bivariate correlations examining the relationships between mastery imagery ability, challenge appraisal, threat appraisal, perceived stress, and proactive coping are displayed in Table 4. Mastery imagery ability significantly positively correlated with challenge appraisal tendency and proactive coping but significantly negatively correlated with threat appraisal tendency and perceived stress. Challenge appraisal tendency also significantly positively correlated with proactive coping and significantly negatively correlated with perceived stress. Also, threat appraisal tendency significantly positively correlated with perceived stress and significantly negatively correlated with proactive coping. The latter of which also significantly negatively correlated with perceived stress. However, there was no observed significant correlation between challenge and threat appraisal tendencies.

**Table 4**

| | Mastery Imagery Ability | Challenge Appraisal | Threat Appraisal | Perceived Stress |
|---|---|---|---|---|
| Challenge Appraisal | .435** | -- | -- | -- |
| Threat Appraisal | -.144* | -.044 | -- | -- |
| Perceived Stress | -.259** | -.267** | .510** | -- |
| Proactive Coping | .348** | .492** | -.147* | -.191** |

*Pearson's bivariate correlations between mastery imagery ability, challenge and threat appraisal, perceived stress, and proactive coping*

*Note.* * $p < .05$, ** $p < .001$.

**Participant Characteristics and Gender and Sport Type Differences**

The means and standard deviations of mastery imagery ability, challenge appraisal, threat appraisal, perceived stress, and proactive coping according to gender are displayed in Table 5. One-way ANOVAs revealed that compared to females, males displayed significantly higher mastery imagery ability ($F[1, 337] = 13.046$, $p < .001$, $\eta_p^2 = .037$), and significantly lower threat appraisal tendencies, ($F[1, 337] = 18.670$, $p < .001$, $\eta_p^2 = .053$) and perceived stress ($F[1, 337] = 13.127$, $p < .001$, $\eta_p^2 = .038$). There were no significant gender differences for challenge appraisal ($F[1, 337] = 2.670$, $p = .103$, $\eta_p^2 = .008$) or proactive coping ($F[1, 337] = .153$, $p = .696$, $\eta_p^2 < .001$).

**Table 5**

*Means and standard deviations of males and females for mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, and proactive coping*

| | Gender | | | |
|---|---|---|---|---|
| | Males | | Females | |
| | M | SD | M | SD |
| Mastery Imagery Ability (1-7) | 5.62** | 1.09 | 5.13 | 1.16 |
| Challenge Appraisal (1-6) | 4.72 | 0.67 | 4.61 | 0.65 |
| Threat Appraisal (1-6) | 3.67** | 1.08 | 4.20 | 1.02 |
| Perceived Stress (0-40) | 18.74** | 4.74 | 21.00 | 5.55 |
| Proactive Coping (14-56) | 41.07 | 4.32 | 41.21 | 4.62 |

*Note.* * $p < .05$, ** $p < .001$, significantly different to females. Numbers within ( ) indicates possible total score for each scale.

Table 6 shows the means and standard deviations of different variables for athletes and non-athletes, with the results of one-way ANCOVAs showing no significant differences in mastery imagery ability, challenge appraisal, threat appraisal, perceived stress and proactive coping between athletes and non-athletes (*p's* > .05, $\eta_p^2 < .03$). As a result, mediation analyses only controlled for gender.

**Table 6**

*Athlete and non-athlete means and standard deviations for mastery imagery ability, challenge appraisal, threat appraisal, perceived stress and proactive coping, and results of one-way ANCOVAs controlling for gender.*

| | Athletes (n = 46) | | Non-athletes (n = 292) | | |
|---|---|---|---|---|---|
| | M | SD | M | SD | Analysis Summary |
| Mastery Imagery Ability (1-7) | 5.48 | 1.10 | 5.26 | 1.17 | $F(1, 337) = .867$, $p = .352$, $\eta_p^2 = .003$ |
| Challenge Appraisal (1-6) | 4.58 | 0.69 | 4.66 | 0.65 | $F(1, 337) = .838$, $p = .361$, $\eta_p^2 = .002$ |
| Threat Appraisal (1-6) | 3.77 | 1.29 | 4.08 | 1.02 | $F(1, 337) = 2.155$, $p = .143$, $\eta_p^2 = .006$ |
| Perceived Stress (0-40) | 19.96 | 5.37 | 20.32 | 5.41 | $F(1, 337) = .022$, $p = .881$, $\eta_p^2 < .001$ |
| Proactive Coping (14-56) | 42.28 | 4.91 | 40.99 | 4.44 | $F(1, 337) = 3.368$, $p = .067$, $\eta_p^2 = .010$ |

*Note.* Numbers within ( ) indicates possible total score for each scale.

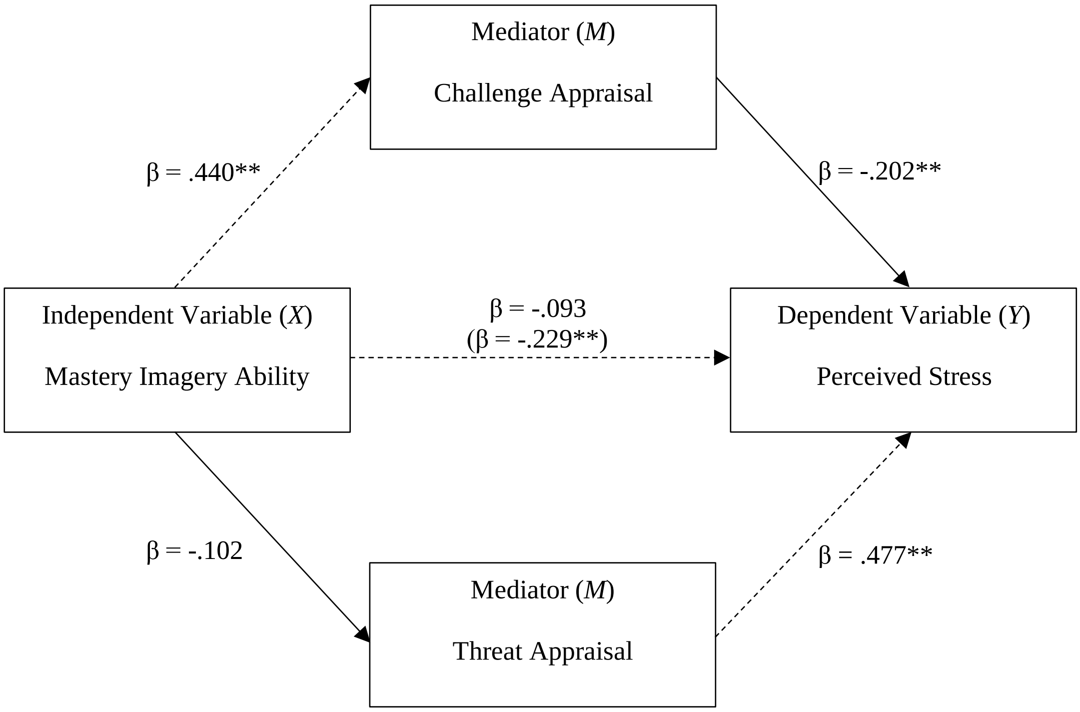
## Mediation Analyses

**Perceived stress.** Depicted in Figure 4 is the mediation analysis conducted to examine the mediating role of challenge and threat appraisal on the relationship between mastery imagery ability and perceived stress (controlling for gender). In the absence of challenge and threat appraisal, mastery imagery ability significantly negatively predicted perceived stress. However, once challenge and threat appraisal were added as mediators, this relationship between mastery imagery ability and perceived stress became non-significant, suggesting it was mediated by stress appraisal tendency. While challenge and threat appraisal both significantly predicted perceived stress (challenge negatively and threat positively), mastery imagery ability only significantly positively predicted challenge appraisal and did not significantly predict threat appraisal. Therefore, the relationship between mastery imagery ability and perceived stress was mediated by challenge appraisal and not threat appraisal. This was reinforced when examining the total indirect effects through challenge appraisal ($\beta = -.408$, LLCI = -.635, ULCI = -.202), and threat appraisal ($\beta = -.226$, LLCI = -.506, ULCI = .027). Put simply, these results show that those with a higher mastery imagery ability tend to appraise situations as more of challenge, and as a result of this appraisal individuals experience lower levels of perceived stress.

**Proactive coping.** As can be seen in Figure 5, mastery imagery ability significantly positively predicted proactive coping. Once challenge and threat were added to the moderation model, the relationship between mastery imagery ability and proactive coping remained significant, suggesting mediation via stress appraisal tendencies. However, the direct prediction between mastery imagery ability and proactive coping was more significant ($p < .001$ rather than $p < .05$). Challenge appraisal significantly positively predicted proactive coping and threat appraisal significantly negatively predicted proactive coping. However, because mastery imagery ability only significantly predicted challenge appraisal (and did not predict threat appraisal), the relationship between mastery imagery ability and proactive coping was only mediated by challenge appraisal tendency (indirect effect: β = .717, LLCI = -.479, ULCI = .974) and not via threat appraisal (indirect effect: β = .052, LLCI = -.007, ULCI = .138). Thus, those with a higher mastery imagery ability appraised stress as more of a challenge, which in part contributed to increased proactive coping.

