# Is Voluntary Musical Imagery an Effective Intervention for Anxiety?

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## Abstract

Anxiety is a common mental health problem that has been treated using imagery interventions, but there is little evidence investigating musical imagery (that is to say, imagining music). The present research explores the development of a novel anxiety reduction intervention - voluntary musical imagery (VMI). Chapter Two initiates this investigation by examining existing relationships between anxiety and musical imagery experiences, as well as associations with secondary variables including depression, thought control, and sleep. Individual differences relating to musical imagery experience in anxiety were found, namely that people with high trait anxiety do not have difficulty controlling deliberate auditory imagery, and report perceiving their frequent involuntary musical imagery (INMI) episodes as negative, yet also helpful. Chapter Four presents a systematic review of research concerning imagery-based interventions for anxiety. Forty-four percent of the studies reviewed provided evidence in support of imagery interventions reducing anxiety but showed no inclusion of musical imagery in the methods. Chapter Five investigates whether non-musicians ($N$ = 34) can be trained in VMI using a four-day training programme, then conducts a preliminary comparison of the effects of VMI versus an active control on ratings of anxiety and mood. This study showed that training in VMI can improve one's VMI ability and that VMI was associated with lower anxiety levels and higher ratings of positive mood than the control. Chapter Six is a test of the effects of the VMI intervention on anxiety and mood in naturalistic settings over six days and showed that VMI is associated with short-term decreases in anxiety and positive mood increases. This thesis provides the first demonstration of the beneficial application of VMI to reduce anxiety, discussing the mechanisms by which VMI might serve as an anxiolytic function, as well as offering suggestions for the optimal VMI use and suggested target populations.

# Table of Contents

# List of Tables

# List of Figures

# Chapter 1
# Anxiety and Musical Imagery

Anxiety rates have increased dramatically in the UK population between 1998 and 2018 (Slee et al., 2020). A recent study found that 31.9% of the general population reported experiencing anxiety due to COVID-19 (Salari et al., 2020). New, accessible, and cost-effective interventions are required urgently. Voluntary musical imagery (VMI; i.e. deliberately imagining music) holds promise as a novel intervention for anxiety and this thesis will argue for the potentially effective application of this method for anxiety reduction. The purpose of this chapter is to provide an introduction to both anxiety and musical imagery. Literature related to the development and maintenance of anxiety, and existing evidence-based anxiety interventions is described. Following this, the landscape of research into VMI is presented, highlighting the experience of auditory imagery in psychological disorders and individual differences in musical imagery.

## 1.1 An introduction to anxiety

Statistics show that there were approximately 8.2 million cases of anxiety in the UK in 2013, which equates to 18.17% of the UK population (Fineberg et al., 2013). In more recent times, this high prevalence of anxiety is still apparent in society, with 31.9% of the general population experiencing anxiety as a result of COVID-19 (Salari et al., 2020). Also, Slee et al. (2020) examined temporal changes in reports of generalised anxiety disorder (GAD) in the UK population and found that there has been a substantial growth in the reports of GAD between 1998 and 2018. Anxiety is an emotional experience encompassing elements of fear, worry, and unease (Blackburn, 2016). On a sub-clinical level, anxiety is common in everyday life for most people and general symptoms can be psychological (feeling uneasy, fearful, or panicked) or physical (excessive sweating, frequent short breaths, or muscle tension). However, when these symptoms persist for longer periods of time and continuously affect one’s ability to function in daily life, resulting in more severe cases of anxiety such as anxiety disorders, there is cause for concern. Anxiety is also often differentiated in relation to whether it is a transient experience (state anxiety) or if it is a more stable personality trait (trait anxiety). The more severe cases of anxiety relate to the latter, as people with anxiety disorders often present with higher trait anxiety (Mundy et al., 2015). For the sole purpose of providing a complete overview of the anxiety experience, a summary of anxiety disorders will follow.

### 1.1.1 Anxiety disorders

According to the *Diagnostic and Statistical Manual of Mental Disorders* (DSM; 5th ed.; [DSM-5]; American Psychiatric Association, 2013), there are seven anxiety disorders; agoraphobia, GAD, panic disorder, phobia, selective mutism, separation anxiety disorder and social anxiety disorder (SAD). It is important to note that previous (and some current) research on anxiety often include post-traumatic stress disorder (PTSD) and obsessive compulsive disorder (OCD) in their discussion, as these two disorders were classed as anxiety disorders before the latest edition of the DSM (APA, 2000). But in the new DSM-5, PTSD is placed under Trauma and Stressor-Related Disorders and OCD is grouped under the Obsessive-Compulsive and Related Disorders category. Further to there being separate anxiety disorders, the diagnostic criteria for each disorder are different to one another. For instance, individuals with GAD normally have frequent experiences of excessive anxiety or worry for at least six months, whereas a criterion of panic disorder is for people to experience regularly occurring panic attacks (APA, 2013). Individual differences in anxiety are not only found in relation to variance between the criteria for anxiety disorders, but also extend to individual differences in the people who experience anxiety.

### 1.1.2 Individual differences in anxiety

Individuals differ on a variety of variables in relation to the anxiety experience and an example of such is gender, as females are more likely to experience anxiety than males (Asher & Aderka, 2018; Asher et al., 2017; Craske & Stein, 2016; McLean et al., 2011). This difference can be considered from a biological perspective. Li et al. (2016) propose that variability in the way in which the female and male brains respond to stress-associated hormones (e.g., oxytocin) leads to males being less likely to experience anxiety. This is due to the production of a stress hormone binding protein being found in males, but not females. Not only has the idea of females having a higher risk of developing anxiety been researched cross-culturally, with Ahmed and Alansari (2004) providing corroborating evidence in Arabian cultures, this pattern has also been found from a young age (Anderson et al., 1987) through to adolescence (Bowen et al., 1990; Lewinsohn et al., 1998; McGee et al., 1990; Muris & Ollendick, 2002) and adulthood (Bruce et al., 2005). In addition to gender differences contributing to the experience of anxiety, variation can be found in relation to thought control in anxiety.

Thought control is a dominant theme in anxiety, being that anxious individuals are known to have problems controlling their thoughts (Wells & Davies, 1994). But there is variance within the thought control strategies people engage in to manage unwanted thoughts. Wells and Davies (1994) developed the Thought Control Questionnaire (TCQ) to assess individuals' capability of controlling unwanted thoughts. The researchers identified five different thought control strategies used in the process of controlling undesirable thoughts - distraction, social control, worry, punishment and re-appraisal. It is suggested that the type of thought control strategy used can depend upon the type of anxiety disorders people have, with it being acknowledged that individuals with GAD tend to use the worry and punishment thought control strategies (Coles & Heimberg, 2005; Wells & Carter, 2009). Highlighting these individual differences could potentially further the understanding of why certain anxiety interventions are more effective for some individuals compared to others. It could be that similarities between the type of thought control strategies used and the underlying mechanisms of anxiety interventions are responsible for there being an increased likelihood for effective outcomes. For example, if individuals use the distraction strategy more to control unwanted thoughts, then interventions that incorporate distraction elements might prove more effective for those people, due to familiarity with this type of technique. It also provides an insight into how the anxiety experience might differ from one individual to another, but these differences cannot explain why anxiety occurs. To account for this, several theories have been developed to explain this experience from a variety of perspectives.

### 1.1.3 Anxiety theories

The theories offered to explain anxiety range from the Learning theory, which suggests that anxiety can be learnt through three mechanisms - classical, vicarious and operant conditioning (Bouton et al., 2001; Mineka & Zinbarg, 2006), to the Biological theory, which insists that biological mechanisms such as genetics (Morris-Rosendahl, 2002) and abnormal levels of neurotransmitters influence the presence of anxiety (Frick et al., 2015). Whilst offering accounts for anxiety, early theorists had a tendency to attribute anxiety to a single cause, such as the psychoanalytic theory of anxiety (Compton, 1972), but more recent theories have acknowledged that a single causal factor might not be the only way to explain the development and maintenance of anxiety (Antony et al., 2008). Therefore, combining elements from different theories through a multidimensional approach might provide a better account of anxiety, an example of such being the Biopsychosocial model (Engel, 1977) which includes biological, cognitive, behavioural, and environmental elements (Borrell-Carrio et al., 2004). Looking at anxiety in this way can further the understanding of the mechanisms behind the development of the problem and direct the way in which interventions are designed for treatment. This is because this multidimensional approach can provide clear focal points relating to factors that can be targeted when trying to reduce anxiety. An example of how this can be done is through inspecting anxiety using one of the most prominent approaches from which the problem has been accounted for—the cognitive perspective (Beck, 1976; Beck & Haigh, 2014)—but by also looking at the affective mechanisms that are associated with the experience of anxiety.

Viewing anxiety from a cognitive perspective has been dominant beyond mental health research and played an important role in the development of frequently used cognitive evidence-based interventions including cognitive therapy (CT) and cognitive behavioural therapy (CBT; see section 1.1.5.1). A strength of this perspective in relation to mental health research includes how it places an emphasis on thought processes, because the way in which an individual processes information in their environment often determines the type of behaviour they would exhibit (Beck & Haigh, 2014). This is of great value in anxiety, since if incoming information is interpreted with negative biases, individuals might engage in maladaptive behaviours (Beck & Haigh, 2014), and these behaviours are detrimental for anxiety as they contribute towards the maintenance of the problem. Another advantage of examining anxiety from a cognitive angle is how this perspective makes it easier for people to distinguish mental disorders from one another. In the Generic Cognitive Model (GCM) of psychological disorders offered by Beck and Haigh (2014), it is suggested that these disorders can be differentiated based on the type of thoughts people have. This is especially relevant for disorders that are similar or have an overlap in their symptomatology, such as anxiety and depression.

#### 1.1.3.1 The cognitive perspective of anxiety

The cognitive view proposes that the people experience anxiety due to the type of information processing that occurs and how this processing subsequently informs an individual’s behaviours and their emotions. Beck’s (1976) Cognitive Theory of Emotional Disorders (including anxiety and depression) acts as the starting framework for the cognitive view of anxiety, by suggesting that the emotions one feels are influenced by dysfunctional thoughts, beliefs, and attitudes. The effect emotions have on behaviour is a critical aspect of anxiety as it determines the type of behaviour an individual would display - adaptive or maladaptive behaviour. If this behaviour is maladaptive, it leads to the maintenance of anxiety. For example, individuals with SAD might believe that other people constantly form negative opinions about them whenever they are in social settings, such as a work meeting. Those beliefs could result in negative feelings like embarrassment or shame, which might lead to avoidant behaviours that maintain social anxiety, as those behaviours do not allow individuals to understand how they can cope in these types of anxiety-triggering situations.

This Cognitive Theory of Emotional Disorders also states that there are three levels of cognition involved in these disorders: schemas, bias information processing, and negative automatic thoughts (Clark & Beck, 2010). Schemas occur at the innermost level and consist of representations of the human experience. Biased representations can particularly impact anxiety. This schematic content can be triggered by anxiety-related stimuli and consequently control how information is processed - if the schema includes biased beliefs then it is likely for there to be dysfunctional information processing in response to the anxiety stimuli. In anxiety, this might be selectively attending to and processing threatening stimuli that are likely to provoke anxiety further. This type of information processing therefore results in negative thoughts that can affect one's emotional state, leading to emotional distress. A key point offered in this theory is how the emotions experienced by an individual are dependent on the thought activity before and during the anxiety-triggering situation. Cognitive distortions occur when faced with these situations, due to biased beliefs about the anxiety stimuli. And so with this cognitive explanation of anxiety, Beck (1976) argues that as the schemas are repeatedly activated over time, the beliefs in the schemas become more coherent, to a point where less intense stimuli that are related to anxiety can easily trigger their activation. Not only does this lead to the continued presence of negative biases in the information processing system, but also a reduced ability to control one's emotions, due to the lack of access to alternative positive ways of thinking.

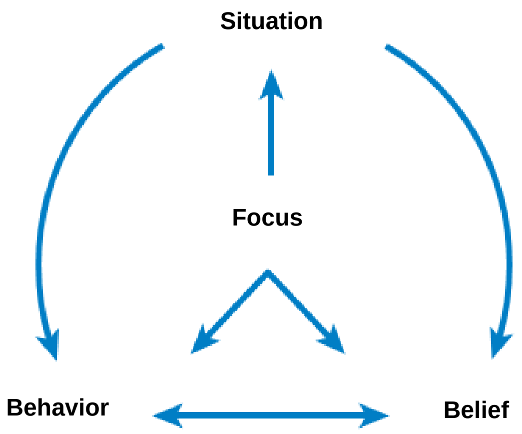
Support for the cognitive view of anxiety takes the form of treatment methods that have been developed based on this perspective, including CBT for anxiety (Jolstedt et al., 2018). Schema therapy has also been developed to treat anxiety, aiming to target the dysfunctional schemas that contribute towards the maintenance of the anxiety experience. Morvaridi et al. (2019) specifically tested the effects of emotional schema therapy on social anxiety symptoms, where people with social anxiety used a range of techniques, including identifying and separating emotions as well as disputing negative beliefs they might have about those emotions, to change the beliefs held in their emotional schemas for anxiety.

Compared to a wait list control group, emotion schema therapy was more effective at reducing anxiety symptoms in people with social anxiety. Additionally, looking at associations between cognitive mechanisms that drive the anxiety experience can provide support for this perspective, as McEvoy and Brans (2013) found that repetitive negative thinking is strongly associated with anxiety symptoms. However, a major criticism of the early theory proposed by Beck (1976) is that several aspects of psychological disorders in this original cognitive account of anxiety were not thoroughly explained. Examples include “goals, normal adaptations, and mechanisms of activation and deactivation of schemas” (Beck & Haigh, 2014, p. 2). This drove Beck and Haigh (2014) to present an updated theoretical model to account for these features - the GCM.

In line with the original theory that was proposed by Beck (1976), the GCM also suggests that psychological disorders arise due to faulty information processing, as a consequence of the negatively biased analysis of a situation that leads to the production of negative thoughts. This thus impacts how one feels, causing emotional distress and an increase in maladaptive behaviours to cope with this distress. Differences in this updated cognitive model for anxiety, compared to Beck’s (1976) original suggestions, focus on various components including a detailed account of schema activation, how important stimuli are processed by protoschemas, and multiple processing pathways. Specifically, the model states that there are two interacting processing pathways - the automatic and reflective processing systems. Incoming information related to anxiety is first analysed by the automatic processing system, with this process occurring rapidly and sorting this information into broad categories. The reflective system then analyses the information in a more slow and controlled manner, so that the interpretation is more refined and less likely to be erroneous. These interacting systems are guided by schemas. Protoschemas, which are cognitive structures within schemas that analyse and determine responses to stimuli, direct the type of processing that occurs in the automatic processing system. The new detail about the activation of schemas in the GCM asserts that anxiety protoschemas are activated based on whether the anxiety stimuli correspond to the anxiety protoschema, producing a match in stimuli and protoschema. The activation of this protoschema triggers additional information processing, which is governed by the biased beliefs associated with the stimuli. This results in the behavioural, affective and motivational systems (that are linked with these beliefs) being activated, and thus facilitating a response to the stimuli - anxiety symptoms.

Additionally, another new aspect that the GCM proposes is how psychological disorders share common underlying processes, but a key factor that determines the disorder an individual has is the type of dysfunctional belief they hold. Examples of the type of beliefs that distinguish anxiety disorders from other psychological disorders include “Something bad is likely to happen” for GAD (Beck & Haigh, 2014, p.16) and “If I try to speak I will sound stupid” for social phobia (Beck & Haigh, 2014, p.16). In addition to presenting an updated version for the cognitive perspective of anxiety, Beck and Haigh (2014) discuss the applications of the model in the development of interventions for psychological disorders. Beck and Haigh (2014) state that the four main mechanisms in the model should be the target points in these interventions. These are biased beliefs, maladaptive behaviour, focus and situation (Figure 1.1).

Figure 1.1 *A visual depiction of the GCM (Beck & Haigh, 2014, p. 14)*




Evidence in support of the GCM can be found in meta-analyses of the effect of the specific cognitive elements that the model suggests influence anxiety. For example, a study conducted by Hallion and Ruscio (2011) found that cognitive bias modification is effective at reducing anxiety, indicating that cognitive biases are a contributing factor towards the development of anxiety. These biases have also been found in relation to the impact they have on emotion regulation in anxiety. Everaert et al. (2020) showed how people who have a tendency to continuously interpret ambiguous situations in a negative way are more likely to use maladaptive emotion regulation strategies (which has already been shown to be an aspect of anxiety; Schäfer et al., 2017). These pieces of evidence corroborate the presence of some of the mechanisms that the GCM suggests play important roles in the anxiety experience.

Even though explaining anxiety from a cognitive perspective can provide a sufficient account of the problem, there is an important aspect in the anxiety experience that the model fails to consider. This model looks at anxiety in a singular fashion, as opposed to using a multidimensional approach to understand this mental health problem like Engel's (1977) Biopsychosocial model. A limitation to explaining the occurrence of anxiety from one perspective is that this approach rejects other factors that might have just as much an important role in anxiety as the cognitive mechanisms discussed above. For instance, research has provided evidence in support of the attentional bias to threat in anxiety, as some anxious individuals tend to attend to more threatening stimuli in their environments, compared to neutral stimuli (Lichtenstein-Vidne et al., 2017). Attention bias modification treatments (ABMTs) have been developed as a result of this bias and research has shown that using ABMTs to change the direction of anxious individuals' attention (away from threatening stimuli) can reduce anxiety symptoms (Cai et al., 2018; Heeren et al., 2012). Considering anxiety using a multidimensional approach not only shines a light on the various interacting factors that might be present in anxiety (beyond cognitive components), but also assists in the understanding of the development of anxiety that can inform what the optimal types of intervention are to be used to treat this problem.

### 1.1.4 Anxiety as a problem

As mentioned earlier, the increasing prevalence rates of anxiety (Slee et al., 2020) indicate that this phenomenon is still an issue in society today. There are various problems associated with experiencing anxiety, but a commonly experienced example relates to one's quality of life. Quality of life can be defined as how satisfied or dissatisfied an individual is with various aspects in their life (Abrams, 1973), such as physical and mental health, employment, and family life. There is a negative association between anxiety and quality of life, indicating that low levels of quality of life are linked to high levels of anxiety (Norberg et al., 2008; Sudhir et al., 2012). Similarly, Mendlowicz and Stein (2000) demonstrated that anxiety disorders significantly decrease people's quality of life. Further evidence of this relationship has been presented by Geraedts et al. (2015), who used a cohort study to look at psychopathological predictor variables for quality of life in individuals with acromegaly - a condition involving abnormal hormone growth (Zahr & Fleseriu, 2018). These findings showed that anxiety can be identified as a potential factor to target for the improvement of quality of life ratings. This relationship remains consistent from childhood (Hauken et al., 2018), through to later in life (Sarma & Byrne, 2014). With these studies showing how the presence of anxiety is related to a lower quality of life, it is important to address the implications, as having a lower quality of life can lead to an increase in the chances of individuals leading more unhealthy lifestyles (Savolainen et al., 2014). In extreme cases, people who report having a poorer quality of life have an increased chance of mortality (Guney et al., 2012).

Another problem associated with anxiety is the co-occurrence of other illnesses, specifically mental illnesses. A common comorbidity in psychopathology is anxiety and depression, with the occurrence of these two disorders often being researched simultaneously (Carek et al., 2011; Ibbotson et al., 1994; Martinsen, 2008). Reasons as to why individuals with anxiety commonly present with symptoms of depression have focused on there being a high degree of commonality in abnormal neurotransmission activity related to serotonin and dopamine (Shahzad et al., 2014). A potential problem that arises from this comorbidity is the possibility of treatment issues (Hofmeijer-Sevink et al., 2012), due to an overlap in the symptoms of anxiety and depression. Symptom overlap has been seen in GAD and major depressive disorder, specifically relating to feelings of restlessness and fatigue, as well as having difficulty concentrating (Zbozinek et al., 2012). Another negative implication of this comorbidity is that one’s quality of life further diminishes when experiencing both disorders at the same time (Zhou et al., 2017), which additionally decreases one’s mental health state. With this in mind, and with anxiety being known to reoccur in individuals’ lives on a long-term basis if treatment is not sought (Craske & Stein, 2016), the impact of anxiety is detrimental. Because of this, various interventions have been developed to improve anxiety conditions and minimise the probability of its reoccurrence.

