INVESTIGATING UNIQUE PROFILES OF POSITIVE AND NEGATIVE IMAGERY ABILITY WITH STRESS AND EMOTION REGULATION

by

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Abstract

The objective of this thesis was to determine whether unique profiles of positive and negative imagery ability exist, and if so, to evaluate the effects of these profiles on stress and emotion regulation outcomes. A thorough review of the literature was first provided in Chapter 1. This was followed by Chapter 2, which investigated the potential existence of imagery ability profiles in a large cross-sectional sample using multivariate cluster analysis. This chapter also examined whether these imagery ability profiles were differentially associated with emotion regulation strategies, perceptions of stress, and general anxiety. Next, Chapter 3 investigated whether the unique imagery ability profiles identified in Chapter 2 could be replicated in a different sample. This chapter also examined whether these profiles differentially impacted stress, anxiety, and emotional responses to experimental manipulations of guided imagery to elicit challenge and threat appraisals. In summary, three imagery ability profiles were identified: Higher overall imagers, higher positive/lower negative imagers, and lower overall imagers. Notably, higher positive/lower negative imagers demonstrated a unique capacity for stress regulation and well-being, marked by adaptive emotion regulation, lower perceived stress, lower general anxiety, skillful utilization of positive imagery, and resilience to negative imagery. This thesis is novel in that it represents the first attempt to identify unique profiles of positive and negative imagery ability, as well as determine whether certain profiles are more (or less) suited to adaptive stress responding and emotion regulation, both in everyday life, and in response to guided imagery of stress-evoking situations. The results of this research could have significant implications for future stress intervention studies, as it may lead to the development of targeted interventions to enhance specific types of imagery ability, which could ultimately improve the optimization of stress responses to reach desired goals, rather than just reducing or avoiding stress.

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List of Abbreviations

Imagery Terms

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

Questionnaires and Theories

E-ERQ	Extended Emotion Regulation Questionnaire
EIQ	Ease of Imagery Questionnaire
EPM	Extended Process Model of Emotion Regulation
ERQ	Emotion Regulation Questionnaire
HADS	Hospital Anxiety and Depression Scale
IAMS	Immediate Anxiety Measurement Scale
PANAS	Positive and Negative Affect Schedule
PSS	Perceived Stress Scale
RAMDIU	Revised Applied Model of Deliberate Imagery Use

Analysis Terms

SD	Standard Deviation
ANOVA	Analysis of Variance
ANCOVA	Analysis of Covariance
B-H	Benjamini-Hochberg
EMA	Ecological Momentary Assessment

CHAPTER ONE

General Introduction

Investigating Unique Profiles of Positive and Negative Imagery Ability with Stress and Emotion Regulation

Defining the Problem: Stress and Disease

It is well established that psychological stress is a risk factor for adverse mental and physical health outcomes (Cohen et al., 2007; Epel et al., 2018; Lupien et al., 2009). Although many definitions of stress have been put forward (Lazarus & Folkman, 1984), stress can broadly be defined as "the experience of encountering or anticipating adversity in one's goal-related efforts" (Carver & Connor-Smith, 2010, p. 684). In turn, the "stress response" is the body's nonspecific response (e.g., physiological, behavioral, and emotional) to the demands made upon it through the experience of stress (e.g., Crum et al., 2020; Selye, 1974). In the short-term, this response is believed to be adaptive, resulting in the mobilization of physiological and cognitive resources needed to meet the demands of the situation at hand (Gianaros & Jennings, 2018; Sapolsky, 1996; Schneiderman et al., 2005). However, in the long-term, continued activation of these responses can lead to eventual wear and tear on the body, thus placing individuals at increased risk for mental and physical disease (Cohen et al., 2016; Cohen et al., 2007; O'Connor et al., 2021). As a result, stress is typically regarded in the literature as debilitative, and much focus has been placed on finding ways to reduce or avoid stress altogether (Crum et al., 2013; 2020). Unfortunately, avoiding or reducing stress exposure is not always a possibility, and recent research has argued that individuals should instead focus on improving their responses to stress, in order to facilitate more beneficial stress-related outcomes (Crum et al., 2013).

Optimizing Stress Responses: A Theoretical Model

Stress optimization is a recently developed approach for regulating stress responses (Crum et al., 2020; Jamieson et al., 2018) and is based on three keys areas of foundational

research, namely, *stress mindset*, which derives from mindset theory (Crum et al., 2013), *stress reappraisal*, which derives from the biopsychosocial model of challenge and threat (Blascovich & Tomaka, 1996; Jamieson et al., 2010), and *emotion regulation dynamics*, which derive from the extended process model of emotion regulation (Gross, 2015). In brief, the stress optimization approach explains how altered valuations of stress (from "stress is bad" to "stress is good") lead to changes in regulatory goals (from "reducing stress" to "optimizing stress"), which can be further facilitated and maintained through various regulatory strategies (Crum et al., 2020). Each of these key areas of research are described in more depth below.

Stress Mindset

Stress mindset refers to the general attributes and expectations that an individual holds regarding the experience of stress (Jamieson et al., 2018). In other words, "stress mindset refers to the evaluation of *the nature of stress itself* as enhancing or debilitating" (Crum et al., 2013, p. 718). An individual who holds a "stress-is-debilitative mindset" tends to believe that the experience of stress is debilitative or harmful to performance, health, and well-being outcomes. In contrast, an individual who holds a "stress-is-enhancing mindset" tends to believe that the experience of stress can enhance or improve performance, health, and well-being. These perceptions of stress have been shown to be associated with how individuals respond to stress. Indeed, correlational evidence shows that a stress-is-enhancing mindset is associated with more adaptive physiological responding, increased life satisfaction, and decreased anxiety and depression (e.g., Crum et al., 2013). Experimental evidence also provides support for the effectiveness of stress mindset interventions, which have been found to successfully improve physiological responding, emotional responding, work performance, and general health outcomes (e.g., Crum et al., 2013; Goyer et al., 2018).

Stress Reappraisal

Stress reappraisal differs from stress mindset in that it is focused primarily on altering appraisals of demands and resources within a specific stressful situation, rather than focusing on beliefs about the nature of stress in general (Jamieson et al., 2018). Stress reappraisal interventions are based upon the biopsychosocial model of challenge and threat, which provides a theoretical rationale for how cognitive appraisals of situational demands (i.e., perceived uncertainty, danger, and effort) and personal coping resources (i.e., skills/abilities, knowledge, familiarity, dispositions, and social support) interact to determine either a challenge- or threat-like stress response in motivated performance situations (Blascovich & Mendes, 2000;2010; Blascovich & Tomaka, 1996). A *challenge* state is induced when an individual perceives themselves to have sufficient personal resources to handle the demands of the situation at hand (Blascovich & Mendes, 2010). In contrast, a *threat* state is induced when an individual perceives themselves to have insufficient resources to handle the situational demands (Blascovich & Mendes, 2010). Both states can be identified by distinct patterns of physiological responding, such that a challenge response is marked by increased cardiac efficiency and dilation of vasculature, whereas a threat response is marked by decreased cardiac efficiency, constriction of vasculature, and release of cortisol (Seery, 2011). Challenge responses are also associated with higher self-efficacy, perceived control, and confidence, as well as approach motivation, facilitated performance, and more adaptive emotional experiences. In contrast, threat responses are associated with lower self-efficacy, perceived control, and confidence, avoidance motivation, debilitated performance, and less adaptive emotional experiences (Blascovich et al., 1999; Moore et al., 2012; Turner et al., 2013; 2014; Williams & Cumming, 2012b).

Stress reappraisal interventions aim to improve stress responses by inducing a challenge state and its associated responses through altering appraisals of stress-related physiological arousal. For example, during the intervention, participants are informed that the physiological arousal they experience in response to stress can actually be viewed as a functional resource that improves their performance (e.g., Jamieson et al., 2010). Arousal reappraisal interventions are associated with better performance, more adaptive physiological arousal, and even lower levels of self- or observer-reported anxiety in response to stress (e.g., Beltzer et al., 2014; Jamieson et al., 2010; 2012; 2016; 2018; John-Henderson et al., 2015).

Anxiety is a common stress-related outcome, and consists of feelings of worry and concern, as well as increases in physiological arousal (Buss et al., 1955). Indeed, acute psychological stress exposures in the laboratory have been found to elicit feelings of anxiety in anticipation of, as well as during, the stress exposures (Jamieson et al., 2016; Trotman et al., 2018; Williams et al., 2017). Interestingly, arousal reappraisal has also been shown to alter the directional interpretation of anxiety, such that individuals assigned to an arousal reappraisal condition reported more facilitative (i.e., helpful) interpretations of their anxiety compared to controls (Ginty et al., 2022; Moore et al., 2015). This is in line with Jones' (1995) model of facilitative and debilitative anxiety, which states that perceptions of anxiety symptoms (i.e., facilitative or debilitative) are influenced by various factors, including but not limited to perceived control, beliefs about coping abilities, and expectancies of goal attainment (Jones, 1995; Jones & Hanton, 1996). Indeed, while a challenge state is associated with more facilitative interpretations of anxiety symptoms, a threat state is typically associated with more debilitative interpretations of anxiety (Moore et al., 2012; 2013; Williams et al., 2010).

Emotion Regulation Dynamics

Emotion regulation is most commonly referred to as the modification of which emotion is being experienced, when it manifests, and how exactly it is expressed outwardly (Gross, 1998). When faced with a stressful situation, emotion regulation enables an individual to evaluate the emotional significance of the situation and decide the appropriateness of different emotional reactions, as well as when and how they are expressed (Wang & Saudino, 2011). While there are numerous frameworks for conceptualizing the various ways in which individuals regulate their emotions (refer to, Gratz & Roemer, 2004; Koole et al., 2009; Larsen, 2000; Parkinson & Totterdell, 1999; Thayer et al., 1994), perhaps the most common and widely accepted framework is Gross's (1998) process model of emotion regulation, and more recently, the extended process model of emotion regulation (Gross, 2015).

The original process model of emotion regulation (1998) provides a useful framework for categorizing emotion regulation into different types of strategies, depending upon when they are employed in the timeline of the developing emotional response (for review, see Gross, 2015). For example, strategies that are employed early (i.e., before an emotional response is fully developed) are often referred to as "antecedent-focused" strategies, whereas strategies that are employed late (i.e., after an emotional response is fully developed) are referred to as "response-focused" strategies. Antecedent-focused strategies include situation selection (e.g., avoiding a stressful situation that is expected to be emotionally evocative), situation modification (e.g., making direct changes to a stressful situation in order to alter its emotional impact), attentional deployment (e.g., engaging in selective attention or distraction as a way to either avoid or focus on particular emotional components of a stressful situation), and cognitive change (e.g., reappraising a stressful situation or one's capacity to handle it). In contrast, response-focused

strategies involve some form of modulation of an emotional response that is already underway (e.g., suppressing the experience or expression of a stress-induced emotional response).

Extensive research has shown that antecedent-focused strategies are most effective at reducing negative affect and even physiological arousal in response to stressful or emotional stimuli (for review, see Gross, 2014). *Cognitive reappraisal*, a type of antecedent-focused strategy, has been deemed particularly adaptive, such that the habitual use of reappraisal has been associated with increased positive affect and decreased negative affect, as well as lower perceived stress, anxiety, and depression (Balzarotti et al., 2017; Chervonsky & Hunt, 2019; Gross, 1998; Gross & John, 2003; Webb et al., 2012). Alternatively, response-focused strategies, such as *expressive suppression*, are often associated with worse psychological outcomes, such as decreased positive affect and increased negative affect, as well as greater anxiety and depression (Gross, 1998; Gross & John, 2003; Gross & Levenson, 1997; Nolen-Hoeksema & Aldao, 2011; Webb et al., 2012). Even more, when examining the impact of different emotion regulation strategies on anxiety responses to a stressor, a prior study found that situational reappraisal (i.e., reappraising the stress task as non-threatening) was significantly more effective at regulating physiological arousal and subjective feelings of anxiety in response to the stressor compared to expressive suppression (Hofmann et al., 2009).

The extended process model of emotion regulation (EPM; Gross, 2015) builds upon the framework of the previous model by also introducing the concept of *valuation* (i.e., is this emotion "good for me", or "bad for me"). In the extended framework, emotion generation and emotion regulation are regarded as two separate but overlapping processes. Emotion generation occurs as a first-order process (also referred to as the first-level valuation system), during which an environmental stimulus (e.g., having to give a presentation) is perceived and evaluated

compared to one's target goals (e.g., giving the presentation is necessary to get a desirable job), and thus gives rise to an emotional response (e.g., anxiety). However, if the emotional response is incongruent with one's target goals (e.g., my anxiety is negatively affecting my performance), a second-order process is engaged to regulate or modify the original emotion (also referred to as the second-level valuation system). In this case, the environmental stimulus is now the emotion (e.g., anxiety), which is perceived and evaluated (e.g., as harmful or helpful to my performance), thus giving rise to various emotion regulation strategies to modify the original emotional experience (e.g., up- or down-regulate the experience of anxiety; refer to Figure 1.1). As mentioned above, emotion regulation strategies can be implemented at any stage of the emotion generation process (e.g., changing the emotion, changing how the emotion is perceived/valued, or changing the behavioral response to the emotion).

In sum, the stress optimization approach (Crum et al., 2020) argues for the integration of the stress mindset and stress reappraisal literatures within the EPM framework of valuation and strategy implementation. This approach aims to facilitate adaptive second-level valuations of stress (i.e., stress and stress responses can be good for me) and in doing so, change the goal of stress regulation from the "reduction of stress" to the "optimization of stress" (i.e., how can stress help me to reach my valued goals?). The facilitation of stress optimization can then be achieved through the flexible use of various regulatory strategies.

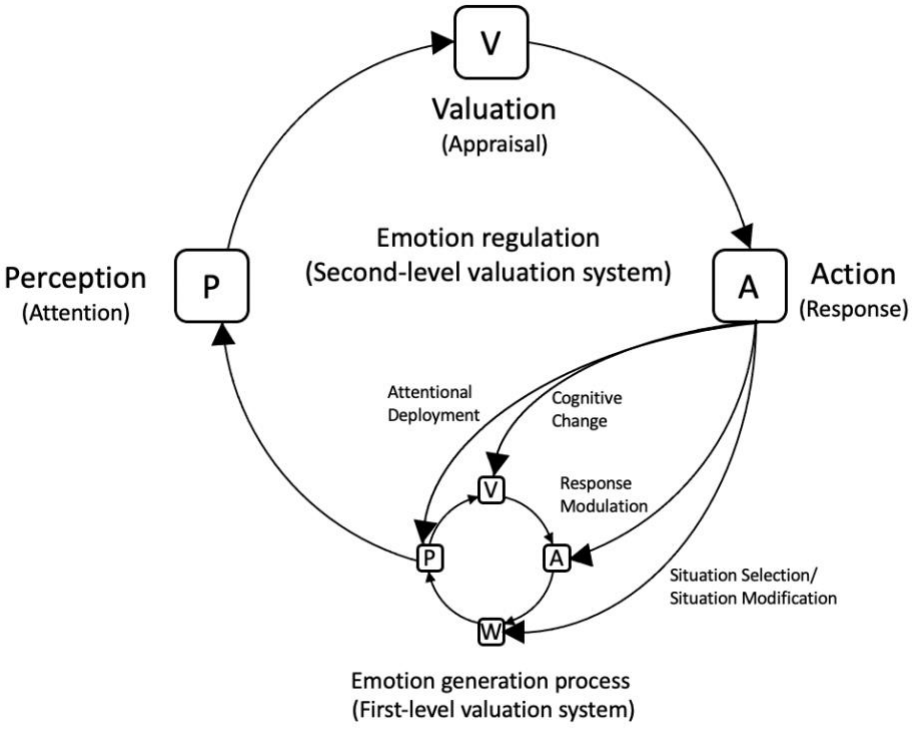


Figure 1.1. Emotion regulation as a second-level valuation system operating on the first-level valuation system that is generating emotion.

Note. Copyright © 2020 by American Psychological Association. Reproduced with permission. Crum, A. J., Jamieson, J. P., & Akinola, M. (2020). Optimizing stress: An integrated intervention for regulating stress responses. *Emotion, 20,* 120. https://doi.org/10.1037/emo0000670. W = world (the environmental stimulus); P = perception (what aspects of the stimulus the valuation system is paying attention to in that moment); V = valuation (the evaluation of that perception compared to one's target goals as either good for me, bad for me, or indifferent); A = Action (the cognitive, emotional, and behavioral responses to that valuation). In the present model, the "action" impulses consist of emotion regulatory strategies, which differentially target the various stages of the original emotion generation process in efforts to alter its impact.

Imagery as a Stress Optimization Strategy

One potential stress optimization technique that has been shown to reliably alter stress mindsets, arousal appraisals, and emotion regulation is that of *mental imagery* (Holmes & Matthews, 2010; Keech et al., 2021; Williams et al., 2010). Imagery has been previously defined

as a cognitive experience that mimics a real experience (White & Hardy, 1998). It involves "using all the senses to recreate or create an experience in the mind" (Vealey & Walter, 1993, p. 201), such that "we can be aware of 'seeing' an image, feeling movements as an image, or experiencing an image of smell, tastes, or sounds without actually experiencing the real thing" (White & Hardy, 1998, p. 389). Imagery differs from dreaming, such that individuals are self-aware, awake, and conscious when imaging (Richardson, 1969; White & Hardy, 1998).

Prior research has established imagery as an effective intervention strategy for regulating stress appraisals and responses (Cumming et al., 2007; Williams & Cumming, 2012a; Williams et al., 2010;2017). Lang's (1979) bioinformational theory proposes that imagery is comprised of three types of propositions, namely, *stimulus* propositions (i.e., specific details of the imagery scenario), *response* propositions (i.e., physiological and affective responses to the scenario), and *meaning* propositions (i.e., how the response propositions are perceived by the individual). The type of meaning propositions included in an imagery script will typically determine whether the imagery and the subsequent response propositions are perceived as facilitative (i.e., positive meaning propositions) or debilitative (i.e., negative meaning propositions). For example, different types of imagery scripts have been shown to differentially alter cognitive appraisals of upcoming stressful scenarios, such that imagery scripts including positive meaning propositions (i.e., being able to cope, being in control, having high self-confidence) have been found to elicit increased confidence and challenge appraisals in both athletic and non-athletic participants (Cumming et al., 2007; Williams & Cumming, 2012a; Williams et al., 2010; 2017). While participants also reported higher anxiety levels in response to these scripts, their anxiety was perceived as more facilitative (i.e., helpful), thus indicating that this type of imagery is successful at promoting the reappraisal of a stressful scenario as more positive. In contrast, imagery scripts

including negative meaning propositions (i.e., being unable to cope, not being in control, having low self-confidence) have been found to elicit decreased confidence and greater threat appraisals, as well as more debilitative anxiety interpretations and even higher cardiovascular responses (Cumming et al., 2007; Williams & Cumming, 2012a; Williams et al., 2010; 2017).

Imagery has also been shown to be effective at altering the experience of positive and negative emotions in both clinical and non-clinical samples (Holmes et al, 2007; 2008a; 2016; Holmes & Matthews, 2010; Pile et al., 2021). Prior experimental studies reveal that participants who were asked to generate imagery in response to emotionally-valenced cues reported congruent changes in positive and negative affective states (Holmes et al., 2006, 2008b; Pictet et al., 2011; Stopa et al., 2012). This is in contrast to participants who were asked to verbally process the same emotional stimuli and reported no comparable changes in affective states (Holmes & Mathews, 2005; Holmes et al., 2008b). In fact, research has coined imagery as an "emotional amplifier" of both positive and negative affective states and is believed to play a key role in various emotional disorders (Holmes et al., 2008a; Holmes & Matthews, 2010). As such, imagery has been identified as a promising intervention technique for up-regulating positive emotions and down-regulating negative emotions in clinical and non-clinical samples (Holmes & Matthews, 2010), and thus may also be a potentially useful regulatory strategy to employ for the purpose of stress optimization.

All in all, it is clear that imagery can be used for a variety of purposes, such as modifying cognition and regulating arousal and emotions, as mentioned above (Martin et al., 1999). These types of images are proposed to serve a motivational function, and reside within the "motivational general" (MG; i.e., images to alter arousal and mastery) category of Paivio's (1985) original imagery framework. Other functions within Paivio's framework include

motivational specific (MS; i.e., images to achieve goals), cognitive general (CG; i.e., images to improve strategies and routines), and cognitive specific (CS; i.e., images to refine skills). This framework was later extended by Hall et al. (1998) to include additional subdimensions of the MG category, namely, motivational general-arousal (MG-A; i.e., images to regulate affect and arousal) and motivational general-mastery (MG-M; i.e., images to increase confidence, resilience, and positivity in the face of challenges). It has been argued that for imagery to be effective, individuals should utilize content that helps facilitate the primary function of why they are imaging (Cumming & Williams, 2013; Martin et al., 1999)[1]. While this may vary greatly across individuals (e.g., different imagery content can serve different functions for different people), for the most part, it appears that images of positive emotions, or images of successfully overcoming challenges, are some of the most effective content for coping with stress and regulating emotions (e.g., MG-M and MG-A functions; Holmes et al., 2006; Pictet et al., 2011; Williams & Cumming, 2012a; Williams et al., 2010; 2017). As such, if the desired outcome is stress optimization (as is the case with the present thesis), then imagery interventions should consist of imagery content that best serves MG-A and MG-M functions.