**Figure 4**

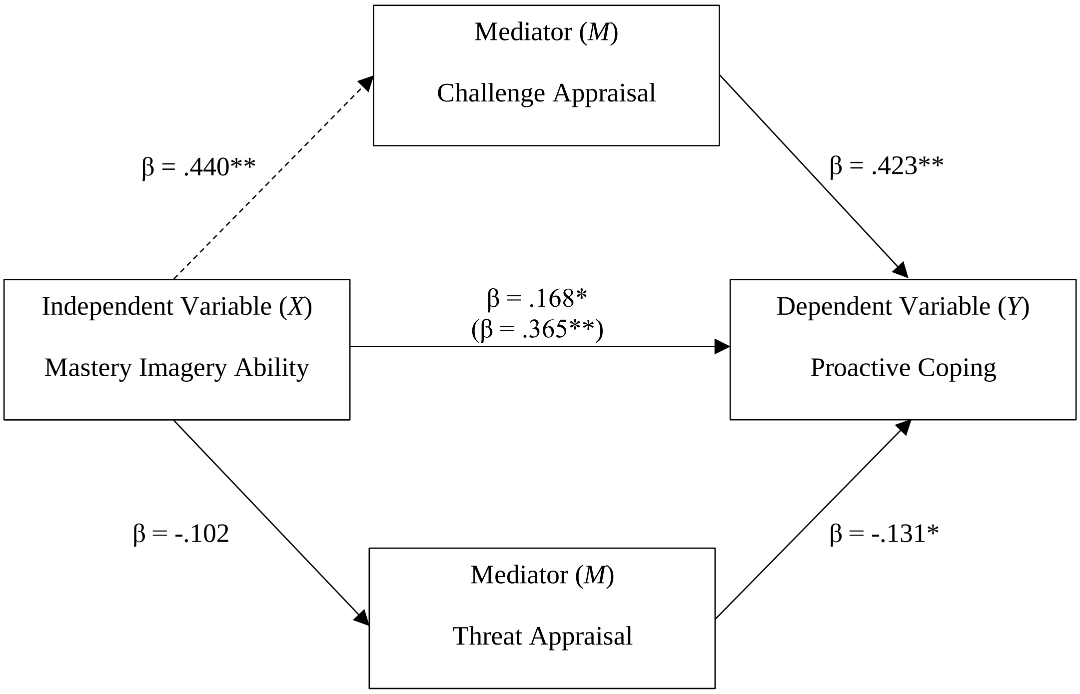
*Mediation analysis depicting the extent to which challenge and threat appraisals mediate the relationship between mastery imagery ability and perceived stress*




*Note.* * $p < .05$, ** $p < .001$. Standardised beta coefficients reported.

**Figure 5**

*Mediation analysis depicting the extent to which challenge and threat appraisals mediate the relationship between mastery imagery ability and proactive coping*




*Note.* * $p < .05$, ** $p < .001$. Standardised beta coefficients reported.

**Study 2 Results Summary**

By using a sample of predominantly non-athletes, Study 2 aimed to test the findings observed in Study 1. In line with the hypotheses, mastery imagery ability was significantly correlated with challenge and threat appraisal, where those with a higher mastery imagery ability had an increased tendency to appraise stressful situations as more of a challenge and less of a threat. However, the relationship between mastery imagery ability and threat appraisal became non-significant once gender was controlled for. Mastery imagery ability was also found to significantly correlate with decreased perceived stress and increased proactive coping. Mediation analyses of these relationships found that challenge appraisal had a mediating role on the relationship between mastery imagery ability and perceived stress, and on the relationship between mastery imagery ability and proactive coping. A comparison of the results of Study 1 and Study 2 can be seen in Table 7.

**Table 7**

*Summary comparison of results of correlation analyses, gender differences, and mediation analyses between Study 1 and Study 2*

| | Key Finding | Study 1 | Study 2 |
|---|---|---|---|
| Correlation Analysis | Mastery Imagery Ability- Challenge Appraisal | Positive** | Positive** |
| | Mastery Imagery Ability-Threat Appraisal | Negative** | Negative* |
| | Mastery Imagery Ability- Perceived Stress | Negative** | Negative** |
| | Mastery Imagery Ability- Proactive Coping | Positive** | Positive** |
| Gender Differences | Mastery Imagery Ability | M** | M** |
| | Challenge Appraisal | M* | M |
| | Threat Appraisal | F** | F** |
| | Perceived Stress | F** | F** |
| | Proactive Coping | F | F |
| Mediation Analysis | Mastery Imagery Ability-Perceived Stress | Threat Mediation | Challenge Mediation |
| | Mastery Imagery Ability-Proactive Coping | Challenge Mediation<br>Threat Mediation | Challenge Mediation |

*Note.* * $p < .05$, ** $p < .001$. M = males greater, F = females greater.

## Discussion

The primary aim of the present two study programme of research was to examine the relationships between mastery imagery ability, challenge and threat appraisals, perceived stress and proactive coping. Specifically, both studies aimed to examine the mediating role of challenge and threat appraisal on the relationships between mastery imagery ability and perceived stress and proactive coping. As Study 1 used a UK based sample and Study 2 a US based sample, this research also assessed the cross-cultural reliability of the findings, and furthered our understanding of the associations between mastery imagery ability and proactive coping. For both studies it was hypothesised that those with a higher mastery imagery ability would display greater challenge appraisal tendencies and lower threat appraisal tendencies, these appraisal tendencies would relate to lower levels of perceived stress and higher levels of proactive coping. Consequently, it was hypothesised that challenge and threat appraisal would mediate the relationship between mastery imagery ability and perceived stress, and between mastery imagery ability and proactive coping.

Study 1 and Study 2 showed mastery imagery ability significantly negatively correlated with perceived stress, replicating previous research that also found an association between higher mastery imagery ability and lower levels of perceived stress (Möller, 2019; Beevor et al., under review), suggesting that possessing a greater mastery imagery ability is important in maintaining low perceived stress levels. While studies have previously shown challenge imagery to result in more adaptive coping responses when confronted by a stressful situation (Williams et al., 2010), the present two studies are the first to show that mastery imagery ability is also associated with more proactive coping.

Consistent across both studies, when controlling for gender, mastery imagery ability shared a significant relationship with challenge appraisal. Specifically, those with a higher mastery imagery ability were more likely to appraise situations as a challenge, supporting literature that has shown associations between mastery imagery ability and a challenge appraisal state in both athlete and non-athlete samples (Möller, 2019; Quinton et al., 2018; Williams & Cumming, 2011; 2012b). As an increased challenge appraisal tendency has been related to improved performance, and more adaptive coping (Skinner & Brewer, 2004; Trotman et al., 2019; Williams & Cumming, 2011), perceiving stressful situations as a challenge is crucial in aiding the regulation of stress. Given the vast amount of supporting research, it remains important to develop a high mastery imagery ability due to the associations with perceiving stressful situations as a challenge rather than as a threat.

Results between mastery imagery ability and threat appraisal were inconsistent between studies. Study 1 showed a negative association (i.e., higher mastery imagery was associated with lower threat appraisal), but Study 2 found no relationship once gender was controlled for. The non-significant finding in Study 2 is contrary to research that suggests that possessing a higher mastery imagery ability is less likely to lead to a threat appraisal (Williams & Cumming, 2012b). However, a more recent study in this area has reported that mastery imagery ability was not a predictor of threat appraisals (Quinton et al., 2018). Whilst the aforementioned study used a large athlete-only sample, in comparison to the predominantly non-athlete based sample of Study 2, results support the findings of Study 2. Similarly, findings of Study 1 showed challenge appraisal to significantly negatively correlate with threat appraisal, and is supported by research that shows challenge and threat appraisal to share an inversely proportional relationship (Williams & Cumming, 2012a). On the contrary, in Study 2 this relationship was non-significant, adding evidence to previous research that demonstrated that an increased likelihood to perceive stressful situations as a challenge does not necessarily mean an individual is less likely to perceive stressful situations as a threat (Quinton et al., 2018). While it is evident that stress appraisals do relate to mastery imagery ability, more research is warranted to establish a more consistent relationship between mastery imagery ability and challenge and threat appraisal tendencies. In particular, more comparisons between samples from different cultures and different athlete and non-athlete representations would be prudent in order to uncover whether differences exist due to the nature of the samples or whether other factors are driving these inconsistencies.

Both studies demonstrated that stress appraisals mediate the relationship between mastery imagery ability and perceived stress. However, in Study 1, threat appraisal was the mediator, while in Study 2 challenge appraisal was the mediator. As discussed, there are inconsistencies in the literature as to whether challenge or threat appraisal tendencies are more strongly related to mastery imagery ability, and whether this may be due to the specific sample being investigated. Although this research offers an interesting first insight into the mediating role of challenge and threat appraisals, more research is needed to examine the mediating role of appraisal states to understand when challenge is likely to mediate the relationship and when threat is likely to mediate the relationship. Irrespective of this, findings emphasise the importance of assessing both challenge and threat appraisals when conducting stress appraisal research as either could emerge as the mediator.

Mediation analysis for proactive coping revealed that stress appraisals mediated the relationship between mastery imagery ability and proactive coping. More specifically, both studies showed that challenge appraisal was the mediator as threat appraisal did not mediate in Study 2. The beta values in Study 1 also highlighted that challenge was a stronger mediator. Given that research conceptualises proactive coping as something that occurs following the appraisal of situations as challenges (Greenglass & Fiksenbaum, 2009), it is perhaps not surprising that present two studies collectively highlight the importance of challenge appraisals in explaining the relationship between mastery imagery ability and proactive coping.

The present research has a number of key strengths and implications that make it a valuable contributor to the literature. The two-study approach using similar measures and analysis approaches makes the consistent findings more robust. However, it would have been advantageous to recruit a larger sample in Study 1 to ensure more even samples and thus a more balanced comparison between the results of the two studies. In comparison to the previous work which has predominantly used athlete-only populations (Williams & Cumming, 2012a; 2012b; 2015; Quinton et al., 2018; 2019) the inclusion in the present study of both athletes and non-athletes within UK and US populations means the work has greater generalisability to more of the general population. The present research extends the previous research conducted in this area by extending our understanding of dispositions and constructs that mastery imagery ability is associated with and stress demonstrating proposed mechanisms to explain these relationships (Quinton et al., 2018; Williams & Cumming, 2011; 2012b; Möller, 2019; Beevor et al., under review). As the findings suggest that a higher mastery imagery ability is associated with more adaptive stress appraisal, lower perceived stress, and more proactive coping it could be that increasing mastery imagery ability has the potential to alter stress appraisal and in turn lower stress and increase one's ability to proactively cope. Highlighting the importance of this research, given the associations between increased levels of perceived stress and worse health (Schneidermann et al., 2005), and fact that proactive coping is associated with lower perceived stress (Greenglass & Fiksenbaum, 2009), results of the present study can be used by practitioners to help identify early risk factors for poorer mental and physical health.

However, despite these established associations, the present research was correlational, meaning causality cannot be established. Furthermore, the use of atemporal data cannot truly demonstrate mediation meaning that future research should re-examine these relationships using temporal data. As research has shown that imagery ability can be improved using practice (Cumming & Williams, 2012; Möller, 2019; Williams et al., 2013), future research should examine whether improving mastery imagery ability results in tendencies to appraise stressful situations as more of a challenge and less of a threat, and whether this is accompanied by a reduction in perceived stress levels and an increase in proactive coping. Further, due to the young average age of the samples used in this research, and given imagery ability declines with age (Cumming & Williams, 2012, pp. 213**)**, future research should re-examine these relationships with older populations in order to increase the generalisability of the findings.