### 1.1.5 Anxiety interventions

The National Institute for Health and Care Excellence (NICE) proposed that evidence-based psychological interventions should be the first-line treatments for anxiety (NICE, 2014). There is a need for anxiety interventions that are evidence-based, as the potential effectiveness of such interventions is derived from research outcomes, as opposed to subjective opinion (Cook et al., 2017b). This allows for consistency in the treatment and it also filters out suggested methods that do not improve anxiety, so these methods can be eliminated. Additionally, these interventions have contributed towards reducing relapse rates of anxiety disorders (Batelaan et al., 2017; Yonkers et al., 2003). There are various effective interventions available for anxiety, but an example of a frequently used psychological intervention is CBT.

#### 1.1.5.1 Cognitive behavioural therapy (CBT)

CBT involves a therapist working with an individual to alter their anxiety-related thoughts and behaviour, in order to alleviate the symptoms of anxiety (Wong et al., 2016). As discussed above, Beck and Haigh (2014) acknowledge the clinical applications of the GCM, specifically relating to the treatment of psychological disorders through interventions that are theory driven. The model acts as a guide on how to reduce anxiety symptoms, with Beck and Haigh (2014) proposing that the four components of the model that cause anxiety should be targeted. This consists of what individuals focus their attention on, the biased beliefs they hold in relation to anxiety stimuli, the display of maladaptive behaviours and the type of situation people are faced with (this can be seen in Figure 1.1). It is suggested that targeting at least one of these four mechanisms can reduce symptoms, but to improve the durability of treatment methods, creating an intervention that targets all of the components of the GCM would be most effective. CBT mainly focuses on targeting the biased beliefs and maladaptive behaviours mechanisms.

The primary aim of CBT is for therapists to help individuals with anxiety acknowledge negative biases in their thought processes and develop new ways of thinking, in order to reduce their emotional distress and the amount of maladaptive behaviours they display. Anxious individuals are encouraged to alter their thought patterns in relation to anxiety stimuli or events, in order to reduce the chances of the interpretation of these stimuli being distorted. By focusing on alternative interpretations, and consequently changing one's beliefs about the anxiety stimuli, this will alter the content of schemas that are held for anxiety stimuli, potentially reducing the biased beliefs. A reduction in these beliefs in the anxiety schemas mean that it is less likely for individuals to engage in maladaptive behaviours. This is because the anxiety schemas are potentially becoming more inactive, due to people developing new ways of thinking, and not leading to individuals needing to use maladaptive behaviours as a mechanism for coping with the anxiety that occurs.

With NICE (2014) suggesting that interventions used to treat anxiety should be evidence-based, a plethora of studies have investigated the effect of CBT on anxiety. Berg et al. (2020) assessed CBT effects on anxiety reduction in patients with an implanted cardioverter defibrillator, compared to patients who received usual care (which was medical therapy). These researchers found better improvements in anxiety in the intervention condition. Additionally, respiratory nurses in Heslop et al.'s (2016) study delivered CBT to individuals with chronic obstructive pulmonary disease. The outcome was a reduction in anxiety levels and this work is further supported by Luik et al. (2017), who found alleviations in anxiety in participating individuals after receiving CBT. There have also been demonstrations of CBT being effective in comparison to other established interventions, such as relaxation therapy (Montero-Marin et al., 2018) and internet-delivered CBT (iCBT), with Newby and McElroy (2020) finding that iCBT was more effective than psychoeducation, monitoring and clinical support at improving health anxiety in individuals with cyberchondria (which involves an extreme increase in concerns about health symptoms after completing online searches).

Moreover, CBT has proven to be effective in individuals who have co-occurring problems. For instance, improvements in anxiety following CBT treatment have been found in women with breast cancer (Ren et al., 2019), women with human immunodeficiency virus (HIV; Nobakht et al., 2018) and individuals with inflammatory bowel disease (Geccherle et al., 2017). Systematic reviews and meta-analyses have also been conducted to look at the overall efficacy of CBT. Slais et al. (2018) reviewed different types of CBT that have been used for anxiety disorders, consisting of methods including strategies from cognitive and exposure therapies, and concluded that the CBT research for anxiety disorders demonstrates how effective the method is. Several more recent reviews into CBT for anxiety have continued to highlight the overall effectiveness for long-term effects on anxiety (van Dis et al., 2020) and improvements in anxiety in Iranian infertile women (Golshani et al., 2020). These findings further support the proposal that it is common for individuals with anxiety to have psychological vulnerabilities (such as negative thought patterns), that are likely to be contributing towards the maintenance of their anxiety (as suggested in the cognitive view of anxiety).

The evidence presented above shows that there is a large body of research in support of the promise CBT has for anxiety reduction, which is reassuring for CBT therapists and anxiety patients. Several of these studies have focused on the short-term effects of CBT, but the long-term effects of treatment methods hold just as much importance. DiMauro et al. (2013) drew attention to this in a follow-up study they conducted investigating the effectiveness of CBT for anxiety disorders on a long-term basis for an outpatient clinical sample. DiMauro et al. (2013) compared symptom severity and improvement in the pre-treatment stage with those variables at a post-treatment stage, and at follow-up point one year later. Their findings showed that the effectiveness of CBT for anxiety was mostly maintained after follow-up assessments. Similarly, Watanabe et al. (2010) found that improvements in SAD are maintained one year after CBT treatment and Dugas et al. (2003) also presented similar results, but in a follow-up period of two years.

Despite the success of CBT, the limitations of this method cannot be disregarded. Shortcomings of CBT appertain to this form of treatment being time consuming, as individuals not only have to attend multiple CBT sessions but are required to complete additional work outside of these sessions, and CBT being expensive. Given the cost of CBT, there is a chance that access to this type of therapy may be limited for certain groups of people, including individuals who have a low socioeconomic status (Delgadillo et al., 2018). The inequalities arising from this limited access suggest that it is important to explore cheaper, yet still effective, alternative intervention options. Additionally, there are some suggestions that CBT might be less effective for certain age groups. Wetherell et al. (2013) looked at whether there were age differences in the outcomes of a collaborative care intervention (which included the use of CBT) for a variety of anxiety disorders including GAD, SAD, PTSD and panic disorder in young (18-59 years old) and old adults (60–75 years old). For younger adults, the intervention was more effective for GAD, SAD, and panic disorder, but only older adults with SAD and PTSD responded well to the treatment methods. Furthermore, there is evidence to show that therapist factors, including therapist treatment style, how strictly the therapists adhere to CBT protocol, their prior clinical experience and specific anxiety treatment experience can predict outcomes in anxiety in children (Podell et al., 2013). Moreover, even though CBT primarily targets the belief and behaviour aspects of anxiety, it might be useful to focus on other mechanisms in anxiety, such as emotional distress. An example of such includes emotion regulation therapy (ERT), where this type of treatment can be used to help individuals regulate their emotions in a more adaptive manner to reduce anxiety (Mennin et al., 2004). Alternative options that could overcome the limitation of inequalities in access to CBT, better outcomes in certain age groups and therapist effects includes art-based interventions.

#### 1.1.5.2 Music interventions

Frequently used art-based treatment methods for anxiety are music interventions. Music interventions involve using music in a therapeutic way to improve various aspects of one’s life such as social, mental, and physical health problems. In healthcare research, the use of music as an intervention has been regularly considered, with a review by Tang and Vezeau (2010) showing that a predominant aim of music interventions within healthcare is to reduce anxiety. This review also highlighted how there are two main forms of music interventions: active and receptive. Active music interventions are those that involve active participation in music and many studies have demonstrated how various forms of this intervention type can reduce anxiety. For instance, Fancourt et al. (2019) used a non-randomised longitudinal controlled study to investigate the effects of a weekly choir group on anxiety in cancer carers over six months. These researchers showed how there were greater decreases in anxiety for individuals who attended this group, compared to a control group consisting of individuals who did not attend these sessions and continued with their normal routines. Although, it is important to acknowledge how the exclusion of an active control in this study might limit the validity of the results, as there was no comparator to which the effect of the choir group can be deemed as superior. Following on from this, Sung et al. (2012) also tested the effectiveness of active music interventions but focused on using percussion instruments. In this study, older adults with dementia were instructed to play percussion instruments whilst listening to familiar music twice a week, for six weeks. Compared to a control group who only received usual care, the adults in the music condition had lower anxiety scores. The benefits of music have also been demonstrated in samples that include people with anxiety disorders, seen in Carr et al.’s (2013) systematic review into music therapy for acute adult psychiatric in-patients, as well as in a study by Gutiérrez and Camarena (2015) where music therapy was shown to reduce anxiety in individuals with GAD.

Receptive music interventions are the most common form of music interventions that are used to treat anxiety, and these methods involve passive musical activities such as listening to music (Cimen et al., 2020; Karadag et al., 2019; Mou et al., 2020). This intervention type has been used in various situations with research providing promising results, including anxiety reduction in cancer patients (Jasemi et al., 2016), decreases in anxiety following perioperative music listening (Tan et al., 2020) and improvements in anxiety in patients with heart failure, after listening to classical music (Burrai et al., 2020). Further to this, Lee et al. (2017) investigated the effects of music listening on anxiety reduction in surgical patients, comparing these individuals to a control group who received routine nurse care. They found that the individuals in the music listening condition had significantly lower levels of anxiety, compared to the control group. Also, Panteleeva et al.’s (2017) meta-analysis on the use of music listening for anxiety reduction in non-clinical samples allowed them to conclude that listening to music can reduce self-reported anxiety levels.

Specific features of music listening can contribute towards the positive effects this activity has on the alleviation of anxiety. For example, anxiety has been associated with increased blood pressure (Andrade et al., 2019) and researchers interested in the use of music listening therapies for anxiety reduction have shown how music can reduce blood pressure (Loomba et al., 2012), which thus leads to a decrease in anxiety. There have also been suggestions that music characterised by slow tempi (between 50 and 60 beats per minute) is associated with anxiety reductions (Suguna & Deepika, 2017). Furthermore, using music interventions for anxiety is beneficial as not only are music interventions non-invasive and inexpensive methods, there are minimal side effects associated with these interventions (compared to other methods such as pharmacotherapy). Additionally, this type of intervention allows for anxiety treatments to be more personalised, as individuals can select their own music - most likely familiar music that they know can induce calming states and improve their mood. Therefore, with music listening demonstrating significant reductions in anxiety (Cutshall et al., 2011; Lee et al., 2005; Levine-Gross & Swartz, 1982; Smolen et al., 2002; Szabo et al., 2005), discussing the rationale behind the functionality of music interventions can help in the understanding of this treatment method.

#### 1.1.5.2.1 Rationale behind music interventions for anxiety

With reference to the GCM, music listening therapies target the focus mechanism as this activity can direct an individual's attention towards the music being played. There are various reasons as to why music can focus one's attention. This could be due to the presence of prominent musical features that can easily grab one's attention, or relatable messages in the lyrical content of the music. Also, as music is a dynamic phenomenon, it requires sustained focus due to the temporal unfolding of the music. Having the ability to determine which stimuli one attends to in their environment can redirect the focus away and distract individuals from potentially threatening stimuli. As a result, it can be suggested that this new point of focus will interact with the other mechanisms in the GCM by increasing the likelihood of anxiety-related schemas being inactive and reducing the presence of biased beliefs. This would mean that individuals are then less likely to engage in maladaptive behaviours as a coping mechanism for the anxiety symptoms. Expanding beyond cognitive models, considering the relationship that music holds with emotions may also explain why music listening has anxiolytic effects.

When exploring how anxiety and emotion are related to one another, Cisler et al. (2010) examined emotion regulation in anxiety disorders through an integrative review. Within this review, the authors showed that experimental and clinical studies investigating emotion regulation in anxiety concluded that faulty emotion regulation strategies are a common occurrence across anxiety disorders. For instance, individuals with GAD tend to experience emotions more intensely, are unable to understand emotions well and are more likely to react negatively to an emotional experience, as suggested by the emotional dysregulation model for the disorder (Mennin et al., 2005). Similarly, those who have SAD engage in dysfunctional emotion regulation strategies (Helbig-Land et al., 2015), specifically using expressive suppression, which has been shown to increase the feelings of negative emotions (Kalokerinos et al., 2015) as opposed to cognitive re-appraisal, which is associated with more internal positive emotions and less internal negative emotions (Kalokerinos et al., 2015; Kivity & Huppert, 2018; Nowlan et al., 2016). Therefore, music interventions may function to reduce anxiety by serving to regulate emotions in the desired direction - positively (Sakka & Juslin, 2018). Cook et al. (2017a) demonstrated how music can regulate emotions through the boosting of emotional arousal, whilst also showing how certain types of music can up-regulate emotionality that is positive and down-regulate negative emotionality. Specifically, they found that soul and funk music shared a positive relationship with music being used to increase the presence of positive emotions.

Further to music listening being able to regulate emotions in a healthy manner, the way in which music can elicit emotions in individuals also contributes to the impact music listening has on the alleviation of anxiety. Theories have been offered to explain the emotional significance of music. Juslin (2013) suggests that music evokes emotions through multiple mechanisms, such as the emotional contagion mechanism, whereby individuals experience similar emotions to the emotions that are expressed in the music. Huron (2006) offered the ITPRA theory (Imagination, Tension, Prediction, Reaction and Appraisal), proposing that people experience emotion due to the anticipation of the unfolding of music through time. For anxiety, this means that positive emotions can be elicited through a variety of mechanisms, in order to improve symptoms. Additionally, the structural features of music pieces can influence the type of emotional response listeners experience. The emotional significance of musical tempo has been tested through the observation of how the adjustment of music tempo can affect emotion (Liu et al., 2018). Balkwill et al. (2004) also demonstrated a similar set of findings in Japanese and Hindustani music. Particularly, Japanese listeners associated music with high tempi with joy, whereas slow tempo music was related to feelings of sadness. In relation to anxiety, music tempi that are associated with specific physiological effects can also be associated with decreases in anxiety. As mentioned above, tempi between the range of 50 to 60 beats per minute are linked to a reduction in heart rate and blood pressure (Edworthy & Waring, 2006), both of which are associated with a state of relaxation (Lipman et al., 2002). It is important to note, however, that individual differences can mediate the effect of such musical features on the experienced level of physiological arousal, such as music genre preference.

**1.1.5.3 Imagery-based interventions**

In addition to music interventions, imagery-based interventions for anxiety are another treatment option. Imagery-based interventions involve the use of mental imagery of various sensory modes to improve a condition and this form of treatment has been considered widely in psychological disorders (Dugué et al., 2018; Renner et al., 2017). Several studies have used this method in the treatment of depression (Blackwell et al., 2015; Torkan et al., 2014; Williams et al., 2015), and have done so in a variety of ways. For instance, people have been trained in positive mental imagery to reduce depressive symptoms by being encouraged to visualise themselves in response to various positive cues (Dainer-Best et al., 2018) or through using imagery rescripting and memory specificity training, where individuals change the content of their intrusive imagery to positive imagery and create positive past memories (Pile et al., 2020). With participants engaging in this activity, Pile et al. (2020) showed that imagery rescripting can be used to decrease the distress that is linked to negative images in individuals with depression and instead create positive prospective imagery. Additionally, researchers have focused on cognitive bias modification interventions, by instructing individuals to imagine a description of various scenarios that initially begin as emotionally ambiguous, then become more positively valenced (Lang et al., 2012; Pictet et al., 2016). Imagery approaches have been adopted by others when treating anxiety too, including imagery rescripting for anxiety disorders (Nilsson et al., 2019), relaxation-guided imagery for perioperative anxiety (Vagnoli et al., 2019) and guided imagery for the improvement of state and trait anxiety (Veena & Alvi, 2016).

Guided imagery is a common imagery-based approach used to reduce anxiety, and this method involves a practitioner assisting an individual in the generation of mental images to induce feelings of relaxation, by focusing on how the mind and body interact with one another (Chiaramonte et al., 2014). Many studies have tested and demonstrated the effectiveness of guided imagery for anxiety in various settings including patients who experience preoperative anxiety (Felix et al., 2018), patients undergoing haemodialysis (Afshar et al., 2018), anxiety in mental health workers (Kiley et al., 2018) and test anxiety in nursing students (Grammatica, 2018). With the acknowledgment of how effective guided imagery can be for anxiety reduction, further strengthening the desired effects of guided imagery has been considered. One of the ways in which this has been achieved is through nature-based guided imagery. Nguyen and Brymer (2018) investigated the effects of nature-based guided imagery on state anxiety levels in 48 participants, compared to guided imagery alone. Not only did the findings indicate that the post-intervention state anxiety levels were lower in both of the imagery conditions, but the difference between the pre and post-intervention state anxiety levels was greater for nature-based guided imagery, compared to guided imagery. The authors of this paper proposed that combining nature elements with guided imagery would be beneficial for individuals undergoing anxiety treatment, as previous studies have already established a positive relationship between the exposure to nature and lower levels of anxiety (Carrus et al., 2017; Fabjanski & Brymer, 2017; Lawton et al., 2017; Martyn & Brymer, 2016; Panno et al., 2017; Schweitzer et al., 2018; Wheeler et al., 2012; Yeh et al., 2017). The development of this type of intervention (nature-based guided imagery) overcomes practical obstacles that might occur for those who wish to use nature to reduce their anxiety but reside in city areas, with minimal exposure to nature. Therefore, a combination of two evidence-based methods for reducing anxiety—exposure to nature and guided imagery—can enhance the alleviation of anxiety. Guided imagery has also been combined with music as a way of enhancing the effects of the imagery technique (Anolak et al., 2018).

When combined with guided imagery, music assists in the ease with which individuals can generate and maintain images during guided imagery sessions and promotes a more relaxed environment. An example of an established intervention incorporating guided imagery with music is the Bonny Method of Guided Imagery and Music, which has been used to reduce anxiety and improve other health problems (McKinney & Honig, 2017). Earlier evidence on how guided imagery with music can reduce anxiety was presented by Hammer (1996). In this study, state anxiety was the main anxiety outcome, as Hammer (1996) intended to determine if guided imagery with music could reduce anxiety scores (assessed through the State-Trait Anxiety Inventory [STAI]) in volunteers from a chemical dependency and alcoholism unit, compared to a control group receiving no treatment. The results demonstrated that individuals in the experimental group experienced a greater decrease in state anxiety in comparison to a control group, suggesting that this method was effective. Guided imagery with music has also been used in settings where individuals have an increased likelihood of experiencing anxiety, such as hospitals (Gullich et al., 2013), with the effect of guided imagery with music on chemotherapy-induced anxiety being investigated by Karagozoglu et al. (2013). Through a cross-sectional method, these researchers combined guided visual imagery with music, by providing patients with a painting and instructing them to imagine that they were in the place depicted in the painting, whilst listening to music at the same time, 15 minutes before their chemotherapy began. Anxiety levels were measured before and after the second chemotherapy session (no intervention received) and the third chemotherapy session (intervention received). By comparing the pre and post-intervention measures for anxiety, the researchers concluded that guided visual imagery with music significantly decreased state and trait anxiety scores. However, as the participants in this study were their own control (and the order in which they received the intervention was not counterbalanced), there is a possibility that order effects might have affected to the findings obtained.

In imagery techniques that incorporate the various forms of mental imagery based on the different sensory modes, most research exploring anxiety reduction through imagery has focused on visual imagery (e.g., Tavakolizadeh et al., 2018; Walker et al.,1987). It is useful to see how imagery-based interventions can reduce anxiety, but problems can arise when there is a lack of studies investigating alternative modes of imagery in the interventions. Specifically, there are no reports of studies that only look at the potential effect of auditory imagery on anxiety reduction, especially musical imagery (see Chapter Four). The lack of emphasis on the application of musical imagery provides an opportunity for investigations to be conducted to test whether such methods might be able to reduce anxiety, and this stimulated the primary research question in this thesis, which is whether VMI is an effective intervention for anxiety.