The Role of Imagery Ability

In addition to ensuring that the content appropriately addresses the function of the imagery, the effectiveness of an imagery intervention also depends on *imagery ability* (Cumming & Williams, 2013), which can be defined as "an individual's capability to form vivid, controllable images and retain them for sufficient time to effect the desired imagery rehearsal" (Morris, 1997, p. 37). While this ability is present in most individuals, it can vary from high to

[1] The effectiveness of an imagery intervention to meet desired outcomes also greatly depends on "imagery meaning" (i.e., an individual's perception of an image as either facilitative or debilitative). However, for the purposes of this thesis, imagery meaning was not examined.

low ability (Paivio, 1985). Imagery ability is not a fixed trait, but rather can be modified through time, effort, and practice (Cumming & Williams, 2012; Cumming et al., 2016). The revised applied model of deliberate imagery use (RAMDIU; Cumming & Williams, 2013) provides a useful framework for understanding the role of imagery ability in the process of deliberate imagery use. Firstly, imagery ability is proposed to moderate the relationship between one's use of imagery and the outcomes experienced, such that individuals who are better at imagery (i.e., are able to image with greater ease and vividness) will benefit more from imagery interventions when compared to those who find it more difficult to image (Gregg et al., 2005; Robin et al., 2007; Williams et al., 2013). Imagery ability is also proposed to play a direct role in what an individual images (i.e., imagery content), as well as how they image (i.e., imagery characteristics). In other words, an individual may select a certain type of imagery content based on the simple fact that it is the easiest for them to image. This is an important distinction, as research suggests that imagery ability is not an all-encompassing trait, but instead varies based on the content being imaged (Paivio, 1985). For example, images involving affective content (e.g., feelings and emotions) are typically reported as the easiest images to generate, whereas images involving mastery content (e.g., overcoming challenges) tend to be significantly more difficult (Simonsmeier & Buecker, 2017; Williams & Cumming, 2011; Williams et al., 2023).

In addition to imagery ability influencing the effectiveness of imagery use, imagery ability is also associated with certain psychological constructs. From a stress and coping perspective, positive affect and mastery imagery ability (in the absence of imagery use) are associated with greater trait confidence, more adaptive stress appraisals, and a more positive stress mindset, as well as lower perceived stress, anxiety, and depressive symptoms in both athlete and non-athlete specific samples (Quinton et al., 2018; Williams & Cumming, 2012b;

2015; Williams et al., 2021; 2023). This is in contrast to other types of imagery ability (e.g., cognitive imagery ability, such as skills or strategies), which have been found to be unrelated to coping with stress and anxiety in athletic samples only (Williams & Cumming, 2012b; 2015). Interestingly, only one study to date has examined imagery ability with emotion regulation strategies, such that the habitual use of cognitive reappraisal positively predicted the ability to image five types of imagery that athletes use in relation to their sport (i.e., skill, strategy, goal, affect, and mastery), with the strongest prediction being mastery imagery ability (Anaur et al., 2017). Expressive suppression did not predict any of the five types of imagery ability. Nevertheless, research investigating the relationships between imagery ability and emotion regulation is still in its infancy, and as such, it is important to examine other emotion-related outcomes that may be associated with mastery and affect imagery ability, particularly in non-athlete-specific samples.

Positive and Negative Imagery Ability

It is important to note that the majority of previous work on imagery ability has focused on the ability to image positive content. This is a notable limitation, as negative imagery content can also be experienced (Quinton et al., 2016) and it has been argued that some individuals may find it easier to image negative content over positive content, and vice versa (Quinton et al., 2018). This idea is strongly supported in clinical psychology literature, which suggests that individuals who suffer from anxiety and mood disorders experience greater vividness of negative imagery and poorer vividness of positive imagery (Holmes et al., 2008; 2010; 2016; Morina et al., 2011). Moreover, as previously mentioned, the content of the imagery is likely to influence its effectiveness, such that imagery consisting of negative content (i.e., being unable to cope, not being in control, having low self-confidence) has been found to reliably elicit debilitative

consequences (e.g., decreased confidence, greater threat appraisals, debilitative anxiety interpretations; Cumming et al., 2007; Williams & Cumming, 2012a; Williams et al., 2010). It is possible that a greater ability to image negative content would further amplify the debilitative consequences of negative imagery and may even be associated with debilitative outcomes in the absence of direct imagery use. However, most imagery ability assessments only examine imagery ability of positive content, meaning research often neglects the possible effects of the ability to image negative content.

Using a novel design, Quinton et al. (2018) demonstrated the importance of examining both positive and negative forms of imagery ability, such that the ability to image negative mastery content (e.g., giving up in the face of challenges), and to some extent, negative affect content (e.g., negative feelings and emotions), predicted greater threat appraisals and cognitive anxiety intensity, specifically in athletes. In contrast, the ability to image positive mastery content (e.g., overcoming challenges), and to some extent, positive affect content (e.g., positive feelings and emotions), predicted greater challenge appraisals and lower cognitive anxiety intensity (Quinton et al., 2018). These findings highlight the clinical relevance of separately examining positive and negative imagery ability, as it may be useful for modifying interventions to focus on enhancing specific types of imagery ability, rather than overall ability (Cumming et al., 2016).

More recently, Williams and colleagues (2023) developed the Ease of Imagery Questionnaire (EIQ), which allows researchers to simultaneously examine positive and negative forms of affect and mastery imagery ability. The usefulness of the EIQ has already been established, with research in non-athlete-specific samples demonstrating the different subscales contribute to unique variance in various stress related outcomes, such as perceived stress, stress

mindset, challenge and threat appraisal tendencies, and anxiety (Williams et al., 2023). Differences in imagery ability between the subscales have also been shown, with positive affect easier to image than negative affect and grit imagery (previously referred to in the literature as positive mastery), which were both in turn significantly easier to image than relent imagery (previously referred to in the literature as negative mastery; Quinton et al., 2018), suggesting that it is generally easier to image positive content compared to negative content (Williams et al., 2023). These differences in imagery ability suggest that the EIQ would be a useful measure to investigate how imagery ability of stress-related content is associated with other stress and emotion-related outcomes in non-athlete-specific samples.

Imagery Ability Profiles

While imagery ability is known to vary between individuals, and research suggests imagery ability differs based on imagery content (including whether this is positive or negative; Paivio, 1985), it is perhaps surprising that research has yet to investigate whether different imagery ability profiles exist (e.g., perhaps some individuals display mixed imagery ability, such that they are simultaneously high in negative imagery ability and low in positive imagery ability, or vice versa). A profile analysis would allow us to identify possible patterns across the different types of imagery ability, rather than examining each type in isolation. This could have important implications for stress regulation research, as high negative imagery ability may not solely be responsible for poor stress and affective outcomes, but rather it may be the unique combination of finding it easier to image negative content along with finding it harder to image positive content that produces potential risk for an individual. Likewise, high positive imagery ability combined with low negative imagery ability may be indicative of an adaptive or more resilient profile. As such, examining unique profiles of imagery ability and how these relate to different

stress and emotional outcomes both generally and when performing imagery could prove particularly useful for identifying individuals at risk for poor stress responding, and thus later-life disease.

The Present Project

The overall aims of this thesis were threefold: 1) to investigate the potential existence of positive and negative imagery ability profiles in non-athlete-specific samples, 2) to examine how these profiles may be differentially associated with habitual use of emotion regulation strategies and various stress-related outcomes, and 3) to examine whether or not these profiles impact the effectiveness of an imagery intervention designed to elicit stress reappraisal. To accomplish the first aim, multivariate cluster analysis was employed in Study 1 and Study 2, with the four subscales from the novel EIQ (Williams et al., 2023) serving as cluster variables. Cluster analysis is a valuable analytical approach that reduces complex multivariate data into smaller groups (or clusters) based on the statistical similarity of a number of *a priori* defined variables (e.g., Haldar et al., 2008; Windgassen et al., 2018). This approach allows for the identification of possible patterns across different types of imagery ability rather than examining each type in isolation. The second and third aims of this thesis were accomplished using cross-sectional (Chapter 2: Study 1) and experimental (Chapter 3: Study 2) approaches respectively, which are discussed in more detail at the beginning of each chapter. This thesis is novel in that it represents the first attempt to identify unique profiles of positive and negative imagery ability, as well as whether the emerging profiles may be more (or less) suited to successful stress optimization and well-being. This research may prove to be particularly valuable for future stress intervention research, such that interventions aimed at enhancing specific types of imagery ability could, in turn, improve successful stress optimization.

CHAPTER TWO

Study 1

Introduction

It is argued that imagery ability plays a key role in the regulation of stress and its associated emotions (Williams et al., 2017). Indeed, in the absence of imagery use, the ability to image positive content is associated with lower perceived stress and anxiety, whereas the ability to image negative content is associated with higher perceived stress and anxiety (Williams et al., 2023). Increased vividness of negative imagery and decreased vividness of positive imagery is also a hallmark feature of various emotional disorders (Holmes et al., 2010). Interestingly, poor emotion regulation is known to play a significant role in the development and maintenance of various anxiety and stress-related disorders (e.g., Campbell-Sills et al., 2014; Seligowski et al., 2015; Wang & Saudino, 2011), however, there is very little research examining the relationship between emotion regulation and imagery ability. A single cross-sectional study involving athletes revealed that greater ability to image positive content was associated with greater use of cognitive reappraisal, typically known as an adaptive emotion regulation strategy (Anaur et al., 2017). That said, to our knowledge, no research to date has attempted to examine the relationship between *negative* imagery ability and emotion regulation, nor has any research attempted to identify *profiles* (i.e., subgroups) of positive and negative imagery ability, and whether or not these profiles (if they exist) are differentially associated with stress, anxiety, and emotion regulation.

As such, the purpose of Study 1 was to first employ multivariate cluster analysis to identify the existence of unique profiles of positive and negative imagery ability, and if found, to then also examine if these imagery ability profiles were differentially associated with stress-related outcomes (i.e., perceived stress, general anxiety) as well as the habitual use of various emotion regulation strategies (i.e., cognitive reappraisal, expressive suppression, distraction,

selective attention, and situation selection). In efforts to extend prior research and increase generalizability of findings, this study utilized a non-athlete-specific sample. Based on prior research, it was hypothesized that (should different clusters of positive and negative imagery ability exist) greater overall imagery ability (i.e., higher in all types of imagery ability) would *not* actually be associated with the most beneficial stress and emotion regulation outcomes, but rather, it is the unique combination of *higher* positive imagery ability with *lower* negative imagery ability that will be associated with the best outcomes (i.e., higher use of adaptive emotion regulation strategies, such as cognitive reappraisal, as well as lower levels of perceived stress and anxiety).

Method

Participants and Procedures

A total of 663 university-aged students participated in the present study (mean age = 19.12, SD = 1.35 years; 69.7% female; 67.7% White, 21.6% Hispanic or Latino; refer to Table 2.1 for full demographic information). To be eligible to take part, participants had to be at least 18 years old. Participants were recruited through Baylor University's (Waco TX, USA) online subject pool between August 2021 and May 2022. Upon expressing interest to take part, participants were given access to the online questionnaire pack, which was administered via Qualtrics (Qualtrics, Provo, UT, USA). Prior to completing the questionnaires, participants were presented with an online information sheet and consent form, which explained that all participation was voluntary, all data collected would remain confidential, and any participants could withdraw from the study if they wanted to. If participants agreed to continue, they provided informed consent and then completed the online questionnaire pack. The study took approximately 30 minutes to complete, and participants were granted 1 h of research credits as

compensation, which was applied to their psychology and neuroscience course requirements. This study was approved by the Baylor University Institutional Review Board.

Table 2.1

Overall sample demographics (Study 1)

Variables	N	Mean (SD) or %
Age	652	19.13 (1.36)
Gender		
Male	194	29.8
Female	452	69.3
Prefer not to specify	6	0.9
Ethnicity		
Hispanic or Latino	139	21.3
Not Hispanic or Latino	513	78.7
Race		
American Indian/Alaska Native	10	1.5
Asian	106	16.3
Black/African American	54	8.3
Native Hawaiian/Other Pacific Islander	7	1.1
White	443	67.9
Mixed/Other	32	4.9

Measures

Ease of Imagery Questionnaire

The Ease of Imagery Questionnaire (EIQ; Williams et al., 2023) was used to assess imagery ability of positive and negative imagery content. The four subscales include: relent imagery ability (e.g., *"How easy is it for you to image giving up when things are not going well"*), negative affect imagery ability (e.g., *"How easy is it for you to image the negative emotions associated with a bad day"*), positive affect imagery ability (e.g., *"How easy is it for you to image the positive emotions you feel when doing something you enjoy"*), and grit imagery ability (e.g., "*How easy is it for you to image persevering in the face of adversity").* The 16-item EIQ is the first questionnaire of its kind to separately assess imagery ability of both positive and negative imagery content associated with emotions and difficult situations in non-athlete specific samples. Participants imaged each item and rated how easy/hard it was to image on a 7-point scale (1 = *very hard to image* to 7 = *very easy to image*). Scores for each subscale were averaged with higher scores indicating higher imagery ability in that respective dimension. The EIQ has been shown to be a valid and reliable measure of the ability to image positive affect, negative affect, grit, and relent content. In the present sample, internal consistency was good for relent imagery ability (α = .84), negative affect imagery ability (α = .81), positive affect imagery ability (α = .90), and grit imagery ability (α = .79).

Extended Emotion Regulation Questionnaire

The Extended Emotion Regulation Questionnaire (E-ERQ; Guassi Moreira et al., 2021) was utilized to assess the habitual use of five emotion regulations strategies. This questionnaire includes 10 existing items from the original Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), which assess the use of two commonly studied strategies (cognitive reappraisal and

expressive suppression) as well as 12 new items, which assess the use of three additional, understudied strategies (distraction, selective attention, and situation selection). Example items include, "*When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm*" (reappraisal subscale), "*I distract myself from emotions that I do not want to feel*" (distraction subscale), and "*I control my emotions by physically changing the situation I am in*" (situation selection). Participants responded to each item using a seven-point Likert scale (1 = *strongly disagree* to 7 = *strongly agree*). Higher subscale scores indicate higher use of that respective strategy. In the present sample, internal consistency was good for cognitive reappraisal (α = .89), expressive suppression (α = .81), distraction (α = .81), selective attention (α = .81), and situation selection (α = .80).

Perceived Stress Scale

The 10-item Perceived Stress Scale (PSS; Cohen et al., 1983) was used to assess the degree to which participants perceived their lives as stressful. Using a five-point Likert scale, participants rated how frequently, over the past month, they felt their lives were unpredictable, uncontrollable, and overloaded (0 = *never* to 4 = *very often*). Example items include, "*In the last month, how often have you felt nervous and stressed?*" and "*In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?*". Items were summed to create a total score (4 items were reverse coded), with a higher total score indicating higher levels of perceived stress. The PSS is a valid and reliable measure of perceived stress (Cohen et al., 1983). In the present sample, the internal consistency was found to be good (α = .84).

Hospital Anxiety and Depression Scale

The 7-item anxiety subscale of the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was used to assess general anxiety. Participants rated how they have been feeling in the past week on a 4-point Likert scale (0-3). Example items include, "*worrying thoughts go through my mind*" and "*I feel tense or wound up*". Higher scores indicate higher levels of general anxiety. The HADS is widely accepted as a psychological screening tool to assess general anxiety (Bjelland et al., 2002; Herrmann, 1997). In the present sample, internal consistency was good for the HADS anxiety subscale ($\alpha = .83$).

Statistical Analyses

Data Screening and Preliminary Analyses

Data were first screened for any missing values. Participants were excluded from final data analyses if values were missing from any of the main variables of interest (EIQ, E-ERQ, PSS, and HADS Anxiety). The initial relationships between these main variables of interest were then assessed using Pearson product-moment correlations.

Study Aim 1

Hierarchical cluster analysis using Ward's method (Ward, 1963) was carried out to examine the potential for different imagery ability profiles. Raw scores for the EIQ subscales were converted to standardized z-scores and used as clustering variables. Ward's method operates in a series of steps, beginning with the same number of clusters as cases and subsequently reducing the clusters by one through the combination of cases until one remaining cluster includes all cases. To determine the new cluster at each step, Ward's method examines which two clusters out of all possible cluster combinations most minimize the variance when merged. This is measured by a total sum of squares, which is calculated using within-cluster

sums of the squared Euclidean distances between individual scores and the means of each variable included in each cluster. The smaller the within-cluster sum of squares, the greater the similarity between individuals included in that cluster. Likewise, the smaller the increase in the total sum of squares, the more similar the merging clusters. A substantial increase in the total sum of squares reveals the combination of two dissimilar clusters. The 'natural solution' to the process is detected by examining the clusters directly prior to this point. One-way ANOVAs and *post-hoc* pairwise comparisons were used to examine if the resulting clusters differed significantly on the EIQ subscales. Additional one-way ANOVAs and chi-square analyses were run to assess between-cluster differences on study demographics.

Study Aim 2

One-way ANCOVAs were conducted to examine potential differences in emotion regulation strategies, perceived stress, and general anxiety between the imagery ability clusters, while also adjusting for potential confounding variables (i.e., age, gender, race, ethnicity). Significant relationships were further probed using *post-hoc* pairwise comparisons. Due to the use of multiple ANCOVAs, the Benjamini-Hochberg (B-H) follow-up procedure was implemented to reduce the false discovery rate and prevent the likelihood of Type 1 error (Benjamini & Hochberg, 1995). Specifically, the *p*-values of each ANCOVA were ranked from smallest to largest. These ranked *p*-values were compared to B-H critical values, which were determined based on the *p*-value ranking and number of tests run (Benjamini & Hochberg, 1995). The false discovery rate was set at 0.05. This procedure effectively corrects for multiple comparisons by reducing the false discovery rate while at the same time maintaining power (Benjamini & Hochberg, 1995). All statistical analyses were run in SPSS version 28 (IBM Corp, USA). Results were reported as statistically significant if p values were $\leq .05$. Effect size was

reported using partial eta-squared (η_p^2) with the following magnitude cutoffs for interpretation: small ($\eta_p^2 = 0.01$), medium ($\eta_p^2 = 0.06$), and large ($\eta_p^2 = 0.14$).

Results

Study Population

Missing data were observed for 11 participants; these participants were subsequently excluded from data analysis, resulting in a final sample size of 652 participants. This sample size was sufficient for cluster analysis, in which at least 2^m (m = number of cluster variables) is recommended (Mooi & Sarstedt, 2011). A correlation matrix for all main variables of interest can be found in Table 2.2. It should be noted that all correlational coefficients were less than .90, suggesting acceptable collinearity among the study variables for cluster analysis (Mooi & Sarstedt, 2011).

Cluster Analysis

Following the previously mentioned criterion for selecting the appropriate number of clusters, which included agglomeration schedule coefficients and dendrogram inspection, a distinct three-cluster solution emerged. Independent one-way ANOVAs and *post-hoc* analyses demonstrated that the three clusters differed significantly in all four types of imagery ability (ps $\leq .008$; please refer to Figure 2.1; Table 2.3). Cluster 1 (n = 318; 48.8%) was characterized by the highest mean scores for relent and negative affect imagery ability but was closer to the sample means for grit and positive affect imagery ability. As such, Cluster 1 is reflective of those who find it relatively easy to image both positive and negative types of imagery (i.e., higher overall imagery ability). In contrast, Cluster 2 (n = 203; 31.1%) was lowest on relent imagery ability, below the sample mean for negative affect imagery ability, and highest for grit and positive affect imagery ability. In other words, Cluster 2 is reflective of those who find it relatively easy to image, but only with regards to positive imagery content (i.e., higher positive,

lower negative imagery ability). Finally, Cluster 3 (n = 131; 20.1%) was closer to the sample mean for relent imagery ability, but demonstrated the lowest mean scores for positive affect, grit, and negative affect imagery ability when compared to the other clusters. This suggests that Cluster 3 is reflective of those who find it the least easy to image across all the assessed types of content (i.e., lower overall imagery ability). Analysis of study demographics also revealed statistically significant cluster differences for gender ($p < .001$), such that higher overall imagers had the highest percentage of females, followed by higher positive/lower negative imagers, and lastly lower overall imagers. No significant differences were observed for age, race, or ethnicity (please refer to Table 2.3).