Whilst all the measures in this study have been shown to have good validity, the Sport Imagery Ability Questionnaire (SIAQ: Williams & Cumming, 2011) was originally designed for athlete populations. However, the SIAQ is currently the only validated questionnaire that is able to measure mastery imagery ability and it has previously been shown to produce reliable and valid results in non-athlete populations (Möller, 2019; Beevor et al., under review). Despite this, future research should aim to develop a questionnaire that specifically assesses mastery imagery ability related to non-sport contexts. Finally, whilst the use of PROCESS to conduct the mediation analysis with multiple mediators was a strength of this research, future research should employ more advanced statistical analysis such as structural equation modelling. This would allow for the testing of more complex models including additional variables (such as those identified in the TCTSA-R), furthering our understanding of how mastery imagery ability relates to appraisals and responses to stress and coping.

In conclusion, the present multi-study research aimed to examine the extent to which challenge and threat appraisals mediated the relationship between mastery imagery ability, and perceived stress and proactive coping. Results revealed that greater mastery imagery ability was significantly related to lower levels of perceived stress and greater proactive coping, due to the mediating role of appraisal states. While this research emphasises the important mediating role of challenge and threat appraisal on these relationships, future research should aim to establish more consistent results as to the role of different appraisal tendencies on these relationships. Future research should also seek to increase mastery imagery ability to examine whether this leads to more adaptive stress appraisals, lower perceived stress, and more proactive coping.

# Chapter Three

## The Effectiveness of an Online Mastery Imagery Intervention in Increasing Mastery Imagery Ability, Challenge and Threat Appraisal Tendencies, Perceived Stress, and Proactive Coping

## The Effectiveness of an Online Mastery Imagery Intervention in Increasing Mastery Imagery Ability, Challenge and Threat Appraisal Tendencies, Perceived Stress, and Proactive Coping

A US survey showed 64% of respondents noted work as being a key stressor, whilst 60% felt that money was a source of stress for them (American Psychological Association; APA, 2019). Furthermore, the stress levels of those aged between 18 and 23 has increased year-on-year across the last three years (APA, 2019). Perceived stress – experienced when one perceives that they have insufficient resources to cope with an external event (Lazarus & Launier, 1978) – has been shown to increase an individual's vulnerability to disease by posing a risk level for developing cardiovascular disease equal to that of smoking and a lack of physical activity (Dimsdale, 2008; Rozanski, 2014). Perceived stress can also lead to poor psychological health and has been associated with increased anxiety and low self-confidence (Morina et al., 2011).

One such factor influencing the detrimental effect stress has on health and wellbeing could be how individuals appraise potentially stressful situations. Research has demonstrated that appraising situations as a challenge or threat can influence the magnitude of cardiovascular (e.g., total peripheral resistance) and psychological (e.g., anxiety) responses experienced (Blascovich & Mendes, 2000; Williams et al., 2017). A challenge appraisal leads to more positive interpretations of anxiety and greater self-confidence (Jones et al., 2009; Skinner & Brewer, 2004; Swain & Jones, 1996; Thomas et al., 2007). In turn, appraising situations as a threat, has been shown to lead to a greater intensity of anxiety symptoms as well as more debilitating interpretations of anxiety experienced (Jones et al., 2009; Mallorqui-Bague et al., 2016; Williams et al., 2010). The emotional and physiological stress responses caused by threat are thought to contribute to worsening physical health symptoms (Cohen et al., 2016). Related to perceived stress itself, Chapter 2 of this thesis showed that individuals more likely to perceive stressful situations as a threat typically display higher levels of perceived stress as well as possess a reduced ability to proactively cope, while individuals with a greater challenge appraisal tendency tend to report lower perceived stress and a more proactive coping style.

According to the biopsychosocial model of challenge and threat, stress appraisals are responses to situations deemed stressful where one evaluates the balance between the demands of the external event against their personal coping resources (Blascovich, 2008). A challenge appraisal is characterised by the individual perceiving themselves to have sufficient resources to meet the demands of the external event (influenced by higher self-efficacy and perceived control, and an approach orientated goal focus), while the individual perceiving themselves to possess insufficient resources to meet the demands of the external event (through lower self-efficacy and perceived control, and an avoidance orientated goal focus), results in a threat appraisal (Blascovich, 2008; Jones et al., 2009). Given that challenge appraisals are associated with lower perceived stress and improved psychological wellbeing, it remains crucial to examine techniques that can elicit a greater challenge appraisal tendency.

One such technique that can regulate appraisals and responses to stress is imagery, which is the mental representation of thoughts, feelings and emotions (Cumming & Williams, 2012). Imagery can be used to lower feelings of stress as well and the intensity of stress responses such as heart rate and anxiety (Charalambous et al., 2015; Cumming et al., 2007; Jones et al., 2002; Mellalieu et al., 2009; Williams & Cumming, 2012a). However, imagery can also be used to alter the appraisal of stress and the interpretation of the subsequent responses. More specifically, imagery designed to elicit a challenge appraisal through instilling feelings of confidence and control during a stressful situation have been found to elicit lower threat appraisal, higher confidence, and a more facilitative anxiety interpretations compared to imagery designed to elicit a threat appraisal (Moore et al., 2012; Williams &

Cumming, 2012a; Williams et al., 2010; Williams et al., 2017). Collectively these studies show the important role that imagery can have in regulating stress appraisals and the subsequent responses to stress.

Importantly, research has shown that imagery ability is also a correlate of more adaptive stress appraisals. For example, individuals with an increased mastery imagery ability (i.e., ease of imaging the mastering of challenging or difficult situations such as giving 100% effort when things are not going well) are more likely to appraise stressful situations as a challenge rather than a threat (Quinton et al., 2018; Quinton et al., 2019; Williams & Cumming, 2012b). Mastery imagery ability is also associated with lower perceived stress (Beevor et al., under review; Möller, 2019) and more adaptive stress responses such as more facilitative interpretations of anxiety and greater self-confidence (Williams & Cumming, 2012b; Williams & Cumming, 2015). Specifically, the results from Chapter 2 demonstrated that those with greater mastery imagery ability reported lower levels of perceived stress and more proactive coping, and that these relationships were mediated by challenge or threat appraisals.

Chapter 2's findings of the present thesis suggest that mastery imagery ability may lead to more adaptive stress appraisals which in turn leads to lower perceived stress (and more proactive coping). However, as with most mastery imagery ability research to date, Chapter 2 was cross-sectional, meaning that causation could not be established. Imagery ability is a modifiable disposition that can be improved. Therefore, in order to show that mastery imagery ability can result in changes in challenge and threat appraisals, perceived stress and proactive coping, studies are needed that explore whether increasing mastery imagery ability is accompanied by alterations in stress appraisals and perceived stress and coping tendencies.

Imagery ability can be improved with practice, as well as methods such as action observation, and PETTLEP imagery, and imagery ability training (Cumming & Ste-Marie, 2001; Guillot & Collet, 2005; Rodgers et al., 1991; Williams, 2019; Williams et al., 2013). Once such training method, is Layered Stimulus Response Training (LSRT; Cumming et al., 2016). This LSRT is a technique developed based on Lang's bioinformational theory (1977), whereby the image is broken down into stimulus (sensory information related to the imaged situation; e.g., weather), response (the individual's emotional and physiological responses to the imaged situation; e.g., increased heart rate) and meaning (how the individual's response to the stimulus is interpreted; e.g., facilitative vs debilitative) propositions. These propositions are added to the imagery scenario using three stages known as "image", "reflect", and "develop" (Cumming et al., 2016). First, the individual images the content before reflecting on it and then developing the image further by laying in additional details. This process is completed a number of times to gradually build the image up in a layering approach to increase the individual's capacity to image the content (Cumming et al., 2016).

Research shows LSRT to be effective in increasing imagery ability and thus imagery effectiveness. For example, Williams, Cooley and Cumming (2013) found that compared to an imagery practice group, participants in the LSRT group experienced greater improvements in their visual and kinaesthetic movement imagery ability which also translated into improvements in golf putting performance. Other studies have also shown LSRT to improve the ability to image other imagery content such as being physically active (Weibull et al., 2015). Specific to altering meaning propositions, LSRT has been used in applied settings to help an equestrian rider to jump over more difficult fences by imaging easier fences and adding details to the image in order to change the negative thoughts and feelings they had when jumping over harder fences (Davies, 2015). Despite LSRT's apparent effectiveness, research is yet to sufficiently examine the technique with regards to altering appraisals and responses to stress, with research applying LSRT in performance-based scenarios rather than using LSRT to combat stressful scenarios.

Bioinformational theory suggests that an individual's behaviours can be altered by changing their emotional and physiological responses through altering meaning propositions (Lang, 1979). Therefore, using LSRT to alter the meaning propositions of a stressful situation may help individuals be able to appraise the situation and the responses experienced in a more favourable way (i.e., as a challenge rather than a threat). For example, an individual may image the moments immediately prior to a job interview, and be able to see the environment (i.e., stimulus propositions) and how they would be feeling such as experiencing elevations in heart rate (i.e., response propositions) and identify details that were easier and more vividly experienced as well those that were more difficult to imagine (i.e., reflect phase). In the development phase the participant could then identify ways to alter the meaning propositions so that the elevated heart rate is associated with being prepared to perform well rather than fear. Each time the imagery cycle is repeated, these meaning propositions become reinforced, contributing to developing the desired behavioural change during the imagery (Lang, 1979).

One pilot study to examine the potential effectiveness of LSRT on mastery imagery was conducted by Möller (2019). Although a pilot study, results suggested that the LSRT was an effective method for improving mastery imagery ability. Whilst this study acts as an important example of how LSRT can be used to improve mastery imagery ability, the study was conducted with a female only sample meaning research is needed to examine the usefulness of LSRT in improving the mastery imagery ability of both females and males. Furthermore, there has been no research that examines alternative delivery methods of LSRT or the effect of LSRT on appraisal states, perceived stress and proactive coping. Due to technological advancements, as well as the COVID-19 pandemic and an ability to limit the need for additional resources, there is a growing emphasis being placed on online research and interventions. Therefore, it was felt that it would be prudent to examine the effectiveness of an online mastery imagery intervention in order to uncover the feasibility of carrying out online interventions.

Consequently, the first aim of this pilot study was to assess the effectiveness of a 2-week online LSRT intervention in improving mastery imagery ability in a sample of males and females. The second aim was to build on the results of Chapter 2 and examine whether an increase in mastery imagery ability was accompanied by (1) a greater challenge appraisal tendency, (2) a lower threat appraisal tendency, (3) lower perceived stress, and (4) a greater proactive coping tendency. Based on previous LSRT studies and the results in Chapter 2, it was hypothesised that participants in the online mastery LSRT intervention group would experience an increase in mastery imagery ability, and as such experience an increase in challenge appraisal tendencies, a reduction in threat appraisal tendencies, and a reduction in perceived stress and increase in proactive coping. In comparison, it was hypothesised that individuals in the control group would experience no change in any of these variables and instead experience an increase in skill imagery ability (due to the content of the control group intervention).