#### 1.1.5.3.1 Rationale behind imagery-based interventions

Like music interventions, imagery-based interventions can also target some of the four mechanisms in the GCM that contribute towards the development and maintenance of anxiety. Specifically, imagery interventions are apt for targeting the focus mechanism in this model. By encouraging individuals to focus their attention on the deliberate imagery being generated, they can focus on maintaining this mental imagery in their minds. This newly directed focus will activate schemas that are associated with the mental imagery, as opposed to anxiety schemas. As a result, this direction of focus could interact with the other three mechanisms, as potentially unbiased beliefs found in the schemas for mental imagery will drive the type of information processing that will occur, which is not likely to be negative. This would reduce the chance of negative thought patterns arising and thus limit the need for people to engage in maladaptive behaviours, as it is unlikely for them to experience anxiety symptoms.

The effectiveness of imagery-based interventions may also be explained through the impact imagery has on emotions. Holmes and Mathews (2010) have explored the relationship between mental imagery and emotion, and presented a review looking at mental imagery in emotion and emotional disorders. In this review, these authors proposed that there are at least three ways in which mental imagery can evoke emotion; by directly influencing the neural emotional systems that respond to sensory signals, through the presence of an overlap between response to emotions in imagined and perceived stimuli (resulting in one reacting to imagined events that elicit emotion as if they were perceived events), and through mental images being able to access previous emotional memories. As discussed earlier, music listening as an intervention is effective for anxiety management due to the relationship music holds with emotion and how that can subsequently moderate the emotional experience of anxiety. Therefore, this same rationale can be applied when exploring the basis behind imagery-based interventions being able to successfully reduce anxiety (Esplen & Hodnett, 1999; Heath, 1992).

Regarding the overlap between imagined and perceived stimuli, Holmes and Mathews (2010) focused on similarities in their processing that lead to individuals responding to imagined events as if they actually happened. This suggestion arises from imagined and perceived processes (from the same sensory modality) sharing cognitive resources, and thus competing for such resources. Evidence for this claim stems from instances of interference when individuals attempt to complete a perceived activity at the same time as its imagined counterpart. For example, auditory imagery can affect how well one can hear sounds in the environment (Segal & Fusella, 1969), and the vividness of auditory imagery is said to be reduced when individuals count aloud (Baddeley & Andrade, 2000; Brodsky et al., 2003). There is also evidence of neural overlap when listening to and imagining auditory stimuli. Zatorre and Halpern (2005) have shown how auditory imagery occupies the auditory cortex in the same way sound does, but the activated area is dependent on the task demands. Further to this, the idea that imagined and perceived stimuli activate similar neural areas can be considered in terms of whether mental imagery and its analogous counterpart share the same processes when processing emotion.

The amygdala is a part of the brain implicated in the processing of emotions (Gallagher & Chiba, 1996). Phelps and Anderson (1997) argued that the amygdala plays a central role in emotional memory and evaluating emotional stimuli, whereby it is used to strengthen the long-term consolidation of emotionally arousing events in one's memory, and is activated when emotional cues in the environment are evaluated. This is evident in research focusing on how damage to the amygdala affects the processing of emotion. For example, Adolphs et al. (1994) showed how damage to the human amygdala in a patient with Urbach-Wiethe syndrome impaired the recognition of emotion through facial expressions. This was concluded as the individual could process faces in a typical manner but failed to assess emotions in facial expressions correctly. With what has been explored in relation to mental imagery and perceived stimuli activating similar brain areas, it leads to the suggestion that the amygdala could be involved in the processing of emotions in mental imagery too. Holmes and Mathews (2010) documented this concept in their review and focused on evidence relating to facial expressions. Such is a study by Kim et al. (2007), who used functional magnetic resonance imaging (fMRI) to monitor brain activation when imagining emotional and neutral facial expressions, and found that the amygdala played an important role in processing emotion in facial expressions for imagery. Further support of the amygdala's role in emotional processing in mental imagery is seen in research that looks at how imagining past and future emotional events can lead to amygdala activation (Cabeza & St. Jacques, 2007; Sharot et al., 2007). Therefore, with the evidence discussed above highlighting how imagined and perceived stimuli share similar underlying neural mechanisms when processing emotion, it allows one to conclude that imagery-based interventions for anxiety work in part on the premise that they can alter negative emotions. As addressed earlier, emotions are an important element of anxiety. Thus, if an individual is exposed to imagery that can change negative emotions (that maintain the anxiety), then this change in emotions could increase the likelihood of anxiety-related symptoms being reduced.

Through the discussion of interventions for anxiety, it is evident that music and imagery-based interventions are effective at reducing anxiety. This is primarily due to how these methods target the mechanisms in the GCM, but also because of the relationships that these treatment methods have with emotions (Cook et al., 2017a; Holmes & Matthews, 2010). As highlighted earlier, within the domain of imagery-based interventions, it is clear that there are no studies investigating the potential effect of an imagery intervention for anxiety making sole use of musical imagery, as opposed to other modes of imagery such as visual (Tavakolizadeh et al., 2018; Walker et al., 1987). This presents an opportunity to investigate whether deliberately imagining music can be used to alleviate symptoms of anxiety. However, as the use of VMI as an intervention method for anxiety has not yet been established as an evidence-based treatment, the research in this thesis will not restrict the testing of this method to individuals who have been explicitly diagnosed with clinical forms of anxiety. The next section in this thesis explores the research that has been conducted in the field of musical imagery.

## 1.2 An introduction to musical imagery

Musical imagery involves hearing music in the mind (Halpern, 2001). This phenomenon can be divided into two categories dependent on whether an individual imagines music voluntarily (voluntary musical imagery, henceforth VMI) or unintentionally, known as involuntary musical imagery (INMI). The latter, a form of spontaneous cognition, occurs when individuals imagine music with no conscious effort (Floridou et al., 2015). Since research into INMI began (Bailes, 2002), there has been a wide breadth of topics covered ranging from how the repetition and recency of musical pieces can increase INMI development (Byron & Fowles, 2015), to the INMI experience and cognitive load (Floridou et al., 2017; Hyman et al., 2013; Hyman et al., 2015), and how aspects of the INMI experience correlate with the specific brain areas (Farrugia et al., 2015). Specifically, the frequency and helpful aspects of INMI episodes positively correlate with neural areas that are activated during auditory perception, and the activation of cortical structures that form part of the affective processing network correlate with the negative evaluation of INMI. The extensive amount of studies investigated in such a variety of topics indicates the increasing interest that researchers have in INMI (Liikkanen & Jakubowski, 2020). Additionally, this interest extends to VMI.

### 1.2.1 Voluntary musical imagery (VMI)

VMI involves the conscious and deliberate imagination of music. People use VMI in everyday life, for example musicians voluntarily imagine music when mentally rehearsing for a performance (Fine et al., 2015). There are various cognitive components involved when people deliberately imagine music, including mental control, attention, and memory. Cotter (2019) recently demonstrated how mental control is a necessity for the deliberate imagination of musical imagery in her Dual Component Model of mental control in musical imagery. This model is formed of two components - initiation and management. Initiation of musical imagery refers to whether this process is controlled, at the start of the musical imagery experience (spontaneous or voluntary), and the management of musical imagery concerns how the imagery is controlled after the initiation. In the case of VMI, the musical imagery is initiated on a voluntary basis and individuals can deliberately decide to continue maintaining this musical imagery in their mind. Attention is essential for VMI too as it contributes to the maintenance of the musical imagery, ensuring that people can concentrate on keeping the mental imagery of this piece of music in their minds (Dalagna et al., 2013). When the VMI is for a piece of familiar music, it not only uses memory, but this type of VMI is also a form of memory. Working memory plays a role in VMI, and it has been argued that the phonological loop is activated during this activity (Kalakoski, 2001). Baddeley and Hitch (1974) suggested that the phonological loop handles auditory and verbal information. Supporting evidence for this claim can be found in studies that have investigated whether the processing of musical imagery is affected when individuals are prompted to engage in other activities that would also activate the phonological loop. For instance, Logie and Edworthy (1986) demonstrated how individuals could not deliberately imagine auditory pieces of information (that were musical) whilst simultaneously engaging in a homophone judgment task - a task that also uses the phonological loop component of the working memory.

Researchers interested in VMI have covered a range of topics varying from similarities between VMI and characteristics of heard music (Halpern, 1988a) to individual differences in VMI based on musical training (Aleman et al., 2000). Despite some researchers conducting musical imagery studies without distinguishing between whether the music is imagined voluntarily or involuntarily (Bailes, 2006; Beaty et al., 2013; Huovinen & Tuuri, 2019), it has become common practice to either investigate one form or the other (Liikkanen, 2011; Williamson et al., 2012; Williamson et al., 2014).

### 1.2.2 Voluntary musical imagery and involuntary musical imagery (INMI)

A valid question that arises in musical imagery research is to what extent INMI and VMI are associated, being that the only categorical difference between the two types of imagery is whether there is conscious effort involved in the initiation and maintenance of the imagery (Cotter, 2019). Weir et al. (2015) conducted a study looking at potential relationships that might be present between INMI and VMI. Their focus was on whether increases in INMI activity are associated with more accurate VMI experiences, on the basis that musical imagery repetition in memory is present in both INMI and VMI. By comparing the performance accuracy on a VMI assessment task with self-reported INMI experiences in 67 participants, the findings indicated that there was no association between INMI and VMI in relation to whether longer and more frequent experiences of INMI might lead to improvements in VMI ability. Some might suggest that this finding could contribute towards an argument in favour of VMI and INMI being studied as separate phenomena, but so far Weir et al. (2015) appear to be the only researchers to have explicitly investigated whether there are any associations between these two types of musical imagery. In addition to seeing whether VMI and INMI are associated, researchers have looked at similarities between VMI and music listening.

### 1.2.3 Similarities between voluntary musical imagery and music listening

Previous research has shown how there are similarities and close relationships between INMI and music listening, namely that music listening behaviour can shape the INMI experience (Filippidi & Timmers, 2017). Additional considerations of whether the act of voluntarily imagining music shares any similarities with listening to music can relate to a comparison between the two domains in relation to musical features, based on whether these features are preserved in VMI. The potential for individuals to voluntarily imagine music at the same or similar tempo as the perceived music can first be addressed. Earlier research into the preservation of tempo in imagined music has shown that participants' perception of tempo in imagined and perceived music is similar to one another (Halpern, 1988a). In a mental scanning activity, Halpern (1988a) presented participants with two song lyrics and asked whether the second lyric was from the same song as the first. Additionally, the participants were asked to decide if there was a pitch difference between two different lyrics from the same song. From observing the amount of time taken to complete those tasks, Halpern (1988a) noticed a relationship between the distance between lyrics in the song, and the time spent completing the activity. The findings indicated that the participants were scanning through the song in their minds, demonstrating that there are temporal elements of music represented in musical imagery. The concept of musical tempo preservation in musical imagery has also been found by other researchers including Weber and Brown (1986), who conducted a study involving the tracking of melody contours whilst perceiving and imagining music. The authors found no significant difference between the time taken in each task. Additionally, Halpern (1988b) conducted more work into this phenomenon by asking participants to compare the tempo of familiar music pieces whilst listening to and imagining the music. The participants made tempo adjustments corresponding to what they perceived as correct in both conditions (listening vs imagining). Halpern (1988b) found that the tempi in both conditions were correlated with one another, indicating that the participants were imagining the music at a similar tempo to their preferred listening tempo.

The variety of innovative methods in these studies strengthens the claim of tempo preservation in musical imagery, yet a shortcoming associated with the findings presented above is that they cannot provide exact measures to indicate more precisely how closely related the tempo ratings were in both the perceived and imagined conditions. Jakubowski et al. (2016) addressed this limitation in a study where the primary aim was to investigate whether there were differences between perceived and imagined tempi in music in a more objective manner through tapping data. Participants were required to complete three tasks (two of which were imagery tasks); tapping to the beat of the imagined music (imagery motor task), adjusting a click track in accordance with the beat of the imagined music (imagery non-motor task) and a perceived music task. By comparing the tempo judgments in these tasks, Jakubowski et al. (2016) found that the most accurate tempo judgments were presented in the perceived music task, but interestingly the imagery motor task provided better tempo judgements compared to the imagery non-motor task. These findings not only suggest that tempo is represented in musical imagery, but also highlight the value of motion to reinforce the mental representation of auditory information (Bailes, 2019). Acknowledging potential parallels between VMI and music is vital for this thesis, as it can assist in furthering the understanding of why VMI might be an effective intervention for anxiety in similar ways to music listening.

### 1.2.4 Individual differences in voluntary musical imagery

Section 1.1.2 in this chapter discussed individual differences in anxiety. Within the broad realm of mental imagery, individual differences related to various types of imagery have also been studied. For example, Isaac and Marks (1994) focused on developmental changes and specialisation differences in different modes of mental imagery, whereas Borst and Kosslyn (2010) looked at individual differences in spatial imagery. Likewise, individual differences are present in musical imagery. An example of such is neuroticism, openness to experience and schizotypy being correlated to the frequency of INMI (Cotter et al., 2016). It is thus acceptable to suggest that individual differences would be present in VMI as well.

In Weir et al.'s (2015) study that was previously discussed, secondary findings demonstrated that VMI ability was related to musical training and practise, indicating a possible presence of individual differences in VMI ability in their sample. The notion that musical training might determine how well an individual can voluntarily imagine music has been previously raised too. Aleman et al. (2000) compared the performance of individuals who were either musically trained or musically naïve on a musical imagery task involving the comparison of pitches, a non-musical auditory imagery task (where participants compared features of everyday sounds with mental imagery of these sounds), and a visual imagery task. Findings indicated that the participants who were musically trained performed better not only on the musical imagery task, but also the non-musical auditory imagery task. This finding was further supported by Bishop et al. (2013) who established an association between how accurately people imagine the musical dynamics suggesting that musical training is related to a more veridical representation of the loudness in musical imagery. Further to this, others have presented results in line with the suggestion that musicians are better at imagining music compared to non-musicians, in terms of the clarity and vividness of the musical imagery that is imagined (Campos & Fuentes, 2016). As it has already been shown that there is neural overlap in music listening and musical imagery (Herholz et al., 2008; Zatorre & Halpern, 2005), this musical training difference could be explained by the idea that musicians have increased auditory cortical representations (Pantev et al., 1998). This is due to musicians being more familiar with music, and thus musical imagery, during music performance practice.

These pieces of evidence suggest that musical training is positively related to the VMI experience (specifically the ability to deliberately imagine music, as well as how clear and vivid the imagery is), but it does not imply that non-musicians are not capable of voluntarily imagining music. Previous research has shown that individuals (irrespective of musicianship) can imagine various musical elements with conscious effort such as single tones (Farah & Smith, 1983) and musical scales (Janata & Paroo, 2006). It might be that non-musicians are capable of deliberately imagining music, but just not as well as musicians. Therefore, it could be suggested that if VMI is to be applied in an intervention setting, non-musicians might need to undergo training or practise VMI to improve their ability. This is to overcome the potential for VMI ability to negatively affect anxiety outcomes after using this method in an intervention setting. Following on from this, as the present thesis concerns both anxiety and VMI, it would be interesting to see if there are individual differences in anxiety and imagining music. There has been no explicit evidence of these differences, but researchers have studied spontaneous auditory imagery experiences in psychological disorders.

### 1.2.5 Auditory imagery and psychological disorders

Individual differences in music imagery experiences can be considered in relation to mental health problems (Negishi & Sekiguchi, 2020). Research has shown that the role of multisensory mental imagery in psychological disorders is similar to the role of negative thoughts - they maintain the problem (Çili & Stopa, 2015). Even though there is interest in these experiences in various kinds of mental health problems, for this thesis, it would be worthwhile to explore whether there is clear evidence of auditory (including musical) imagery in individuals with anxiety. It is important to see whether anxious individuals have a natural tendency to imagine music, might have difficulty with controlling their imagery, and if they have vivid musical imagery episodes.

Previous research has demonstrated how auditory imagery, including musical imagery, can either maintain mental health problems or be symptomatic. For example, the occurrence of intrusive images in psychological disorders and the potential role they might have has been explored (Çili & Stopa, 2015). INMI has been researched in OCD, with demonstrations that individuals with OCD have a higher chance of experiencing severe cases of INMI (Taylor et al., 2014), here referred to as musical obsessions. This is evident in case reports on individuals with OCD who experience musical obsessions (Aneja et al., 2015; Islam et al., 2014; Naskar et al., 2017), as well as musical obsessions being experienced in an obsessive way (Saha et al., 2012). Even though a limitation of case report studies is that they may not be generalisable, these studies still provide valuable insights into the experience of intrusive musical imagery in OCD. Auditory hallucinations, which involve hearing voices in the mind in the absence of heard voices, are a form of auditory imagery that is found in both PTSD (Brewin & Patel, 2010) and schizophrenia (McCarthy-Jones & Longden, 2015; Thomas et al., 2007). There has also been research into the presence of musical hallucinations (perceiving music when nothing is playing; Moseley et al., 2018) in schizophrenia, as Bleich-Cohen et al. (2011) used fMRI to document the experience of obsessive musical hallucinations that are present in schizophrenia.

In summary, much of the research into the experience of musical imagery within mental health has focused on intrusive auditory imagery, showing how this type of imagery can contribute towards the maintenance of the problem or develop as a symptom. However, there is no clear evidence of people with anxiety deliberately imagining musical imagery, experiencing problems with controlling these forms of imagery, or experiencing unwanted musical imagery. It is worthwhile investigating whether these relationships exist, as they would have implications for the proposed use of VMI as an anxiety intervention method.

### 1.2.6 Application of musical imagery to alleviate anxiety

As discussed in this chapter, anxiety is a prevalent mental health problem that has been previously treated using a variety of interventions including CBT, music listening therapies and imagery interventions. For the latter however, there is no published evidence of the use of VMI as an intervention. There is also little evidence relating to the application of musical imagery for any type of health problem, whether mental or physical. To date, the closest form of mental imagery to musical imagery that has been used in interventions for anxiety is auditory imagery. For instance, Jing et al. (2011) tested the effects of guided imagery on anxiety during centrifuge training, where the participants listened to a guided imagery tape that taught them how feel more relaxed by imagining a calming environment using auditory, visual, olfactory and tactile imagery. A review of the literature (which is presented in Chapter Four) shows that imagery intervention studies that incorporate auditory imagery within the intervention activities for anxiety reduction have consistently done so through using multimodal imagery, rather than auditory imagery in isolation. Thus, it cannot be established whether it is the inclusion of auditory imagery that leads to the desirable anxiety outcomes. Furthermore, when auditory imagery is mentioned in imagery intervention studies for anxiety, no clear details are provided about the auditory imagery that is being imagined. For instance, Tolgou et al. (2018) studied the effects of imagery techniques on health anxiety, and the participants' instructions related to auditory imagery were "Experience the scene as if it were happening at that moment and to focus on sensory information such as images, sounds, smells, tastes, and physical perceptions" (p. 4). This is similar to the instructions provided by Thompson and Coppens (1994), who tested the effects of guided imagery on anxiety in individuals who underwent magnetic resonance imaging scans, "The participants were instructed to imagine the colours, sounds, smells, and feelings this place brought to them" (p. 63). Indeed, there is also no indication of whether these individuals who are instructed to deliberately imagine sounds are doing so for musical or other sounds. This is a disadvantage associated with the study design, being that the researchers did not ensure that the content of the auditory imagery was monitored.

With the demonstration of imagery interventions being effective at reducing anxiety (using various modes of imagery including visual, auditory and olfactory (Apóstolo & Kolcaba, 2009; Beizaee et al., 2018), and with there being no evidence of musical imagery being applied in an intervention setting for anxiety, this further highlights the need to explore this potential VMI intervention method. The benefits of using musical imagery in a deliberate manner to alleviate anxiety revolve around this activity being non-invasive, cost-effective, and being personalised to each individual.