Cluster Membership and Emotion Regulation Strategies

A series of one-way ANCOVAs revealed that the clusters differed significantly on four of the five types of emotion regulation strategies (i.e., E-ERQ subscales), even when controlling for covariates (all ps < .001; refer to Table 2.4). The B-H correction did not alter these results, with all remaining significant. *Post-hoc* analyses indicated that higher positive/lower negative imagers were significantly highest on reported use of cognitive reappraisal and situation selection, but significantly lowest on reported use of expressive suppression. In contrast, lower overall imagers were significantly lowest on reported use of cognitive reappraisal, situation selection, and distraction. Higher overall imagers and lower overall imagers did not significantly differ from each other on reported use of expressive suppression (p = .95), nor did higher overall imagers and higher positive/lower negative imagers significantly differ on reported use of distraction (p = .77). No significant differences were observed between any of the clusters and reported use of selective attention as an emotion regulation strategy (p = .19).

Cluster Membership, Perceived Stress, and General Anxiety

An additional series of one-way ANCOVAs revealed that the clusters also differed significantly on self-reported perceived stress (i.e., PSS) and general anxiety (i.e., HADS), even after controlling for covariates (all *p*s < .001; refer to Table 2.4). Once again, B-H correction did not alter these results. *Post-hoc* analyses revealed that higher positive/lower negative imagers were significantly lowest on perceived stress and general anxiety compared to the other two clusters. No significant differences were observed between higher overall imagers and lower overall imagers on perceived stress ($p = .17$) or general anxiety ($p = .80$).

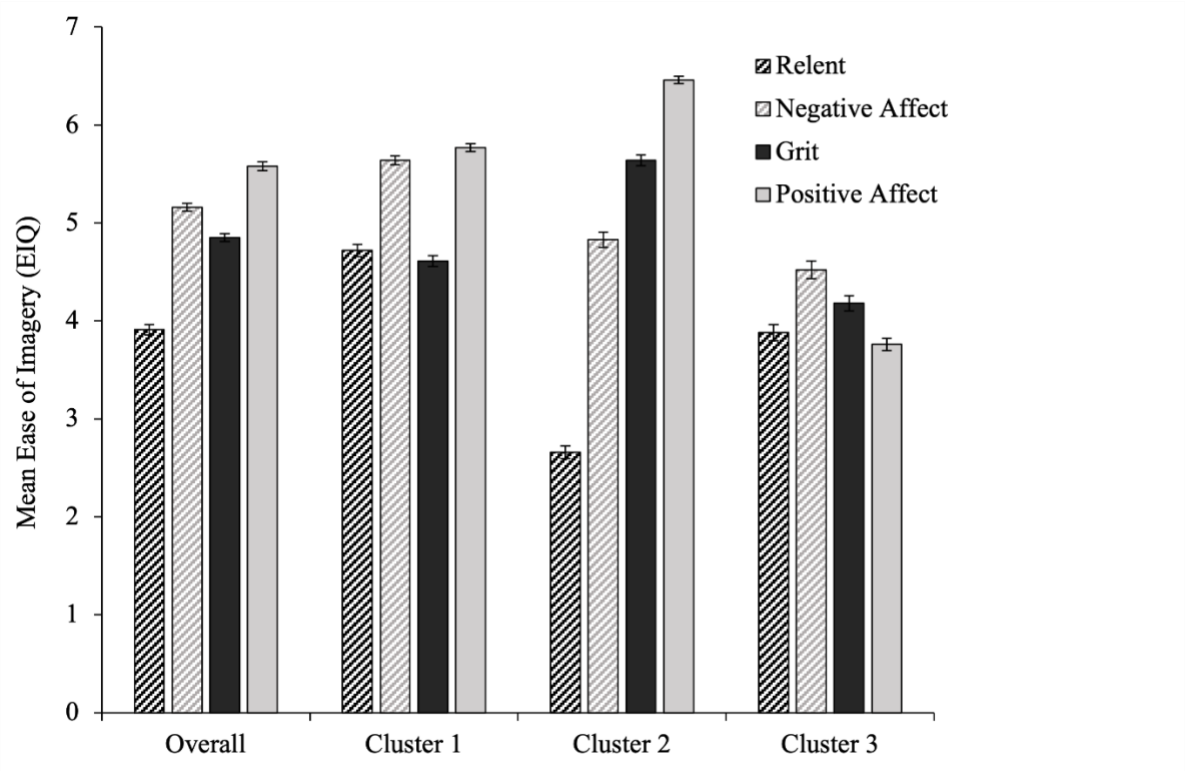


Figure 2.1. Means and standard errors of imagery ability (EIQ subscales) based on cluster membership (Study 1).

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. The three clusters differed significantly in all four types of imagery ability (*p*s ≤ .008). Error bars represent standard error. EIQ = Ease of Imagery Questionnaire

Table 2.2

Correlations between imagery ability, emotion regulation, perceived stress, and anxiety

	1	2	3	4	5	6	7	8	9	10	11
Relent (EIQ)	—										
Positive Affect (EIQ)	-.12**	—									
Grit (EIQ)	-.32**	.48**	—								
Negative Affect (EIQ)	.44**	.21**	.04	—							
Reappraisal (E-ERQ)	-.19**	.39**	.36**	-.04	—						
Suppression (E-ERQ)	.19**	-.16**	-.07	.11**	-.004	—					
Distraction (E-ERQ)	.04	.17**	.07	.11**	.56**	.30**	—				
Selective Attention (E-ERQ)	.12**	-.08*	.03	.02	.31**	.45**	.51**	—			
Situation Selection (E-ERQ)	-.10*	.34**	.32**	.05	.62**	-.06**	.43**	.21**	—		
Perceived Stress (PSS)	.41**	-.23**	-.33**	.38**	-.25**	.17**	.02	.05	-.12**	—	
General Anxiety (HADS)	.30**	-.22**	-.26**	.31**	-.21**	.17**	.06	.06	-.07	.64**	—

Note. *Denotes $p < .05$, ** denotes $p < .001$. EIQ = Ease of Imagery Questionnaire. E-ERQ = Extended-Emotion Regulation Questionnaire. PSS = Perceived Stress Scale. HADS = Hospital Anxiety and Depression Scale.

Table 2.3

Means (SDs) of imagery ability and study demographics across the three clusters (Study 1)

	Sample (*n* = 652)	**Cluster 1 (*n* = 318)**	**Cluster 2 (*n* = 203)**	**Cluster 3 (*n* = 131)**	
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	***F* / x^2 test (η_p^2 or ϕ_c)**
Ease of Imagery					
Relent	3.91 (1.36)	4.72 (1.11) [b, c]	2.66 (0.91) [a, c]	3.88 (0.94) [a, b]	254.50 (0.44) [**]
Negative Affect	5.16 (1.05)	5.64 (0.77) [b, c]	4.83 (1.09) [a, c]	4.52 (1.04) [a, b]	84.89 (0.21) [**]
Grit	4.85 (1.05)	4.61 (0.96) [b, c]	5.64 (0.79) [a, c]	4.18 (0.88) [a, b]	128.25 (0.28) [**]
Positive Affect	5.58 (1.17)	5.77 (0.72) [b, c]	6.46 (0.53) [a, c]	3.76 (0.71) [a, b]	688.54 (0.68) [**]
Demographics					
Age	19.13 (1.36)	19.08 (1.53)	19.17 (1.16)	19.17 (1.20)	0.32 (0.001)
Sex (% female)	69.32	76.42 [b, c]	67.98 [a, c]	54.20 [a, b]	25.31 (0.14) [**]
Race (% white)	67.94	66.35	74.88	61.07	12.76 (0.10)
Ethnicity (% Hispanic)	21.32	20.75	20.69	23.66	0.54 (0.03)

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3; [**] denotes $p < .001$.

Table 2.4

Means (SDs) of emotion regulation strategies, perceived stress, and general anxiety across the three clusters

	Sample (*n* = 652)	**Cluster 1 (*n* = 318)**	**Cluster 2 (*n* = 203)**	**Cluster 3 (*n* = 131)**	
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	***F* test (η_p^2)**
Emotion Regulation					
Reappraisal	4.61 (1.12)	4.55 (1.07) [b, c]	5.12 (1.08) [a, c]	3.96 (0.90) [a, b]	52.36 (0.14) [**]
Suppression	4.02 (1.38)	4.20 (1.39) [b]	3.65 (1.46) [a, c]	4.16 (1.11) [b]	11.53 (0.03) [**]
Distraction	4.55 (1.11)	4.63 (1.04) [c]	4.70 (1.19) [c]	4.11 (1.05) [a, b]	13.88 (0.04) [**]
Selective Attention	3.81 (1.15)	3.87 (1.10)	3.69 (1.28)	3.85 (1.03)	1.73 (0.005)
Situation Selection	4.74 (1.13)	4.72 (1.12) [b, c]	5.17 (1.05) [a, c]	4.15 (1.02) [a, b]	36.80 (0.10) [**]
Stress-Related Outcomes					
Perceived Stress	22.34 (6.28)	24.46 (5.11) [b]	18.52 (6.31) [a, c]	23.09 (6.15) [b]	66.14 (0.17) [**]
General Anxiety	9.55 (4.32)	10.59 (3.90) [b]	7.57 (4.12) [a, c]	10.08 (4.56) [b]	33.03 (0.09) [**]

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3; [**] denotes $p < .001$. All results remained statistically significant after adjusting for Benjamini-Hochberg correction false discovery rate = 0.05.

Discussion

The purpose of Study 1 was to investigate whether there were unique profiles of positive and negative imagery ability, and if so, whether these profiles were differentially associated with emotion regulation strategies, as well as perceived stress and general anxiety. Using multivariate cluster analysis, three distinct imagery ability profiles emerged with statistically significantly different patterns of emotion regulation, stress and anxiety: higher overall imagers (i.e., both positive and negative images; Cluster 1), higher positive and lower negative imagers (Cluster 2), and lower overall imagers (Cluster 3). Notably, the profile characterized by higher positive, but lower negative, imagery ability (Cluster 2) demonstrated the most adaptive pattern of emotion regulation, as well as the lowest levels of perceived stress and anxiety. This suggests that individuals who find it easier to image positive content and more difficult to image negative content may be more emotionally resilient. In contrast, the other two profiles demonstrated significantly less adaptive patterns of emotion regulation and greater perceived stress and anxiety, with lower overall imagers exhibiting some of the worst outcomes. Results remained significant even after adjusting for covariates (i.e., age, gender, race, and ethnicity).

Individuals who found it easier to image positive content but harder to image negative content reported the highest use of facilitative emotion regulation strategies (i.e., cognitive reappraisal, situation selection) and the lowest use of debilitative strategies (i.e., expressive suppression). Prior research has reported a similar pattern of emotion regulation strategy use (i.e., high cognitive reappraisal and situation selection, low expressive suppression) and has linked this pattern to adaptive mental health symptoms, such that individuals who reported using this mixed pattern of emotion regulation strategies also reported the lowest levels of anxiety, depression, general distress, and perceived stress (Guassi Moreira et al., 2021), as well as higher

psychological resilience (Polizzi & Lynn, 2021). This association was further supported in the present study, such that higher positive and lower negative imagers also reported the lowest levels of perceived stress and general anxiety when compared to the other two clusters. As such, this research suggests that higher positive/lower negative imagers may experience better mental health outcomes via an adaptive "mixed" use of emotion regulation strategies.

It is possible that individuals who find it easier to image positive content may experience greater benefits from using facilitative emotion regulation strategies, and thus, in turn, employ them more often than others. For example, higher positive imagers may find it easier to imagine themselves in a desirable future situation and then take action to make it happen (situation selection), or they may find it easier to reframe the negative meaning of a present unavoidable situation as more positive (cognitive reappraisal). What's more, recent research has revealed that positive imagery ability, particularly mastery imagery ability (i.e., grit), may buffer against the debilitative outcomes associated with negative imagery content (Quinton et al., 2019). This is an important finding, as spontaneous negative imagery is a known maintenance factor in many emotional disorders, such as anxiety and depression (Brewin et al., 2010; Görgen et al., 2015; Holmes et al., 2016; Laing et al., 2016; Moscovitch et al., 2011). Consequently, interventions focused on the improvement of positive imagery ability may be particularly useful for increasing the effectiveness of adaptive emotion regulation strategies and also combating the possible debilitative outcomes associated with intrusive negative imagery.[2]

Despite the potential benefits of higher positive imagery ability, higher overall imagers of both positive and negative content exhibited worse outcomes when compared to higher

[2] Researchers should maintain caution when following this suggestion, as a major limitation of this study is its cross-sectional nature. As such, we cannot ascertain causation (e.g., does positive imagery ability lead to the use of facilitative emotion regulation strategies, or does the use of facilitative strategies lead to greater ability to image positive content?). Clearly, more research is needed before interventions are developed.

positive/lower negative imagers, suggesting that the ability to image negative content must also play an important role in emotion regulation and stress-related outcomes. Indeed, higher overall imagers demonstrated an above average ability to also image negative content. When compared to higher positive/lower negative imagers, the higher overall imagers reported significantly greater levels of perceived stress and anxiety, greater use of debilitative emotion regulation strategies (i.e., expressive suppression), and lower use of facilitative strategies (i.e., cognitive reappraisal, situation selection). This association is strongly supported by clinical psychology, which has shown that individuals with emotional disorders experience greater vividness of negative imagery (Holmes et al., 2008; 2010; 2016; Morina et al., 2011). It is possible that a greater ability to image negative content may further compound the known debilitative outcomes associated with negative imagery use (Quinton et al., 2018; Williams & Cumming, 2012a); that said, more research is needed to directly test this assumption. Negative imagery is often spontaneous and intrusive, making it more difficult to employ facilitative regulatory strategies early in the emotion-generative process, thus forcing an overreliance on late-acting regulatory strategies, such as expressive suppression. While suppression is successful at reducing the behavioral expression of emotion, it fails to decrease the emotional experience itself (Gross, 1998; 2002). As such, the ability to easily image both positive and negative content is not necessarily adaptive, as a greater ability to image negative content may counteract any benefits that could be experienced from the ability to also image positive content.

Finally, lower overall imagers exhibited the worst emotion regulation outcomes when compared to the other two profiles, such that individuals in this profile reported the lowest habitual use of cognitive reappraisal, situation selection, and even distraction. This result is unsurprising, as lower imagery ability, specifically lower mastery imagery ability, has been

associated with other poor stress and coping outcomes, such as lower trait confidence, higher anxiety intensity, higher perceptions of anxiety as debilitative, and even worse performance outcomes (Quinton et al., 2018; Williams & Cumming, 2012b, 2015; 2021). Given that lower overall imagers already have a lowered ability to image negative content, it is quite possible that interventions aimed at simply boosting their positive imagery ability could significantly improve stress and emotion regulation outcomes, thus perhaps more closely resembling the adaptive outcomes observed in higher positive/lower negative imagers. However, given this study was cross-sectional, researchers should proceed with caution, as more rigorous research is still needed to determine causality and better inform potential future intervention work.

Some key strengths of Study 1 are the large sample size (and thus greater statistical power), the use of a novel questionnaire (i.e., the EIQ) to assess both positive and negative forms of imagery ability, and the first ever use of multivariate cluster analysis to examine different imagery ability profiles. Although the present study provides novel and important contributions to the existing literature, it is not without limitations. First, as mentioned above, given the study design was cross-sectional in nature, causality cannot be inferred. For example, it is quite possible that some participants experience emotion dysregulation and poor mental health, which may lead to experiencing more spontaneous negative images; as such, these individuals may be better at imaging negative content. Future research would benefit from using more rigorous study designs to further explore the present results and understand the emerged relationships in more depth (e.g., longitudinal assessments or experimental imagery interventions). Second, there is always the possibility of a third unexamined variable confounding the results (Christenfeld et al., 2004); however, a variety of important demographic variables were controlled for in this study (i.e., age, gender, race, and ethnicity), with significant outcomes still observed.

It should also be noted that the role of imagery meaning was not examined in this study. This is important, as positive and negative imagery content may not always be synonymous with positive and negative outcomes (Short et al., 2002). Rather, there may be times when positive content is interpreted by the individual as debilitative and thus serves debilitative functions or brings about debilitative outcomes, and negative content is interpreted by the individual as facilitative and thus serves facilitative functions or brings about facilitative outcomes. For example, imaging a scenario typically regarded as positive (e.g., being surrounded by family and loved ones during the holidays) may in fact be regarded as debilitative for some individuals (e.g., they've lost their loved ones or have tumultuous family relationships). In contrast, imaging a negative scenario (e.g., not knowing anyone at a social event) may be regarded as facilitative for some (e.g., an opportunity to make new friends). A similar point can be made about the perceptions of emotion regulation strategies, such that there may be times when a typically adaptive strategy (e.g., cognitive reappraisal) is perceived by some individuals as debilitative, and a typically maladaptive strategy (e.g., expressive suppression) is perceived as facilitative (Gross, 2014). As such, more research is clearly needed to understand how perceptions of imagery meaning and emotion regulation strategies may impact the observed outcomes associated with different imagery ability profiles.

In summary, this study identified three unique profiles (i.e., clusters) of positive and negative imagery ability in a non-athlete-specific sample, as well as demonstrated how these profiles are differentially associated with emotion regulation, stress, and anxiety outcomes. Given that imagery interventions are an effective approach to helping individuals regulate their emotions to deal with stress and anxiety (Holmes & Matthews, 2010; Williams et al., 2010), and imagery ability is thought to influence imagery's effectiveness, it is very important for

subsequent research to examine the potential influence of these imagery ability profiles on the effectiveness of guided imagery scripts designed to alter stress appraisals (this is the aim of upcoming Chapter 3).

CHAPTER THREE

Study 2

Introduction

Mental imagery serves as a valuable tool in the management of stress appraisals. For instance, imagery scripts that emphasize feelings of confidence and control have been found to reliably induce confidence and challenge appraisals, as well as promote more facilitative interpretations of anxiety symptoms in both athlete and non-athlete-specific samples (Cumming et al., 2007; Williams & Cumming, 2012a; Williams et al., 2010; 2017). Conversely, imagery scripts that emphasize a lack of confidence and control tend to decrease confidence, increase threat appraisals, and also promote more debilitative interpretations of anxiety symptoms (Cumming et al., 2007; Williams & Cumming, 2012a; Williams et al., 2010; 2017). It is worth noting that individuals with greater imagery ability will typically benefit more from an imagery intervention compared to those with lower imagery ability (Gregg et al., 2005; Robin et al., 2007; Williams et al., 2013).

However, to our knowledge, no research to date has attempted to examine whether the ability to image positive content may enhance the effectiveness of imagery interventions designed to elicit facilitative stress appraisals and subsequent responses (i.e., challenge imagery). Likewise, while we now know that negative imagery ability is associated with a host of maladaptive psychological outcomes (Quinton et al., 2019; Williams et al., 2023), no research to date has attempted to examine whether the ability to image negative content could possibly enhance the effectiveness of imagery interventions designed to elicit debilitative stress appraisals and responses (i.e., threat imagery). It has even been shown that imagery ability of positive content regarding coping and persevering in the face of adversity (referred to as grit or mastery imagery ability) may protect against the debilitative consequences associated with threat imagery (Quinton et al., 2019); although this remains to be replicated. Clearly, more research is needed to

gain a deeper understanding of the influence of positive and negative imagery ability on the efficacy of imagery interventions for modifying stress appraisals.

Based on the findings of Study 1, it was proposed that the newly identified *profiles* of positive and negative imagery ability, if replicated, will likely impact the effectiveness of challenge and threat imagery. For example, higher overall imagers (e.g., high in both positive and negative imagery ability) may experience both challenge and threat imagery as effective, leading to greater facilitative and debilitative effects, respectively. Higher positive/lower negative imagers may similarly experience challenge imagery as effective and thus report greater facilitative effects, but by contrast, they may also find the threat imagery to be less effective, and thus be less likely to experience its debilitative effects. As revealed in Study 1, higher positive/lower negative imagers reported the highest habitual use of cognitive reappraisal, suggesting they may also be more likely to successfully employ cognitive reappraisal during imagery (specifically during challenge imagery, which explicitly instructs the use of reappraisal). Finally, lower overall imagers may find it more difficult to effectively image both types of imagery, and thus experience more diminished effects across the scripts.

As such, the aims of Study 2 are as follows: 1) to examine whether the unique profiles of positive and negative imagery ability observed in Study 1 could be replicated in a different (yet still non-athlete-specific) sample, and if so, 2) to examine whether or not these profiles were differentially associated with psychological responses to both challenge and threat imagery. Based on prior research, it was hypothesized that higher positive/lower negative imagers would experience more facilitative responses to the challenge imagery and less debilitative responses to the threat imagery. It was expected that higher overall imagers would also experience facilitative responses to the challenge imagery, but in contrast to higher positive/lower negative imagers,

they would also experience more debilitative responses to the threat imagery. Finally, it was proposed that both the challenge and threat imagery would be less effective for lower overall imagers compared to the other two profiles.