## Methods

### Participants

Eighteen participants were recruited for this study, between the ages of 18 and 21 years old (M = 19.11 SD = 0.90). Participants were recruited from Baylor University in the United States and the University of Birmingham in the United Kingdom. The sample consisted of 11 females and 7 males (61% female, 39% male). All participants provided informed consent and had the right to withdraw at any time. Those from the United Kingdom who fully completed the intervention study could choose to receive either 2 hrs of class research credit or a £10 gift voucher, whereas those from the United States received both the research credits and a $30 payment card. The study was approved by the University's ethics committees at both Baylor University and University of Birmingham.

## Measures

**Imagery ability.** The Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) is a 15-item questionnaire used to assess an individual's imagery ability. Three of the 15-items are used to specifically measure mastery imagery ability. Asked in relation to the sport participants play, participants are asked to image the following three items are: "Giving 100% effort even when things are not going well", "Staying positive after a setback" and "Remaining confident in a difficult situation". Another three items (i.e., "Refining a particular skill", "Improving a particular skill" and "Making corrections to physical skills") assess the ability to image skills/movements. For those who did not regularly play a sport, questions were asked in relation to the sport they most recently played. Using a 7-point Likert-type scale, responses were made on a 7-point scale from 1 (*very hard to image*) to 7 (*very easy to image),* with scores for each subscale averaged to give separate mastery imagery and skill imagery scores between 1 and 7 (a higher score reflecting a higher imagery ability). The SIAQ has been shown to demonstrate a good internal validity and reliability of mastery and skill imagery ability (Williams & Cumming, 2011) including when used in a non-athlete population (Beevor et al., under review). The internal reliability of the SIAQ for both subscales was shown to be at a good level during the present study (see Table 12).

**Challenge and threat appraisal.** The 18-item Cognitive Appraisal Scale (CAS; Skinner & Brewer, 2002) was used to provide a measure of participants' tendency to appraise stress as a challenge or as a threat. For each item, participants were asked to provide their level of agreement in relation to a meaningful situation. Ten items were used to assess threat appraisal (e.g., "I worry about the kind of impression I make"), and eight items were used to measure challenge appraisal (e.g., “In general, I look forward to the rewards and benefits of success”). Using a 6-point Likert-type scale from 1 (*strongly disagree*) to 6 (*strongly agree*), participants indicated the most reflective response for each item. The responses for each subscale are averaged to provide separate challenge and threat appraisal tendency scores between 1 and 6 whereby a higher score indicates a greater likelihood to appraise situations as a challenge/threat. The CAS has been shown to possess good validity and reliability (Skinner & Brewer, 2002). The internal reliability for the present study is displayed in Table 12.

**Perceived stress.** To assess perceived stress levels, the 10-item Perceived Stress Scale (PSS; Cohen, Kamarck & Mermelstein, 1983) was used. The PSS asks participants about stress experiences over the preceding month, for example, “How often have you felt that things were going your way?” Participants then respond to each item on a 5-point Likert-type scale ranging from 0 (*never*) to 4 (*very often*). From the scale, positively worded items are reversed scored and then a total perceived stress score is calculated by adding all responses together, providing a total score from 0 to 40, with a higher score indicating a higher perceived stress level. The PSS has demonstrated good validity and adequate reliability of perceived stress (Cohen, Kamarck & Mermelstein, 1983). In the present study the questionnaire showed a good level of reliability (see Table 12).

**Proactive coping.** The Proactive Coping Inventory (PCI; Greenglass et al., 1999) was used to measure participant’s proactive coping. Specifically, the proactive coping subscale of the PCI was used. From 14 statements, participants are asked to indicate how true each statement is on a 4-point Likert-type scale from 1 *(not at all true*) to 4 *(completely true*). Example statements include, “I try to let things work out on their own” and “I try to pinpoint what I need to succeed”. Of the 14-items, three are reversed scored before all responses are added together to provide a total proactive coping score (between 14 and 56). Those with a higher score have a greater tendency to proactively cope. The ‘Proactive Coping Scale’ of the PCI has demonstrated good validity and acceptable reliability (Greenglass et al., 1999). The Cronbach’s *alpha* score in the present study is displayed in Table 12.

**Post-session questionnaire.** The post-session questionnaire pack consisted of two parts. Part one contained five items regarding the imagery experienced in the session. The first item was an open-ended question in which participants were asked to describe the scenario they imaged in the session. The second item assessed the ease of the scenarios imaged with responses made on a 7-point Likert scale ranging from 1 (very hard to image) to 7 (very easy to image). The third and fourth items assessed the extent participants imaged the scenario as instructed and how engaged they were in the session with responses to both being made on a 7-point Likert-type scale from 1 (not at all as instructed/not at all engaged) to 7 (exactly as instructed/very engaged).

Part two of the questionnaire consisted of the three mastery imagery ability items from the SIAQ (Williams & Cumming, 2011) to measure mastery imagery ability, and three items devised for the purpose of the study (i.e., “Reaching to pick up a mug”, “Putting a watch on my wrist”, and “Walking down some stairs”) to assess movement imagery ability. Responses to all six items were made on the SIAQ’s 7-point Likert-type scale assessing ease of imaging (1 = very hard to image, 7 = very easy to image). Answers for each three items were averaged to give separate scores for both mastery imagery ability and movement imagery ability.

**Intervention evaluation.** Participants were asked to provide their thoughts regarding the intervention. Firstly, participants were asked to indicate their feelings regarding the effectiveness of the intervention in accordance with the following three items; “Reducing your stress levels”, “Helping you view stress as more positive” and “Helping you cope with stress”. Responses were collected using a 7-point Likert-type scale from 1 (*not at all* *effective*) to 7 (*very effective*). Again using a 7-point Likert-type scale, participants were asked to provide a response as to whether they thought that the intervention was an appropriate length in terms of session number (1 = *not enough sessions,* 4 = *ideal number of sessions,* 7 = *too many* sessions) and session length (1 = *sessions were too short,* 4 = *sessions were an ideal length,* 7 = *sessions were too long*) as well as whether online or face-to-face delivery, or a combination of both, would be more effective to deliver the intervention (1 = *online was much better than face to face would have been,* 4 = *the delivery format is indifferent,* 7 = *face to face would have been much better than online*).

**Intervention Conditions**

**Layered Stimulus Response Training to improve mastery imagery ability.** For the experimental condition, each participant attended four one-to-one LSRT sessions conducted online via Zoom. The number of sessions is in line with previous research showing four sessions as capable of increasing imagery ability (Möller et al., 2019; Williams et al., 2013). Once the participant had accessed the Zoom session via video link, they were provided with a broad outline of the session. For the first session, participants were played a 3-minute Microsoft PowerPoint video via screen share which contained a description of imagery ability and the differences between different modalities and visual perspectives, as well as examples of when it can be used in real life. Participants were told they could perform the imagery in the study from either perspectives or a combination of both. After the video participants were asked whether they understood what imagery was and were provided with the opportunity to ask questions about anything they were unsure about.

During each LSRT session, participants were invited to use any scenario they find stress-evoking to serve as the imagery content as research has shown that imagery that is personalised and meaningful is more effective (Lang, 1979). Scenarios used included job interviews, exams, driving tests, public speaking, and sporting competitions, among others.

At the start of each session, participants were asked to image the scenario for 20 seconds in sessions one and two, and for 30 seconds in sessions three and four (i.e., image phase), where the initial focus was on ensuring the image was resemblant of real life and gradually contained stress-evoking content. After imaging the content, participants were invited to describe the content of what they imaged, how easy and vivid the imagery was to perform, whether different aspects of the image were clearer/more vivid than others and how realistic they found the image in comparison to real life (i.e., reflect phase). Following this, the participant discussed with the primary researcher how the image could be developed further in order to make the image more resemblant of the real-life scenario. This could include either attempting to make certain details more vivid or lifelike, or including additional details which were previously overlooked in the image. During this phase, participants were asked about existing details of the image and if they felt that incorporating these details more strongly or in a different way might make the image easier or more vivid. Similarly, new details could be incorporated into the image as well as whether the participant felt that any aspects of the image could be removed if they felt that they were not helpful in forming a realistic image (i.e., develop phase).

As each session progressed, and once participants were able to develop a real-life, stress-evoking image, the focus of the imagery changed to ensure participants imaged themselves mastering the stress and that they could image themselves in control of the scenario. For example, during the develop phase, a participant imaging themselves in an exam would add a detail such as doing well on a question and becoming more confident, which would then be incorporated into the next image. During each session, imagery was performed approximately six to eight times. In order for sessions to remain stimulating, for individuals who showed signs of more rapid improvement, a new imagery scenario would be used for each session, however for those who did not learn as quickly, two scenarios were practised throughout the four sessions (i.e. the first scenario in sessions one and two, the second scenario in sessions three and four).

**Layered Stimulus Response Training to improve movement imagery ability.** For the control condition, a movement imagery intervention was conducted which was matched with the mastery imagery LSRT intervention in terms of number of sessions, session duration, number of images performed during the sessions, and online delivery.

Participants used the video link provided to access the online Zoom call, with the first visit beginning with participants being shown a very similar video to the LSRT condition. The only difference was changing stress-related examples to movement related examples of how imagery could be used. For each session, participants used a different imagery scenario, all of which consisted of movement skills (e.g., golf swing, walking upstairs, running, brushing teeth). The protocol was then the same as the Mastery LSRT group in terms of how the training was conducted.