## 1.3 Overview of thesis

The main aim of this thesis is to develop and test a VMI-based intervention to reduce anxiety. A schematic diagram of the thesis is shown below in Figure 1.2 and this investigation is achieved through four studies; a survey of the relationship between experiences of musical imagery and anxiety, a systematic review into imagery-based interventions for anxiety, a study testing the feasibility of VMI training and collecting preliminary data on the effects of VMI on anxiety and mood, and a final test of the VMI intervention on anxiety and mood using a daily diary approach. An outline of the thesis follows:

**Chapter Two: Investigating the Relationship Between Musical Imagery and Anxiety**

An online survey will explore associations between people's reported experiences of anxiety and musical imagery, to serve as a baseline before investigating whether VMI can be used as an intervention for anxiety. Secondary aims of this survey relate to the impact of thought control ability on the relationship between anxiety and musical imagery, potential associations between depression and musical imagery, and how sleep relates to anxiety and musical imagery. The knowledge acquired from this part of the thesis might have implications for the application of VMI in an intervention setting.

**Chapter Three: Potential of Voluntary Musical Imagery as an Intervention for Anxiety**

This chapter will examine the mechanisms that might account for VMI serving as an effective intervention for anxiety. Emphasis will be placed on cognitive and affective mechanisms, with a discussion about how properties of VMI might target the underlying components responsible for anxiety. This chapter also considers the ability of VMI to regulate emotions in a positive direction and the potential subsequent effects of this regulation on anxiety.

**Chapter Four: A Systematic Review of Imagery-Based Interventions for Anxiety**

The review of literature in the present chapter introduced the concept of imagery-based interventions for anxiety and highlighted how there are no existing reviews of this intervention method for anxiety specifically. As a first step towards the development of a novel imagery intervention for anxiety, the purpose of this chapter is to systematically review empirical studies that have investigated imagery-based interventions for anxiety and assess the quality of these studies. The review is intended to provide a comprehensive overview of imagery-based interventions for anxiety, including information on the effectiveness of these interventions and several important study characteristics such as the type of methods used, the mode of imagery and the dosage of intervention activities. The review also assesses the risk of bias in these studies, while pointing out where future imagery study designs can be improved.

**Chapter Five: An Exploratory Investigation into Voluntary Musical Imagery Training, and the Effects of Voluntary Musical Imagery on Anxiety and Mood**

Following in line with a previous proof of principle study into the effects of training in mental imagery on pathological worry (Skodzik et al., 2017), Chapter Five will investigate whether it is possible to train non-musicians to voluntarily imagine music (using newly suggested methods). This chapter will also test the applicability of imagining music in real-life settings and gather preliminary data on the effects of VMI on anxiety and mood.

**Chapter Six: The Effects of Voluntary Musical Imagery on Anxiety and Mood**

Chapter Six will present the final experimental study in this thesis, to provide evidence on the effects of VMI on anxiety reduction and on mood. Advancing on from the study design in Chapter Five, participants will be invited to a music studio to practise voluntarily imagining music and completing a control activity. Through a daily diary approach, participants will incorporate these activities in their daily lives, and report their anxiety and mood levels.

**Chapter 7: General Discussion**

The final chapter will critically evaluate the notion that VMI can serve to reduce anxiety, synthesising the key themes that emerged in the course of the research. These themes focus on possible accounts for the effects of VMI (including short-term effects), the target population for the VMI intervention, individual differences in musical imagery experiences (and how these differences might impact the effectiveness of the intervention), and recommendations for the application of the intervention.

Figure 1.2 *A schematic diagram of the PhD thesis*

**Primary thesis research question:**

Is Voluntary Musical Imagery an Effective Intervention for Anxiety?

↓

**Chapter One:**

Review of the literature on anxiety and musical imagery

↓

**Chapter Two:**

Exploring the relationship between musical imagery and anxiety

↓

**Chapter Three:**

Explaining the rationale behind the potential effectiveness of VMI as an anxiety intervention

↓

**Chapter Four:**

Systematically reviewing imagery-based intervention studies for anxiety reduction and assessing the quality of these studies

↓

**Chapter Five:**

Training non-musicians in VMI and collecting preliminary data on the effects of VMI on anxiety and mood

↓

**Chapter Six:**

Testing the effects of VMI on anxiety and mood

↓

**Chapter Seven:**

Critically analysing the effects of VMI on anxiety, exploring key themes to emerge from the research

# Chapter 2
# An Investigation into the Relationship Between Musical Imagery and Anxiety

As the overall aim of this thesis is to examine the effects of VMI as an intervention method for anxiety reduction, the literature review in Chapter One first explored individual differences in anxiety and musical imagery separately. Following these differences, the next step is to examine baseline associations between musical imagery and anxiety, before addressing the main studies in the thesis. Thus far, despite researchers taking an interest in relationships between mental imagery and psychological disorders (Çili & Stopa, 2015), there have been no studies investigating the association between musical imagery and anxiety specifically. Therefore, this chapter sought to address this gap by presenting an online survey to investigate the relationship between musical imagery experience and anxiety. The main research question for this survey asks whether there is a relationship between musical imagery experience and anxiety. Secondary interest concerns potential moderating effects of thought control ability (TCA) on this relationship, due to thought control playing an important role in both anxiety (Wells & Davies, 1994) and musical imagery (Cotter, 2019), and how sleep, musical imagery and anxiety relate to one another. Chapter One acknowledged the frequent comorbidity of anxiety and depression (Carek et al., 2011), so potential relationships between depression and musical imagery are also considered.

## 2.1 Introduction

### 2.1.1 Mental imagery and well-being

Mental imagery and well-being have often been studied in combination, with researchers investigating the remedial effects of imagery (Bakke et al., 2002; Jerling & Heyns, 2020; Sit et al., 2020). For example, through survey data, Blackwell et al. (2013) showed that the vividness of future mental imagery that is positive is associated with optimism. Kaplan et al. (2014) also demonstrated how mental imagery practice can improve daily well-being, by encouraging participants to practise brief mental imagery exercises every morning for one week. In addition to mental imagery being used in an intervention-like manner, the role of imagery in the maintenance of mental health problems has also been considered. Research has shown that mental imagery can act as a contributing factor towards poor mental health, such as adding to the preservation of psychological disorders by occurring in an intrusive manner (Brewin et al., 2010). As suggested by Çili and Stopa (2015), the intrusive characteristic associated with some forms of mental imagery can have an emotional impact on people suffering from psychological disorders, as these types of images have frequently been linked to negative emotions (Reynolds & Brewin, 1999; Schulze et al., 2013). This emotional impact is also associated with anxiety-related behaviours that further contribute towards the maintenance of mental health concerns. For instance, intrusive images in SAD give rise to internal monitoring, which is a safety behaviour that has an adverse effect on one's social performance (Clark & Wells, 1995). Thus, it is important to explore mental imagery and health simultaneously. For specific mental health problems, mental imagery has been investigated alongside anxiety and depression, covering a broad range of topics such as mental imagery in anxiety disorders (Hirsch & Holmes, 2007) to imagery-based interventions for anxiety (Nguyen & Brymer, 2018).

#### 2.1.1.1 Anxiety, depression and mental imagery

##### 2.1.1.1.1 Anxiety

The role mental imagery plays in anxiety ranges from how it maintains the problem, to how unwanted involuntary mental imagery is common in anxiety disorders (Hirsch & Holmes, 2007). Researchers have even considered how various aspects of anxiety incorporate imagery and how these features can be targeted in treatment methods. For example, worry, a central element of some forms of anxiety (Hirsch et al., 2013; Hoyer et al., 2001), has been studied in relation to mental imagery and anxiety. Stokes and Hirsch (2010) have shown how, despite verbal thoughts being important in maintaining a sense of worry, anxious individuals also worry in the form of multimodal imagery. Whereas Skodzik et al. (2018) demonstrated how mental imagery can be used to reduce pathological worry, through training people in mental imagery. In addition to this, there are also differences in the type of imagery present in certain anxiety disorders.

As the previous chapter highlighted that diagnostic criteria vary between anxiety disorders, these variations can also be applied to imagery-based differences in the different types of anxiety. Trait anxiety can differ between individuals in terms of whether people present with high or low levels. The level of trait anxiety one has is also related to one's experience of mental imagery. In instances where trait anxiety is high (such as GAD; Hirsch et al., 2013), it has been shown for individuals to experience more prospective mental imagery that is negative and intrusive (Tallon et al., 2020). Researchers have also observed how the intensity of imagery can vary across anxiety types, as people who have higher levels of dental anxiety experience more intense fear-based imagery compared to those with low levels of dental anxiety (Schneider et al., 2018).

Differences in mental imagery are also found in the form of self-images. Social anxiety is centred on this type of anxiety being triggered by social events where anxious individuals believe others form negative opinions about them, which in turn can inform their own opinions of themselves. Self-images are one of the main components of social anxiety (Hirsch et al., 2003), and negative self-images have consistently been shown to play an important role in the maintenance of the problem (Makkar & Grisham, 2011; Schreiber & Steil, 2013). This is a clear imagery-based difference in anxiety experiences as negative self-images are less likely to be present in other forms of anxiety such as phobia. Another imagery-based difference is imagery ability, which consists of the capability to deliberately generate and maintain mental images. There is evidence to show how anxious individuals are more likely to exhibit poorer imagery ability compared to non-anxious people, with respect to generating visual mental images. For instance, Morrison et al. (2011) compared response times on an imagery generation task between people with social anxiety and a group of control participants who did not have clinical anxiety. For this study, the participants had to first memorise a set of blocks with letters, then take part in an imagery generation task. In this activity, the participants were presented with a block marked with an X and had to decide if the letter on this block (in the original set that was memorised) would have covered the X, through creating a mental image of the blocks. Individuals with social anxiety had slower responses when responding to “late” rather than “early” parts of the letters, compared to the control group. This finding suggests that people with social anxiety have greater difficulty in generating neutral imagery, compared to non-anxious individuals. When considering this implication in relation to the main aim of the thesis—whether deliberately imagining music can reduce anxiety—as it is likely that VMI might be positively valenced, due to music listening being perceived as a positive experience (Chang et al., 2020), these such concerns regarding image generation for those with anxiety might not be an obstacle. This is helpful as the ability to deliberately imagine music is an important factor to acknowledge when considering the potential effectiveness of VMI as an intervention method. There is also very little research that has isolated specific mental imagery modalities or investigated associations that anxiety might share with musical imagery.

**2.1.1.1.2 Depression**

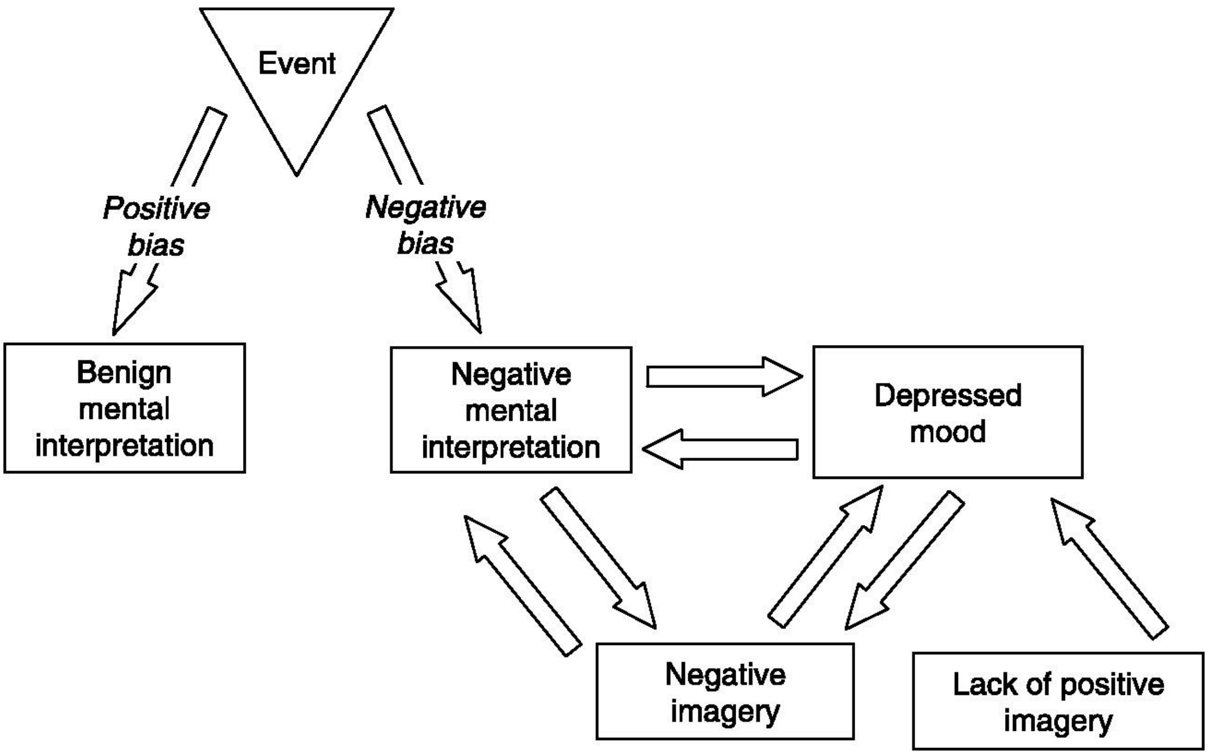
Holmes et al. (2016) suggest that there are three important reasons to research depression in association with mental imagery: 1) to create a greater understanding of the mental activities of depressive patients in clinical assessment, 2) to increase the effectiveness of psychological therapy for depression by incorporating imagery elements and 3) to acquire more information about the underlying mechanisms (both neural and cognitive) present in the association between depression and imagery, as a way to assist in the development of future treatment methods for depression. Regarding depression and mental imagery, researchers have mainly examined these variables from the same two perspectives as anxiety - by looking at mental imagery experiences in depression and using mental imagery as an intervention for depression.

There are a variety of ways in which mental imagery is experienced in depression. To begin, depression is associated with mental imagery dysfunction, as there is an imbalance of negative and positive imagery in this experience. Depressive individuals have elevated levels of intrusive negative mental imagery (Holmes et al., 2016) and generate fewer positive mental imagery episodes (MacLeod & Conway, 2007; MacLeod & Salaminiou, 2001; MacLeod et al., 2005; Weßlau et al, 2015). Depression is also associated with problems in the formation and modification of deliberate mental imagery (Holmes et al., 2016). Cocude et al. (1997) showed how depressive individuals find it harder to generate visual images compared to non-depressed individuals through an imagery generation task. In this study, participants had to generate visual mental images in response to nouns. The time taken to generate these images, as well as the duration of the images, were recorded and the findings showed that not only did the depressed individuals struggle with the deliberate formation of these images, but the generation latencies were longer compared to the control group. Further to this, a more recent study by Chen et al. (2013) showed how the more depressive episodes one has, the slower the manipulation of one’s mental images.

Holmes et al. (2009a) proposed a subcomponents model of depression that shows how mental imagery works, to either maintain or further enhance depression (as seen in Figure 2.1). This model is based on the relationship imagery holds with emotions (being that mental imagery can evoke strong emotive reactions; Pictet & Holmes, 2013), and suggests that mental imagery can exacerbate depression through negative mental images enhancing negative mood and interpretation bias. As previous research has already shown that depression is associated with more frequent occurrences of negative imagery and impoverished positive imagery (Holmes et al., 2016; MacLeod & Conway, 2007; MacLeod &

Salaminiou, 2001; MacLeod et al., 2005; Weßlau et al, 2015), these mental images will work to only aggravate the situation. These examples show how mental imagery can contribute to the maintenance of depression, due to the effect negative imagery has on mood - an important element of depression. The model also suggests that the promotion of positive mental imagery can be used to assist in the reduction of depressive symptoms, a factor that has been considered in the treatment of depression (Dainer-Best et al., 2018; Torkan et al., 2014), as it shows that a lack of positive mental imagery reinforces depression. This leads on to the other perspective from which mental imagery and depression have been studied - imagery-based interventions for depression.

Figure 2.1 *A schematic diagram of the subcomponents model of depression, addressing mental imagery and interpretation bias, presented by Holmes et al. (2009a, p.24)*




Similarly to imagery-based interventions for anxiety, researchers have used this type of method to help alleviate depressive symptoms. There are several ways in which this has been achieved and one example is through enhancing the presence of positive mental imagery. This has been explored through Imagery Cognitive Bias Modification (Blackwell et al., 2015; Williams et al., 2015), which focuses on encouraging individuals to engage in the repetitive generation of positive mental imagery (when presented with ambiguous stimuli) to form imagery biases that are more positive. It is suggested that this method could be more effective at targeting and improving certain elements of depression that other conventional approaches fail to address - specifically anhedonia, one of the key symptoms in depression (Holmes et al., 2016). This is based on the notion that anhedonia is associated with low levels of positive affect (Heininga et al., 2019) and positive mental imagery can overcome this deficit as a result of the positive mood that is elicited from the deliberate generation of positive mental imagery. An important point to emphasise, nonetheless, is the lack of studies, either investigating mental imagery in depression or as an intervention for depression, that solely focus on auditory imagery. Holmes and Mathews (2005) have already acknowledged the important relationship that various modes of mental imagery share with emotions, being that imagery has the ability to evoke strong emotional reactions. With depression being an emotional disorder (Heyes et al., 2013), and with Chapter One shedding light on the frequently occurring comorbidity of anxiety and depression (Carek et al., 2011; Ibbotson et al., 1994; Martinsen, 2008), it would be worth exploring potential relations between depression and musical imagery, in addition to anxiety and musical imagery.

So far, there is no clear evidence of musical imagery being considered with respect to the potential relationship this form of imagery might share with anxiety or depression, either naturally occurring, or as an intervention. Further to this, it is important to highlight how there is research that touches on the general experience of mental imagery outside of its occurrence in anxiety and depression, as well its use as an intervention. This involves attributes of the mental imagery itself and Pearson et al. (2015) have suggested that it is necessary to have a thorough understanding of the mental imagery experience in mental disorders, as this awareness would greatly contribute to the development of novel imagery-based interventions.

#### 2.1.1.1.3 Characteristics of the mental imagery experience

Within mental health research, there has been interest in the content and occurrence of mental imagery, with several investigations looking at the frequency of imagery in psychological disorders. Patel et al. (2007) have previously found that more frequent involuntary mental imagery is associated with depression. Additionally, Stöber (2000) conducted an early replication study of MacLeod et al.’s (1997) investigation into retrospective and prospective events in anxiety and depression, specifically relating to memory. They were interested in examining prospective cognitive activities in anxiety and depression. To do this, 70 students completed the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983) and the short form of the Beck Depression Inventory (Beck & Beck, 1972). Then the participants were instructed to form mental images in response to a list of future events (that were either positive or negative), and rate the vividness, speed and how detailed these images were. Stöber (2000) found that high anxiety scores were positively correlated with the frequency of imagery for negative events, whilst depression scores were positively associated with reduced imagery for positive events. This finding is further supported by Bjärehed et al. (2010) who found the same results as those mentioned above, but within a sample of individuals who had mild to moderate levels of depression. For anxiety, there has been an emphasis on how negative imagery is more frequent, with Homer and Deeprose (2017) showing how negative involuntary imagery is more frequent in people with social anxiety. It is evident that several of these studies mainly focus on the balance of negative and positive imagery frequency. This emphasis on the valence of the imagery in these disorders suggest that the affective characteristic of mental imagery is an important imagery feature that should be carefully considered when developing imagery treatment methods for anxiety.

Moreover, some studies have also touched on the vividness of imagery in anxiety and depression. Several studies have demonstrated how reduced vividness of positive mental imagery is a common feature in depression, compared to negative mental imagery (Morina et al., 2011; Szőllősi et al., 2015). Morina et al. (2011) specifically compared the experience of negative and positive prospective mental imagery in individuals with anxiety disorders, clinical depression, and a control group of healthy participants. By instructing participants to complete tasks relating to deliberate and intrusive prospective imagery, these researchers found that depressed individuals had poorer vividness ratings for positive future imagery, whereas the participants with anxiety had enhanced vivid imagery for negative events, compared to the control group. Pile and Lau (2018) also found similar results to Morina et al. (2011), but for past event imagery as opposed to prospective imagery; individuals with more anxiety symptoms displayed more vivid imagery for past negative events.

In the studies investigating anxiety, depression and mental imagery, most of the research addresses clinical anxiety and depression, which indicates that little is known about the mental imagery experiences of those with various levels of sub-clinical anxiety and depression. This presents an opportunity for more to be learnt about these phenomena. By doing this, studying the mental imagery experience in sub-clinical anxiety and depression would contribute to the literature regarding these two experiences by providing more detail about musical imagery in anxiety and depression. As mentioned above, this would produce valuable knowledge for developing a greater understanding of these disorders and assist in the development of imagery-based interventions for these mental health problems. Furthermore, within the anxiety and mental imagery experience, there is a unifying dimension between the two - thought control.