Method

Participants

A total of 271 male and female university students participated in the present experimental study (mean age = 19.43, SD = 1.50 years; 60.1% female; 59.4% White; refer to Table 3.1 for full demographic information). To be eligible to take part, participants had to be at least 18 years old and meet the following inclusion criteria: proficient in understanding English, no hearing impairment that could not be corrected (e.g., with a hearing aid) which prevented them from being able to hear audio recordings, and no medically diagnosed mental health condition at the time they took part in the study. Data collection took place at the two separate universities of the authors. At the first university (University of Birmingham, UK), participants were recruited between November 2022 and February 2023 via social media, emails, campus flyers, and class announcements. At the second university (Baylor University, TX, USA), participants were recruited through the university's online subject pool between February 2023 and May 2023. All participants provided online informed consent prior to data collection, and were offered 2 h of research credit, which was applied to their respective course requirements. This study was approved by both universities' Institutional Review Boards.

Table 3.1

Overall sample demographics (Study 2)

Variables	N	Mean (SD) or %
Age	271	19.43 (1.50)
Gender		
Male	107	39.5
Female	163	60.1
Other	1	0.4
Race/Ethnicity		
Asian	37	13.7
Black/African American	22	8.1
Hispanic/Latino	29	15.8
White	161	59.4
Mixed/multiple ethnicities	18	6.6
Other	4	1.5

Measures

Ease of Imagery Questionnaire

The same 16-item Ease of Imagery Questionnaire (EIQ; Williams et al., 2023) administered and described in Study 1 was administered in this study to assess imagery ability of positive and negative content. In the present sample, internal consistency was good for relent imagery ability (α = .85), negative affect imagery ability (α = .77), positive affect imagery ability (α = .88), and grit imagery ability (α = .79).

Imagery Manipulation Checks

Four items were included in the post-imagery questionnaire completed after each script. Participants responded to each item using a seven-point Likert scale. The first item assessed the extent to which participants could image the scenario as described (1 = *not at all as described,* 7 = *exactly as described*), and the second item assessed the ease with which participants imaged the scenario described to them (1 = *very hard to image*, 7 = *very easy to image*). For the third item, participants rated how stressful they found the imagery scenario (1 = *not at all stressful*, 7 = *very stressful*). For the final item, participants rated the extent to which they appraised the imaged scenario as a challenge or a threat (1 = *completely threatening/not at all challenging*, 7 = *completely challenging/not at all threatening;* Turner et al., 2012; 2014). All four items have been used previously in imagery research (Williams & Cumming, 2012a; Williams et al., 2017).

Cognitive and Somatic State Anxiety

After listening to each imagery script, the Immediate Anxiety Measures Scale (IAMS; Thomas et al., 2002) was used to assess the intensity and directional interpretation of cognitive and somatic anxiety experienced in response to the imagery. Prior to completing the questionnaire, participants received definitions of the constructs to ensure they fully understood

the differences between cognitive and somatic anxiety. Part one of the questionnaire asked participants to rate on a seven-point scale the extent to which they felt cognitively and somatically anxious during the imagery (1 = *not at all*, 7 = *extremely*). Part two of the questionnaire asked participants to rate on a different seven-point scale whether they perceived their cognitive and somatic anxiety as positive or negative in relation to performing well in the scenario described (-3 = *very debilitative/negative*, +3 = *very facilitative/positive*). Participants completed both parts for cognitive anxiety before completing the same items for somatic anxiety. It should be noted that the IAMS also includes self-confidence; however, this was not examined in the present study. Previous research has established the IAMS as a reliable and valid measure for assessing cognitive and somatic state anxiety (Thomas et al., 2002). The IAMS has also been used in previous imagery research (Williams et al., 2010; 2017).

Positive and Negative State Affect

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was administered after listening to each imagery script to assess levels of positive and negative affect experienced during each of the imagery scenarios. The PANAS includes 20 items, with 10 items included to assess positive affect (e.g., *interested, excited, enthusiastic, inspired, proud*), and 10 items to assess negative affect (e.g., *distressed, upset, nervous, irritable, afraid*). Participants rated the experience of each emotion, specifically during the imagery, on a five-point Likert scale (1 = *not at all*, 5 = *extremely*). Items for each subscale were summed so that higher subscale scores indicated higher experience of positive or negative affect during the imagery. In the present sample, internal consistency was good for positive and negative affect following all imagery scripts (positive affect α's $\geq .87$; negative affect α's $\geq .84$).

An additional single item was included at the end of the PANAS to assess the pleasantness of the emotions experienced, with participants responding on a nine-point Likert-scale, with anchors from – 4 (*extremely unpleasant*) to + 4 (*extremely pleasant*). This item has been employed in previous experimental emotion research (e.g., Gross & Levenson, 1997).

State Emotion Regulation

Two individual items were included in the post-imagery questionnaires to assess the state use of two common emotion regulation strategies during the imagery scripts. The first item aimed to assess the state use of cognitive reappraisal during the imagery (i.e., *"I tried to see the imagery scenario as positive as possible"*). The second item aimed to assess the state use of emotional suppression during the imagery (i.e., "*During the imagery, I controlled my emotions*"). Responses were made on a six-point Likert scale (0 = *not at all*; 5 = *extremely*). Both items were drawn from two brief 3-item scales that were previously created to measure reappraisal and suppression during stressful tasks (Egloff et al., 2006). However, due to mixed findings regarding the reliability of these scales (Egloff et al., 2006), only a single item was used from each scale. Previous research has implemented the use of single items to assess state emotion regulation during laboratory tasks (e.g., Mauersberger et al., 2018).

Imagery Scripts

Three imagery scripts were designed based on those employed in previous work to elicit a challenge appraisal, a threat appraisal, and a neutral state (Williams et al., 2010; 2017; see Appendix 17). These scripts described the moments before a hypothetical stressful scenario, namely, having to give a presentation to a large audience. Following the recommendations of Lang's (1979) bioinformational theory, scripts included stimulus (e.g., "*all eyes are on you as you make your way to the front and get into position*"), response (e.g., "*you feel your heart*

racing"), and meaning (e.g., …*but you are confident*") propositions. The challenge and threat scripts were identical with regards to stimulus and response propositions; however, these scripts differed in their assigned meaning propositions. For example, the challenge script was designed to elicit feelings of stress while also being accompanied by feelings of confidence (e.g., "*you are filled with confidence*") and control (e.g., "*you feel in complete control*") to try and instill a challenge state, while the threat script was designed to elicit the same feelings of stress but instead be accompanied by low confidence (e.g., "*you are filled with panic*") and low control (e.g., "*you feel completely helpless*") to attempt to instill a threat state (Jones et al., 2009). In contrast, the neutral script was designed to be a control comparison and thus did not refer to any response propositions inducing feelings of stress, but rather included additional non-stress related stimulus propositions (e.g., *"you get out your water bottle and take a sip of water"*). All scripts were matched on the amount of content as well as length. Scripts were audio recorded and each lasted approximately 3 minutes. Prior to data collection, all three scripts were pilot tested and adjusted slightly based on feedback to the wording. Once finalized, the scripts were played to participants through a computer using headphones.

Procedures

Upon arrival to the laboratory, participants were presented with an information sheet, which explained the nature of the study, including that all data collected would remain confidential and that participants were free to withdraw from the study at any point. If participants agreed to take part, they provided informed consent and were randomly allocated to one of six protocol conditions stratified by gender, based on a random pre-generated list. The protocol conditions were completely identical, except for the order in which participants listened to the three imagery scripts, which were counterbalanced across the six conditions. Prior to the

first imagery script, participants received instructions to image the content described as clearly and vividly as possible in their preferred visual perspective with their eyes open or closed. They then listened to the first script and immediately after this completed a post-imagery questionnaire, which included the IAMS, PANAS, state emotion regulation, and manipulation check items. Participants then completed a distractor task, which was designed to distract the participant from carrying over any thoughts about the imagery script they just heard into the next condition. This task lasted for three minutes and consisted of matching numbers to letters of the alphabet. Participants were told that their performance on the task would be scored and to perform to the best of their ability to encourage them to focus fully on the task; however, for the purposes of this study, task scores were not retained. The imagery protocol was then repeated for the remaining two imagery scripts (i.e., imagery, post-task questionnaire, distractor task). At the end of the session, participants completed a series of questionnaires, including demographic questions and the EIQ. Each visit lasted approximately 60 to 90 minutes.

Statistical Analyses

Similar to Study 1, hierarchical cluster analysis using Ward's method (Ward, 1963) was employed to examine the potential for different imagery ability profiles (Study Aim 1). The same process was followed as outlined in Study 1. Follow-up one-way ANOVAs and *post-hoc* pairwise comparisons were employed to examine if the resulting clusters differed significantly on the EIQ subscales. Additional one-way ANOVAs and chi-square analyses were utilized to check for between-cluster differences on study demographics (i.e., age, sex, race/ethnicity).

Based on the three clusters that emerged, four separate 3 (script) × 3 (cluster) mixed design ANOVAs examined any differences in ease of imaging, imaging as instructed, perceived stressfulness, and challenge/threat appraisal due to the imagery script, as well as whether any

script differences were influenced by imagery ability cluster. These analyses served as an initial manipulation check. Next, a follow-up series of 3 (script) × 3 (cluster) mixed design ANOVAs were conducted to examine any differences due to script, cluster, or whether there were any script by cluster interactions in the main variables of interest: cognitive and somatic anxiety intensity and interpretations, positive and negative affect (as well as the perceived pleasantness of these emotions), and finally, state use of cognitive reappraisal and emotional suppression (Study Aim 2). When appropriate, the significant main effects of script and cluster, or the significant interactions between script and cluster were further probed using *post-hoc* comparisons. It should be noted that for all repeated-measures ANOVAs, Mauchley (*W*) tests were used to assess sphericity assumptions and Greenhouse-Geisser correction values were reported when sphericity assumptions were violated (Greenhouse & Geisser, 1959; Jennings, 1987). Due to the high number of multiple comparisons, the Benjamini-Hochberg (B-H) follow-up procedure was implemented to reduce the false discovery rate and prevent the likelihood of Type 1 error (Benjamini & Hochberg, 1995). Results were reported as statistically significant if *p* values were $\leq .05$, and effect size was reported using partial eta-squared (η_p^2) with the following magnitude cutoffs for interpretation: small ($\eta_p^2 = 0.01$), medium ($\eta_p^2 = 0.06$), and large ($\eta_p^2 = 0.14$). All statistical analyses were run in SPSS version 28 (IBM Corp, USA).

Results

Cluster Analysis

A distinct three-cluster solution emerged upon inspection of the agglomeration schedule coefficients and associated dendrogram. These clusters closely resembled the clusters found in Study 1 (refer to Figure 3.1). Specifically, Cluster 1 ($n = 98$; 36.2%) was characterized by the highest mean scores for relent and negative affect imagery ability and was slightly above the

sample means for grit and positive affect imagery ability (i.e., higher overall imagers). Cluster 2 (n = 69; 25.5%) was lowest on relent imagery ability, below the sample mean on negative affect imagery ability, highest on grit imagery ability, and slightly above the sample mean on positive affect imagery ability (i.e., higher positive/lower negative imagers). Cluster 3 (n = 104; 38.4%) remained close to the sample mean for relent and negative affect imagery ability but was lowest on grit and positive affect imagery ability (i.e., lower overall imagers).

Means and standard deviations of the four EIQ subscales for the three clusters as well as the overall sample are displayed in Table 3.2. While separate one-way ANOVAs showed significant differences in all four EIQ subscales due to cluster (ps < .001; refer to Table 3.2 for F values and effect sizes), the *post-hoc* comparisons revealed some non-significant differences in imagery ability between certain clusters. More specifically, higher positive/lower negative imagers and lower overall imagers were not significantly different with regards to negative affect (p = .47), and higher positive/lower negative imagers and higher overall imagers were not significantly different with regards to positive affect (p = .36). All other *post-hoc* comparisons were significant (ps ≤ .002). No significant differences were observed across the clusters for demographic variables (i.e., age, sex, race/ethnicity; refer to Table 3.2).

To summarize, higher overall imagers were found to have higher than average scores on positive and negative imagery ability, whereas lower overall imagers were found to have lower than average scores on positive and negative imagery ability. In contrast, higher positive/lower negative imagers were found to have higher than average scores on positive imagery, but lower than average scores on negative imagery ability.

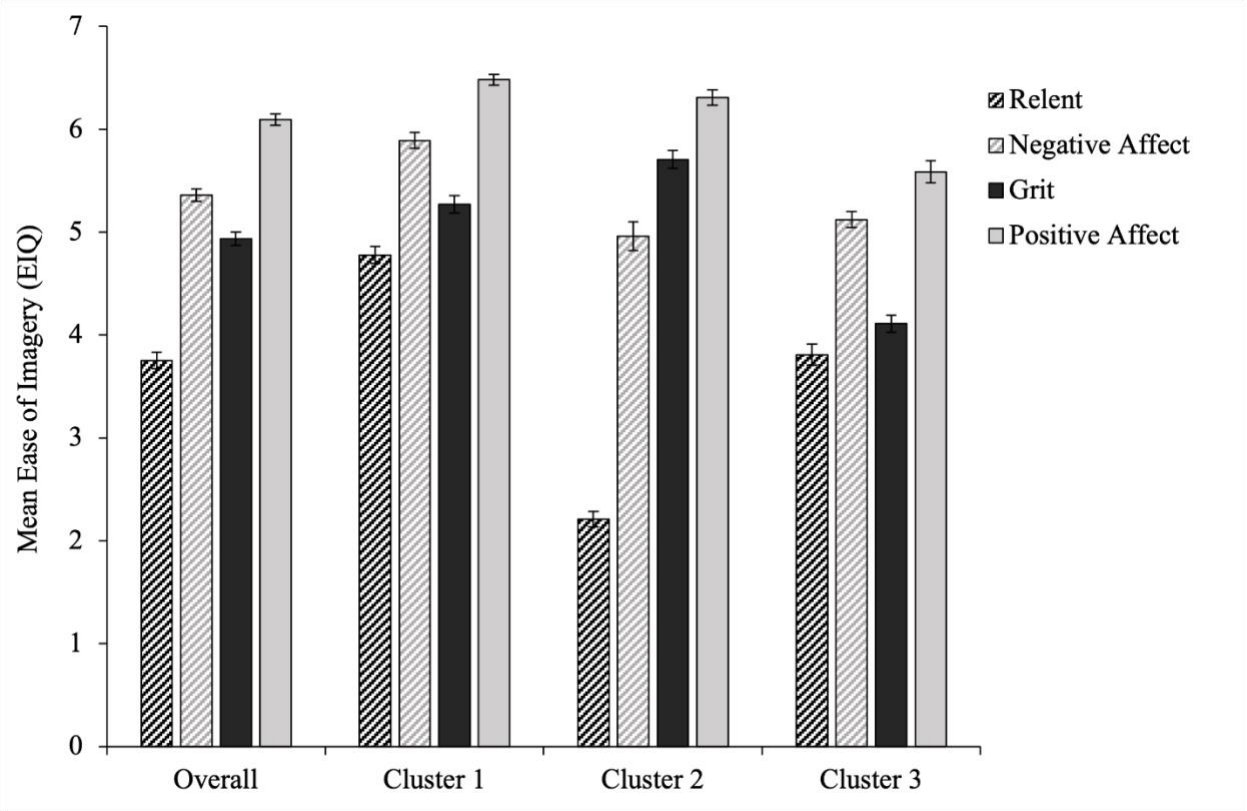


Figure 3.1. Means and standard errors of imagery ability (EIQ subscales) based on cluster membership (Study 2).

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. The three clusters differed significantly in all four types of imagery ability (all *p*s < .001), except for Clusters 1 and 2 on positive affect ($p = .36$), and Clusters 2 and 3 on negative affect ($p = .47$). Error bars represent standard error.

Table 3.2

Means (SDs) of imagery ability and study demographics across the three clusters

	Sample (*n* = 271)	**Cluster 1 (*n* = 98)**	**Cluster 2 (*n* = 69)**	**Cluster 3 (*n* = 104)**	
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	***F* / x^2 test (η_p^2 or ϕ_c)**
Ease of Imagery					
Relent	3.75 (1.32)	4.78 (0.80) [b, c]	2.21 (0.61) [a, c]	3.81 (1.04) [a, b]	178.27 (0.57) [**]
Negative Affect	5.36 (0.98)	5.89 (0.75) [b, c]	4.96 (1.17) [a]	5.12 (0.80) [a]	27.76 (0.17) [**]
Grit	4.94 (1.05)	5.27 (0.85) [b, c]	5.71 (0.72) [a, c]	4.11 (0.83) [a, b]	93.58 (0.41) [**]
Positive Affect	6.09 (0.91)	6.48 (0.51) [c]	6.31 (0.63) [c]	5.58 (1.10) [a, b]	33.81 (0.20) [**]
Demographics					
Age	19.43 (1.50)	19.54 (2.06)	19.52 (1.16)	19.26 (0.99)	1.06 (0.008)
Sex (% female)	60.4	61.85	53.62	63.46	1.82 (0.08)
Race (% white)	59.41	55.10	68.11	57.69	6.92 (0.11)
Ethnicity (% Hispanic)	10.70	11.22	10.14	10.58	

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3; [**] denotes $p < .001$.

Cluster Differences in Responses to the Imagery Scripts

Imagery Manipulation Checks

The means and standard deviations for the imagery manipulation checks (ease of imaging, extent of imaging as instructed, perceived stressfulness, and challenge/threat appraisal) across the three different imagery scripts and broken down by imagery ability clusters are reported in Table 3.3. A 3 (script) x 3 (cluster) mixed design ANOVA looking at ease of imaging revealed no significant main effect for script, $F(1.90, 509.03) = 2.93$, $p = .06$, $\eta_p^2 = .01$, and no script by cluster interaction, $F(3.80, 509.03) = 0.89$, $p = .47$, $\eta_p^2 = .007$; however, there was a significant main effect for cluster, $F(2, 268) = 3.04$, $p = .049$, $\eta_p^2 = .02$, such that higher overall imagers were able to image the scripts more easily than those in the other two clusters (e.g., higher positive/lower negative imagers, lower overall imagers; ps $\leq .04$). That said, this finding did *not* survive B-H correction. For extent of imaging as instructed, a 3 (script) x 3 (cluster) mixed design ANOVA revealed no significant main effect for script, $F(2, 532) = 0.77$, $p = .46$, $\eta_p^2 = .003$, no significant main effect for cluster, $F(2, 266) = 1.98$, $p = .14$, $\eta_p^2 = .01$, and no script by cluster interaction, $F(4, 532) = 0.60$, $p = .66$, $\eta_p^2 = .004$.

For perceived stressfulness, a significant main effect was found for script, $F(2, 534) = 181.69$, $p < .001$, $\eta_p^2 = .40$, such that participants, irrespective of cluster, reported significantly higher perceptions of stress in response to the threat script compared to the challenge and neutral scripts (ps $< .001$), as well as significantly higher perceptions of stress in response to the challenge script compared to the neutral script ($p = .003$). The B-H correction did not alter these results. A significant main effect was also found for cluster, $F(2, 267) = 3.38$, $p = .04$, $\eta_p^2 = .02$, such that higher positive/lower negative imagers reported lower overall perceptions of stress in response to the imagery scripts compared to lower overall imagers ($p = .01$; survived B-H

correction) and higher overall imagers (p = .04; did *not* survive B-H correction). No significant script by cluster interaction was found for perceived stressfulness, $F(4, 534) = 1.15$, $p = .33$, $\eta_p^2 = .009$.

For challenge/threat appraisal, a significant main effect was found for script, $F(1.84, 484.92) = 67.51$, $p < .001$, $\eta_p^2 = .20$, but not for cluster, $F(2, 263) = 0.59$, $p = .55$, $\eta_p^2 = .004$. Results also revealed a significant script by cluster interaction, $F(3.69, 484.92) = 3.90$, $p = .005$, $\eta_p^2 = .03$. *Post hoc* analysis revealed that for each of the imagery ability clusters, the challenge script was perceived as significantly more challenging than the threat script (ps < .001), whereas the threat script was perceived as significantly more threatening than both the challenge and neutral scripts (ps <.001). The B-H correction did not alter these results. When looking between clusters, higher overall imagers also reported significantly greater challenge appraisals to the challenge script compared to lower overall imagers (p = .01), and greater threat appraisals to the threat script compared to both of the other two clusters (ps ≤ .04). However, none of these between-cluster results survived B-H correction. No significant between-cluster differences were observed for the neutral script (ps ≥ .81).