## Procedure

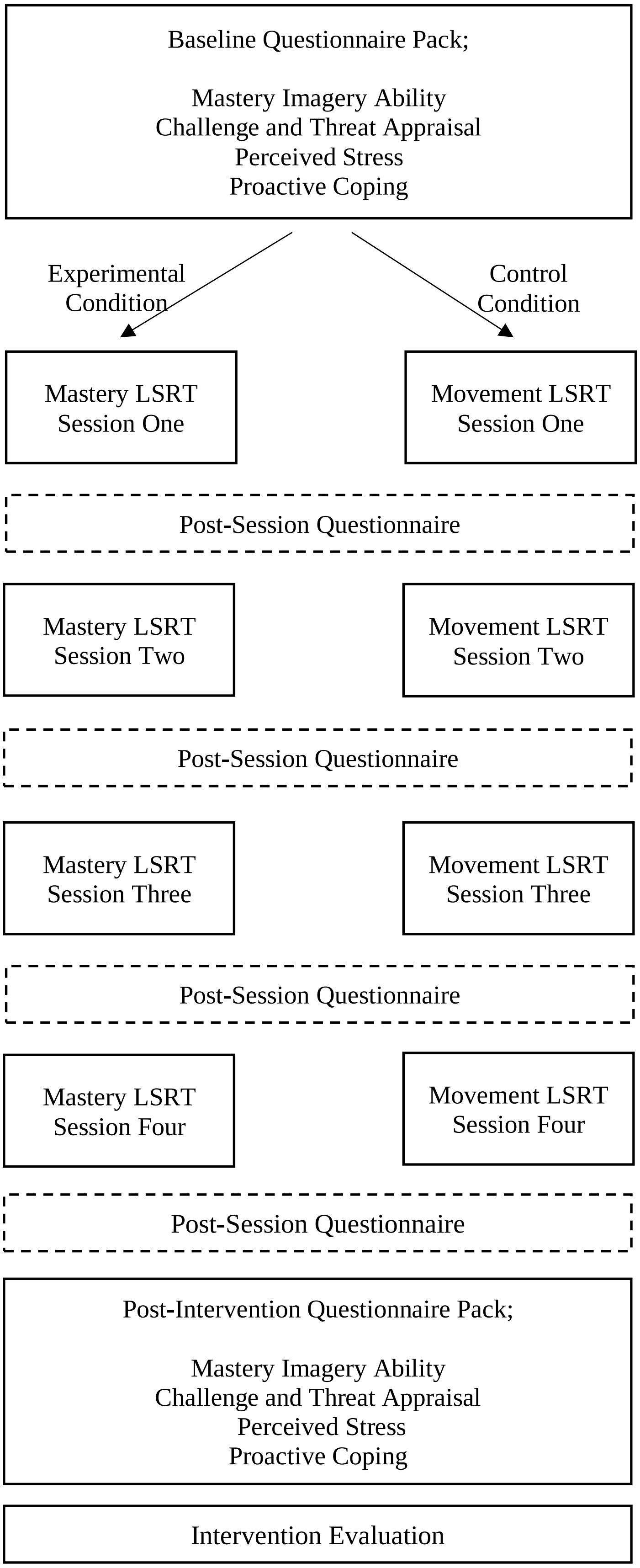
Figure 6 outlines the study procedures and when measures were collected. All participants were recruited through Baylor University's and the University of Birmingham's online subject pools to participate in a cross-sectional study (see Chapter 2). Participants from the cross-sectional study who had a SIAQ mastery imagery ability score at or below five were approached by email to be recruited. This was to prevent a ceiling affect and used the same criteria employed in previous LSRT interventions (Williams et al., 2013). In total, 41 individuals from the University of Birmingham and 110 individuals from Baylor University were eligible for participation and were contacted to take part in the intervention. Interested participants read the provided information sheet and had the opportunity to ask questions. Those agreeing to take part provided informed consent. Following consent, participants were randomly assigned (stratified by gender), using a random number generator, to undergo

LSRT to improve either mastery imagery ability (experimental condition) or to improve movement imagery ability (control condition).

For this study, due to the ongoing COVID-19 guidelines to minimise social contact, US participants were provided with two options to take part. The first option provided participants with the opportunity to undertake the intervention in an online-only format where they would access each online LSRT session via their own laptop or computer. Alternatively, participants were offered an in-person option where they could attend the laboratory and use the laboratory computer from which they were able to access the online LSRT sessions. Participants in the UK were only given the option of completing the study online due to restrictions in the UK**.** Participants completing the online-only option were emailed with a link to the online Zoom session which would need to be accessed to conduct the session. Post-session questionnaires (which took approximately 5 minutes to complete) were sent via link to participants immediately following each session for the participant to complete. For the in-person option each laboratory visit was overseen by a research assistant who set up the participant on a computer where they could access the Zoom software. The LSRT sessions were undertaken one-on-one between the participants and the primary researcher online via Zoom. Post-session questionnaires were administered electronically and completed by the participant before they left the laboratory.

**Figure 6**

*Procedure used for both the online and in-person visits for the experimental and control conditions*



**Data Analysis**

Data were downloaded to Microsoft Excel and then exported to SPSS (IBM SPSS Version 24.0). Data was screened and missing data was identified (post-intervention perceived stress = 1 missing, baseline proactive coping = 1 missing, post-intervention proactive coping = 1 missing). Due to the small sample size, participants who had missing data were retained but missing data points were excluded from any of the analysis involving their respective variables. Outliers (1.5 standard deviations removed from the mean) from baseline and post-intervention questionnaire packs were also identified in the data set (baseline skill imagery ability = 1 outlier, post-intervention challenge appraisal = 1 outlier, baseline threat appraisal = 3 outliers, post-intervention threat appraisal = 3 outliers). Given the sample size used, and the fact that these were not extreme outliers, identified outliers were retained within the data set for the analysis.

Means and standard deviations were calculated for all variables being analysed, and internal reliabilities were calculated for all questionnaire subscales pre- and post-intervention. First, a series of analyses was conducted to examine group differences in how the intervention was perceived by participants. One-way ANOVA examined any group differences in LSRT session length, as well as participants' evaluations of the number of sessions, the duration of sessions, and delivery method. Next, one-way ANOVAs examined any group differences in session engagement, ease of imaging, and whether participants were imaging the scenarios as instructed. To assess whether participants felt that the intervention was effective at regulating their stress responses, following completion of all four sessions, items examined whether participants felt that the intervention; (1) reduced their stress levels, (2) helped them view stress more positively and (3) helped them cope with stress.

Next, analyses were conducted to examine the effectiveness of the intervention on the main variables of interest. Separate 2 group (intervention, control) by 2 time (pre- post-intervention) mixed model ANOVAs examined any changes over time in mastery imagery ability, skill imagery ability, challenge appraisal, threat appraisal, perceived stress and proactive coping. However, due to the limited sample size for the study, repeated measures ANOVAs were also conducted separately for each group to examine differences from pre-intervention to post-intervention in these variables. The critical alpha level for analysis was set at .05 and partial eta squared was the measure of effect size for all ANOVAs conducted.

# Results

## Evaluation of Session Number, Duration, and Delivery

Sessions lasted between 22 and 28 minutes (M = 24.56, SD = 1.36). The duration of the Mastery LSRT (M = 24.82, SD = 1.39) sessions were approximately the same as the Movement LSRT (M = 24.22, SD = 1.26) sessions, with a one-way ANOVA revealing no significant differences between each group ($F[1,71] = 3.652$, $p = .060$, $\eta_p^2 = .050$).

As observed in Table 8, participants in both conditions indicated that their respective intervention had the ideal number of sessions and were of an ideal length. Participants from each group also tended to think that online delivery was better than face-to-face would have been. No significant differences were reported between groups in terms of how appropriate they found the number of sessions, the duration of sessions or their preferred method of delivery ($p$'s > .05).

**Table 8**

*Analysis of Variance (ANOVA) for the evaluation of session number, duration and delivery by those in the Mastery LSRT and Movement LSRT conditions.*

| | Mastery LSRT | | Movement LSRT | | Model Summary | | | |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | DoF | F | *p* | $\eta_p^2$ |
| Session Number ( 1 = not enough, 4 = ideal, 7 = too many) | 4.00 | 0.67 | 4.13 | 0.84 | 1, 17 | .125 | .728 | .008 |
| Session Duration ( 1 = too short, 4 = ideal, 7 = too long) | 4.00 | 1.25 | 4.13 | 0.35 | 1, 17 | .075 | .788 | .005 |
| Session Delivery (1 = *online was much better*, 4 = *the delivery format is indifferent*, 7 = *face to face would have been much better*) | 2.60 | 1.17 | 2.00 | 0.93 | 1,17 | 1.391 | .255 | .080 |

*Note.* All measures use a 1-7 scale; M = mean; SD = standard deviation, DoF = degrees of freedom. Numbers within ( ) indicates possible range of scores for each scale.

## Manipulation Checks

Manipulation checks were performed after each session in order to monitor participation engagement in the sessions, whether participants were performing the imagery as instructed by the primary researcher and whether they found this imagery difficult or easy, with means and standard deviations of each variable reported in Table 9. One-way ANOVAs revealed that there were no significant differences in any of the variables for each session between the Mastery or Movement LSRT groups ($p$'s > .05).

## Evaluation of Intervention's Effectiveness at Regulating Stress

Means, standard deviations, and ANOVA results of group differences in the perceived intervention's effectiveness at reducing stress, helping view stress more positively, and helping to cope with stress are reported in Table 10. Compared to those in the Movement LSRT, participants in the Mastery LSRT group thought the intervention was significantly more effective at reducing their stress levels, helping them view stress more positively, and at helping them to cope with stress.

**Table 9**

*Mean and standard deviations for manipulation checks reported after each session for the Mastery LSRT and Movement LSRT conditions*

| | | Session Engagement | | Imaging as Instructed | | Ease of Imagery | |
|---|---|---|---|---|---|---|---|
| | | M | SD | M | SD | M | SD |
| Session One | Mastery LSRT | 6.30 | 0.82 | 5.30 | 1.16 | 5.50 | 1.17 |
| | Movement LSRT | 6.25 | 0.70 | 5.50 | 1.19 | 5.75 | .70 |
| Session Two | Mastery LSRT | 6.40 | 0.84 | 5.70 | 1.33 | 6.20 | 1.13 |
| | Movement LSRT | 6.25 | 0.88 | 6.25 | 0.70 | 5.88 | 0.64 |
| Session Three | Mastery LSRT | 6.60 | 0.69 | 6.60 | 0.69 | 6.10 | 1.10 |
| | Movement LSRT | 6.50 | 1.06 | 6.25 | 0.70 | 6.00 | 1.06 |
| Session Four | Mastery LSRT | 6.60 | 0.69 | 6.50 | 0.70 | 6.50 | 0.52 |
| | Movement LSRT | 6.38 | 0.91 | 6.63 | 0.51 | 6.50 | 0.75 |

*Note.* All measures use a 1-7 scale; M = mean; SD = standard deviation.