#### 2.1.1.2 Thought control and mental activity

Dysfunctional thought control is often thought of as a contributing factor towards poor mental health. For instance, people with bipolar disorder are known to use unhelpful thought control strategies (Østefjells et al., 2017). Previous research has also found associations between anxiety and a lack of thought control (Wells & Davies, 1994), indicating that more severe experiences of anxiety are related to poorer control of unwanted thoughts. When mental imagery is discussed, the controllability of imagery is also highlighted. Often, the mental imagery experience is either depicted as being voluntary or involuntary. What sets these two forms of imagery apart is the fact that there is variation in the extent to which individuals control their mental imagery. Cotter (2019) presented the Dual Component Model to describe mental control in musical imagery and suggested that there are two components involved in the control of musical imagery - initiation and management. Initiation involves whether the imagery begins involuntarily (with no control) or voluntarily (with control). The management of the musical imagery is related to the type of control that occurs once the imagery is initiated, one example being whether the individual decides to continue imagining the music. The former part of this model is what distinguishes the two main forms of musical imagery (INMI and VMI), being that INMI occurs when the initiation of musical imagery is involuntary, whilst the initiation of VMI is deliberate. Following this initiation, the music that is imagined can continue in an involuntary or voluntary manner in INMI, whereas the management of VMI is predominantly voluntary.

When considering possible links between thought control and musical imagery, research conducted on the musical imagery experience in relation to instances of dysfunctional thought patterns should be examined. Müllensiefen et al. (2014) looked at how obsessive compulsions relate to INMI. In this study, participants completed questionnaires that gathered data on everyday music-related behaviours, INMI and obsessive compulsions. The results obtained regarding obsessive compulsions and INMI showed that people who had high levels of obsessive compulsions had an increased chance of experiencing more frequent INMI episodes. With obsessive compulsions involving the experience of repetitive and uncontrollable thoughts (NICE, 2014), this finding indicates that experiences where individuals lack control over their thoughts may increase their vulnerability to experiencing spontaneous musical imagery. Thus, this highlights the importance of thought control in musical imagery. Further to this, Beaman and Williams (2013) focused on how individual differences in mental control, namely schizotypy (openness to experience) and thought suppression, might predict INMI, finding that both thought suppression and schizotypy were positively related to the length of INMI, how disruptive the INMI episodes were to individuals and how difficult they were to dismiss. It is also worthwhile looking at how unwanted thoughts might be associated with the musical imagery experience. In research presented by Hyman et al. (2015), it was reported that there was a positive relationship between the frequency of INMI and of involuntary thoughts. These researchers also found that the INMI experience was related to thought suppression, being that higher frequencies of INMI were positively related to being more likely to have suppression tendencies which, along with the findings from Beaman and Williams (2013), suggests that INMI could potentially reflect the experience of other spontaneous cognitive activity such as unwanted thoughts.

These studies do not focus on anxiety specifically, but they do provide an insight into the importance of thought control in relation to the musical imagery experience. However, there is little known about the relationship between the control of mental activity in anxiety and musical imagery specifically. This is particularly relevant for this thesis as the intended intervention method being explored involves the engagement and control of the deliberate imagination of musical imagery to overcome anxiety.

### 2.1.2 Sleep

Another commonality between mental imagery and anxiety is sleep. Anxiety and sleep share a bi-directional relationship with one another, as having anxiety can lead to poor sleep quality (potentially due to the increased presence of involuntary thoughts occurring at this time, as anxiety is associated with poor thought control; Wells & Davies, 1994), and problems with sleep can lead to increased anxiety (Gray & Lemkre, 2017; Horváth et al., 2016; Norbury & Evans, 2019; Trousselard et al., 2014). In the context of musical imagery specifically, one can look at associations between INMI and involuntary thoughts, and how these relate to anxiety, and thus sleep. Hyman et al. (2015) conducted a survey to explore individual differences in intrusive thoughts (also deemed involuntary) by using INMI. The survey focused on four main topics - INMI, music experience, involuntary thoughts, and the control of consciousness. An important finding from that study, which is of relevance here, is that the frequency of INMI was positively correlated with the frequency of other involuntary thoughts. From this result, the authors concluded that experiences of INMI (or songs that are stuck in one's head) can represent other forms of involuntary thoughts or memories. Thus, with INMI being considered as a form of involuntary thought, which is a common experience in anxiety (Wells & Davies, 1994), it could be likely for those with anxiety to experience more INMI when trying to sleep, compared to individuals who are less anxious when trying to sleep. This would in turn negatively impact one's quality of sleep.

Following this, research exploring relationships between mental imagery and sleep have also reported how mental imagery can negatively impact sleep. Using a semi-structured interview, Nelson and Harvey (2003a) explored pre-sleep cognitive activity in individuals with insomnia, focusing on verbal thoughts and mental imagery. Compared to individuals who do not experience problems with sleep, people with insomnia reported to have more distressing mental images during their pre-sleep period. These individuals were also more likely to report experiences of negative mental images, compared to positive. The experience of negatively valenced mental imagery in people with insomnia is further demonstrated by Nelson and Harvey (2003b), who found that patients with insomnia, compared to good sleepers, experience more unpleasant mental imagery. Suggestions for the more frequent negative mental imagery experiences in people who have problems with their sleep is said to relate to the idea that problems with sleep often co-exist with negative pre-sleep cognitive activity (Harvey, 2000).

### 2.1.3 Individual differences in musical imagery

Self-reported individual differences in musical imagery have been investigated within the literature, with a focus on INMI. These differences have covered a variety of topics ranging from personality traits, where researchers have found correlations between INMI and schizotypy (Beaman & Williams, 2013; Cotter et al., 2016) as well as transliminality (Bailes, 2015; Wammes & Barušs, 2009), to musical practice (Liikkanen, 2012) and musical training (Campos & Fuentes, 2016). Research has shown how two personality traits, specifically neuroticism and openness to experience, share associations with INMI. Openness to experience is said to be positively related to the frequency of INMI (Cotter et al., 2016), whilst neuroticism is positively related to the duration of INMI but negatively related to the reported pleasantness of the experience (Floridou et al., 2012). Beaty et al. (2013) used a cross-sectional approach to examine differences in musical imagery experience based on music genre preference, personality and musical value, where participants completed self-reports of their musical imagery experience and questionnaires in relation to personality, music genre preference and music value. For personality specifically, Beaty et al. (2013) found that openness to experience and neuroticism were positively related to the frequency of musical imagery reported by the participants.

With respect to individual differences in musical training, Campos and Fuentes (2016) found a positive relationship between training levels and clearer, as well as more vivid, musical imagery episodes. These researchers gave 200 participants (either music or non-music students) the Clarity of Auditory Imagery Scale (CAIS; Willander & Baraldi, 2010) and the Bett's Questionnaire upon Mental Imagery (Bett, 1909), and not only did the music students have higher vividness of auditory imagery scores, they also obtained higher scores in the clarity of their auditory imagery, compared to non-musicians. Another individual difference is gender, as Liikkanen (2012) has reported that women experience more INMI compared to men, although there are others who have provided evidence that run counter to this finding (Beaman & Williams, 2010; Hyman et al., 2013).

When considering musical imagery individual differences in relation to anxiety, there is little evidence about the relationship between anxiety and musical imagery experiences - whether involuntary or voluntary. Thus, the purpose of this study is to fill the gap with respect to what individual differences might exist regarding the relationship between naturally occurring anxiety and musical imagery experiences. For mental imagery in general, a range of questionnaires exist to assess self-reported vividness and clarity of various forms, such as the Vividness of Visual Imagery Questionnaire (Marks, 1973), the Vividness of Movement Imagery Questionnaire-2 (Roberts et al, 2008), the CAIS (Willander & Baraldi, 2010) and the Bucknell Auditory Imagery Scale (BAIS; Halpern, 2015). Researchers have also adopted self-report methods when measuring mental well-being; including the assessment of state anxiety (Marteau & Bekker, 1992; Spielberger et al., 1983), trait anxiety (Spielberger et al., 1983) and symptoms of anxiety (Beck et al., 1988). As evidenced above, the researchers who examined these individual differences in musical imagery made use of self-report questionnaires as a method of assessment. Thus, when considering how to study relationships between anxiety and musical imagery, continuing the tradition of using a correlational study design using self-report questionnaires can be recommended.

### 2.1.4 Aims and predictions

Based on the need to address this gap in the research regarding the relationship between anxiety and musical imagery, an online survey was conducted to explore the overarching relationship between these two experiences. As mentioned in section 2.1.1.1.2, Holmes et al. (2016) state three reasons to research depression and mental imagery together, and those reasons can also be applied to the study of anxiety and mental imagery. By researching anxiety and musical imagery, it allows for the development of a greater understanding of mental imagery activities (specifically musical imagery) in relation to varying levels of anxiety. Moreover, the research allows for more to be understood about shared mechanisms between anxiety and musical imagery, that relate specifically to the control of mental activity. Findings that are obtained in relation to these points would help with the development of intervention methods for anxiety that involve musical imagery.

This survey aimed to primarily investigate whether there is a relationship between musical imagery experience (measured by the frequency, valence and usefulness of INMI, and the vividness and controllability of auditory imagery) and anxiety (including trait anxiety). Secondary research aims were to establish possible associations between the other measures of interest, which related to depression, sleep and thought control.

The hypotheses relating to anxiety were:

- High levels of trait anxiety correlate with more frequent INMI.
- High levels of trait anxiety correlate with poorer controllability of auditory imagery.
- High levels of trait anxiety correlate with INMI being perceived as negative.
- Thought control moderates the relationship between trait anxiety and INMI frequency, as well as the relationship between trait anxiety and the controllability of auditory imagery.
- People with anxiety disorders report more frequent INMI episodes.
- High levels of trait anxiety correlate with more frequent occurrences of music being imagined whilst trying to sleep.

The hypotheses for depression were:

- High levels of depression correlate with more frequent INMI.
- High levels of depression correlate with poorer controllability of auditory imagery.
- High levels of depression correlate with INMI being perceived as more negative.

High levels of trait anxiety and more frequent depressive symptoms were predicted to correlate with more frequent reports of INMI, and poorer control over auditory imagery, as the literature focusing on thought control and anxiety, as well as depression, has shown that these mental health problems are often associated with poorer control over thoughts (Wells & Davies, 1994). Thought control moderating both the relationship between trait anxiety and INMI frequency, as well as trait anxiety and the controllability of auditory imagery, was predicted as more frequent musical imagery episodes are associated with a higher occurrence of intrusive thoughts (Hyman et al., 2015), and intrusive thoughts are common in the anxiety experience (Moradi et al., 2014). Further to this, people with anxiety disorders reporting more frequent INMI episodes was hypothesised as previous research has shown how high trait anxiety is positively related to having an anxiety disorder (Chambers et al., 2004; Hirsch et al., 2013), and it has already been predicted that high trait anxiety would be associated with more frequent INMI. Finally, the hypothesis relating to trait anxiety and the frequency of music imagined whilst trying to sleep was formulated based on intrusive thoughts occurring in anxious individuals whilst attempting to sleep (Wicklow & Espie, 2000).

## 2.2 Method

### 2.2.1 Design and participants

The study used a correlational design. 432 participants (323 females, 101 males and 8 other) between the ages of 18 and 68 (*Mdn* = 20, *M* = 41.5, *SD* = 11.35) completed the online survey. Responses from 10 participants were excluded as they reported experiences of hearing loss. The number of participants included in the final set of data analyses varied between 410 and 421, due to missing data. The location of residence of the participants was spread across the world, as seen below in Table 2.1.

Table 2.1 *Dispersion of countries where the participants resided*

| Country | Frequency (percentage) |
|---|---|
| Australia | 2 (.5) |
| Austria | 1 (.2) |
| Belarus | 1 (.2) |
| Belgium | 1 (.2) |
| Brazil | 1 (.2) |

| | |
|---|---|
| Canada | 3 (.7) |
| Czech Republic | 1 (.2) |
| Estonia | 9 (2.1) |
| Finland | 1 (.2) |
| France | 3 (.7) |
| Germany | 1 (.2) |
| Greece | 3 (.7) |
| Hungary | 2 (.5) |
| Ireland | 6 (1.4) |
| Italy | 7 (1.6) |
| Latvia | 1 (.2) |
| Netherlands | 1 (.2) |
| Nigeria | 1 (.2) |
| Poland | 6 (1.4) |
| Portugal | 8 (1.8) |
| Slovenia | 1 (.2) |
| Spain | 3 (.7) |
| Sweden | 1 (.2) |
| Switzerland | 1 (.2) |
| UK | 346 (79.9) |
| US | 16 (3.7) |
| Zambia | 1 (.2) |

The participants were mainly recruited online via the University of Leeds mailing lists (Appendix B.1) and social media (Appendix B.2) through volunteer and snowball sampling methods. Additional recruitment methods included using the undergraduate student participation pool in the School of Psychology at the University of Leeds, and Prolific (a participant recruitment website found at - www.prolific.co; Appendix B.3). Exclusion criteria for the participant sample consisted of individuals who had experiences of hearing loss and were below the age of 16. Reasons for this include hearing loss affecting how individuals would respond to the questions that focus on music (musical engagement and imagery) and an adult sample being the targeted population demographic of interest. As a reward for participating, individuals who were psychology undergraduate students at the University of Leeds received two course credits, those who completed the survey via Prolific received £2.50 as a participatory reward, and the other participants who were recruited through other methods had the option of being entered into a prize draw to win a £10 Amazon voucher. Random Result (www.randomresult.com) was used for the prize draw. For the participants who did not receive course credits or the £2.50 participatory reward and wanted to be entered into the prize draw, their email addresses were entered into a list on Random Result and one email address was selected to win the £10 Amazon voucher. This survey received ethical approval from the Faculty of Arts, Humanities and Cultures Research Ethics Committee at the University of Leeds (PVAR 17-116) on 11th June 2018 (Appendix C).

### 2.2.2 Materials

Online Surveys (an online survey tool - www.onlinesurveys.ac.uk) was used to administer the questionnaire survey and there were three versions of the survey that varied in relation to the order of the questions, to overcome order effects. The questionnaires were grouped under five categories: 1) musical engagement (Goldsmiths Musical Sophistication Index [Gold-MSI]; Müllensiefen et al., 2014), 2) musical imagery (Involuntary Musical Imagery Scale [IMIS]; Floridou et al., 2015, and the BAIS including the vividness [BAIS-V] and control [BAIS-C] scales; Halpern, 2015), 3) hearing loss, 4) well-being (State-Trait Anxiety Inventory-Trait Scale [STAI-T]; Spielberger et al., 1983, Center for Epidemiological Studies Depression Scale [CES-D]; Radloff, 1977, clinical anxiety, clinical depression and sleep questions), and 5) thought control (Thought Control Questionnaire [TCQ]; Wells & Davies, 1994). The three orders of the surveys were as follows:

Order 1: Thought control, musical engagement, musical imagery, hearing loss and well-being
Order 2: Well-being, musical engagement, musical imagery, hearing loss and thought control
Order 3: Musical engagement, musical imagery, hearing loss, well-being and thought control

In addition to the established test inventories, questions were asked about sleep experiences, hearing loss (Appendix D.3), anxiety diagnosis and depression diagnosis (Appendix D.6). Help links were also provided to signpost participants to mental health support before, during and after the completion of the survey - www.mind.org.uk, www.rethink.org and www.youngminds.org.uk.

#### 2.2.2.1 State-Trait Anxiety Inventory-Trait Scale (STAI-T; Spielberger et al., 1983)

The STAI-T is a self-report questionnaire used to assess trait anxiety (Appendix D.4). Twenty items are included in the form of a Likert scale focusing on worry, nervousness, apprehension, and tension. Participants are asked to rate how they generally feel in response to those items, such as ‘I feel pleasant,’ on a scale from 1 (*Almost never*) to 4 (*Almost always*). Within this scale, there are two type of items that are either direct (representing negative feelings) or reversed (representing positive feelings). Examples of these include ‘I am anxious’ (direct) and ‘I feel calm’ (reversed). Scoring for the reversed items is as follows: 1 = 4, 2 = 3, 3 = 2 and 4 = 1. Thus, for the direct items, 4 indicates high anxiety and for the reversed items, 1 indicates high anxiety. Trait anxiety scores can range between 20 (lowest) and 80 (highest). This questionnaire has been used frequently in mental health research to assess trait anxiety (Hallit et al., 2019; Nordahl et al., 2019; Weeks et al., 2019), due to good levels of convergent validity and internal consistency (Vitasari et al., 2011), and the level of consistency for this sample was high, $\alpha = .93$. In addition to this questionnaire, two extra questions were used to ascertain whether the participants had an anxiety disorder, as well as the type of disorder - “Have you ever been diagnosed with an anxiety disorder?” and “If the answer to the previous question is yes, please state the type of anxiety disorder” (Appendix D.6).

#### 2.2.2.2 The Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977)

The CES-D is a 20-item self-report questionnaire that measures the severity of depressive symptoms over the past week (Appendix D.5). Each item on the questionnaire includes four possible response options: 1) Rarely or none of the time (Less than 1 day), 2) Some or a little of the time (1-2 days), 3) Occasionally or a moderate amount of time (3-4 days) and 4) Most or all of the time (5-7 days). Here are some examples of questions: ‘I felt I was just as good as other people,’ ‘I had trouble keeping my mind on what I was doing’ and ‘I felt depressed.’ Scores can range between 0 and 60, and higher scores represent more severe depressive symptoms. This questionnaire had a good level of internal consistency in this sample ($\alpha = .75$) and a moderate test-retest reliability (.45 - .70; Radloff, 1977).

#### 2.2.2.3 Sleep questions

Questions relating to sleep were included as sleep is a topic that has been frequently researched together with anxiety, as well as mental imagery. These questions were taken from the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989). Additionally, this questionnaire is frequently used in research that studies sleep and anxiety simultaneously (Choueiry et al., 2016; El-Tantawy et al., 2014; Teker & Luleci, 2018), due to having good levels of internal consistency in different populations (including Serbian people with depression and obstructive sleep apnea; Popević et al., 2018, and older men; Spira et al., 2012), as well as good validity (Backhaus et al., 2002). The sleep questions in the present survey were formulated based on the PSQI, due to this questionnaire being repeatedly used in studies that investigate sleep and anxiety (Gould et al., 2018; Oh et al., 2019; Teker & Luleci, 2018), and also due to the good levels of consistency (Popević et al., 2018; Spira et al., 2012) and validity (Backhaus et al., 2002). The questions in this survey focused on sleep quality (SQ), sleep difficulty due to anxiety (S-A) and musical imagery frequency whilst trying to sleep (S-MI), and were modified by using the same timeframe as the PSQI (the past month), but relating the questions specifically to anxiety and musical imagery. The questions developed are as follows:

1. During the past month, how would you rate your overall sleep quality?
a) Very bad, b) Fairly bad, c) Fairly good, d) Very good

2. In the past month, how likely is it that you've had difficulty getting to sleep due to anxiety?
1 (*Not very likely*) to 9 (*Extremely likely*)

3. In the past month, how often have you imagined music whilst trying to get to sleep?
1 (*Not very often*) to 9 (*Extremely often*)

**2.2.2.4 The Involuntary Musical Imagery Scale (IMIS; Floridou et al., 2015)**

The IMIS is a self-report questionnaire that collects information regarding the experience of INMI (Appendix D.2). The questionnaire consists of 15 items in the form of a Likert scale, that measure four aspects of INMI episodes: negative valence (INMI-NV), movement (INMI-M), personal reflections (INMI-PR) and help (INMI-H). There are another two items including the frequency of INMI (INMI-F) and the duration of INMI experiences. An example item from the questionnaire follows: 'Earworms help me when I'm trying to get things done' and this is rated on a scale from 1 (*Never*) to 5 (*Always*). This questionnaire was used as it is one of the only questionnaires that measure the involuntary experience of musical imagery. For this sample, the questionnaire had a good level of internal consistency, $\alpha = .80$.