Table 3.3

Means (SDs) of imagery manipulation checks across the three different imagery scripts and imagery ability clusters

	Challenge Imagery			Neutral Imagery			Threat Imagery		
	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3	Cluster 1	Cluster 2	Cluster 3
Ease of Imaging	6.17 (0.85)	5.93 (1.09)	5.79 (1.10)	6.10 (1.06)	5.83 (0.94)	5.85 (1.12)	5.91 (1.08)	5.64 (1.40)	5.81 (1.15)
Extent of Imaging	6.31 (0.83)	6.09 (1.07)	6.03 (1.22)	6.15 (1.12)	6.15 (0.88)	5.99 (1.12)	6.23 (0.99)	5.99 (1.26)	5.95 (1.07)
Perceived Stress	3.69 (1.54)	3.64 (1.77)	3.80 (1.53)	3.41 (1.59)	2.99 (1.61)	3.61 (1.75)	5.68 (1.51)	5.07 (1.83)	5.64 (1.37)
Challenge/Threat	5.23 (1.51)[c]	5.10 (1.45)	4.71 (1.49)[a]	4.77 (1.46)	4.82 (1.44)	4.80 (1.35)	3.49 (1.49)[b,c]	4.01 (1.57)[a]	3.92 (1.49)[a]

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. Ease of imaging ratings ranged from 1 (very hard to image) to 7 (very easy to image). Extent of imaging ratings ranged from 1 (not at all as described) to 7 (exactly as described). Perceived stressfulness ratings ranged from 1 (not at all stressful) to 7 (very stressful). Challenge/threat appraisal ratings ranged from 1 (completely threatening/not at all challenging) to 7 (completely challenging/not at all threatening). Within each script, [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3. It should be noted that these results did *not* survive correction for Benjamini-Hochberg correction false discovery rate = 0.05.

Cognitive and Somatic State Anxiety

Means and standard deviations for cognitive and somatic state anxiety across the imagery scripts are reported in Table 3.4, as well as Figures 3.2 and 3.3. When looking at cognitive anxiety intensity, a 3 (script) x 3 (cluster) mixed design ANOVA revealed a significant main effect for script, $F(1.93, 510.76) = 134.14$, $p < .001$, $\eta_p^2 = .34$, but not cluster, $F(2, 264) = 1.99$, $p = .14$, $\eta_p^2 = .01$, or the script by cluster interaction, $F(3.87, 510.76) = 0.67$, $p = .61$, $\eta_p^2 = .005$. Specifically, irrespective of cluster, participants reported higher cognitive anxiety intensity in response to the threat script compared to the challenge and neutral scripts (ps $< .001$); no significant differences were observed between the challenge and neutral scripts ($p = .09$; refer to Figure 3.2A). The B-H correction did not alter these results.

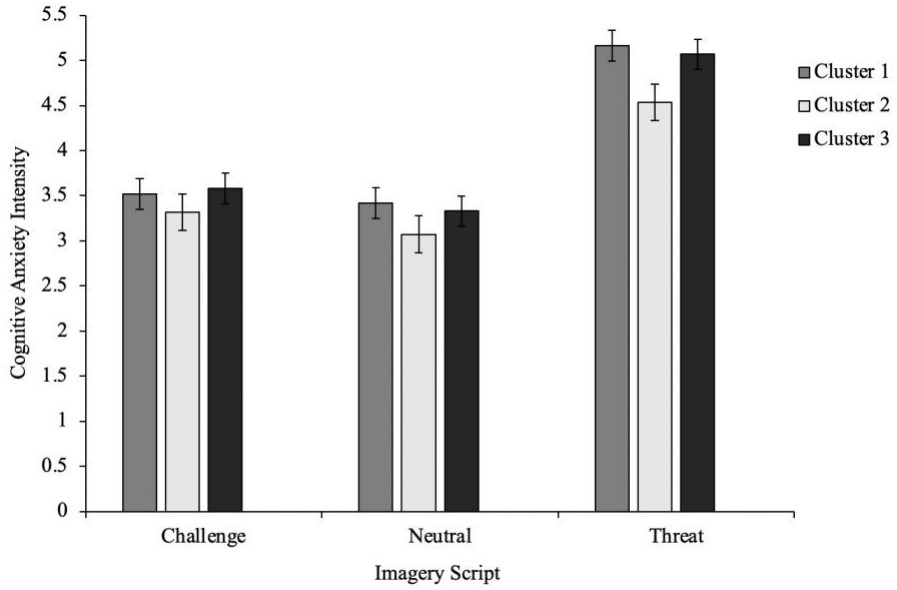
For cognitive anxiety interpretations, a significant main effect was found for script, $F(1.94, 519.07) = 225.30$, $p < .001$, $\eta_p^2 = .46$, and cluster, $F(2, 268) = 5.89$, $p = .003$, $\eta_p^2 = .04$, as well as a significant script by cluster interaction, $F(3.87, 519.07) = 3.22$, $p = .01$, $\eta_p^2 = .02$. *Post hoc* analysis revealed that for each of the imagery ability clusters, cognitive anxiety in response to the challenge script was perceived as significantly more facilitative (i.e., positive) than in response to the threat script, whereas cognitive anxiety in response to the threat script was perceived as significantly more debilitative (i.e., negative) compared to both the challenge and neutral scripts (ps $\leq .001$). Cognitive anxiety in response to the challenge script was also perceived as significantly more facilitative compared to the neutral script for higher overall imagers and lower overall imagers (ps $\leq .02$), but not for higher positive/lower negative imagers ($p = .60$). The B-H correction did not alter these results. When looking between clusters, higher positive/lower negative imagers perceived their cognitive anxiety in response to the threat script as significantly less debilitative compared to the other two clusters (ps $\leq .001$). Higher

positive/lower negative imagers also perceived their cognitive anxiety in response to the neutral script as significantly more facilitative compared to lower overall imagers ($p = .01$), but not higher overall imagers ($p = .07$). No between-cluster differences were observed at the level of the challenge script ($ps \geq .09$; refer to Figure 3.2B). Once again, the B-H correction did not alter these results.

When looking at somatic anxiety intensity, a significant main effect was observed for script, $F(2, 536) = 86.82$, $p < .001$, $\eta_p^2 = .24$, but not for cluster, $F(2, 268) = 0.24$, $p = .79$, $\eta_p^2 = .002$. Additionally, no significant interaction was found between script and cluster, $F(4, 536) = 0.21$, $p = .93$, $\eta_p^2 = .002$. Irrespective of cluster, participants reported higher somatic anxiety intensity in response to the threat script compared to the challenge and neutral scripts ($ps < .001$), and higher somatic anxiety intensity in response to the challenge script compared to the neutral script ($p < .001$; refer to Figure 3.3A). The B-H correction did not alter these results.

For somatic anxiety interpretations, a significant main effect was found for script, $F(1.93, 517.40) = 142.07$, $p < .001$, $\eta_p^2 = .35$, and cluster, $F(2, 268) = 3.66$, $p = .03$, $\eta_p^2 = .03$, but not for the script by cluster interaction, $F(3.86, 517.40) = 1.39$, $p = .24$, $\eta_p^2 = .01$. Irrespective of cluster, participants rated their somatic anxiety as significantly more facilitative in response to the challenge script compared to the neutral script ($p = .02$), which in turn, was rated as significantly more facilitative compared to the threat script ($p < .001$). Higher positive/lower negative imagers reported significantly more positive interpretations of somatic anxiety in response to the imagery scripts compared to both of the other clusters ($ps \leq .02$; refer to Figure 3.3B). The B-H correction did not alter these results.

A)



B)

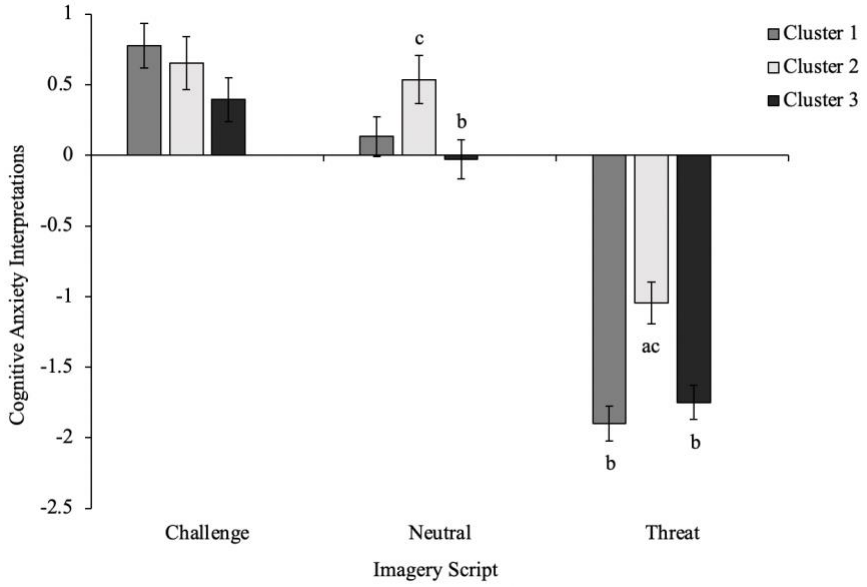
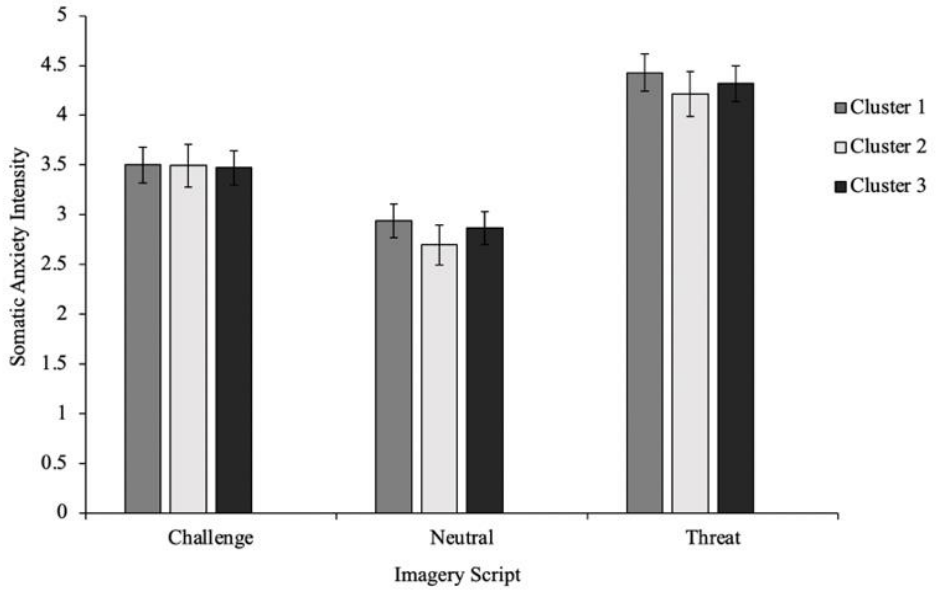


Figure 3.2. Means and standard errors of cognitive anxiety intensity and interpretations across the imagery conditions based on cluster membership.

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. Cognitive anxiety intensity ratings ranged from 1 (not at all) to 7 (extremely); Cognitive anxiety interpretation ratings ranged from -3 (very debilitative/negative) to +3 (very facilitative/positive); [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3. All results remained statistically significant after adjusting for Benjamini-Hochberg correction false discovery rate = 0.05. Error bars represent standard error.

A)



B)

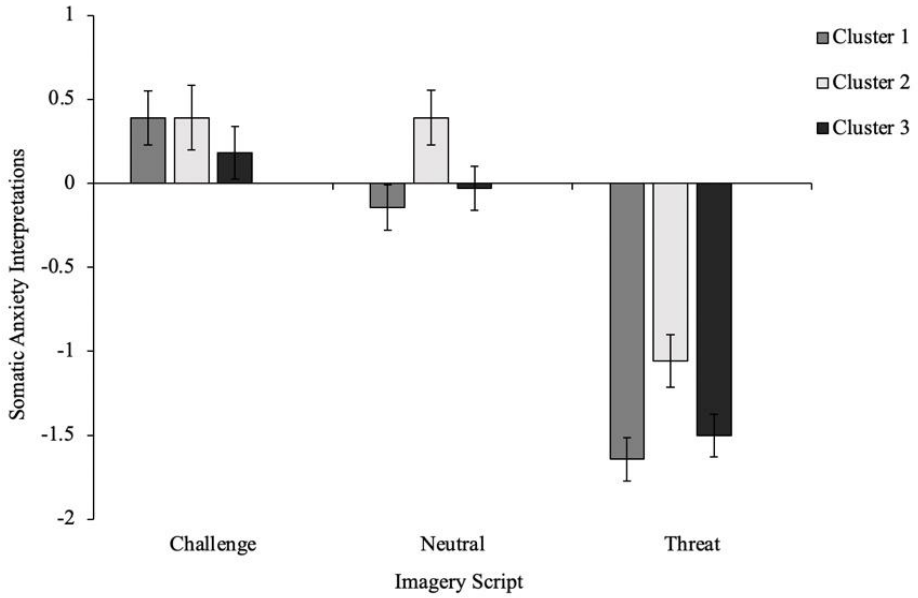


Figure 3.3. Means and standard errors of somatic anxiety intensity and interpretations across the imagery conditions based on cluster membership.

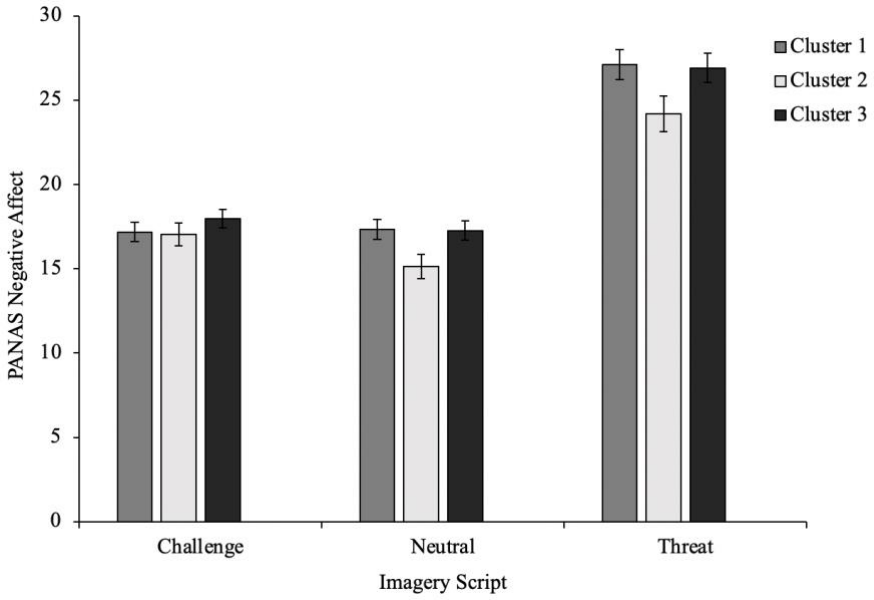
Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. Somatic anxiety intensity ratings ranged from 1 (not at all) to 7 (extremely); Somatic anxiety interpretation ratings ranged from -3 (very debilitative/negative) to +3 (very facilitative/positive); [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3. All results remained statistically significant after adjusting for Benjamini-Hochberg correction false discovery rate = 0.05. Error bars represent standard error.

Positive and Negative State Affect

Means and standard deviations for positive and negative state affect across the imagery scripts are reported in Table 3.4 and Figure 3.4. For negative affect, a 3 (script) x 3 (cluster) mixed design ANOVA revealed a significant main effect for script, $F(1.81, 485.11) = 261.55$, $p < .001$, $\eta_p^2 = .49$, but not for cluster, $F(2, 268) = 2.96$, $p = .054$, $\eta_p^2 = .02$, or the script by cluster interaction, $F(3.62, 485.11) = 1.54$, $p = .19$, $\eta_p^2 = .01$. Irrespective of cluster, participants reported higher negative affect in response to the threat script compared to the challenge and neutral scripts (*p*s < .001), and higher negative affect in response to the challenge script compared to the neutral script ($p = .03$; refer to Figure 3.4A). The B-H correction did not alter these results.

For positive affect, a significant main effect was found for script, $F(1.95, 523.91) = 185.69$, $p < .001$, $\eta_p^2 = .41$, and cluster, $F(2, 268) = 10.94$, $p < .001$, $\eta_p^2 = .07$, as well as a significant script by cluster interaction, $F(3.91, 523.91) = 2.82$, $p = .02$, $\eta_p^2 = .02$. *Post hoc* analysis revealed that individuals in each cluster reported significantly higher positive affect in response the challenge script compared to the neutral and threat scripts, and significantly lower positive affect in response to the threat script compared to the challenge and neutral scripts (*p*s ≤ .02). The B-H correction did not alter these results. However, when looking between clusters, it was found that higher overall imagers and higher positive/lower negative imagers reported significantly higher positive affect in response to the challenge script compared to lower overall imagers (*p*s ≤ .01). Higher positive/lower negative imagers also reported higher positive affect in response to the neutral and threat scripts compared to both of the other two clusters (*p*s ≤ .008; refer to Figure 3.4B). Once again, the B-H correction did not alter these results.

A)



B)

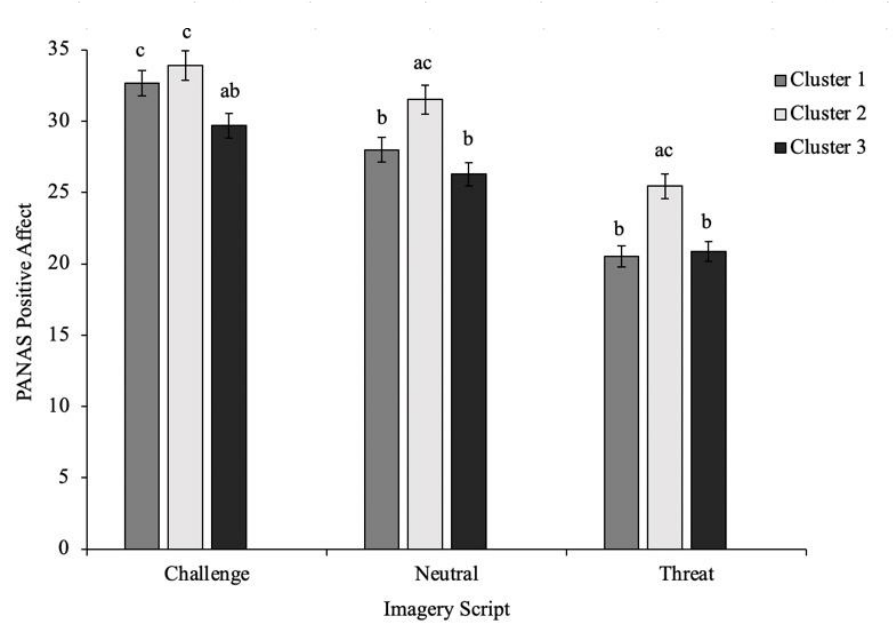


Figure 3.4. Means and standard errors of negative and positive affect across the imagery conditions based on cluster membership.

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3. All results remained statistically significant after adjusting for Benjamini-Hochberg correction false discovery rate = 0.05. Error bars represent standard error.

When looking at emotional pleasantness, a significant main effect was observed for script, $F(2, 536) = 270.99$, $p < .001$, $\eta_p^2 = .50$, and cluster, $F(2, 268) = 6.79$, $p = .001$, $\eta_p^2 = .05$, as well as a significant script by cluster interaction, $F(4, 536) = 2.56$, $p = .04$, $\eta_p^2 = .02$. *Post hoc* analysis revealed that for each of the imagery ability clusters, emotions in response to the challenge script were perceived as significantly more pleasant than in response to the threat script, whereas emotions in response to the threat script were perceived as significantly less pleasant compared to both the challenge and neutral scripts (*p*s < .001). Emotions in response to the challenge script were also perceived as significantly more pleasant compared to the neutral script for higher overall imagers ($p = .02$), but not for higher positive/lower negative imagers or lower overall imagers (*ps* ≥ .41). The B-H correction did not alter these results. When looking between clusters, higher overall imagers and higher positive/lower negative imagers reported significantly more pleasant emotions in response to the challenge script compared to lower overall imagers (*p*s ≤ .02). Higher positive/lower negative imagers also reported significantly more pleasant emotions in response to the neutral script compared to lower overall imagers ($p = .01$), but not higher overall imagers ($p = .14$). Lastly, higher positive/lower negative imagers reported significantly more pleasant emotions in response to the threat script compared to both of the other two clusters (*p*s ≤ .01; refer to Figure 3.5). Once again, the B-H correction did not alter these results.