**Table 10**

*Analysis of Variance (ANOVA) between Mastery LSRT and Movement LSRT conditions for variables assessing the effectiveness of each intervention condition*

| | Mastery LSRT | | Movement LSRT | | Analysis Summary | | | |
|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | DoF | F | *p* | $\eta_p^2$ |
| Reducing Stress Levels | 5.80* | 1.03 | 4.50 | 1.51 | 1, 17 | 4.694 | .046 | .227 |
| Helping View Stress as More Positive | 6.30* | 0.95 | 4.00 | 2.07 | 1, 17 | 9.873 | .006 | .382 |
| Helping Cope with Stress | 6.10* | 0.99 | 4.13 | 1.81 | 1, 17 | 8.729 | .009 | .353 |

*Note.* All measures use a 1-7 scale; M = mean; SD = standard deviation; DoF = degrees of freedom, * = significantly greater than the movement LSRT group.

### Mixed Model ANOVAs for Outcome variables

Table 11 displays the means, standard deviations, and results of the 2 time (pre-intervention and post-intervention) by 2 group (Mastery LSRT and Movement LSRT) mixed model ANOVAs for mastery imagery ability, skill imagery ability, challenge and threat appraisals, perceived stress, and proactive coping.

Analyses revealed a significant time effect for mastery imagery ability, skill imagery ability, and challenge appraisal all increasing pre- to post-intervention. There were no other significant time effects, no significant group effects, and no significant time by group interactions in for any of the other mixed model analyses.

### Repeated Measures ANOVAs for Outcome Variables

Repeated measures ANOVAs were conducted to separately examine the impact of each intervention condition on mastery imagery ability, skill imagery ability, challenge appraisal, threat appraisal, perceived stress, and proactive coping, and can be seen in Table 12.

**Mastery imagery ability, skill imagery ability and appraisal states.** The Mastery LSRT condition exhibited a significant increase in mastery imagery ability from pre-intervention to post-intervention. Furthermore, from pre-intervention to post-intervention the mastery LSRT group experienced significant increases in challenge appraisal tendency and significant reductions in threat appraisal tendency. In comparison, there were no differences in participants' mastery imagery ability for the movement group. Adding to this, challenge and threat appraisals did not significantly change pre- to post-intervention for the Movement LSRT group. Neither groups experienced any significant changes in skill imagery ability, however the difference in skill imagery ability for those in the Movement LSRT group was approaching significance.

**Table 11**

*Mixed model ANOVA displaying visit, group and visit by group interactions for mastery imagery ability, skill imagery ability, challenge and threat appraisal, perceived stress and proactive coping for the Mastery LSRT and Movement LSRT conditions from pre-intervention to post-intervention*

| | | Pre-Intervention | | Post-Intervention | | Main Effect for Visit | | | | Main Effect for Group | | | | Visit x Group Interaction | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | SD | M | SD | DoF | F | *p* | $\eta_p^2$ | DoF | F | *p* | $\eta_p^2$ | DoF | F | *p* | $\eta_p^2$ |
| Mastery Imagery Ability (1-7) | Mastery LSRT | 4.83 | 1.01 | 6.00 | 0.79 | 1, 16 | 19.279 | **.000** | .546 | 1, 16 | 3.62 | .075 | .191 | 1, 16 | .393 | .539 | .024 |
| | Movement LSRT | 4.08 | 1.12 | 4.96 | 1.50 | | | | | | | | | | | | |
| Skill Imagery Ability (1-7) | Mastery LSRT | 5.67 | 0.83 | 5.97 | 1.02 | 1, 16 | 6.335 | **.023** | .281 | 1, 16 | .261 | .616 | .016 | 1, 16 | .684 | .420 | .041 |
| | Movement LSRT | 5.17 | 1.17 | 5.96 | 0.88 | | | | | | | | | | | | |
| Challenge Appraisal (1-6) | Mastery LSRT | 4.55 | 0.40 | 4.84 | 0.50 | 1, 16 | 5.182 | **.037** | .245 | 1, 16 | 3.590 | .076 | .183 | 1, 16 | .610 | .446 | .037 |
| | Movement LSRT | 4.18 | 0.43 | 4.33 | 0.74 | | | | | | | | | | | | |
| Threat Appraisal (1-6) | Mastery LSRT | 4.04 | 1.18 | 3.67 | 1.17 | 1, 16 | 4.464 | .051 | .218 | 1, 16 | .054 | .819 | .003 | 1, 16 | 2.257 | .153 | .124 |
| | Movement LSRT | 4.01 | 1.06 | 3.95 | 1.24 | | | | | | | | | | | | |
| Perceived Stress (0-40) | Mastery LSRT | 22.00 | 4.64 | 21.56 | 6.73 | 1, 15 | .602 | .450 | .039 | 1, 15 | 2.874 | .111 | .161 | 1, 15 | .089 | .769 | .006 |
| | Movement LSRT | 18.63 | 3.02 | 17.63 | 3.81 | | | | | | | | | | | | |
| Proactive Coping (14-56) | Mastery LSRT | 40.67 | 4.21 | 41.56 | 3.68 | 1, 15 | .513 | .485 | .033 | 1, 15 | .842 | .373 | .053 | 1, 15 | .004 | .952 | .000 |
| | Movement LSRT | 39.13 | 5.25 | 39.88 | 4.05 | | | | | | | | | | | | |

*Note.* Numbers within ( ) indicates range of scores possible for each scale, bold text indicates significant result; M = mean; SD = standard deviation; DoF = degrees of freedom.

**Table 12**

*Repeated measures ANOVA for the change in mastery imagery ability, skill imagery ability, challenge and threat appraisal, perceived stress and proactive coping for the Mastery LSRT and Movement LSRT conditions from pre-intervention to post-intervention*

| | | Pre-Intervention | | | Post-Intervention | | | Analysis Summary | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | M | SD | α | M | SD | α | DoF | F | *p* | $\eta_p^2$ |
| Mastery Imagery Ability (1-7) | Mastery LSRT | 4.83 | 1.01 | 0.88 | 6.00 | 0.79 | 0.94 | 1, 9 | 41.604 | **.000** | .822 |
| | Movement LSRT | 4.08 | 1.12 | | 4.96 | 1.50 | | 1, 7 | 3.449 | .106 | .330 |
| Skill Imagery Ability (1-7) | Mastery LSRT | 5.67 | 0.83 | 0.87 | 5.97 | 1.02 | 0.91 | 1, 9 | 1.761 | .217 | .164 |
| | Movement LSRT | 5.17 | 1.17 | | 5.96 | 0.88 | | 1, 7 | 4.521 | .071 | .392 |
| Challenge Appraisal (1-6) | Mastery LSRT | 4.55 | 0.40 | 0.49 | 4.84 | 0.50 | 0.83 | 1, 9 | 12.496 | **.006** | .581 |
| | Movement LSRT | 4.18 | 0.43 | | 4.33 | 0.74 | | 1, 7 | 0.577 | .472 | .076 |
| Threat Appraisal (1-6) | Mastery LSRT | 4.04 | 1.18 | 0.93 | 3.67 | 1.17 | 0.95 | 1, 9 | 6.348 | **.033** | .414 |
| | Movement LSRT | 4.01 | 1.06 | | 3.95 | 1.24 | | 1, 7 | 0.211 | .660 | .029 |
| Perceived Stress (0-40) | Mastery LSRT | 22.00 | 4.64 | 0.77 | 21.56 | 6.73 | 0.84 | 1, 8 | 0.080 | .785 | .010 |
| | Movement LSRT | 18.63 | 3.02 | | 17.63 | 3.81 | | 1, 7 | 1.333 | .286 | .160 |
| Proactive Coping (14-56) | Mastery LSRT | 40.67 | 4.21 | 0.76 | 41.56 | 3.68 | 0.57 | 1, 8 | 0.329 | .582 | .040 |
| | Movement LSRT | 39.13 | 5.25 | | 39.88 | 4.05 | | 1, 7 | 0.197 | .670 | .027 |

*Note.* Numbers within ( ) indicates range of scores possible for each scale, bold text indicates significant result; M = mean; SD = standard deviation; α = Cronbach's alpha coefficient; DoF = degrees of freedom.

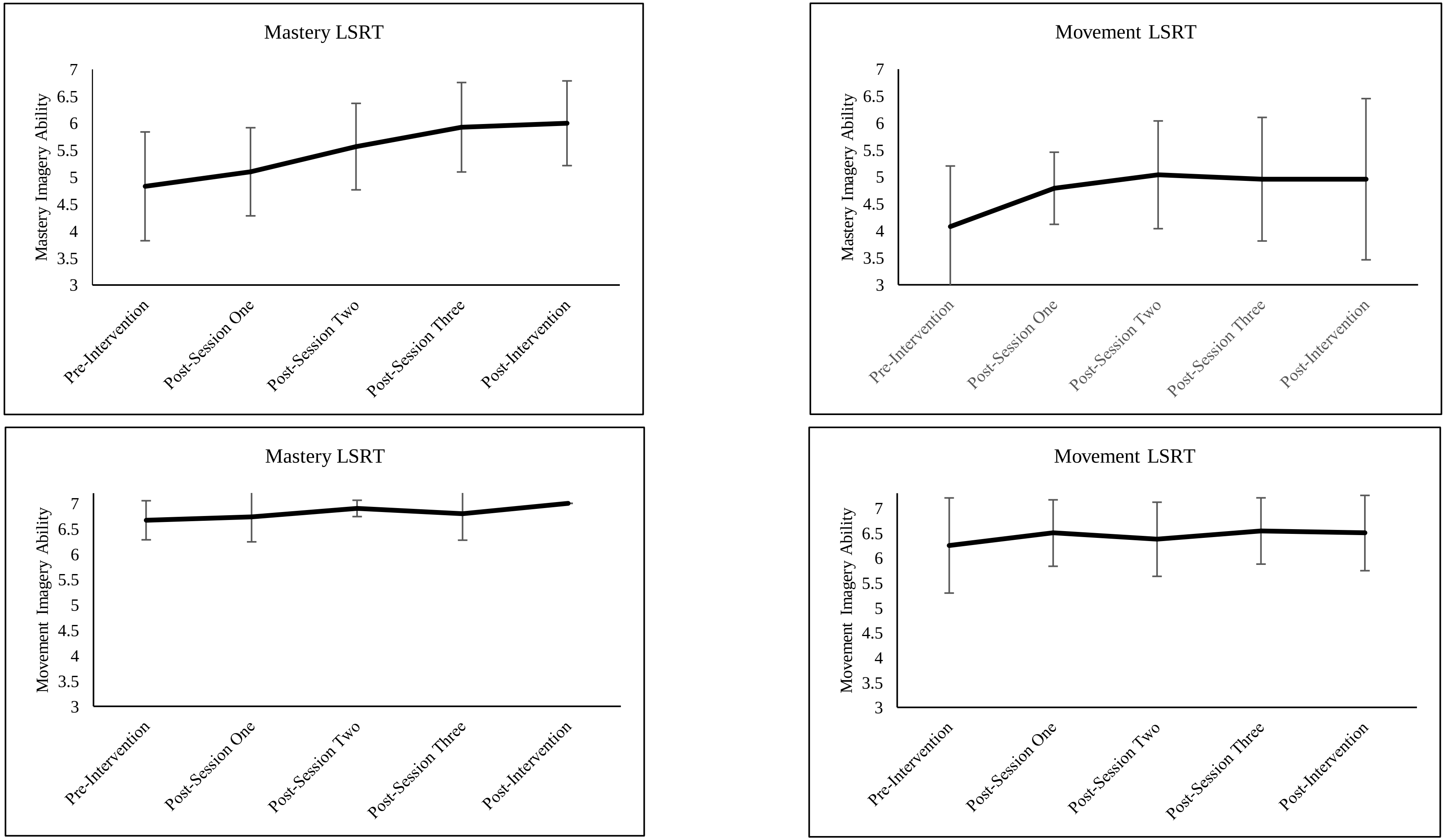
**Perceived stress and proactive coping.** Observed in Table 12, no significant differences were observed in perceived stress or proactive coping from pre-intervention to post-intervention for either the Mastery LSRT or Movement LSRT groups.