**2.2.2.5 The Bucknell Auditory Imagery Scale (BAIS; Halpern, 2015)**

This questionnaire seeks to find out about the auditory imagery experience (Appendix A). There are only a few questionnaires that assess auditory imagery in a deliberate manner, such as the CAIS (Willander & Baraldi, 2010). However, a limitation of that questionnaire is that it does not acknowledge the vividness or controllability of auditory imagery, which are important elements. Therefore, Halpern's (2015) BAIS was used to overcome this limitation. The BAIS taps into individuals' experiences of voluntarily imagining auditory information, by measuring the vividness and controllability of the auditory imagery through the two scales of the questionnaire (each with 14 items) - the BAIS-V (Appendix A.1) and the BAIS-C

(Appendix A.2). For each item, a scenario is presented along with a description of a specific sound. For the BAIS-V, respondents are required to form a mental image of that particular sound then use the vividness subscale to rate how vivid that image was on a scale from 1 (*No image is present*) to 7 (*The image is as vivid as the actual sound*). Here is an example question taken from this part of the questionnaire: '1. For the first item, consider the beginning of the song "Happy Birthday." Rate the vividness of the sound of a trumpet beginning the piece.' For the BAIS-C, the participants are given a scenario then asked to rate how easy it is to change the image of one sound to the image of another on a scale that ranges from 1 (*No image is present*) to 7 (*Extremely easy to change the image*). Here is an example question: '1. For the first pair, consider attending a choir rehearsal. Rate the ease of change from a. The sound of an all-children's choir singing the first verse of a song, to b. An all-adults' choir now sings the second verse of the song.' Both scales in this questionnaire had a high level of internal consistency in the current sample, BAIS-V, $\alpha = .90$ and BAIS-C, $\alpha = .88$.

#### 2.2.2.6 The Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen et al., 2014)

The Gold-MSI is a self-report questionnaire that assesses individual differences in musical sophistication by measuring musical engagement and behaviour (Appendix D.1). Thirty-one of the items are presented in the form of a 7-point Likert scale, where participants rate their level of agreement with the statement in the questionnaire items from 1 (*Completely disagree*) to 7 (*Completely agree*), for example 'I spend a lot of my free time doing music-related activities.' The next seven questions are delivered in a multiple-choice format and assess musical behaviour using an ordinal measure. An example of that is 'I engaged in regular, daily practice of a musical instrument (including voice) for 0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 or more years.' From the Gold-MSI, an overall musical sophistication score can be formed, but there are an additional five sub-scales presenting scores on the following: active engagement, perceptual abilities, musical training, singing abilities and emotions. Lima et al. (2020) state that the Gold-MSI is a favourable psychometric measure for the assessment of musical sophistication, as the questionnaire has good internal consistency and test-retest reliability. These authors also assert that this applies to the convergent and discriminant validities of the Gold-MSI.

#### 2.2.2.7 The Thought Control Questionnaire (TCQ; Wells & Davies, 1994)

The TCQ assesses the ability to control unwanted thoughts, including the effectiveness of the individual strategies that are often applied to control these thoughts (Appendix D.7). There are 30 items in the questionnaire that are scored on a scale ranging from 1 (*Never*) to 4 (*Almost always*). Within the questionnaire, there are five sub-scales that measure the different types of thought control strategies used for unwanted thoughts. These sub-scales are distraction (TCA-D), worry (TCA-W), punishment (TCA-P), social control (TCA-SC) and re-appraisal (TCA-RA). Wells and Davies (1994) state that the subscales have good internal consistency, ranging from .64 to .79, and the total test-retest reliability score is .83, indicating that this questionnaire is a stable measure. Additionally, this sample had a high level of internal consistency, $\alpha = .81$.

### 2.2.3 Procedure

The participants completed the survey online and it lasted approximately 30 minutes. These individuals were informed that their identities would remain confidential and their data anonymous. The participants could withdraw their data from the study without the need to give a reason from when they consented to taking part, up until one month after they had completed the survey. The survey was advertised from 2nd July 2018 to 26th February 2019.

### 2.2.4 Data analysis

The main analyses were conducted based on the primary research questions focusing on musical imagery and anxiety, whereas the second set of data analyses was exploratory and addressed the secondary aims of the survey - focusing on depression and sleep variables. Before the data were analysed (using IBM SPSS Statistics 25; SPSS), the normality of the data was tested to inform the type of statistical tests that would be used (parametric or non-parametric). As the data were normally distributed, parametric tests were used for most of the analyses. A non-parametric test was used for the only group difference analysis, which involved the presence of anxiety disorders variable, because there was an uneven group size. As the type of data collected was from questionnaires, tests that focus on highlighting relationships between variables were used such as Pearson Product-Moment Correlation tests and multiple regressions (including moderated multiple regression), following the procedures outlined by Field (2009). Bonferroni correction was applied to the p values for the tests relating to the musical imagery variables being correlated with trait anxiety and depression. As five Pearson Product-Moment Correlation tests were conducted for both trait anxiety and depression, the alpha value was .01. Moderated multiple regression analysis was used to test for the moderating effects of TCA on the relationship between musical imagery and anxiety. Trait anxiety and TCA were first mean centred, then these predictor variables (including an interaction variable between both predictor variables) were entered in this order: trait anxiety (mean centered), followed by TCA (mean centered), then trait anxiety x TCA to see if there were any interaction effects (Field, 2009).

## 2.3 Results

### 2.3.1 Descriptive statistics

For the main study variables, the mean trait anxiety score was 48.40 (*SD = 10.64,* range between 20 and 75), the mean INMI-F was 3.61 (*SD* = 1.37, range between 1 and 6), the mean BAIS-V score was 4.52 (*SD* = 1.01, range between 1 and 7) and the mean BAIS-C score was 4.84 (*SD* = 1.05, range between 1 and 7). The descriptive statistics for the survey variables are presented in Table 2.2. Further to this, Table 2.3. shows the correlations between most of the variables included in the survey. Inferential statistics about the data analysed are presented in section 2.3.2 and onwards.

Table 2.2 *Descriptive statistics for the survey variables*

| Survey variable | Minimum | Maximum | M | SD |
|---|---|---|---|---|
| Trait anxiety | 20 | 75 | 48.40 | 10.64 |
| INMI-F | 1 | 6 | 3.61 | 1.37 |
| INMI-H | 0 | 9 | 3.8 | 1.9 |
| INMI-NV | 0 | 33 | 15.1 | 5.77 |
| BAIS-V | 1 | 7 | 4.52 | 1.01 |
| BAIS-C | 1 | 7 | 4.84 | 1.05 |
| Depression | 0 | 50 | 20.6 | 9.64 |
| SQ | 1 | 4 | 2.7 | .75 |
| S-MI | 1 | 9 | 3.5 | 2.52 |
| S-A | 1 | 9 | 4.1 | 2.42 |
| TCA | 38 | 102 | 63.7 | 9.25 |
| TCA-D | 6 | 24 | 14.9 | 3.2 |
| TCA-SC | 3 | 23 | 12.2 | 4.23 |

| | | | | |
|---|---|---|---|---|
| TCA-W | 5 | 22 | 11.2 | 3.53 |
| TCA-P | 5 | 21 | 11.1 | 3.4 |
| TCA-RA | 6 | 24 | 14.4 | 3.5 |

*Note.* INMI-F = INMI frequency; INMI-H = Help; INMI-NV = Negative valence; BAIS-V = Vividness of auditory imagery; BAIS-C = Controllability of auditory imagery; SQ = Sleep quality; S-MI = Musical imagery frequency whilst trying to sleep; S-A = Sleep difficulty due to anxiety; TCA = Thought control ability; TCA-D = Distraction; TCA-SC = Social control; TCA-W = Worry; TCA-P = Punishment; TCA-RA = Re-appraisal.

Table 2.3 *A Pearson Product-Moment coefficient correlation matrix displaying the outcome variables* (*N* = 410 - 421)

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Musical imagery | | | | | | | | | | | | | | | | | | |
| INMI characteristics | | | | | | | | | | | | | | | | | | |
| 1. INMI-F | - | | | | | | | | | | | | | | | | | |
| 2. INMI-NV | **.53**** | - | | | | | | | | | | | | | | | | |
| 3. INMI-M | **.38**** | **.60**** | - | | | | | | | | | | | | | | | |
| 4. INMI-PR | **.51**** | **.75**** | **.67**** | - | | | | | | | | | | | | | | |
| 5. INMI-H | **.33**** | **.59**** | **.80**** | **.65**** | - | | | | | | | | | | | | | |
| 6. BAIS-V | **.20**** | **.17**** | .05 | .11* | .10* | - | | | | | | | | | | | | |
| 7. BAIS-C | **.20**** | **.17**** | .08 | .10* | **.13**** | **.70**** | - | | | | | | | | | | | |
| Mental well-being | | | | | | | | | | | | | | | | | | |
| 8. Trait Anxiety | **.13**** | **.13**** | **.18**** | **.13**** | **.19**** | .01 | -.06 | - | | | | | | | | | | |
| 9. Depression | .11* | .12* | **.13**** | .11* | **.14**** | -.05 | -.12* | **.71**** | - | | | | | | | | | |
| Sleep | | | | | | | | | | | | | | | | | | |
| 10. SQ | -.10* | -.11* | -.12* | -.06 | **-.13**** | -.06 | .02 | **-.34**** | **-.38**** | - | | | | | | | | |
| 11. S-MI | **.22**** | **.25**** | .07 | **.21**** | .12* | **.18**** | .08 | .12* | **.15**** | **-.13**** | - | | | | | | | |
| 12. S-A | .04 | **.14**** | **.14**** | .10* | **.16**** | .09 | -.04 | **.53**** | **.45**** | **-.47**** | **.29**** | - | | | | | | |
| Thought control | | | | | | | | | | | | | | | | | | |
| 13. TCA | .03 | **.11**** | -.01 | .06 | .08 | **.16**** | .09 | .003 | .02 | .06 | **.22**** | .089 | - | | | | | |
| 14. TCA-D | .05 | .01 | -.11* | -.004 | -.06 | .10 | .07 | **-.28**** | **-.19**** | **.13**** | **.17**** | -.08 | **.51**** | - | | | | |
| 15. TCA-SC | -.04 | .003 | .001 | -.024 | -.01 | .01 | .02 | **-.22**** | -.11* | .11* | .08 | -.04 | **.54**** | **.17**** | - | | | |
| 16. TCA-W | -.01 | .07 | .06 | .09 | .10* | .06 | .02 | **.41**** | **.26**** | **-.15**** | **.16**** | **.25**** | **.49**** | -.07 | -.02 | - | | |
| 17. TCA-P | .02 | .10* | .06 | .11* | **.15**** | .07 | -.04 | **.36**** | **.28**** | -.10* | .10* | **.23**** | **.46**** | .01 | **-.15**** | **.40**** | - | |
| 18. TCA-RA | .06 | .11* | -.03 | .02 | .02 | **.20**** | **.16**** | **-.21**** | **-.15**** | **.15**** | .07 | -.11* | **.58**** | **.29**** | **.20**** | -.01 | .03 | - |

** Correlation is significant at the .01 level (2-tailed).

* Correlation is significant at the .05 level (2-tailed).

*Note.* INMI-F = INMI frequency; INMI-NV = Negative valence; INMI-M = Movement; INMI-PR = Personal reflection; INMI-H = Help; BAIS-V = Vividness of auditory imagery; BAIS-C = Controllability of auditory imagery; SQ = Sleep quality; S-MI = Musical imagery frequency whilst trying to sleep; S-A = Sleep difficulty due to anxiety; TCA = Thought control ability; TCA-D = Distraction; TCA-SC = Social control; TCA-W = Worry; TCA-P = Punishment; TCA-RA = Re-appraisal.

## 2.3.2 Musical imagery

### 2.3.2.1 Relationship between musical imagery and anxiety

The primary research question concerned the relationship between trait anxiety and musical imagery experience (measured through INMI-F and BAIS-C). Pearson Product-Moment Correlation analyses showed a significant positive relationship between trait anxiety and INMI-F, *r*(417) = .13, *p* = .01, but no significant relationship between trait anxiety and BAIS-C, *r*(420) = -.06, *p* = .20. There was further interest in potential correlations between trait anxiety and specific characteristics of the INMI experience, including the subjective evaluation (negative valence) of INMI and the beneficial and constructive aspects of INMI (help). Two Pearson Product-Moment Correlations showed that individuals with high trait anxiety evaluated INMI episodes as more negative, *r*(421) = .13, *p* = .01, and more helpful, *r*(421) = .19, *p* < .001.

#### 2.3.2.1.1 Relationship between musical imagery experience and anxiety: Testing the moderating effects of thought control

Two moderated multiple regression analyses were conducted to assess the predicted moderating effects of thought control on the relationship between trait anxiety and musical imagery experience. For the first variable contributing to the musical imagery experience, INMI-F, trait anxiety was a significant predictor of INMI-F, $R^2$ change = .02, *F*(1, 415) = 7.34, *p* = .01, whilst TCA was not a significant predictor, $R^2$ change = .02, *F*(1, 414) = .25, *p* = .62. Following on from that, the trait anxiety x TCA interaction was not significant, $R^2$ change = .004, *F*(1, 413) = 1.75, *p* = .19, indicating that TCA did not moderate the relationship between trait anxiety and INMI-F. For BAIS-C, there were no significant main effect of trait anxiety, $R^2$ change = .004, *F*(1, 418) = 1.65, *p* = .20, or TCA, $R^2$ change = .01, *F*(1, 417) = 3.37, *p* = .07, nor was the trait anxiety x TCA interaction significant, $R^2$ change = .001, *F*(1, 416) = .34, *p* = .56. This indicated that TCA did not moderate the relationship between trait anxiety and BAIS-C, as seen in Table 2.4.

Table 2.4 *Coefficients for the moderated multiple regression analyses examining the effect of TCA on the relationship between musical imagery and anxiety*

| Variable | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| INMI-F | | | | | |
| Trait anxiety | .02 | .01 | .13 | 2.7 | .01 |
| TCA | .004 | .01 | .02 | .032 | .62 |

| | | | | | |
|---|---|---|---|---|---|
| Trait anxiety x TCA | -.001 | .001 | -.07 | -1.32 | .19 |
| BAIS-C | | | | | |
| Trait anxiety | -.01 | .01 | -.06 | -1.3 | .20 |
| TCA | .01 | .01 | .09 | 1.9 | .07 |
| Trait anxiety x TCA | .000 | .001 | .03 | .58 | .56 |

*Note.* INMI-F = INMI frequency; TCA = Thought control ability; BAIS-C = Controllability of auditory imagery.

**2.3.2.1.2 Musical imagery and anxiety disorders**

A Mann Whitney-U test was conducted to test whether individuals with an anxiety disorder (19%) experienced more frequent INMI episodes compared to those who did not report having an anxiety disorder (73%). The analysis showed that there was no significant difference in INMI frequency between individuals with and without an anxiety disorder, $U$ = 137545.5, $p$ = .78.

**2.3.2.1.3 Musical imagery and sleep**

A Pearson Product-Moment Correlation was conducted to assess the hypothesised positive relationship between the frequency of musical imagery whilst trying to sleep and one's experience of anxiety. As predicted, a positive relationship was observed between trait anxiety and the amount of music imagined whilst trying to sleep, $r(420) = .12$, $p = .01$.

**2.3.2.2 Relationship between musical imagery and the controllability of thoughts (TCA)**

Three multiple regression analyses were conducted to model the role of thought control strategies as predictors of various measures of the musical imagery experience (formed of three variables - INMI-F, BAIS-V and BAIS-C), with the thought control strategies being distraction (TCA-D), worry (TCA-W), punishment (TCA-P), social control (TCA-SC) and re-appraisal (TCA-RA). The variables entered into the model included the various thought control strategies; TCA-D, TCA-W, TCA-SC, TCA-P and TCA-RA. Significant regression models were found for the BAIS-V, $F(5, 414) = 4.31$, $p = .001$, $r^2 = .05$, and BAIS-C, $F(5, 413) = 2.46$, $p = .03$, $r^2 = .03$, but there was no significant regression model for INMI-F, $F(5, 410) = .67$, $p = .65$, $r^2 = .01$. Individually, TCA-RA (re-appraisal thought control strategy) significantly predicted variance in BAIS-V ($\beta = .06$, $p$ <.001) and BAIS-C ($\beta = .05$, $p = .003$), as seen in Table 2.5, indicating that the more people use the re-appraisal strategy to control unwanted thoughts, the more vivid and controllable their auditory imagery episodes are.

Table 2.5 *Coefficients for the multiple regression analyses regarding musical imagery experience and the controllability of thoughts*

| Variables | *B* | *SE* | *β* | *t* | *p* |
|---|---|---|---|---|---|
| INMI-F | | | | | |
| TCA-D | .02 | .02 | .04 | .81 | .42 |
| TCA-SC | -.02 | .02 | -.05 | -1.06 | .29 |
| TCA-W | -.004 | .02 | -.01 | -.20 | .85 |
| TCA-P | .003 | .02 | .01 | .16 | .88 |
| TCA-RA | .02 | .02 | .06 | 1.2 | .25 |
| BAIS-C | | | | | |
| TCA-D | .01 | .02 | .04 | .72 | .47 |
| TCA-SC | -.01 | .01 | -.03 | -.52 | .60 |
| TCA-W | .01 | .02 | .04 | .83 | .41 |
| TCA-P | -.02 | .02 | -.06 | -1.12 | .26 |
| TCA-RA | .05 | .02 | .15 | 2.98 | **.003*** |
| BAIS-V | | | | | |
| TCA-D | .02 | 0.2 | .05 | .93 | .36 |
| TCA-SC | -.01 | 0.1 | -.04 | -.70 | .48 |
| TCA-W | 0.1 | 0.2 | .05 | .88 | .38 |
| TCA-P | 0.1 | 0.2 | .04 | .78 | .44 |
| TCA-RA | 0.6 | 0.2 | .20 | 3.85 | **<.001*** |

*Note.* INMI-F = INMI frequency; TCA-D = Distraction; TCA-SC = Social control; TCA-W = Worry; TCA-P = Punishment; TCA-RA = Re-appraisal; BAIS-C = Controllability of auditory imagery; BAIS-V = Vividness of auditory imagery. * $p < .05$

### 2.3.3 Depression

Three Pearson Product-Moment Correlations were carried out to learn more about the relationship between depression and the musical imagery experience. The variables included in the analyses were depression, INMI-F, the BAIS-V and BAIS-C. An increase in the symptoms of depression was correlated with poorer control over auditory imagery, *r*(420)

= -.12, *p* = .01, but there was no significant relationship between depression and BAIS-V, *r*(421) = -.05, *p* = .31, or depression and the frequency of INMI, *r*(417) = .11, *p* = .03. More Pearson Product-Moment Correlation analyses were also conducted to see if depression shared any associations with the help and negative valence characteristics of INMI. The analyses showed that high levels of depression positively correlated with INMI episodes being deemed as more helpful, *r*(421) = .14, *p* = .003, but not more negative, *r*(421) = .12, *p* = .02.

## 2.4 Discussion

As predicted, those reporting higher levels of trait anxiety also reported more frequent experiences of INMI. Although, the findings in the survey did not confirm the hypothesis of high trait anxiety being associated with poorer auditory imagery control, as people with higher levels of trait anxiety did not have poorer control over their auditory imagery. The overall measure of thought control ability significantly explained variance in the vividness and controllability of auditory imagery, but the only thought control strategy to independently predict both variables was re-appraisal. Also, thought control ability did not moderate the relationship between anxiety and musical imagery experience. For the variables relating to the secondary interest in this survey, as predicted, those reporting more symptoms of depression experienced more frequent INMI and had poorer control over their auditory imagery, and high trait anxiety was seen to positively correlate with the frequency of musical imagery whilst trying to sleep.