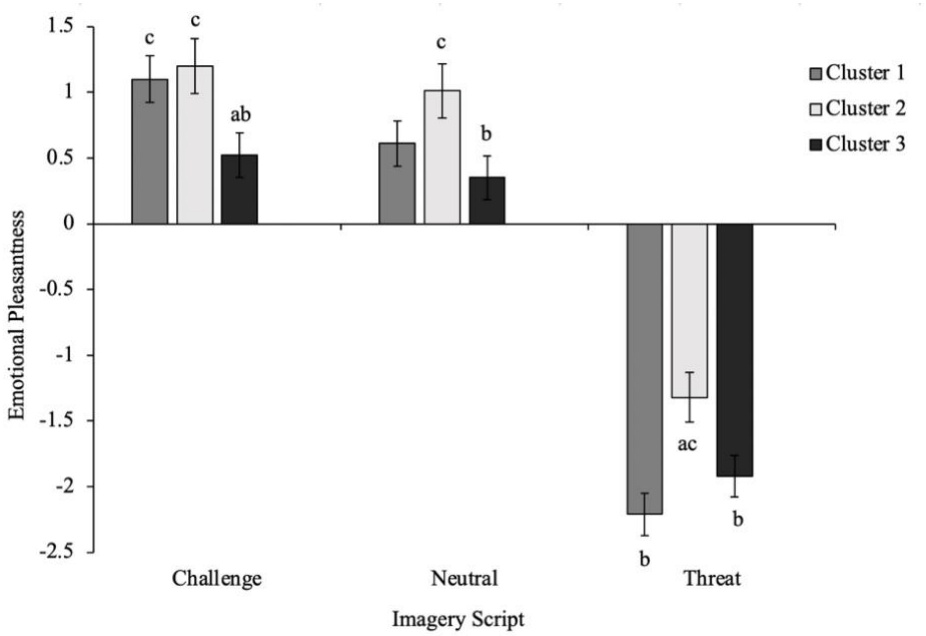


Figure 3.5. Means and standard errors of emotional pleasantness across the imagery conditions based on cluster membership.

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. Emotional pleasantness ratings ranged from -4 (extremely unpleasant) to +4 (extremely pleasant). [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3. All results remained statistically significant after adjusting for Benjamini-Hochberg correction false discovery rate = 0.05. Error bars represent standard error.

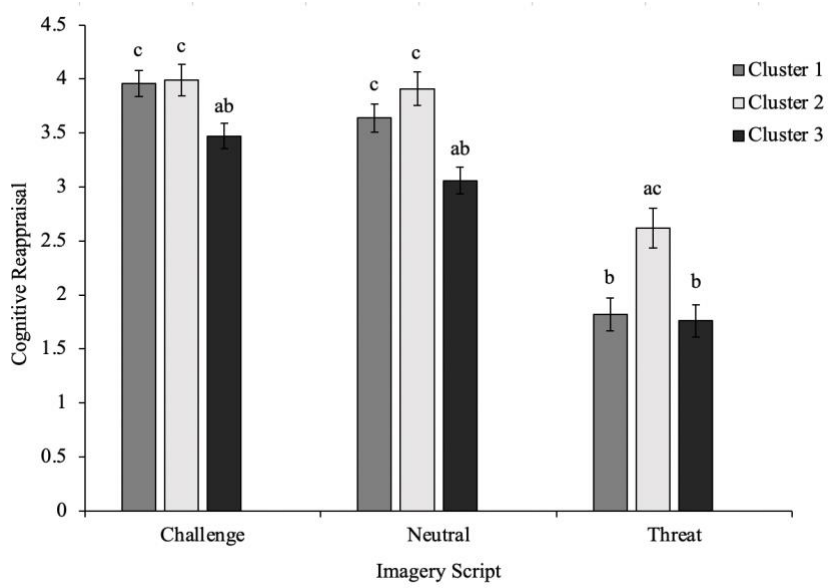
State Emotion Regulation

Means and standard deviations for state emotion regulation across the imagery scripts are reported in Table 3.4 and Figure 3.6. For state use of cognitive reappraisal, a significant main effect was found for script, $F(1.90, 510.15) = 194.59$, $p < .001$, $\eta_p^2 = .42$, and cluster, $F(2, 268) = 11.62$, $p < .001$, $\eta_p^2 = .08$, as well as a significant script by cluster interaction, $F(3.81, 510.15) = 3.39$, $p = .01$, $\eta_p^2 = .02$. *Post hoc* analysis revealed that for each of the imagery ability clusters, state use of cognitive reappraisal was higher during the challenge script compared to the threat

script, whereas state use of cognitive reappraisal was lower during the threat script compared to both the challenge and neutral scripts (*p*s < .001). Cognitive reappraisal was also higher during the challenge script compared to the neutral script for higher overall imagers and lower overall imagers (*p*s < .02), but not for higher positive/lower negative imagers (*p* = .66). The B-H correction did not alter these results. When looking between clusters, higher overall imagers and higher positive/lower negative imagers reported significantly higher use of cognitive reappraisal during the challenge and neutral scripts compared to lower overall imagers (*p*s ≤ .006). Higher positive/lower negative imagers also reported significantly higher use of cognitive reappraisal during the threat script compared to the other two clusters (*p*s < .001; refer to Figure 3.6A). Once again, the B-H correction did not alter these results.

For state use of emotional suppression, a significant main effect was found for script, $F(1.93, 516.53) = 74.99$, $p < .001$, $\eta_p^2 = .22$, and cluster, $F(2, 268) = 3.91$, $p = .02$, $\eta_p^2 = .03$, but no significant interaction was found between script and cluster, $F(3.85, 516.53) = 0.79$, $p = .52$, $\eta_p^2 = .006$. Participants irrespective of cluster reported using emotional suppression less during the threat script compared to the other two scripts (*p*s < .001). No significant differences were found in use of emotional suppression between the challenge and neutral scripts (*p* = .15). Interestingly, higher positive/lower negative imagers reported greater overall use of emotional suppression during the scripts compared to the other two clusters (*p*s ≤ .01; refer to Figure 3.6B). The B-H correction did not alter these results.

A)



B)

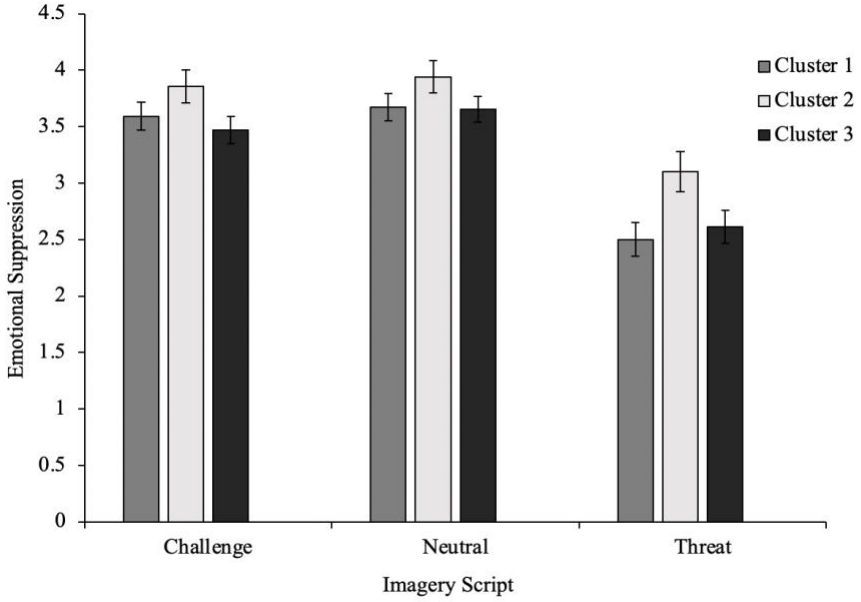


Figure 3.6. Means and standard errors of cognitive reappraisal and emotional suppression across the imagery conditions based on cluster membership.

Note. Cluster 1 = higher overall imagers; Cluster 2 = higher positive/lower negative imagers; Cluster 3 = lower overall imagers. Emotion regulation ratings ranged from 0 (not at all) to 5 (extremely). [a] different from Cluster 1; [b] different from Cluster 2; [c] different from Cluster 3. All results remained statistically significant after adjusting for Benjamini-Hochberg correction false discovery rate = 0.05. Error bars represent standard error.

Table 3.4

Means (SDs) of state psychological responses across the three different imagery scripts

	Challenge Imagery	**Neutral Imagery**	**Threat Imagery**
	Mean (*SD*)	**Mean (*SD*)**	**Mean (*SD*)**
Cognitive anxiety intensity	3.49 (1.68) [c]	3.30 (1.69) [c]	4.97 (1.69) [a, b]
Somatic anxiety intensity	3.49 (1.76) [b, c]	2.85 (1.67) [a, c]	4.33 (1.86) [a, b]
Cognitive anxiety interpretation	0.60 (1.57) [b, c]	0.17 (1.41) [a, c]	-1.62 (1.27) [a, b]
Somatic anxiety interpretation	0.31 (1.59) [b, c]	0.04 (1.36) [a, c]	-1.44 (1.31) [a, b]
Negative affect	17.44 (5.58) [b, c]	16.74 (5.93) [a, c]	26.29 (8.92) [a, b]
Positive affect	31.83 (8.80) [b, c]	28.23 (8.63) [a, c]	21.90 (7.37) [a, b]
Emotional pleasantness	0.90 (1.75) [b, c]	0.61 (1.73) [a, c]	-1.87 (1.62) [a, b]
Cognitive reappraisal	3.78 (1.21) [b, c]	3.49 (1.33) [a, c]	2.00 (1.56) [a, b]
Emotional suppression	3.61 (1.21) [c]	3.73 (1.17) [c]	2.70 (1.50) [a, b]

Note. Cognitive/somatic anxiety intensity ratings ranged from 1 (not at all) to 7 (extremely). Cognitive/somatic anxiety interpretation ratings ranged from -3 (very debilitative/negative) to +3 (very facilitative/positive). Emotional pleasantness ratings ranged from -4 (extremely unpleasant) to +4 (extremely pleasant). Cognitive reappraisal/emotional suppression ratings ranged from 0 (not at all) to 5 (extremely). Letter superscripts represent significant script main effects, such that [a] different from challenge; [b] different from neutral; [c] different from threat. Results remained significant after adjusting for B-H correction.

Discussion

The purpose of Study 2 was to examine whether the unique profiles of positive and negative imagery ability observed in Study 1 could be replicated, and if so, to also examine whether these profiles were differentially associated with psychological responses to challenge and threat guided imagery scripts. Similar to Study 1, three distinct imagery ability profiles emerged: higher overall imagers (Cluster 1), higher positive/lower negative imagers (Cluster 2), and lower overall imagers (Cluster 3). In support of our hypotheses, higher overall imagers and higher positive/lower negative imagers reported significantly greater facilitative effects from the challenge imagery, whereas lower overall imagers reported the least facilitative effects. In contrast, higher overall imagers and lower overall imagers reported significantly greater debilitative effects from the threat imagery, whereas higher positive/lower negative imagers reported the least debilitative effects.

Imagery manipulation checks revealed no significant differences between the three scripts on ease or extent of imaging; however, it should be noted that when looking at the imagery ability profiles, higher overall imagers reported the greatest ease of imaging across all three scripts (although this did not survive correction for the false discovery rate). Further manipulation checks revealed that the imagery scripts were successful in altering perceptions of stress and stress appraisals, such that (irrespective of cluster), the threat script elicited greater perceptions of stress and greater threat appraisals compared to the other two scripts. The challenge script also elicited greater perceptions of stress compared to the neutral script; however, participants also reported greater challenge appraisals. When looking at anxiety responses to the imagery scripts, participants reported greater cognitive and somatic anxiety in response to the threat script, as well as more debilitative interpretations of anxiety symptoms.

While the challenge script only elicited greater somatic anxiety compared to the neutral script (no differences were observed between the two scripts on cognitive anxiety), participants reported more facilitative interpretations of *both* cognitive and somatic anxiety symptoms in response to this script. These findings lend support to previous research suggesting that challenge and threat imagery is an effective technique for altering interpretations of anxiety symptoms (Cumming et al., 2007; Williams et al., 2010; 2017). That said, the present study further builds upon previous challenge and threat imagery research by demonstrating that these scripts can also alter positive and negative affect. In response to the threat script, participants reported greater negative affect and lower positive affect (compared to the other scripts). While participants reported greater negative affect in response to the challenge script compared to the neutral script, they also reported greater positive affect compared to both of the other scripts. To our knowledge, this is the first study to show that challenge and threat imagery can successfully alter the experience of positive and negative affect (alongside anxiety and stress appraisals).

When looking at the imagery ability profiles, higher positive/lower negative imagers demonstrated the most adaptive pattern of psychological responses. Across all three scripts, higher positive/lower negative imagers reported significantly lower perceptions of stress and more positive interpretations of somatic anxiety compared to the other profiles. In response to the challenge script specifically, higher positive/lower negative imagers reported greater positive affect and emotional pleasantness compared to lower overall imagers. These findings reveal that positive imagery ability significantly enhances the effectiveness of positive imagery content. Moreover, in response to the threat script, higher positive/lower negative imagers also reported greater levels of positive affect and emotional pleasantness, as well as less negative interpretations of cognitive anxiety symptoms. These results suggest that the unique combination

of higher positive imagery ability with lower negative imagery ability protects against some of the debilitative consequences associated with negative imagery content. It is possible that a lowered ability to image negative content leads to the imagery of such content to be less effective at eliciting detrimental outcomes. Furthermore, prior research has demonstrated that positive imagery ability acts as a buffer against the debilitative outcomes associated with negative imagery content (Quinton et al., 2019). As such, this study provides promising evidence for a distinct profile of individuals who may be particularly resilient to intrusive negative imagery, a known prominent feature in various psychological disorders (e.g., Brewin et al., 2010).

Higher positive/lower negative imagers also reported greater use of cognitive reappraisal during the challenge imagery compared to lower overall imagers. This outcome is similar to what was observed in Study 1, such that higher positive/lower negative imagers reported the greatest habitual (i.e., trait) use of cognitive reappraisal. Given that the challenge imagery is designed to facilitate the reappraisal of stress as more positive, it makes sense that individuals who typically report frequently using cognitive reappraisal in everyday life will be more likely to successfully employ it during reappraisal imagery, and thus also experience greater facilitative effects. Interestingly, higher positive/lower negative imagers also reported greater use of cognitive reappraisal during the threat imagery compared to both of the other profiles. Active attempts to view the threat imagery as more positive (even though they were not explicitly told to do so in the script), may be another explanation for why these individuals experienced fewer debilitative outcomes in response to the threat imagery. However, it should be noted that this study was limited by the use of single item to assess cognitive reappraisal during the imagery. Future research should examine whether these findings can be replicated using a more reliable and valid measure of state cognitive reappraisal.

A particularly noteworthy finding to emerge from this study was that higher overall imagers (i.e., higher in both positive and negative imagery ability) appeared to be the most responsive to *both* imagery manipulations. Higher overall imagers reported significantly greater challenge appraisals in response to the challenge script compared to lower overall imagers, as well as greater facilitative effects (i.e., higher positive affect, emotional pleasantness, and use of cognitive reappraisal, similar to that of higher positive/lower negative imagers). However, these same individuals also reported significantly greater threat appraisals in response to the threat script compared to both of the other profiles, as well as significantly greater debilitative effects (i.e., lower positive affect, emotional pleasantness, and use of cognitive reappraisal). These findings suggest that imagery ability reflective of script content significantly impacts the effectiveness of that content at instilling the intended appraisal state (e.g., challenge imagery elicits a challenge response, threat imagery elicits a threat response) and supports the notion that higher imagery ability leads to more effective imagery use.[3] While the ability to image positive content is advantageous, the ability to also image negative content may increase the risk of psychological disorders (Holmes & Matthews, 2010). Indeed, referring back to Study 1, higher overall imagers reported greater levels of perceived stress and general anxiety in everyday life. Further research is needed to explore the link between this imagery ability profile and other psychopathology symptoms, such as depression or mania. For example, it has been proposed that positive and negative imagery processes may work concurrently to amplify and fuel symptoms observed within bipolar disorder (Holmes et al., 2008; 2011).

Finally, it was observed that lower overall imagers were the *least* responsive to the imagery manipulations, specifically the challenge imagery. Indeed, these individuals

[3] That said, it is important to acknowledge that cluster-level differences in challenge/threat appraisal ratings did not withstand correction for the false discovery rate, thus warranting cautious interpretation.

demonstrated significantly diminished challenge appraisals in response to the challenge script compared to the other two profiles, as well as lower positive affect, emotional pleasantness, and use of cognitive reappraisal. Lower overall imagers also reported diminished threat appraisals in response to the threat script compared to higher overall imagers, as well as lower positive affect, emotional pleasantness, and use of cognitive reappraisal compared to higher positive/lower negative imagers. Interventions focused on enhancing positive imagery ability could lead to significant improvements in how these individuals respond to challenge and threat imagery; however, this remains to be tested. Future research should examine the possibility of training lower overall imagers to boost their positive imagery ability, such as through layered stimulus response training (LSRT) or imagery rescripting (Cumming et al., 2016; Holmes et al., 2007).

Some key strengths of Study 2 include the novel use of multivariate cluster analysis to examine different imagery ability profiles, as well as the use of a previously well-established experimental imagery manipulation. That said, this study is not without limitations. First, the within-subjects design of this study may have resulted in carry-over effects across imagery conditions; however, these effects were minimized by 1) counterbalancing the order of imagery script presentation, and 2) including extensive manipulation checks. Second, it should be acknowledged that data collection for this study took place at two separate universities in two different geographical regions (United Kingdom and United States). That said, a grouping variable was included to assess potential differences in outcomes across the testing sites, and no statistically significant differences were observed. Third, similar to Study 1, the role of imagery meaning was not considered in this study. This is crucial to note, as positive and negative imagery content may not always correspond with positive and negative outcomes, respectively (Short et al., 2002). As such, future research is needed to ascertain how imagery meaning may

impact the effectiveness of challenge and threat imagery interventions in the context of different imagery ability profiles.

All in all, this study provides evidence for the replicability of the imagery ability profiles identified in Study 1. This study also reveals that these profiles play a significant role in the effectiveness of challenge and threat imagery interventions, with the most notable outcome demonstrating that individuals who find it easier to image positive content over negative content will experience greater facilitative effects from challenge imagery and fewer debilitative effects from threat imagery. It would be worthwhile for future research to explore the possibility of enhancing positive imagery ability in lower overall imagers, as well as reducing negative imagery ability in higher overall imagers, in order to assess whether or not such interventions would improve imagery outcomes for these individuals.

CHAPTER FOUR

General Discussion

General Discussion

The primary objectives of this thesis were threefold: 1) to explore the existence of positive and negative imagery ability profiles in non-athlete-specific samples, 2) to examine how these profiles may be associated with different emotion regulation strategies and stress-related outcomes, and 3) to determine the impact of these profiles on the effectiveness of imagery interventions designed to elicit stress reappraisal (i.e., challenge and threat). To achieve the first objective, multivariate cluster analysis was employed, with the four EIQ subscales (Williams et al., 2023) included as the cluster variables. The second and third objectives were addressed through a combination of cross-sectional (Chapter 2: Study 1) and experimental (Chapter 3: Study 2) approaches.

Summary of Findings

In Chapter 2, three distinct imagery ability profiles were identified: higher overall imagers, higher positive/lower negative imagers, and lower overall imagers. Higher positive/lower negative imagers reported greater habitual use of adaptive emotion regulation strategies (i.e., cognitive reappraisal, situation selection), lower habitual use of maladaptive strategies (i.e., expressive suppression), and lower perceived stress and general anxiety. In contrast, higher and lower overall imagers reported significantly less adaptive patterns of emotion regulation strategy use (i.e., greater use of expressive suppression, lower use of cognitive reappraisal), as well as greater levels of perceived stress and anxiety.

In Chapter 3, the imagery ability profiles were successfully replicated and also found to differentially influence the effectiveness of challenge and threat imagery manipulations. Specifically, higher positive/lower negative imagers reported greater facilitative effects from the challenge imagery (i.e., greater positive affect, emotional pleasantness, and use of cognitive

reappraisal) as well as fewer debilitative effects from the threat imagery (i.e., less debilitative interpretations of cognitive anxiety, greater positive affect, emotional pleasantness, and use of cognitive reappraisal). Higher overall imagers also reported greater facilitative effects from challenge imagery; however, this was offset by the fact that they also experienced greater debilitative effects from threat imagery. Finally, lower overall imagers were the least responsive to the imagery scripts, notably reporting the fewest facilitative effects from the challenge imagery.

Implications

The overall findings from this thesis carry several important implications, both for advancing our theoretical understanding of imagery abilities and for practical applications in the realm of stress management and emotion regulation.