**Sessional Changes in Imagery Ability**

Figure 7 displays session changes in mastery imagery ability and movement imagery ability for both intervention groups. Results of the one-way repeated measures ANOVAs showed the Mastery LSRT group exhibited a significant increase in their mastery imagery ability (F[4, 32] = 10.441, $p < .001$, $\eta_p^2 = .566$). Post hoc analysis showed participants reported higher mastery imagery ability in session 4 compared with before the intervention ($p = .004$) after the first session ($p = .010$). The Movement LSRT group reported no significant increase in mastery imagery ability during the intervention (F[4, 28] = 2.698, $p = .051$, $\eta_p^2 = .278$), and neither group exhibited significant increases in movement imagery ability over the course of the four sessions (Mastery LSRT group: F[3.148, 28.334] = 1.631, $p = .203$, $\eta_p^2 = .153$; Movement LSRT group: F[4, 28] = 1.788, $p = .159$, $\eta_p^2 = .203$).

**Figure 7**

*Change in mastery imagery ability and movement imagery ability of Mastery LSRT and Movement LSRT groups session-to-session from pre-intervention to post-intervention*



## Discussion

The present study aimed to assess the effectiveness of an online imagery intervention in improving mastery imagery ability and examining its resulting effects on appraisal states, perceived stress, and proactive coping. By using an online delivery format, this study also aimed to explore the feasibility of using an online intervention rather than using a face-to-face design. It was hypothesised that individuals participating in the Mastery LSRT intervention would experience an increase in their mastery imagery ability and challenge appraisal tendencies, a decrease in threat appraisal tendencies and perceived stress, as well as an increase in proactive coping. In comparison, it was hypothesised that the Movement LSRT (control) condition would experience no change in these variables but would experience an increase in skill imagery ability.

Manipulation checks demonstrated that no differences existed between each intervention condition in terms of participants performing the imagery as instructed, with no differences reported between each condition in terms of how engaged they felt in the sessions and how easy they found the imagery. Alongside this, no significant differences were reported between the session duration of each condition. Taken together, it can therefore be suggested that any differences that existed between each condition only did so because of the content of the respective intervention.

Due to this being a pilot study, it used a small sample size. This is likely to have contributed to the non-significant mixed design ANOVA interactions. However, when analysing the groups independently, results suggest that mastery imagery ability significantly increased from pre-intervention to post-intervention in the Mastery LSRT group, replicating previous research that also suggested a mastery imagery intervention is effective at improving mastery imagery ability (Möller, 2019). The Movement LSRT group experienced no such increases in mastery imagery ability, suggesting that the group effect observed in the mixed design ANOVA was likely to have been driven by the Mastery LSRT group, supporting previous research in this area showing that LSRT is a useful method for improving the targeted type of imagery ability (e.g., mastery, movement; Möller, 2019; Williams et al., 2013).

Whilst these results indicate that the online mastery imagery intervention was successful at increasing mastery imagery ability, due to the lack of statistical power possibly as a result of a low sample size, no significant group or visit by group interactions were observed. However, the repeated measures ANOVA demonstrated that for those in the Mastery LSRT group, mastery imagery ability from pre- to post-intervention displayed a very large effect size ($\eta_p^2$ = .822). Given the lack of significant interactions displayed in the mixed model ANOVA, and that a post hoc power analysis suggests that a sample of at least 54 participants is required to attain sufficient power, future research should seek to increase the statistical power of results by replicating this study using a larger sample.

When examining the changes in mastery and skill imagery ability from session-to-session, the repeated measures ANOVA showed that significant differences only occurred from pre-intervention to post-session four, suggesting that at least four sessions of the intervention are required to elicit changes in one's mastery imagery ability. Whilst the repeated measures ANOVA showed a significant visit effect from pre- to post-intervention for skill imagery ability, further analysis showed that neither group underwent any significant increases in skill imagery ability from pre- to post-intervention. Given previous research shows that LSRT interventions to improve movement imagery ability have been effective (Weibull et al., 2015; Williams et al., 2013), and the repeated measures ANOVA yielded a p value of .071 and effect size of .392, this non-significant finding could have been as a result of a lack of statistical power.

Further results showed that there was a significant main visit effect for challenge appraisal from pre- to post-intervention. Given that with those in the Mastery LSRT group experienced a significant increase in challenge appraisal from pre-intervention to post-intervention, it can be suggested that the main visit effect was driven by the Mastery LSRT group. Adding to this, the repeated measures ANOVA showed that those in the Mastery LSRT group significantly decreased their threat appraisal tendencies from pre-intervention to post-intervention. Taken together, these results suggest that an online mastery imagery intervention is not only effective at increasing one's mastery imagery ability, but is also effective at increasing challenge appraisal tendencies and decreasing the tendency to appraise situations as a threat. Whilst the small sample size means these results cannot be treated with a large degree of certainty, the present study becomes the first to propose that a mastery imagery intervention is effective at altering appraisal states.

Although the increased mastery imagery ability was accompanied by increases in challenge appraisal tendency and a reduction in threat appraisal tendency, this was not accompanied by any changes in perceived stress and proactive coping. This may initially seem somewhat surprising given Chapter 2 of this thesis showed that higher mastery imagery ability is associated with lower levels of perceived stress and greater proactive coping, and that these relationships were mediated by challenge and/or threat appraisal tendencies. However, the disparity in results may exist because participants in the Mastery LSRT condition were specifically asked to image stressful situations that have occurred in the past or possible future stressful situations they may encounter. Given that the measure of perceived stress reflected stressful feelings of the previous two weeks, it is possible that the types of scenarios imaged in the intervention differed from those enquired about by the perceived stress measure, meaning the perceived stress reported by the participant post-intervention may not have been impacted at all by the intervention. Similarly, for proactive coping, proactive coping occurs prior to a stressful event, and aims to prevent the initial stress from occurring (Aspinwall & Taylor, 1997). As the Mastery LSRT intervention focused on imaging feelings of stress and changing one's perceptions of a stressful event, it could be suggested that participants did not engage in more proactive coping as the intervention focused on confronting stress after its onset. Finally, it may be due to the effects of the intervention and changes in stress appraisals needing more time to translate into changes in perceived stress and proactive coping.

Although the intervention did not seem to influence perceived stress and proactive coping, intervention evaluation results show that the Mastery LSRT group felt that the intervention was significantly more effective at reducing their stress levels, helping them view stress more positively, and helping them cope with stress than those in the Movement LSRT group. As the mean scores across these variables for participants in the Mastery LSRT group ranged from 5.80 to 6.30 out of 7 (i.e., participants found the intervention to be effective in regards to these variables), these results suggest that the intervention was looked upon favourably by participants for helping them regulate stress. To examine the intervention's effectiveness more comprehensively, future research could use a longer duration intervention to have assessed whether mastery imagery ability continued to increase after further sessions. In addition to this, follow-up assessments could be included to examine whether increasing mastery imagery ability affects perceived stress levels and the extent to which the stress is viewed positively or negatively, as well as proactive coping in the subsequent weeks and months following the intervention.

An important novelty of the present study was examining the effectiveness of an online delivery method for improving mastery imagery ability. Findings suggest that online LSRT interventions appear effective in improving imagery ability, and that this can translate into changes to other dispositions (e.g., stress appraisals). Adding to this, with mean scores of

2.60 for the Mastery LSRT group and 2.00 for the Movement LSRT group (2 = *online was better than face to face would have been*, 3 = *online was somewhat better than face to face would have been*), both groups believed that an online delivery method would have been better than using a face-to-face method. Whilst previous studies have shown that LSRT interventions are effective at improving imagery ability (Möller, 2019; Weibull et al., 2015; Williams et al., 2013), this study shows the technique is also effective when delivered online. Given the COVID-19 pandemic and technological advancements in video software, having an effective online delivery format provides much more flexibility for researchers, practitioners, and those receiving the training.

Although the present sample was small, this study became the first to conduct LSRT in a younger non-athlete sample. Previous intervention studies have used either athlete-only or women-only samples when investigating the effectiveness of LSRT (Möller, 2019; Williams et al., 2013), meaning results of this study further expand the generalisability of LSRT. However, a limitation of the present study is that the average age of the sample was only 19, with no participants aged over 21. As research suggests imagery ability declines with age (Cumming & Williams, 2012), it is important future research examines the effects of LSRT in older samples to further increase the generalisability of the training method.

The main limitation of the present study is the small sample size. While the ANOVA interactions were non-significant, the separate pre- to post-intervention repeated measures ANOVAs for each group suggested that the intervention appeared to be effective. Although the increased number of tests could have resulted in a Type 1 error, it is important to note that the number of significant findings that emerged are in line with what was hypothesised, and more frequent than what would be expected as a Type 1 error based on the number of tests run. Consequently, it appears that the study was underpowered. This can be further supported by a post hoc power analysis suggesting that for a medium effect, a sample size of 54 was needed to reach sufficient power for mixed-model ANOVAs. Whilst this study was a pilot study to assess the feasibility of an online intervention, future research should seek to replicate this study using a larger sample (e.g., 30 in each group) to increase the statistical power and enable more concreate conclusions to be drawn from the findings. Furthermore, the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011) which was used to measure mastery and skill imagery ability was designed and validated for use in an athlete population. However, since this is the only validated measure of mastery and skill imagery ability, and had been shown to produce reliable and valid results in previous non-athlete samples (Beevor et al., under review; Möller, 2019), it was deemed appropriate to use during this study. That being said, it is recommended that future research seeks to develop and validate a mixed athlete and non-athlete measure of mastery and skill imagery ability.