### 2.4.1 Anxiety and depression: The relationship with musical imagery

This survey showed how highly anxious individuals experience more frequent INMI episodes and how these experiences (in this sample) are more negatively valenced, which is similar to the findings from Homer and Deeprose's (2017) study. In line with the objectives of the survey in this chapter, these researchers aimed to provide a clearer understanding of both voluntary and involuntary mental imagery experiences in anxiety. Two of the main findings from that study, that are relevant here, showed how social anxiety was positively related to the frequency of intrusive imagery, and how these intrusive images are often more negative. In 77.8% of the intrusive imagery episodes, individuals in that study reported auditory imagery - which was the second highest mode of imagery after visual imagery (92.6%). It is important to note that intrusive imagery is used interchangeably with involuntary imagery in the literature, evident in Homer and Deeprose's study. Additionally, Hyman et al. (2015)

have shown how intrusiveness is an important characteristic in INMI, being that the more the music in INMI is seen as intrusive, the less individuals like a song and the more the song would loop itself whilst being repeated.

The higher frequency of INMI, as well as the negative valence of this experience, being associated with high trait anxiety can be explained through the link between INMI being a form of an intrusive thought (Hyman et al., 2015), and the way in which people with high trait anxiety perceive this experience. Intrusive thoughts are a common characteristic of anxiety (Wells & Davies, 1994) that are negative and so it could be that there is a the link between INMI frequency and its experience being perceived as more negative by those who have higher levels of trait anxiety, such that in some ways, these INMI experiences resemble intrusive thoughts. Homer and Deeprose (2017) suggested that involuntary imagery in social anxiety is negative as these images are often self-images. However, as discussed earlier, there are imagery differences present in the type of anxiety people have (Morrison et al., 2011; Schneider et al., 2018) and because this survey did not focus solely on social anxiety, the concept of self-images cannot be used to account for why INMI experience was reported to be more negative. Instead, the negative valence of the INMI can be seen as a reflection of the experienced intrusiveness of the experience for those with higher trait anxiety.

Further to this, the results from this survey suggest a beneficial role for VMI. If the negative evaluation of INMI is a consequence of this type of imagery being unwanted, VMI may be used to change the experience of musical imagery so that it is more desirable. VMI might be able to alter the valence of the imagery experience, as the intrusiveness aspect of imagining music would be eliminated (as VMI involves the deliberate imagination of music, as opposed to involuntary). Also, unlike INMI, VMI allows individuals to imagine self-selected music (which is often preferred) and research has shown how preferred music has a more positive effect on mood than non-preferred (Lesiuk, 2010).

It was anticipated that higher trait anxiety would be associated with higher levels of difficulty in controlling auditory imagery, as evidence has shown how INMI is a representation of unwanted thoughts (Hyman et al., 2015), an important aspect of anxiety. However, finding that people with high trait anxiety do not have poor control over their deliberate auditory imagery is advantageous for the rest of the thesis, as it does not imply that anxious individuals (the target population for the proposed VMI intervention) would have a hard time controlling this type of mental activity. In order to successfully voluntarily imagine music, one must be able to control their mental imagery. This survey suggests that even those with higher levels of trait anxiety are able to control their auditory imagery (contrary to the predicted hypothesis), thus functioning as a good foundation for the introduction of a VMI intervention for anxiety.

Moving on from the relationship between anxiety and musical imagery, there was also an interest in investigating associations between depression and musical imagery, as the experience of depression and anxiety simultaneously is a common comorbidity (Carek et al., 2011; Ibbotson et al., 1994; Martinsen, 2008). There was no significant positive relationship found between depression and INMI frequency, indicating that individuals who are more depressed do not appear to experience INMI more frequently. These findings contradict other studies that have looked at the frequency of mental imagery in depression (Bjärehed et al., 2010; Patel et al., 2007; Stöber, 2000). Additionally, depressed individuals are known to experience more negative mental imagery (Weßlau et al., 2015) and less positive imagery (Bjärehed et al., 2010; Stöber, 2000), which could be due to depression being characterised by a negative interpretation bias of cognitive information (Richards, 2004; Richards & French, 1992). However, the survey did not provide evidence in support of this relationship. It might be that the negative interpretation of mental imagery only applies to specific modes of imagery.

The findings related to INMI being perceived as more negative by individuals with high trait anxiety are consistent with what has been previously found in studies looking at relationships between mind wandering, thought control ability and negative emotions. Firstly, more severe cases of anxiety have been linked to frequent occurrences of unintentional mind wandering (Figueiredo et al., 2020; Seli et al., 2019). In addition to this, using resting-state functional magnetic resonance imaging (fMRI) and questionnaires relating to mind wandering, thought control ability and emotions, He et al. (2019) demonstrated how people who experience frequent mind wandering are more likely to have difficulty in controlling unwanted thoughts. These researchers also showed that more cases of mind wandering are associated with a greater presence of negative emotions. With INMI being associated with unintentional mind wandering (Williamson et al., 2012), and with this survey showing how participants with high trait anxiety experience more frequent INMI episodes and perceive this imagery as more negative[1], it is in line with He et al. (2019), showing how mind wandering is linked to negative emotions. He et al. (2019) suggest that these negative emotions experienced whilst mind wandering are a result of individuals who have problems controlling their unwanted thoughts being unable to inhibit these thoughts that occur during mind wandering. Finally, despite this relationship between trait anxiety and the negative valence of INMI, INMI was

[1] See Table 2.3.

also seen as helpful - suggesting that INMI can help individuals with high trait anxiety focus on other tasks. In relation to the VMI intervention being tested in this thesis, this is beneficial as the VMI intervention was presented on the premise that deliberately imagining music can allow individuals to distract themselves away from negative thoughts that maintain their anxiety, by focusing on the music being imagined instead. Moreover, previous findings have shown how people have different reactions in response to INMI (Beaman & Williams, 2010; Williamson et al., 2014). Williamson et al. (2014) identified how people tend to either distract themselves from their INMI or engage with the INMI, which suggests that some people will either see INMI as an unpleasant experience, whilst others might deem it as pleasant. This difference in the perception of INMI could explain why participants with high trait anxiety perceived INMI as both negative, yet helpful at the same time, whilst people with more depressive symptoms only saw INMI as helpful.

### 2.4.2 Individual differences in musical imagery experience

The ability to control unwanted thoughts explained significant variance in the vividness and controllability of auditory imagery. The overlap in the use of working memory in the control of unwanted thoughts and auditory imagery may account for this finding. Working memory has been shown to be utilised when individuals attempt to control their intrusive thoughts (Brewin & Smart, 2005), and working memory is also a necessary component involved in the increased vividness of auditory imagery (Baddeley & Andrade, 2000). This is also the same for the controllability of auditory imagery (Bailes et al., 2012). As re-appraisal was the only individual thought control strategy to have a significant positive relationship with the vividness and controllability of auditory imagery, this finding suggests that the more individuals use the re-appraisal strategy to control thoughts, the increase in the likelihood of their auditory imagery being more vivid and controllable. The relationship re-appraisal shares with imagery ability can account for this association. Moran (1993) states that imagery ability consists of the controllability and vividness of mental imagery, as well as the accuracy of imagery compared to its analogous counterpart. Anuar et al. (2017) investigated the relationship between emotion regulation (consisting of using the re-appraisal or suppression strategies) and imagery ability in sports through questionnaire data. These researchers demonstrated that people who use the re-appraisal strategy more frequently are more likely to display higher levels of imagery ability. Similar principles may pertain to the present study. Hayes et al. (2010) previously suggested that re-appraisal has the ability to boost memory function and with memory being one of the fundamental elements in mental imagery, especially musical imagery (Kalakoski, 2001; Logie & Edworthy, 1986), this implies that using this re-appraisal strategy can contribute towards ensuring that individuals can have vivid and controllable mental imagery episodes, as there is a strong working memory basis.

### 2.4.3 Does thought control ability moderate the relationship between anxiety and musical imagery experience?

It was predicted that thought control ability would significantly moderate the relationship between trait anxiety and the frequency of INMI, as well as trait anxiety and the controllability of auditory imagery. However, the results obtained indicated that thought control ability was not a significant moderating variable for either of those relationships. As mentioned previously, the hypothesis for this prediction was based on the notion that these variables share similarities in their experiences of control, as trait anxiety is characterised by a lack of control over unwanted thoughts (Wells & Davies, 1994), INMI involves individuals being unable to control the initiation of musical imagery (Cotter, 2019), and the controllability of auditory imagery solely focuses on how well an individual can control this activity. The lack of significance regarding the moderating effect of thought control ability in this present study could be explained by the way unwanted thoughts are operationalised in the thought control ability measure. The TCQ assesses the control of thoughts in relation to unpleasant and unwanted verbal thoughts. Therefore, it could be that significant moderating effects might only be present for cognitive activity that is verbal. Additionally, as thought control did not predict variance in the reported frequency of INMI episodes, this could have reduced the chances of thought control ability being likely to moderate the relationship between trait anxiety and INMI.

### 2.4.4 Musical imagery and anxiety disorders

The initial findings in this study demonstrated that individuals with high trait anxiety reported more frequent INMI episodes. Therefore, further analyses looking at potential differences in musical imagery experience based on whether people have an anxiety disorder were conducted, as previous studies have already shown that some anxiety disorders are related to high levels of trait anxiety (Chambers et al., 2004; Hirsch et al., 2013). The Mann Whitney-U test showed no significant difference between people with and without an anxiety disorder, and the frequency of INMI they report. There are several possible reasons that can be offered to explain this result.

Firstly, 82.7% of the sample did not have any anxiety disorder, whereas only 17.3% reported having an anxiety disorder. This imbalance between the two groups might have made it harder for a significant difference to be detected in the groups' experience of INMI frequency, due to the majority of the sample not having an anxiety disorder. In addition, for the participants who did have an anxiety disorder, a variety of anxiety disorders were reported. Previous studies have provided evidence in support of high trait anxiety being positively related to the presence of an anxiety disorder, but these studies have mainly done so for GAD (Chambers et al., 2004; Hirsch et al., 2013). As there was a mixture of anxiety disorders reported by participants in the survey sample, for example GAD (6.6%), Panic Disorder (1.7%) and SAD (2.8%), this might have made it more difficult for a significant difference in INMI frequency to be established between people with and without anxiety disorders. This is due to the fact that only some of the anxiety disorders share similarities with high trait anxiety and are thus not related to high levels of trait anxiety. Some participants also presented with more than one disorder, such as SAD and GAD (1.1%) and SAD, GAD, and phobia (.2%). There could be potential for some disorders to be more intense than others in instances of these co-occurrences, and so it might cancel out the effect of disorders that are related to high levels of trait anxiety. In relation to the thesis overall, this lack of significance suggests that participant recruitment for the studies which will investigate the effect of VMI on anxiety reduction does not have to be limited to participants who experience clinical levels of anxiety.

### 2.4.5 Musical imagery and sleep

A positive association was established between trait anxiety and the amount of music imagined whilst trying to sleep, suggesting that individuals who are more anxious imagine more music whilst trying to sleep, compared to those who experience less or do not have any anxiety. Acknowledgement of how there is a circular interaction between these variables may account for the findings. Imagining music whilst trying to sleep would reduce one's sleep quality. As poor sleep quality is linked to high levels of anxiety (Gray & Lemke, 2017; Norbury & Evans, 2019), the effect that imagining music whilst trying to sleep would have on sleep quality might in turn increase one's anxiety. Also, this study has already shown how higher levels of anxiety are related to more frequent episodes of INMI. Therefore, being anxious could be triggering the frequent musical imagery episodes whilst trying to sleep, which would reduce one's sleep quality and thus increase one's anxiety.

### 2.4.6 Implications of the findings

The main implication arising from the relationships established in this survey relates to the experience of musical imagery in individuals with trait anxiety. People with high trait anxiety being more likely to experience spontaneous episodes of musical imagery implies that these individuals have a natural tendency to imagine music. In addition, the findings also demonstrated how these individuals do not find it difficult to control deliberate auditory imagery, implying that it is unlikely for people with anxiety to experience difficulty in controlling musical imagery. This is particularly relevant for the VMI intervention method, as it indicates that people who suffer from anxiety might not find it hard to deliberately imagine music.

### 2.4.7 Limitations

As this study made use of a correlational design, using questionnaires, it limits the conclusions that can be drawn from the data. The findings cannot infer causality between the variables studied, but only demonstrate associations established between them. In some ways, this could be viewed as a limitation, on the grounds that there is no evidence of cause and effect regarding the impact one variable might have on another. Yet, it is important to note that not only was this one of the most optimal ways to answer the research questions, the findings obtained from this study are, to the researcher's knowledge, the first to provide evidence of specific associations between musical imagery and anxiety. Another limitation of this survey could relate to the methodology, being that most of the questionnaires included in the survey made use of closed questions. Closed questions are restrictive, in that they do not allow for the participant to respond in detail. For future studies, it could be suggested for additional open questions to be used in combination with closed questions, in order to collect more information about the variables investigated. For instance, participants could expand on their musical imagery experience by focusing on details such as how the imagery makes them feel, specific elements that are of central focus during musical imagery episodes, or whether the musical imagery they experience whilst trying to sleep is wanted.

### 2.4.8 Conclusion

In conclusion, this study addressed the central research question by finding associations between musical imagery experience and anxiety that have not yet been previously studied, namely that higher levels of anxiety were found to be associated with more frequent INMI. The study also delved further into potential moderating effects of thought control ability on this relationship, as well as individual differences in musical imagery experience based on thought control and the presence of an anxiety disorder. There was no evidence of moderating effects of thought control on the correlation between musical imagery and anxiety, no significant difference in musical imagery experience between those who do and do not have anxiety disorders, but thought control was able to predict variance in the controllability and vividness of the auditory imagery experience. Secondary research questions concerned depression, as the survey sought to find out whether depression would significantly correlate with musical imagery experience, due to the frequent comorbidity of anxiety and depression. The findings demonstrated that the more depressed an individual is, the poorer their ability to control auditory imagery. Those with naturally higher levels of trait anxiety appear to suffer from more negative INMI. However, findings from this survey show that as individuals with high levels of anxiety are not finding it difficult to deliberately imagine forms of auditory imagery, it could suggest that these individuals could successfully imagine music in a deliberate manner. The relationships presented in this chapter shed light on individual differences in the musical imagery experience relating to both anxiety and depression. Now that the relationship between musical imagery and anxiety has been examined, it is worthwhile to consider the reasons why VMI may be an effective intervention method for anxiety, which is explored in the next chapter.

# Chapter 3
# Potential of Voluntary Musical Imagery as an Intervention for Anxiety

Building on the evidence presented in the preceding chapter showing that anxiety is associated with musical imagery in a sample from the general population, the purpose of this chapter is to present the reasoning behind the potential effectiveness of VMI as an intervention to reduce anxiety. The characteristics of VMI that may potentially target the cognitive and affective mechanisms involved in the development and maintenance of anxiety are discussed. These attributes focus on the dynamic nature and emotional significance of VMI, the use of self-control in VMI, the structure of VMI, and how VMI can impact the focus mechanism in anxiety. Comparisons between VMI and other modes of imagery are also made, highlighting similarities and differences between these types of imagery with respect to anxiety reduction.

## 3.1 Characteristics of voluntary musical imagery

VMI involves consciously playing music in the mind. There are several properties characterising this experience that relate to why this method might be an effective intervention for anxiety. Firstly, voluntarily imagining music involves an individual using attentional resources and intentional effort to control the initiation and continuation of the deliberate imagination of music (Cotter, 2019). Also, as listening to music is a dynamic phenomenon, it is not surprising that musical imagery is too (Halpern, 2012), with suggestions that there is a preservation of time-sensitive elements, that are often found in music, in musical imagery (Halpern & Zatorre, 1999). As people imagine their way through a piece of music, they might imagine different dynamic properties. Gelding et al. (2015) developed the Pitch Imagery Arrow Task (PIAT) to train individuals to imagine pitches, and this study demonstrated how imagining the pitch contour is preserved in the musical imagery experience. Additionally, individuals can imagine changes in loudness in musical imagery (Bishop et al., 2013) and tempo (Jakubowski et al., 2016), which can contribute to the dynamicity of musical imagery. Tempo preservation in musical imagery has been evidenced when participants are required to tap along to the beat of their musical imagery episodes (Jakubowski et al., 2016). Furthermore, it has also been shown that there are variations in the structure of musical imagery between individuals, in the extent to which music is imagined in a repetitive loop (Huovinen & Tuuri, 2019). Structural variation also extends to the musical features that are imagined. There could be cases where people imagine every musical element including all of the instrumental features and vocals (Bailes, 2007), if applicable, whereas others might isolate specific musical features, focusing on imagining those components only. A substantial number of these characteristics can be considered in relation to how they can target the cognitive and affective mechanisms that account for the development of anxiety.

## 3.2 Voluntary musical imagery and cognitive mechanisms

### 3.2.1 Focus and attention

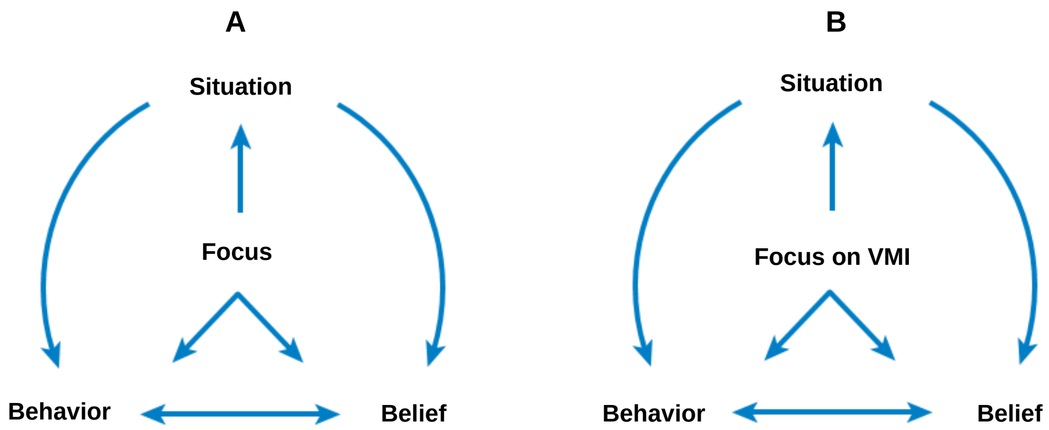
In the Dual Component Model of mental control in musical imagery, Cotter (2019) identified a fundamental difference between VMI and INMI concerning the generation of the imagery. VMI requires individuals to deliberately initiate musical imagery episodes, whereas the initiation of INMI occurs spontaneously. The GCM (Beck & Haigh, 2014) specifies that there are four interacting mechanisms involved in the development and maintenance of anxiety, which are maladaptive behaviour, situation, biased beliefs, and focus (see Chapter One, p. 7). As Beck and Haigh (2014) suggested that the GCM can be utilised when developing an anxiety intervention, designing such intervention with the intention of targeting at least one of the four contributing mechanisms can increase the likelihood of anxiety being reduced. One of these targeted components relevant to the proposed intervention method in this thesis is the focus mechanism.

Deliberately imagining music may target the focus component in the GCM, due to this activity requiring people to take control and focus their minds on initiating and maintaining their musical imagery. Zatorre et al. (2010) presented evidence of the intentional manipulation of musical imagery. In this study, participants either listened to the first couple of notes of a piece of music they were familiar with or were given the name of the song. In both instances, the participants were played a selection of reversed notes of the songs that were either in the correct or incorrect reversal position. As they were instructed to decide which sequence of notes was the exact reversal by imagining this sequence, this method shows that individuals have the ability to deliberately change the structure of their musical imagery episodes. Huovinen and Tuuri (2019) also demonstrated how the variance in the structure of musical images between individuals can include the intentional repeated imagination of one part of a piece of music. In both cases outlined, the focus mechanism is particularly relevant in achieving these specific musical imagery structures. For instance, if someone was to repeatedly imagine a specific section of music in a voluntary manner, they would have to focus on selecting the parts of music they wish to imagine.

The volitional nature of VMI also sheds light on the self-control aspect involved in the purposeful imagination of music, which is important in decreasing anxiety. This self-control relates specifically to the voluntary control involved in the maintenance of musical imagery. There are reports of poorer self-control being associated with higher levels of anxiety (Powers et al., 2020) and this could be a reflection of the dysfunctional thought processing that occurs in anxiety (Beck & Haigh, 2014), or that anxiety leads to increased distraction. This increased distraction in anxiety has been demonstrated in studies where individuals with high trait anxiety have poorer performances on tasks that require attention (Eysenck & Byrne, 1992; Kalanthroff et al., 2016). Thus, the idea of individuals learning to use self-control to initiate and keep their deliberate musical imagery in their minds may promote a sense of autonomy over their mental activity and increase their self-efficacy. Moreover, imagining familiar and liked music may well be a relatively achievable objective. This highlights the potential usefulness of VMI as an intervention for anxiety because individuals are engaging in a potentially enjoyable activity that requires their control.