Advancing Theoretical Understanding

The identification of distinct imagery ability profiles in Chapters 2 and 3 represents a significant leap forward in our theoretical understanding of imagery ability. Indeed, the existence of different imagery ability profiles challenges the conventional perspective that imagery ability is a uniform construct, and instead provides support for research advocating its multifaceted nature (e.g., Hall, 1998; Williams & Cumming, 2011; Williams et al., 2023). These findings suggest that positive and negative imagery ability are not merely opposing points on a single continuum of valence, but rather are distinct constructs. Even more intriguing is the revelation that these abilities can coexist within an individual, forming unique profiles that are indicative of either adaptive or maladaptive stress responding. For example, while the present thesis offers substantial support for the benefits of positive imagery ability (Quinton et al., 2018; 2019; Williams & Cumming, 2012b; Williams et al., 2021), it expands upon this previous research by

arguing that such benefits may not be derived from positive imagery ability alone, but rather, it is the unique combination of higher positive imagery ability *with* lower negative imagery ability that leads to the best stress and emotion regulation outcomes.

Consequently, this thesis highlights the significance of examining profiles of positive and negative imagery ability, rather than examining each type of imagery ability in isolation. This innovative approach offers a more comprehensive understanding of imagery ability and also reduces the risk of misinterpretation regarding how imagery ability relates to various cognitive, affective, and behavioral outcomes. For example, in the absence of profiling, there is a potential for researchers to erroneously conclude that only positive imagery ability is a determinant of improved psychological functioning, thus overlooking the essential role played by negative imagery ability. This could result in the inaccurate categorization of higher positive/lower negative imagers as either higher overall imagers (if solely examining positive imagery ability) or lower overall imagers (if solely examining negative imagery ability). Such an over-generalization would substantially limit the depth and granularity of potential findings.

Overall, this thesis marks the first attempt at exploring unique profiles of imagery ability. As such, further research is needed to replicate these results and gain a better understanding of how these profiles may differentially impact other types of psychological outcomes. This approach holds the potential to reshape how we perceive and investigate imagery ability, ultimately leading to more nuanced and accurate insights into their influence on psychological health and well-being.

Enhancing Stress Optimization

As mentioned above, the present thesis uncovered an interesting and potentially adaptive imagery ability profile, characterized by higher positive and lower negative imagery ability. This

discovery could have significant implications for future stress intervention research, such that higher positive/lower negative imagers may be particularly adept at engaging in successful stress optimization in everyday life. As a refresher, the stress optimization approach advocates for the integration of stress mindset and stress reappraisal literatures within the EPM framework of valuation and strategy implementation (Crum et al., 2020). This approach encourages adaptive valuations of stress, viewing it as a positive influence on goal achievement (i.e., stress and stress responses can be beneficial for me). By shifting the focus of stress regulation from reducing stress to optimizing it, individuals can utilize various regulatory strategies, such as imagery, to manage stress in a way that supports their goals.

It can be proposed that higher positive/lower negative imagers exhibit a distinct advantage in their ability to effectively manage stress via several key mechanisms: 1) they frequently use cognitive reappraisal, which involves reframing stressful situations to reduce emotional impact, 2) they excel at using positive mental imagery to foster positive stress appraisals, enabling a more constructive perspective on stressors, and 3) they exhibit resilience to the negative effects of stress-inducing imagery, thus allowing them to navigate stressors more adaptively and maintain emotional well-being. This unique combination of skills could be what leads to higher positive/lower negative imagers being exceptionally well-suited for effective stress optimization. Understanding these protective mechanisms may provide valuable insights for future research, as well as the development of personalized stress intervention programs (see next section).

Informing Interventions

By recognizing the potential of higher positive/lower negative imagers to succeed in stress optimization, interventions can be designed to harness and enhance these individuals'

innate abilities. Such programs could focus on honing their use of adaptive emotion regulation strategies, further refining their positive imagery skills, and providing tools to maintain their resistance to negative stress-inducing imagery. Moreover, individuals identified as lower overall imagers, who tend to report less adaptive emotion regulation strategy use and heightened stress/anxiety levels, may gain significant benefits from specialized trainings that are designed to improve regulation of emotions (e.g., Dialectical Behavior Therapy, Linehan et al., 1999; Skills Training in Affect and Interpersonal Regulation, Cloitre et al., 2002) as well as enhance positive imagery ability (LSRT, Cumming et al., 2016; imagery rescripting, Holmes et al., 2007). This, in turn, has the potential to facilitate improved stress optimization outcomes, thus mirroring the benefits observed in individuals possessing higher positive/lower negative imagery.

Limitations

While this thesis contributes significantly to our understanding of imagery ability profiles and their implications for stress and emotion regulation, it is essential to acknowledge several limitations that warrant consideration. First, as mentioned in Chapter 2, the use of a cross-sectional study design prevents the determination and direction of causality; however, this thesis was greatly strengthened by the subsequent inclusion of an experimental study design in Chapter 3. Second, there is always the possibility of a third, unexamined variable confounding the results (Christenfeld et al., 2004). That said, a variety of potential confounders were controlled for (e.g., age, sex, race, ethnicity) and significance was still observed. Third, these samples were drawn from a very specific demographic group (i.e., undergraduate students), thus potentially limiting the generalizability of these findings to the broader population. Nonetheless, diversity was still observed with regards to race, gender, and ethnicity (refer back to Table 2.1 and Table 3.1 for breakdown in demographics of both samples). Additionally, this thesis

advances prior imagery research by incorporating non-athlete-specific samples. However, it is worth noting that, as participants weren't specifically queried about their athletic status, the samples may still have included individuals with athletic backgrounds. While measures, imagery scripts, and the context of the present thesis were not sport specific, future research should attempt to replicate these results in other age cohorts, as well as in samples controlling for athletic experience in order to allow for more critical comparisons with the existing imagery literature.

Fourth, the assessment of imagery abilities (as well as stress and emotion regulation) primarily relied on self-report measures. While self-report measures are valuable tools for examining individual experiences, they may be subject to biases or social desirability effects. Combining self-report with observational, physiological, or performance-based assessments in the future could provide a more comprehensive evaluation. Fifth, while this thesis identifies distinct imagery ability profiles, it is crucial to recognize that all individuals are inherently unique. Even within a specific profile, there can be considerable individual variation. Further exploration into the factors contributing to this within-profile variation could shed light on the complexities of imagery abilities. Sixth, it should be acknowledged that while the experimental manipulations of imagery in Chapter 3 do provide valuable insights, they may not capture the complexity of trying to use imagery in the face of real and present stressors. Future research should aim to bridge the gap between the use of imagery in laboratory settings and in everyday life. Lastly, as already mentioned in previous chapters, the role of imagery meaning (i.e., an individual’s perception of an image as either facilitative or debilitative) was not examined in the present thesis. This is a notable limitation, as the success of an imagery intervention in achieving desired outcomes is heavily contingent upon imagery meaning. Consequently, both

researchers and clinicians should exercise caution in endorsing imagery if it fails to evoke the intended "desirable" effects.

Future Directions

Future research should first aim to replicate these results to establish the robustness of imagery ability profiles and their associations with stress and emotion regulation. It is advisable for such research to also incorporate imagery meaning as a manipulation check to further strengthen and clarify findings. Furthermore, it would be valuable to investigate whether these positive and negative imagery ability profiles are linked to other important outcomes, such as resilience, well-being, or even physical health, thus extending our understanding of their potential impact. Additionally, integrating physiological measures, such as cortisol or heart rate variability, alongside self-report data may provide a more comprehensive picture of how imagery ability profiles relate to both physiological and psychological responding to stressors. This interdisciplinary approach could offer a richer understanding of the interplay between imagery ability profiles and stress regulation in real-world contexts. One potential avenue for future research involves the use of ecological momentary assessment (EMA), in which individuals provide real-time reports of their physiological and psychological responses to everyday stress experiences. Subsequently, participants may be prompted to incorporate imagery as a coping strategy, allowing for an examination of its impact on their reported daily responses. Even more, by tracking these experiences longitudinally, researchers can gain a deeper understanding of how imagery abilities manifest in the face of ongoing, dynamic stressors. Indeed, longitudinal research is a powerful tool that may shed more light on the causal relationships and developmental trajectories of these profiles. Lastly, as mentioned above, the integration of positive imagery training into stress management programs represents a promising avenue for

future research. Exploring the effectiveness of such interventions in improving stress responses and emotion regulation among lower overall imagers may provide valuable insights into practical applications.

Conclusion

In conclusion, this thesis contributes significantly to our understanding of the interplay between imagery ability, stress, and emotion regulation in non-athlete-specific samples. In particular, three distinct imagery ability profiles were identified, with a particular focus on higher positive/lower negative imagers. These results demonstrate that individuals with this particular profile exhibit a distinct ability for stress optimization, characterized by their frequent use of cognitive reappraisal, skillful utilization of positive imagery, and resilience to negative imagery. By identifying unique profiles of imagery ability and exploring their impact on stress responding, this thesis lays the groundwork for more effective and personalized stress interventions in the future, while still recognizing the need for continued research and consideration of study limitations.

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Appendix 1: Information Sheet and Consent Form (Study 1)

Baylor University
Psychology and Neuroscience

Consent Form for Research

PROTOCOL TITLE: Emotions and health

PRINCIPAL INVESTIGATOR: Annie Ginty, PhD

SUPPORTED BY: Baylor University

Purpose of the research: The main objective of this study is to investigate how emotions relate to stress and health.

Study activities: Participants in this study will provide responses to short surveys. The entire process should take no longer than 25 minutes.

Risks and Benefits: There are no anticipated risks to this research; however, it is possible that providing answers about your emotions, health, or stress may prove uncomfortable. If you feel uncomfortable, you may end the experiment at any time. There are no anticipated benefits to this research, although participation in this research will help researchers better understand emotions, stress, and health.

Confidentiality: All questionnaire data will be collected through Qualtrics. Qualtrics data is stored on an encrypted server. In addition, no identifying information (e.g., name, birthdate) will be collected. Authorized staff of Baylor University may review the study records for purposes such as quality control or safety.

SONA Credit: If you are taking an Intro Psychology or another course that has SONA requirements, you will receive compensation in the form of 1 research credit for completing the study through SONA. All participants will receive the same amount of credit.

Questions or concerns about this research study: You can call the researcher(s) with any concerns or questions about the research.

- Primary Investigator Name: Annie T. Ginty, Ph.D.
    - Address:
    - Phone #:
    - Fax #:
    - Email:

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), you may contact the Baylor University IRB through the Office of the Vice Provost for Research at or

Taking part in this study is your choice. You are free not to take part or to stop at any time for any reason. No matter what you decide, there will be no penalty or loss of benefit to which you are entitled. If you decide to withdraw from this study, the information that you have already provided will be kept confidential. Information already collected about you cannot be deleted.

By continuing with the research and completing the study activities, you are providing your consent.

Appendix 2: Demographics Form (Study 1)

Are you male, female, or prefer not to specify?

☐ Male ☐ Female ☐ Prefer not to answer

What is your age? _____

Please select the appropriate square with regards to your ethnicity:

☐Hispanic or Latino ☐ Not Hispanic or Latino

Please select the appropriate square with regards to your race:

☐ American Indian or Alaska Native

☐ Asian

☐ Black of African American

☐ Native Hawaiian or Other Pacific Islander

☐ White

☐ Mixed/Other (please specify): _____

Do you have any chronic illnesses/diseases/conditions?
☐ Yes ☐ No

If yes, please state what_____

Are you on any continuous medication?

☐ Yes ☐ No

If yes, please state what _____

Appendix 3: Ease of Imagery Questionnaire (Study 1 & 2)

The purpose of this questionnaire is to obtain information about your ability to generate images of things experienced in everyday life. For each item, bring the image to your mind and then use the scale provided (1=very hard to image to 7=very easy to image) to rate how easy it is for you to form the image.

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

How easy is it for you to image…	1 Very hard to image	2 Hard to image	3 Somewhat hard to image	4 Neutral (not easy or hard)	5 Somewhat easy to image	6 Easy to image	7 Very easy to image
1. Giving up when things are not going well.	1	2	3	4	5	6	7
2. The positive emotions you feel when doing something you enjoy.	1	2	3	4	5	6	7
3. Carrying on with a task when it proves difficult.	1	2	3	4	5	6	7
4. The unease associated with an unenjoyable activity.	1	2	3	4	5	6	7
5. The feelings associated with doing something fun.	1	2	3	4	5	6	7
6. Giving up on a task when it proves difficult.	1	2	3	4	5	6	7
7. The negative emotions associated with a bad day.	1	2	3	4	5	6	7
8. Remaining confident in a difficult situation.	1	2	3	4	5	6	7
9. The excitement associated with an enjoyable activity.	1	2	3	4	5	6	7
10. Giving up in the face of adversity.	1	2	3	4	5	6	7
11. The negative emotions you feel when doing something you dislike.	1	2	3	4	5	6	7
12. Staying motivated when something is hard.	1	2	3	4	5	6	7
13. The positive emotions associated with a good day.	1	2	3	4	5	6	7
14. Being defeated by a setback.	1	2	3	4	5	6	7

How easy is it for you to image…	1 Very hard to image	2 Hard to image	3 Somewhat hard to image	4 Neutral (not easy or hard)	5 Somewhat easy to image	6 Easy to image	7 Very easy to image
15. The emotions felt when something negative happens.	1	2	3	4	5	6	7
16. Persevering in the face of adversity.	1	2	3	4	5	6	7

Appendix 4: Extended Emotion Regulation Questionnaire (Study 1)

Please use the scale below to tell us how much you agree or disagree with the following statements

	1	2	3	4	5	6	7
	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
1. When I want to feel a more positive emotion (such as joy), I change what I'm thinking about.	1	2	3	4	5	6	7
2. I control my emotions by physically changing the situation I'm in.	1	2	3	4	5	6	7
3. When I want to feel a positive emotion, I try to physically put myself in situations or places that I know make me feel good.	1	2	3	4	5	6	7
4. I keep my emotions to myself.	1	2	3	4	5	6	7
5. When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about.	1	2	3	4	5	6	7
6. Whenever I am faced with an undesired emotion, I try to take my mind off it by thinking about something irrelevant.	1	2	3	4	5	6	7
7. Focusing on the boring parts of emotional experiences helps me get past unwanted feelings.	1	2	3	4	5	6	7
8. If I do not like how I am feeling, I try to change my surroundings.	1	2	3	4	5	6	7
9. When I am feeling positive emotions, I am careful not to express them.	1	2	3	4	5	6	7
10. When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm.	1	2	3	4	5	6	7

	1	2	3	4	5	6	7
	Strongly disagree	Disagree	Slightly disagree	Neutral	Slightly agree	Agree	Strongly agree
11. I manage my emotions by focusing on the unemotional parts of an experience.	1	2	3	4	5	6	7
12. I distract myself from emotions that I do not want to feel	1	2	3	4	5	6	7
13. I control my emotions by not expressing them.	1	2	3	4	5	6	7
14. I try to focus on the neutral parts of intense experiences in order to control my emotions.	1	2	3	4	5	6	7
15. Whenever I am frustrated, I try to think about something else in order to let myself cool off.	1	2	3	4	5	6	7
16. I focus on the mundane aspects of emotional experiences if I do not want to feel my emotions strongly.	1	2	3	4	5	6	7
17. I control my emotions by changing the way I think about the situation I'm in.	1	2	3	4	5	6	7
18. I control the emotions I am feeling by distracting myself from them.	1	2	3	4	5	6	7
19. When I want to feel more positive emotion, I change the way I'm thinking about the situation.	1	2	3	4	5	6	7
20. When I am feeling negative emotions, I make sure not to express them.	1	2	3	4	5	6	7
21. If something is upsetting me, I try to think about something else.	1	2	3	4	5	6	7
22. When I want to feel less negative emotion, I change the way I'm thinking about the situation.	1	2	3	4	5	6	7

Appendix 5: Perceived Stress Scale (Study 1)

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way.

In the last month:

		Never	Almost never	Sometimes	Fairly often	Very often
1	How often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2	How often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3	How often have you felt nervous and "stressed"?	0	1	2	3	4
4	How often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5	How often have you felt that things were going your way?	0	1	2	3	4
6	How often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7	How often have you been able to control irritations in your life?	0	1	2	3	4
8	How often have you felt that you were on top of things?	0	1	2	3	4
9	How often have you been angered because of things that were outside of your control?	0	1	2	3	4
10	How often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Appendix 6: Hospital Anxiety and Depression Scale (Study 1)

This questionnaire is designed to help us understand how you feel. Read each item and circle the reply which comes closest to how you have been feeling in the past week. Don't take too long over your replies, your immediate reaction to each item will probably be more accurate than a long thought-out response.

1. **I feel tense or 'wound up'**	Most of the time	A lot of the time	From time to time, occasionally	Not at all
2. **I still enjoy the things I used to enjoy**	Definitely as much	Not quite so much	Only a little	Hardly at all
3. **I get a sort of frightened feeling as if something awful is about to happen**	Very definitely & quite badly	Yes, but not too badly	A little, but it doesn't worry me	Not at all
4. **I can laugh and see the funny side of things**	As much as I always could	Not quite so much now	Definitely not so much now	Not at all
5. **Worrying thoughts go through my mind**	A great deal of the time	A lot of the time	From time to time but not too often	Only occasionally
6. **I feel cheerful**	Not at all	Not often	Sometimes	Most of the time
7. **I can sit at ease and feel relaxed**	Definitely	Usually	Not often	Not at all
8. **I feel as if I am slowed down**	Nearly all the time	Very often	Sometimes	Not at all
9. **I get a sort of frightened feeling like 'butterflies' in the stomach**	Not at all	Occasionally	Quite often	Very often
10. **I have lost interest in my appearance**	Definitely	I don't take as much care as I should	I may not take quite as much care	I take just as much care as ever
11. **I feel restless as if I have to be on the move**	Very much indeed	Quite a lot	Not very much	Not at all
12. **I look forward with enjoyment to things**	As much as ever I did	Rather less than I used to	Definitely less than I used to	Hardly at all
13. **I get sudden feelings of panic**	Very often indeed	Quite often	Not very often	Not at all
14. **I can enjoy a good book or radio or TV program**	Often	Sometimes	Not often	Very seldom

Appendix 7: Birmingham Study Information Sheet (Study 2)

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

What is the study about?
This study seeks to investigate the influence of imagery on aspects of psychological stress and wellbeing.

Who can take part?
Anyone aged 18-35 can take part if they are proficient in understanding English, do not have a hearing impairment that would prevent them from listening to a set of audio instructions, and do not have a medically diagnosed mental health condition.

What will my participation involve?
If you are willing to participate, you will be asked to complete a laboratory visit in the School of Sport, Exercise and Rehabilitation Sciences which will last no longer than 2 hours. During the visit you will listen to three different imagery scripts describing a scenario you may experience in your daily life and then answer some questions about how the imagery made you feel. You will then be asked to complete some questionnaires which will measure different traits and dispositions. Although some people may consider the scenarios to be imagined as stressful in nature, and some questions to be of a sensitive nature (e.g., assessing your stress levels), the imagery and questionnaires completed are no more demanding than questions and activities experienced in daily living. You are also free to stop imaging any scenario you are not comfortable with and can choose not to answer any question you find distressing or do not wish to answer. If you require any additional support with some of the issues linked to mental health in this study, appropriate contact details are provided at the bottom of this information sheet.

What will happen to the responses I provide?
Our overall findings will be used to understand how things like imagery can influence feelings and responses and how this relates to certain personality characteristics. **All your personal data will remain confidential and will be solely used for academic purposes. Consequently, we would be grateful if you were honest in your responses to the questionnaires.** In accordance with the Data Protection Act (2018) data from this study will be kept for a period of ten years following completion of the project. Questionnaires and computer files containing processed data will be kept securely in a locked filing cabinet and will only be accessed by the researchers. After this time period, all the data collected will be destroyed. No identifiable information will be published on any participant meaning you will not be individually identified in any publication.

Do I have to take part?
It is up to you if you take part. Your participation in this study is voluntary and you may withdraw at any time **up to two weeks after** you complete the study, without giving a reason or any negative consequences. If you choose to withdraw from the study, please contact us (contact details provided below) to inform us of your decision. The deadline for withdrawing from the

study is **2 weeks after** you have completed the study. If you choose to withdraw before this time, your data will be destroyed and not included in the study. A brief summary giving an overview of the findings will be available upon request at the end of the study.

What are the benefits and risks?

Participants who take part in the study can receive a £10 Amazon voucher as a thank you for participating. Alternatively, if you are a first year or second year student in the School of Sport, Exercise & Rehabilitation Sciences, you can elect to receive 2 research hours when you have completed the study (rather than receive a £10 Amazon voucher). You will be asked to indicate at the start of the study whether you would prefer to receive the £10 Amazon voucher or the research hours. If you are a student in another school within The University of Birmingham that offers renumeration for taking part in research, you may also be able to claim 2 hours of research credits. Eligibility for this is dependent on schools so please email us to check whether your school qualifies for the research hours. The risks of taking part in this study are no more than those of day to day stressors. All information that we collect will be strictly confidential.