A large number of statistical tests were conducted in the present study increasing the likelihood of a Type 1 error. One approach could have been to conduct a bonferroni correction. Due to the small sample size the results of the present study are already underpowered. Therefore, this more conservative approach of increasing the probability of detecting false negatives (i.e., reducing statistical power even more) was not applied. As a result, findings should be interpreted with caution and future research should re-examine the findings using a larger sample size and conducting an alpha correction to reduce the chance of a Type 1 error occurring.

A further point of consideration for future research is to use objective measures of stress. Given that the measures used in this study are self-report measures that are susceptible to bias which could have resulted in inaccurate scores for different variables, future research should aim to include a wider range of indicators of stress such as cardiovascular responses. Adding to this, it would also be prudent to replicate this study with a two-week follow up in order to examine the impact of an increased mastery imagery ability on the real-life stress experienced in the following two weeks of the intervention.

In conclusion, the present study has demonstrated that an online LSRT intervention is well received by participants and appears to be effective at increasing imagery ability and eliciting more adaptive stress appraisals. Furthermore, participants perceived the intervention to help reduce their stress levels, viewing stress as more positively, and cope with it better. Whilst these results are promising, the small sample size meant the findings were underpowered. As such, future research should build on this pilot work and replicate the study on a larger scale with more participants and follow-up measures to be able to draw more definitive conclusions about the effectiveness of the intervention on regulating and coping with stress.

# Chapter Four

# General Discussion

## General Discussion

This thesis aimed to explore the relationships between mastery imagery ability, appraisal states, perceived stress, and proactive coping, as well as assess any changes in these variables through increasing mastery imagery ability. Chapter 2 of this thesis conducted two cross-sectional studies to examine the mediating role of appraisal states on relationships between mastery imagery ability, perceived stress and proactive coping, and compared the robustness of these findings in two different samples.

Consistent across both studies of the cross-sectional element of this thesis (Chapter 2), associations were found between a greater mastery imagery ability and greater challenge appraisal tendency, extending the body of literature in this area which shares these associations (Quinton et al., 2018; Williams & Cumming, 2011; 2012b). However, by examining these associations in a mixed athlete and non-athlete sample, this research becomes the first to uncover a relationship between mastery imagery ability and challenge appraisal in the general population. Also consistent across both studies of Chapter 2, mastery imagery ability was found to share a significant negative association with perceived stress levels, whereby those with a higher mastery imagery ability reported lower levels of perceived stress, supporting relatively novel research that also reported these associations (Beevor et al., under review; Möller, 2019). Mastery imagery ability was also found to be associated with proactive coping, becoming the first study to find these associations.

Whilst consistent associations were found between other variables, the relationship between mastery imagery ability and threat appraisal was inconsistent, with the first study showing a negative association and the second study showing no association. This mixed finding is in line with previous research that has also shown mixed associations between mastery imagery ability and threat appraisal (Williams & Cumming, 2012b), suggesting more research is needed in this area to establish more consistent conclusions about the relationship between mastery imagery ability and threat appraisal tendencies.

Stress appraisal tendencies were shown to have a significant, mediating role in the relationship between imagery ability and perceived stress. Whilst threat appraisal was shown to mediate the mastery imagery ability-perceived stress relationship in study one, challenge appraisal was shown to mediate this relationship in study two. Crucially, these results show that appraisal states do play a mediating role in this relationship, however more research is warranted to establish when challenge appraisal or threat appraisal is more likely to mediate this relationship. More consistent was the mediating role of stress appraisals in the relationship between mastery imagery ability and proactive coping with challenge appraisal mediating this relationship across both studies. Although research shows that those who possess a greater ability to proactively cope are more likely to appraise situations as challenges (Greenglass & Fiksenbaum, 2009), the finding that challenge appraisal mediates this relationship emphasises the importance that appraisal states have on one's ability to proactively cope. The present thesis is the first to show that challenge and threat appraisal tendencies play a mediating role on the relationships between mastery imagery ability, perceived stress and proactive coping.

This research is the first to show that mastery imagery ability relates to perceived stress and proactive coping via challenge and threat appraisal tendencies. It therefore provides a proposed mechanism for how mastery imagery ability relates to perceived stress and proactive coping (i.e., via predicting more/less adaptive stress appraisals) and highlights which appraisal tendency (challenge or threat) seems to be the stronger mediator explaining the relationships. As such, the findings can be used to inform future research and interventions of the importance of targeting mastery imagery ability and challenge appraisal tendencies as potential constructs to elicit lower perceived stress and better proactive coping.

Chapter 3 progressed the work of Chapter 2 by assessing the effectiveness of a 2-week online intervention at improving mastery imagery ability and examined any resulting differences in challenge and threat appraisal tendencies, perceived stress, and proactive coping. Results suggest that the online Mastery LSRT intervention was effective at increasing mastery imagery ability from pre- to post-intervention compared to a control group. In comparison to previous research that showed movement LSRT to be effective at increasing movement imagery ability (Williams et al., 2013), this research supports a previous pilot study that found a mastery LSRT intervention to be effective at increasing mastery imagery ability (Möller, 2019). Although, both the present research and previous research contained small sample sizes, both suggest that four sessions of LSRT are sufficient to elicit changes in imagery ability (Möller, 2019; Williams et al., 2013). Future intervention studies should therefore seek to use four imagery sessions when aiming to improve imagery ability using LSRT.

The online intervention also assessed any accompanied changes in stress appraisal tendencies, perceived stress, and proactive coping as a result of improving mastery imagery ability. Results suggest that the increase in Mastery imagery ability was accompanied by increases in challenge appraisal tendency and decreases in threat appraisal tendency from pre- to post-intervention, suggesting that an online Mastery LSRT intervention to improve mastery imagery ability is also effective at altering appraisal states. This is important as it suggests the relationships identified in Chapter 2 between mastery imagery ability and challenge and threat appraisal tendencies are in fact causal and that improving mastery imagery ability is likely to result in a greater likelihood to appraise situations as challenges.

However, despite Chapter 2 showing associations between mastery imagery ability, perceived stress and proactive coping, the online intervention did not result in any meaningful changes in perceived stress or proactive coping. Despite results showing no changes in perceived stress levels or proactive coping tendencies, intervention evaluation data suggested that individuals in the Mastery LSRT group believed the intervention was effective at helping them reduce their stress levels, to view stress more positively and help them cope with stress. This suggests that the intervention could be effective at regulating stress levels but the present study failed to capture this. As discussed in Chapter 3, future research should use follow-up assessments to determine whether any changes in perceived stress and proactive coping occur at a later date. Furthermore, a greater in-depth assessment of individual's psychological stress maybe another way to determine any changes.

Whilst the strengths and limitations of specific chapters have been discussed, there are some key overarching limitations of this thesis. Firstly, the measures used across this thesis were self-report, meaning the data collated could have been subject to participants being dishonest in their answers and not providing a true reflection, it would be prudent for future research to approach this area using a multi-disciplinary approach in order to gather objective measures of participants' stress levels (e.g., measuring heart rate). Similarly, throughout this thesis the measure used for mastery imagery ability was from the Sport Imagery Ability Questionnaire (SIAQ; Williams & Cumming, 2011), which is a verified measure within athletes and not the general population. Although the SIAQ has demonstrated good psychometric properties in non-athlete populations, it is important that future research develops a measure of mastery imagery ability that includes content specific designed with the general population in mind. Additionally, future research should employ qualitative research techniques (e.g., interviews, focus groups) to gain a more detailed insight into when mastery imagery is most effective at regulating appraisals and why it is effective.

Finally, in all studies the samples had to meet the criteria of being 18 - 35 years old as well as having no present diagnosed mental health disorder. While this makes the findings generalisable to young non-clinical populations, the results cannot be generalised to different clinical populations or those over the age of 35. By examining the associations between mastery imagery ability, challenge and threat appraisals, perceived stress and proactive coping, future research should aim to assess the replicability of this research in clinical populations and those aged over 35 to assess the generalisability of the thesis results. That being said, by using a mixed-gender, mixed athlete and non-athlete sample in Chapter 3, in comparison to a study that used a female-only sample to test a mastery imagery ability intervention (Möller, 2019), Chapter 3 does possess a good degree of generalisability to the general population.

A further strength of this thesis is the use of both cross-sectional and experimental research design. By utilising a cross-sectional design in Chapter 2, associations between a number of variables were established. Chapter 3 could then investigate these relationships in more depth by utilising an experimental design to be tested for cause-and-effect. By designing the thesis in this way, a highly detailed and extensive investigation of the effects of mastery imagery ability could be carried out. Future research should continue to examine the effects of mastery imagery ability on different aspects of stress and coping. Additionally, based on the revised TCTSA (Meijen et al., 2020), this future work should incorporate physiological measures such as cardiac output and total peripheral resistance, or by incorporating additional measures of appraisal states in order to provide a more comprehensive assessment of challenge and threat appraisals. Future work should also test aspects of the TCTSA-R (Meijen et al., 2020) by examining how mastery imagery relates to trait appraisals and how trait appraisals influence the effects of mastery imagery on changing state challenge and state threat appraisals. In a similar sense, research should also seek to identify the optimal length of mastery imagery interventions and examine these interventions using different populations to establish under which conditions, and in what populations, mastery imagery interventions are most effective.

In conclusion, the present thesis has explored associations between mastery imagery ability, challenge and threat appraisal tendencies, perceived stress, and proactive coping. It has demonstrated that appraisal states could be a potential mechanism through which mastery imagery ability relates to lower levels of perceived stress and greater proactive coping. By using an experimental design, the results of this thesis have suggested that an online mastery imagery intervention using LSRT is effective at improving mastery imagery ability as well as increasing challenge and reducing threat appraisal tendencies. But future work needs to establish whether these changes in stress appraisals also result in lower perceived stress and more proactive coping. Given the success of using an online delivery format in improving one's mastery imagery ability, this thesis has shown a feasible and cost-effective alternative to using a face-to-face intervention format to increase imagery ability and help people appraise stress more positively.

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