Can I change my mind?
If, at any point before or during the study, you wish to withdraw, then you may do so. You do not need to give any reason for this as you do not need to take part. If you decide to withdraw, the data that we collected from you will be destroyed and will not be used for the study.

Who else is taking part?
We will be recruiting other individuals who like you fit the inclusion criteria.

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

If you want to find out more about this study, please feel free to contact us.

Alex Tyra	*Lead Researcher*	[redacted]
Sarah Williams	*Project Supervisor*	[redacted]

In the event that you wish to seek advice and/or information as a result of completing the study, here are some recommended sources: a) your GP, b) the Birmingham and Solihull Mental Health NHS Foundation Trust on 0121 301 0000, website: www.bsmhft.nhs.uk. If you are a student at the University of Birmingham, you can also access the Mental Health and Wellbeing Services. For information about their services and online resources, please have a look at this link: https://intranet.birmingham.ac.uk/student/welfare/mental-health/index.aspx. Or Tel 0121 4145130. Furthermore, this is an online self-referral process at https://intranet.birmingham.ac.uk/student/welfare/mental-health/personalised-support/access.aspx

Appendix 8: Birmingham Consent Form (Study 2)

To be completed by the participant:

	Initial to consent
I confirm that I have read and understand the information sheet and have had the opportunity to ask questions.	
All questions have been answered to my satisfaction.	
I understand that my participation is voluntary and that I am free to withdraw at any time **up to two weeks** after completing the study without giving any reason or my rights being affected.	
I consent to participating in the study.	
I give consent for the data that I provide to be used for research purposes.	

Please select whether you would like to receive the £10 Amazon voucher or the 2 research hours on completion of the study:

£10 Amazon Voucher ☐ 2 Research Hours ☐

If you would like to receive a summary of the study findings please initial below and provide your email address (please note, this is a summary of all the study findings rather than your own individual results).

	Initial to consent
I would like to receive a summary of the results of the study.	
Email: _____	

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

Print name .....

Signed .....

Date .....

Appendix 9: Baylor Information Sheet and Consent Form (Study 2)

PROTOCOL TITLE: **Imagery and Wellbeing**
PRINCIPAL INVESTIGATOR (PI): **Alexandra T. Tyra & Dr. Annie T. Ginty**
SUPPORTED BY: **Baylor University**

Invitation to be Part of a Research Study

You are invited to be part of a research study. This consent form will help you choose whether or not to participate in the study. Feel free to ask if anything is not clear in this consent form.

Important Information about this Research Study

Things you should know:

- The purpose of the study is to investigate the influence of imagery on aspects of psychological stress and wellbeing.
- In order to participate, you must be between 18-35 years old and meet the following inclusion criteria: proficient in understanding English, do not have a hearing impairment that would prevent you from listening to a set of audio instructions, and do not have a medically diagnosed mental health condition.
- If you choose to participate, you will be asked to attend a single laboratory visit on Baylor University's campus, specifically the Baylor Behavioral Medicine Laboratory (BSB.A356). This will take approximately 1.5 hours.
- During the laboratory visit you will: listen to three different imagery scripts describing a scenario you may experience in your daily life and then answer some questions about how the imagery made you feel. You will then be asked to complete some questionnaires which will measure different traits and dispositions.
- Risks or discomforts from this research are minimal but may include stress that is typically experienced in everyday life.
- The possible benefits of this study include learning more about yourself.
- Taking part in this research study is voluntary. You do not have to participate, and you can stop at any time.

More detailed information may be described later in this form. Please take time to read this entire form and ask questions before deciding whether to take part in this research study.

Why is this study being done?

The purpose of the study is to investigate the influence of imagery on aspects of psychological stress and wellbeing.

What will happen if I take part in this research study?

If you agree to take part in this study, we will answer any questions you have regarding your participation in the study and ask you to sign the consent form before we do any study procedures.

Study Visit

The visit will take approximately **1.5 hours** to complete. At this visit, we will ask you to do the following procedures:

- Read the approved consent form and discuss any further questions you have.
- Complete questionnaires on a tablet about your current mood, mental, and emotional health.
- Listen to three different imagery scripts describing a scenario you may experience in your daily life.
- Complete more questionnaires on a tablet regarding your thoughts and feelings about the imagery scenario after listening to each script.
- Complete some final questions on a tablet about different traits and dispositions.

How long will I be in this study and how many people will be in the study?

Participation in this study will last approximately **1.5 hours**. During this time, we will ask you to make **1** study visit to **Baylor Sciences Building A.356**. About 200 subjects will take part in this research study.

What are the risks of taking part in this research study?

There are some risks you might experience from being in this study. They are as follows:

- **Imagery:** You will be asked to imagine scenarios which may be considered by some to be stressful. You will be free to stop imaging if ever it becomes too stressful.
- **Questionnaire/Survey Risks:** You may be uncomfortable with some of the questions and topics we will ask about. You do not have to answer any questions that make you feel uncomfortable.
- **Deception:** As part of this research, you will not be told about some of the study details. If you were told these details at the beginning of the study, it could change the research results. If you decide to be part of the study, you will be given an explanation of what information was withheld from you at the end of your study participation.
- **Loss of Confidentiality:** A risk of taking part in this study is the possibility of a loss of confidentiality. Loss of confidentiality includes having your personal information shared with someone who is not on the study team and was not supposed to see or know about your information. The researcher plans to protect your confidentiality. The researchers' plans for keeping your information private are described later in this consent form.

Are there any benefits from being in this research study?

You may or may not benefit from taking part in this study. Possible benefits include learning a more about yourself. Others may benefit in the future from the information that is learned in this study. Information from this study may be used to develop interventions to help people cope with stress.

How Will You Protect my Information?

A risk of taking part in this study is the possibility of a loss of confidentiality. Loss of confidentiality includes having your personal information shared with someone who is not on the study team and was not supposed to see or know about your information. The researcher plans to protect your confidentiality.

We will keep the records of this study confidential by keeping all data stored with codes instead of your actual name. The key to the codes will be kept on an encrypted file only available to the PI and main study research assistants. We will make every effort to keep your records confidential. However, there are times when federal or state law requires the disclosure of your records.

The following people or groups may review your study records for purposes such as quality control or safety:

- Representatives of Baylor University and the BU Institutional Review Board
- Federal and state agencies that oversee or review research (such as the HHS Office of Human Research Protection or the Food and Drug Administration)

The results of this study may also be used for teaching, publications, or presentations at professional meetings. If your individual results are discussed, your identity will be protected by using a code number or pseudonym rather than your name or other identifying information.

Will information you collect about me be used for future research studies?

Information collected from you as part of this research may be shared with the research community at large to advance science and health. We will remove or code any personal information that could identify you before the information is shared with other researchers to ensure that, by current scientific standards and known methods, no one will be able to identify you from what is shared.

Will I be compensated for being part of the study?

We will give you **2 research hours** for taking part in this study.

What other choices do I have if I do not take part in this study?

You may choose not to take part in this research study. If you are taking this study to receive research course credit and decide after the session begins that you would no longer like to participate, you will still earn your research credit for the amount of time you participated in the study.

Is it possible that I will be asked to leave the study?

The researcher may take you out of this study without your permission. This may happen because:

- The researcher thinks it is in your best interest
- You can't make the required study visits
- Other administrative reasons

Your Participation in this Study is Voluntary

Taking part in this study is your choice. You are free not to take part or to withdraw at any time for any reason. No matter what you decide, there will be no penalty or loss of benefit to which you are entitled. If you decide to withdraw from this study, the information that you have already provided will be kept confidential. You cannot withdraw information collected prior to your withdrawal.

If you are a Baylor student or faculty/staff member, you may choose not to be in the study or to stop being in the study before it is over at any time. This will not affect your grades or job status at Baylor University. You will not be offered or receive any special consideration if you take part in this research study.

Contact Information for the Study Team and Questions about the Research

If you have any questions about this research, you may contact Alexandra T. Tyra by email [redacted] or phone ([redacted]). You may also contact Dr. Annie T. Ginty by email [redacted] or phone ([redacted]).

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the following:

Baylor University Institutional Review Board
Office of the Vice Provost for Research
Phone: [redacted]
Email [redacted]

Your Consent

Optional Consent to be Contacted for Participation in Future Research
I give the researchers permission to keep my contact information and to contact me for future research projects.

YES_____ NO_____ Initials _____
By signing this document, you are agreeing to be in this study. We will give you a copy of this document for your records. We will keep a copy with the study records. If you have any questions about the study after you sign this document, you can contact the study team using the information provided above.

I understand what the study is about and my questions so far have been answered. I agree to take part in this study.

_____ _____
Signature of Subject Date

I have explained the research to the subject and answered all his/her questions. I will give a copy of the signed consent form to the subject.

_____ _____
Signature of Person Obtaining Consent Date

Appendix 10: Birmingham Demographics Form (Study 2)

Please fill in the blank or tick the appropriate response.

1. Gender: Male ☐ Female ☐ Other (please state): _____

2. Current Age: _____ Years

3. Ethnicity:

- ☐ Asian (including Asian British, Indian, Pakistani, Bangladeshi, Chinese, any other Asian background)
- ☐ Black (including Black British, African, Caribbean, any other black background)
- ☐ Mixed/multiple ethnicities (incl. Asian and Black, Asian and White, Black and White, other mixed background)
- ☐ White (including White British, White Irish, any other white background)
- ☐ Gypsy or Irish Traveler
- ☐ Other (please state): _____

4. What is your postcode of your main address where you spend the most time?

_____

5a. Are you a student? Yes ☐ No ☐

5b. If yes, what degree are you studying?

- ☐ Undergraduate
- ☐ Master's
- ☐ PhD
- ☐ Other (please state): _____

6. Would you say your health is…

Poor ☐ Fair ☐ Good ☐ Very Good ☐ Excellent ☐

Appendix 11: Baylor Demographics Form (Study 2)

Please fill in the blank or tick the appropriate response.

What gender do you identify as?

☐ Male ☐ Female Other (please state): _____

2. What is your current age? _____ Years

3. Ethnicity:

- ☐ Asian (including Indian, Pakistani, Bangladeshi, Chinese, any other Asian background)
- ☐ Black (including African, Caribbean, any other black background)
- ☐ Mixed/multiple ethnicities (incl. Asian and Black, Asian and White, Black and White, other mixed background)
- ☐ White (including White European or any other white background)
- ☐ Hispanic or Latino
- ☐ Other (please state): _____

4. What is the zip code of your main address where you spend the most time?

_____

5a. Are you a student? Yes ☐ No ☐

5b. If yes, what degree are you studying?

- ☐ Undergraduate
- ☐ Master's
- ☐ PhD
- ☐ Other (please state): _____

6. Would you say your health is…

Poor ☐ Fair ☐ Good ☐ Very Good ☐ Excellent ☐

Appendix 12: Post-Imagery Manipulation Checks (Study 2)

Please answer the following questions in relation to the imagery you just performed.

1. To what extent did you **image** the scenario **as described**?

1	2	3	4	5	6	7
Not at all as described			Somewhat as described			Exactly as described

If you did not image the scenario as it was described, please explain how your imagery differed from that described in the script:

_____

_____

_____

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

1	2	3	4	5	6	7
Very hard to image	Hard to image	Somewhat hard to image	Neither easy nor hard to image	Somewhat easy to image	Easy to image	Very easy to image

3. How stressful was the scenario you imaged?

1	2	3	4	5	6	7
Not at all stressful			Somewhat stressful			Very stressful

4. Rate the extent to which felt the imaged scenario as challenging or threatening?

1	2	3	4	5	6	7
Completely threatening (not at all challenging)			Equally challenging and threatening			Completely challenging (not at all threatening)

Appendix 13: Immediate Anxiety Measures Scale (Study 2)

The following questionnaire asks you to rate how anxious you felt during the imagery. There are two main types of anxiety which are sometimes experienced. These are cognitive anxiety (the mental component) and somatic anxiety (the physical component). In order to answer as accurately as possible please bear the following definitions in mind:

Cognitive Anxiety: Is the **mental** component of anxiety and may be characterized by thoughts such as concerns or worries about your performance of the task, for example about the way you may perform or the importance of the task.

Somatic Anxiety: Is your **perception** of your **physical** state and may be characterized by symptoms such as physical nervousness, butterflies in the stomach, tense muscles, and increases in heart rate.

Self Confidence: Is how **confident** you are of performing well in the task and may be characterized by factors such as achieving your goals and performing well under pressure.

Below are **3** statements reflecting the thoughts and feelings you may have experienced during the imagery. Each statement requires a response from each of the **2** sections. Section **1** asks you to respond to the **level** of cognitive anxiety, somatic anxiety, and self-confidence (see definitions); Section **2** then asks whether you regarded these feelings as **positive** or **negative** in the scenario that you imaged. Read each statement carefully and then circle the appropriate number in each of the 2 sections.
Please answer the 3 questions with regards to how you **felt during the imagery**.

	Section 1							**Section 2**						
	To what extent were you experiencing **anxiety** and **confidence** (i.e., what **level**)?							Did you regard these feelings as being positive or negative in relation to performance in the imagery scenario?						
During the imagery…	*Not at all*						*Extremely*	*Very debilitative (Negative)*			*Unimportant*			*Very facilitative (Positive)*
1. I was cognitively anxious	1	2	3	4	5	6	7	-3	-2	-1	0	+1	+2	+3
2. I was somatically anxious	1	2	3	4	5	6	7	-3	-2	-1	0	+1	+2	+3
3. I was self-confident	1	2	3	4	5	6	7	-3	-2	-1	0	+1	+2	+3

Appendix 14: State Emotion Regulation Items (Study 2)

We would like to ask you some questions about how you controlled (that is, regulated and managed) your emotions during the imagery. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

I tried to see the scenario as positive as possible.

0	1	2	3	4	5
Not at all					Extremely

During the imagery, I controlled my emotions.

0	1	2	3	4	5
Not at all					Extremely

Appendix 15: Positive and Negative Affect Schedule (Study 2)

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate rating to **indicate how you felt during the imagery scenario**:

	1	2	3	4	5
	Not at all	A little	Moderately	Quite a bit	Extremely
1. Interested	1	2	3	4	5
2. Distressed	1	2	3	4	5
3. Excited	1	2	3	4	5
4. Upset	1	2	3	4	5
5. Strong	1	2	3	4	5
6. Guilty	1	2	3	4	5
7. Scared	1	2	3	4	5
8. Hostile	1	2	3	4	5
9. Enthusiastic	1	2	3	4	5
10. Proud	1	2	3	4	5
11. Irritable	1	2	3	4	5
12. Alert	1	2	3	4	5
13. Ashamed	1	2	3	4	5
14. Inspired	1	2	3	4	5
15. Nervous	1	2	3	4	5
16. Determined	1	2	3	4	5
17. Attentive	1	2	3	4	5
18. Jittery	1	2	3	4	5
19. Active	1	2	3	4	5
20. Afraid	1	2	3	4	5

Appendix 16: Emotional Pleasantness Item (Study 2)

How pleasant would you rate these feelings/emotions?

-4	-3	-2	-1	0	1	2	3	4
Extremely unpleasant								Extremely pleasant

Appendix 17: Imagery Scripts (Study 2)

Challenge Script

Imagine that you have to give a presentation as part of your degree programme... you arrive at the venue and see everyone already sitting in their seats… you see them all staring towards the front of the room where you will be standing to deliver your presentation… you see the member of staff overseeing the presentation motion you to the front of the lecture theatre beside the computer… all eyes are on you as you make your way to the front and get into position ready to begin your talk... you've never noticed the size of the room before or how many people it fills… hundreds of eyes are all staring back at you, ready to evaluate your presentation and what you have to say.

You feel your heart racing and your breathing becomes more rapid……As you wait at the front of the lecture theatre, you feel a knot in your stomach..... the audience members are staring at you, some are whispering to each other as they wait for the session to start…

The lecturer is still setting up for the session… everything feels like it is happening in slow motion……you hear muffled whispers from the audience and can see them staring at you…

You can feel your heart beating faster than usual and you are aware of the butterflies in your stomach…… But you know these feelings are your body's way of getting ready to prepare and perform a very good presentation……You feel nervous which indicates the importance of your presentation……But you are confident that you can cope with the situation… You have practiced lots meaning you feel well prepared…

You notice your throat is very dry so you take a sip of water……you feel your heart pounding as adrenaline courses through your veins..... You are filled with confidence…you feel in complete control…and know you are ready to deliver a good presentation……

You are confident that you are capable of meeting the challenge…and are determined that you can cope……you savour the opportunity to demonstrate to the audience your knowledge of the topic area you are presenting on.

The lecturer is finally ready for you to begin……Your racing heart and the adrenaline coursing through your body tell you that you are indeed ready……You know you will overcome the challenge and give a great presentation……You are eager to demonstrate your knowledge and how well you can speak about it. You relish this opportunity to show everyone just how good a student you are……...

…. This is the end of the imagery script. Please now remove your headphones and let the researchers know the imagery has finished….

Threat Script

Imagine that you have to give a presentation as part of your degree programme... you arrive at the venue and see everyone already sitting in their seats… you see them all staring towards the front of the room where you will be standing to deliver your presentation… you see the member of staff overseeing the presentation motion you to the front of the lecture theatre beside the computer… all eyes are on you as you make your way to the front and get into position ready to begin your talk... you've never noticed the size of the room before or how many people it fills… hundreds of eyes are all staring back at you, ready to evaluate your presentation and what you have to say.

You feel your heart racing and your breathing becomes more rapid……As you wait at the front of the lecture theatre, you feel a knot in your stomach..... the audience members are staring at you, some are whispering to each other as they wait for the session to start…

The lecturer is still setting up for the session… everything feels like it is happening in slow motion……you hear muffled whispers from the audience and can see them staring at you…

You can feel your heart beating faster than usual and you are aware of the butterflies in your stomach…… You know these feelings are your body's way of being unprepared and you will perform a very poor presentation……You feel nervous which indicates the importance of your presentation……you don't feel confident that you can cope with the situation… You have practiced lots but you do not feel well prepared…

You notice your throat is very dry so you take a sip of water……you feel your heart pounding as adrenaline courses through your veins..... You are filled with panic…you feel completely helpless…and know you are not ready to deliver a good presentation……

You are certain that you are not capable of meeting the challenge…and you are convinced you cannot cope……you feel this is a scenario that will demonstrate to the audience your lack of knowledge on the topic area you are presenting on.

The lecturer is finally ready for you to begin……Your racing heart and the adrenaline coursing through your body tell you that you are not at all ready……You know you will mess up and give a terrible presentation……You are fearful of demonstrating your poor knowledge and inadequacy at public speaking. You see this situation as one to show everyone just how poor a student you are……

…. This is the end of the imagery script. Please now remove your headphones and let the researchers know the imagery has finished….

Neutral Script

Imagine that you have to give a presentation as part of your degree programme... you arrive at the venue and see everyone already sitting in their seats… you see them all staring towards the front of the room where you will be standing to deliver your presentation… you see the member of staff overseeing the presentation motion you to the front of the lecture theatre beside the computer… all eyes are on you as you make your way to the front and get into position ready to begin your talk... you've never noticed the size of the room before or how many people it fills… hundreds of people are ready to evaluate your presentation and what you have to say.

You see the lecturer trying to get the computer to work properly on the projector……As you wait at the front of the lecture theatre, you put your bag down and take off your jacket..... the audience members are staring at you, some are whispering to each other as they wait for the session to start…

The lecturer is still preparing for the session… you see the audience setting up their notebooks and laptops to take notes……you hear them whispering and can see them looking towards the front…

You notice a thin streak of sunlight coming in through a small gap in the blinds and spreading across some of the audience…… You open your bag and rummage around for your phone… you pull it out and make sure it is on silent…… you then take out a pen and notebook just in case you need to note anything down after the presentation... You put these on the table next to the computer……

You can see the lecturer still trying to sort the computer..... You get out your water bottle and take a sip of water……You look down at the floor where you are standing and think about your presentation and what you are going to say……

In a moment you will be able to begin the presentation and tell the audience about the topic area you are presenting… you notice that the sun must have gone behind a cloud as the streak of sunlight through the gap in the blinds has disappeared…

The lecturer is finally ready for you to begin…… You make your way over to the lecturer so they can introduce you to the audience…… You place your water bottle down on the table at the front and look at the computer which is now set up properly… You look around the lecture theatre and can see everyone is ready for the session to being. As soon as you have been introduced you can begin your presentation….

…. This is the end of the imagery script. Please now remove your headphones and let the researchers know the imagery has finished….