When considering how the effect of VMI on focus and attention might impact the remaining three mechanisms that the GCM suggests are involved in anxiety, focusing one's attention on the musical imagery can allow an individual to dissociate from their current situation. VMI requires attention, allowing for the generation and maintenance of musical imagery in the mind, ensuring that people can concentrate on going from note to note in their musical imagery (Dalagna et al., 2013). For anxiety, however, problems with attention characterise maladaptive anxiety experiences. Figure 3.1 provides a visual depiction of how VMI could reduce anxiety, in relation to the GCM. When presented with anxiety-triggering stimuli, deliberately imagining music could have the capacity to direct an individual's focus towards the proposed intervention activity. This newly directed focus could lead to attention being diverted away from the stimuli that might be triggering anxiety. This is due to the mind focusing on processing the VMI, rather than interpreting the anxiety stimuli. The impact of this change in focal point could weaken the chances of anxiety-related schema being activated, that tend to result in negative biases in information processing and consequently biased beliefs. Therefore, beliefs that are held in that schema that are associated with anxiety are less likely to affect the processing of VMI. With VMI, as there is no evidence to suggest that this activity is a negative experience for people with anxiety, schemas related to VMI are less likely to result in biased beliefs, and thus provide little opportunity for dysfunctional information processing to occur. As a consequence, individuals might be less likely to engage in maladaptive behaviours as a coping mechanism for anxiety (as there could be less anxiety to deal with). The sustained attention that would be required to continue imagining the dynamic musical imagery would further reduce the likelihood of biased beliefs having an impact on information processing. This continued deployment of attention to the musical imagery would subsequently lead to individuals being able to dissociate from their current situation. Additionally, the reduced focus on anxiety stimuli, and consequently fewer negative biases in information processing, can interact with the affective system, as it is less likely for the anxiety schemas to trigger a negative emotional response that is associated with the anxiety schema. A reduction in anxiety might thus occur because voluntarily imagining music would work by intervening in the process of anxiety induction.

Figure 3.1 *Adapted GCM figure for VMI intervention*




*Note*. Adapted GCM figure from Beck & Haigh (2014, p. 14) to show how VMI might impact the development and maintenance of anxiety.

### 3.2.1.1 Attentional bias

To expand further on the concept of attention, bias in where attention is directed to in the experience of anxiety has been frequently explored. In anxiety, attentional bias involves the tendency for anxious individuals to attend to threatening compared to neutral stimuli (Lichtenstein-Vidne et al., 2017). Examples of investigations into attentional bias in anxiety include a study by Derryberry and Reed (2002), who looked at the function of self-reported attentional control in the regulation of attentional biases, in regard to different types of trait anxiety. Participants were presented with detection targets that were either classed as threatening or safe, and their reaction times in response to attending to these targets were recorded. Individuals with high trait anxiety were found to respond to the threatening stimuli at a quicker rate, compared to the safe stimuli. Attentional control ability also moderated this finding, as people with high trait anxiety and poor attentional control were more inclined to attend to the threatening targets. The findings here demonstrate that not only is attentional bias in attending to threatening stimuli evident in people with more severe cases of anxiety, but if people can engage in voluntary attentional control properly, this engagement might reduce the effect that threatening stimuli have on anxiety. Further to this, selectively attending to threatening stimuli can affect one's thought pattern, emotions experienced and the type of behaviour that is displayed. Therefore, intervention methods that are capable of eliminating these attentional biases can reduce anxiety, as seen in a meta-analytic study by Bar-Haim et al. (2007), who found that attentional bias is present in a range of anxiety populations, including paediatric anxiety, people with anxiety disorders and sub-clinical anxiety, but not in non-anxious individuals.

The importance of reducing attentional bias in the experience of anxiety has been demonstrated through the development of interventions that aim to alter this attentional bias - a prime example being attention bias modification treatments (ABMTs). The therapeutic goal of ABMTs is to address this selective bias in attention by training people to gradually shift their attention away from threatening stimuli and towards less threatening or more neutral stimuli (Hakamata et al., 2010). The effectiveness of ABMTs in anxiety has been presented in several studies, that provide clear demonstrations of how retraining one's attentional focus can lead to a reduction in anxiety (Cai et al., 2018; Hakamata et al., 2010; Heeren et al., 2012). Those studies used a common attention retraining task, the dot-probe task, which was initially developed by Macleod et al. (1986). This task involves the brief presentation of two stimuli on a screen - one that is emotionally salient and one that is neutral. Once the neutral stimuli disappear from the screen, they are replaced by a probe and the participant is required to respond to that specific type of stimulus only (thus ignoring the emotionally salient stimuli that are often negative), and this is repeated over several trials. This would allow the participant to shift their focus towards the neutral stimuli throughout the duration of this task, leading to the retraining of their attentional focus. The success of this method is acknowledged by its inclusion in CBT, where researchers have investigated whether the combination of existing interventions and attention bias modification can increase the likelihood of reducing the severity of anxiety in anxiety disorders (White et al., 2017). Retraining towards positive stimuli is also an option that was explored by Sass et al. (2017), who used a dot-probe task, where probes were always replaced by positive words in the attention-training conditions and positive words only replaced probes 50% of the time in the control condition. The findings showed that training towards positive stimuli can lead to reductions in anxious arousal and worry.

The alleviation of anxiety using VMI, in relation to attentional bias, might work in a similar way to attention retraining activities such as the dot-probe task. The main similarity between the ABMTs and VMI is that by advising individuals to deliberately imagine music whenever they are presented with threatening stimuli that are associated with their anxiety, they would learn to focus their attention on the musical imagery they are maintaining. This musical imagery might be less threatening and potentially more positive. The focus on this positive musical imagery can retrain their attentional focus away from threatening stimuli, which can result in the individual being distracted away from the problematic factors maintaining the anxiety, and thus reduce the associated symptoms. Therefore, anxious individuals would observe the positive effects of VMI and if this method was to be used frequently, it would be likely for people to associate the desired outcome (reduction in anxiety) with the activity (VMI). Furthermore, as Derryberry and Reed (2002) suggested that engaging in voluntary attentional control might reduce the effect that threatening stimuli have on anxiety, voluntarily imagining music also serves this mechanism.

However, there are some instances where attentional bias is not present in anxiety. For example, a lack of attentional bias for threatening stimuli has been found for individuals with GAD, but not for social phobia (Becker et al., 2001). But there are several reasons to account for the findings that demonstrate this. These can first be discussed in relation to research methodology. As mentioned above, the dot-probe task has been commonly applied in attentional bias studies, but alternative paradigms have been used too. In addition to the dot-probe task, Chew et al. (2014) used the emotional Stroop task, where individuals with high and low statistics anxiety had to press keys on a keyboard that represented the colours of threatening or neutral words they were presented with, while having their reaction times recorded. However, there was no evidence of attentional bias in either of these tasks. This finding was similar to the results obtained in a study by Kadosh et al. (2018), who used eye-tracking techniques to assess attentional bias in sub-clinical anxiety. Participants were presented with a face target surrounded by two lines and were instructed to point out which of those lines was horizontal, but again, there was no evidence of attentional bias in this study. Even though the dot-probe task, the emotional Stroop task and the eye-tracking techniques share a commonality, being that the main aim is to measure where one’s attention is directed, the type of attention being assessed in each activity is not the same.

For example, the dot-probe task targets spatial and temporal aspects of attention, whereas the emotional Stroop approach mainly focuses on temporal elements. Additionally, what is operationalised as attentional bias varies in each study, in terms of reaction time. Some researchers state that attentional bias is present at eight milliseconds (Eldar et al., 2012), whereas others suggest that an attentional bias is shown if the mean of a group score is significantly different from zero (O'Toole & Dennis, 2012). Not only can these methodological discrepancies account for the lack of attentional bias in some cases of anxiety, but the type of anxiety being investigated is also a factor to take into consideration.

Most of the studies examined in this field look at a variety of anxiety experiences, ranging from sub-clinical levels, including low and high levels of trait anxiety (Calvo & Avero, 2005), to clinical anxiety disorders (Chew et al., 2014). The magnitude of anxiety differs across these experiences, so this aspect could affect whether attentional bias is present. For example, Waters et al. (2008) previously showed how the greater the severity of an anxiety disorder, the more likely it is for someone to have an attentional bias to threat. This severity of anxiety explaining the lack of attentional bias in anxiety in some studies emphasises the idea that even though VMI could work to reduce anxiety by retraining one's attentional focus over time, this might only be applicable for a subset of anxiety sufferers. It is also important to mention that VMI might be more effective in scenarios that involve immediate temporary distraction away from threatening stimuli. The fact that attentional bias differs in anxiety, depending on the magnitude of the problem, could impact the potential effectiveness of VMI for anxiety reduction. Thus, it would be worthwhile to test the intervention method on people with varying levels of anxiety to see for whom it would be most effective. But even if VMI is not sufficient to modify attentional bias, this method may still serve as a strong enough form of momentary distraction to reduce experienced anxiety.

### 3.2.2 Working memory

Following on from the impact of VMI on focus and attention in anxiety, working memory is another cognitive mechanism of relevance to VMI as an intervention. Working memory is a limited resource system that stores information on a temporary basis (Baddeley, 2003). Negative thoughts, a characteristic of anxiety (Paloș & Vîșcu, 2014; Rood et al., 2010), uses working memory as these thoughts can be manifested as inner speech and the phonological loop is required in this thought process (Buchsbaum, 2013). This type of thought style has been shown to reduce the capacity of working memory, as demonstrated by Hayes et al. (2008), who investigated the impact of worry (including negative thoughts) on working memory capacity (in low and high worriers) compared to non-worrisome thoughts. These researchers used a random key-pressing task, where participants were instructed to think about a worry topic or positive topic and press a random key whenever they heard a bleep probe. As high worriers displayed fewer key presses in the worry condition, it was suggested that these individuals had less working memory capacity whenever they engaged in negative thoughts, compared to positive thoughts. In relation to anxiety, the findings from the study illustrated the importance of working memory. As negative thoughts were classed as a form a worry in this study, and high worriers performed poorly on a task that required working memory, the findings support the idea that negative thoughts contribute towards the limited working memory capacity in anxiety.

VMI uses both long-term memory and working memory, but working memory is of vital importance as the phonological loop is activated during this activity (Kalakoski, 2001). Support for this claim can be found in the form of studies that investigate whether the processing of musical imagery can be affected when individuals are prompted to engage in an alternative activity that would also require the use of the phonological loop. An example of such is an early study by Logie and Edworthy (1986), that demonstrated how individuals could not deliberately imagine auditory pieces of information (that were musical), whilst simultaneously engaging in a homophone judgment task - a task that uses the phonological loop component of the working memory. Brodsky et al. (2003) also provided evidence in support of this claim, as they found that phonatory interference can impact notational audiation (i.e., converting a visual musical score into a musical image) in musicians.

There is a clear overlap in the components of the working memory that are common for negative thinking in anxiety and deliberately imagining music, as both activities occupy the phonological loop (Baddeley & Hitch, 1974; Kalakoski, 2001). With this overlap in the requirement of the phonological loop, as well as the limited capacity that characterises working memory, it would prove difficult for these activities to occur at the same time. Thus, this indicates that if an individual engages in VMI, the deliberate imagination of the music might be able to either limit the chances of negative thinking occurring or reduce the negative thought activity that might already be present. This can be explained by the idea that if VMI was used in a pre-emptive manner, the phonological loop would already be activated by the musical imagery and would mostly be used for this activity. Alternatively, if VMI was used once someone had begun to experience anxiety, the need for the phonological loop (in addition to other cognitive mechanisms that would be impacted by VMI such as where individuals focus their attention), could reduce the presence of negative thoughts, due to the limited capacity of working memory. A lack of attention being paid towards these stimuli (due to VMI occupying the phonological loop) would result in a decreased likelihood of anxiety schemas being activated. Inactivation of these schemas means that individuals would not have to use maladaptive behaviours as a coping mechanism for the anxiety, as there is a reduced chance for the occurrence of anxiety. Consequently, this could initiate the start of the process by which VMI would reduce anxiety, by indirectly targeting the main elements of the anxiety experience - focus, biased beliefs, maladaptive behaviour, and situation (see Figure 3.1). Therefore, working memory is relevant in understanding the nature of VMI for anxiety reduction, not just because of the substantial attention that is required for the memory of the musical imagery, but also because of the potential for VMI to limit the impact of negative thinking on inner speech.

As mentioned in Chapter One, considering anxiety from multiple perspectives not only contributes to an improved understanding of the experience, but also provides more factors to target when developing intervention methods for anxiety. Even though VMI is suggested as a potential intervention predominantly based on how this activity might be able to target the various cognitive mechanisms involved in the development and maintenance of anxiety, VMI also incorporates multiple perspectives. Affective mechanisms have the potential to play an important role in the reasoning behind the proposed effectiveness of anxiety. This relates to how musical features that are preserved in musical imagery may impact anxiety in similar ways to listening to music, and how musical imagery may serve to regulate emotions.

## 3.3 Voluntary musical imagery and emotion regulation

Anxious individuals are known to experience problems with regulating their emotions during anxiety-triggering events (Loevass et al., 2018; McLaughlin et al., 2011). For example, Mennin et al. (2004) offered an emotion dysregulation model for GAD, proposing that individuals with GAD often experience emotions more rapidly, easily, and intensely, which in turn makes it harder for these emotions to be regulated in an appropriate manner. This leads to difficulty in recognising and understanding the negative emotions (Cisler et al., 2010), due to the lack of regulation of these emotions. Despite this model only explaining emotion dysregulation in GAD, similarities in the irregularities by which people process and experience emotions are found in other forms of anxiety too. For instance, people with SAD have problems with emotion regulation strategies, namely that these strategies are used ineffectively (Jazaieri et al., 2014; Kivity & Huppert, 2018). In addition to this, panic disorder has been associated with emotion regulation difficulties, resulting in a decrease in emotional clarity (Tull & Roemer, 2007). Another dimension of problematic emotion regulation relates to suppression (Campbell-Sills et al., 2006; Dryman & Heimberg, 2018; Levitt et al., 2004), which is argued to maintain the symptoms of anxiety (Amstadter, 2008). This is due to negative emotions still being experienced (Gross & Levenson, 1997), as the suppression strategy deals with emotions by limiting the expression of emotions. Other emotion regulation strategies can be deemed as more helpful, like cognitive re-appraisal, as this strategy involves the reinterpretation of anxiety situations to diminish the emotional distress experienced in anxiety (Gross & John, 2003), rather than limit the expression of emotions.

With the difficulties anxious individuals experience in regulating their emotions, there are interventions that incorporate methods to specifically target this problem such as Emotion Regulation Therapy (ERT). This treatment method works by allowing individuals to improve the capability of managing their emotions and how they react to emotionally triggering situations, by promoting the use of favourable emotion regulation strategies that are linked to reduced anxiety (O'Toole et al., 2019), like cognitive re-appraisal (Mennin et al., 2018). This method has been used for various types of anxiety, with Mennin et al. (2015) showing that weekly ERT sessions can reduce symptom severity in GAD, and Behrouian et al. (2020) using training in emotional regulation, including encouraging the use of the cognitive re-appraisal of negative emotions, to reduce sub-clinical experiences of anxiety. Thus, it is worth considering the potential of VMI to regulate emotions for anxiety reduction. Firstly, Holmes and Mathews (2010) have suggested that mental imagery has the capacity to alter emotional states through overlaps in the neural areas activated during the processing of mental imagery and perceived stimuli. The Bio-informational Theory of Emotional Imagery (Lang, 1979) also states that the emotional significance of mental imagery derives from mental imagery using similar emotional information-processing systems to the perceptual counterpart. Specifically, this theory highlights how mental imagery has the capacity to activate emotional response systems involved in information processing in the same way that external stimuli can. Therefore, changes in the emotion people experience during VMI episodes might be possible due to individuals showing emotional responses to musical imagery, in the same way that they would react when listening to music.

When people deliberately imagine familiar pieces of music (that they know can lead to the experience of positive emotions), the absence of emotional distress (that is caused by anxiety) can improve the anxiety experience. The sustained focus and attention used in VMI would mean that this activity has a positive impact on one's emotion throughout the duration of the musical imagery episode. Also, if people decide to repeatedly imagine a section of a song that evokes the most intense positive emotion, this could result in a prolonged positive emotional experience. Moreover, Powers et al. (2020) not only demonstrated how poor self-control is associated with high levels of anxiety, but this relationship is mediated by the type of affect regulation strategies people display. Their findings suggested that individuals who have poor self-control and use maladaptive affect regulation strategies are more likely to experience anxiety. Thus, VMI may serve to address this potential problem by combining an adaptive emotion regulation strategy with a focused task that individuals are able to control.

## 3.4 Voluntary musical imagery in comparison to other modes of imagery

Chapter One made reference to existing imagery-based interventions that have been investigated in relation to anxiety reduction, but none of the mentioned research explicitly stated that musical imagery was incorporated within the intervention activities (Afshar, et al., 2018; Anolak et al., 2018; Felix et al., 2018; Grammatica, 2018; Hammer, 1996; Karagozoglu et al., 2013; Kiley et al., 2018; Nguyen & Brymer, 2018). Despite these studies showing how effective mental imagery can be for anxiety reduction, there are specific characteristics of musical imagery that could make this type of imagery equally or more effective in an intervention setting. It is worth comparing the similarities and differences between musical imagery and other forms of imagery, with reference to the impact of the properties of these modes of imagery on the four mechanisms in the GCM, as well as the affective mechanisms outlined above.

The first comparison between musical and other modes of imagery can be considered in terms of the dynamic aspect of mental imagery. This chapter already highlights how musical imagery is a dynamic activity due to the music that is being imagined unfolding in various ways whilst the ‘listener’ progresses through the musical line. This dynamic nature of musical imagery can also relate to how people can imagine the tempo (Jakubowski et al., 2016) and loudness of musical pieces (Bishop et al., 2013). The significance of these dynamic features associated with musical imagery, in relation to potential anxiolytic effects, concerns their effect on both the cognitive and affective mechanisms in anxiety. When individuals continuously imagine music with deliberate effort, and thus progress through the various changes in musical imagery, this adds to the requirement of sustained focus and attention throughout the musical imagery episode. This contributes to the notion of musical imagery being able to target the focus mechanism that the GCM states plays an important role in the development and maintenance of anxiety. Furthermore, this dynamic aspect has a link with emotions, as there is the potential for a continuous induction of emotion in relation to the imagined music. If the emotion being induced is positive, this can add to the ability for musical imagery to regulate emotions in a positive direction.

Musical imagery is not merely auditory, as other modalities can be involved in this experience (Bailes, 2019). In a review of the involvement of kinesthetic imagery in music performance by Lotze (2013), he concludes that there are representations of auditory-motor connections in the musical imagery experience. For instance, when Eitan and Granot (2006) looked at how movement is imagined when listening to music, they found similarities in the description of movement and changes in features of the musical stimuli, such as pitch height. There is also evidence of the motor cortex being activated during musical imagery, as shown by Callan et al. (2006) in a study that used fMRI to observe which areas of the brain are involved in musical imagery (through covert singing). This multimodality is thus a strength if it is able to combine the advantages of the benefits of imagining in one single modality.

Like musical imagery, motor imagery can be intimately connected to the affective experience, as research has demonstrated that movement can regulate emotion (Melzer et al., 2019; Shafir, 2016; Shafir et al., 2016). Damasio (1999) suggests that this regulation of emotions can occur because motor behaviour represents the physiological state of the body. There are several forms of movement-based methods that exist to improve emotions, such as dance (Walter & Sat, 2013) and exercise (Zhang et al., 2019). With Holmes and Mathews (2010) demonstrating the emotional significance of mental imagery in comparison to perceptual stimuli, being that mental imagery can also evoke emotion, motor imagery might function in a similar way to movement. Referring back to the dynamic nature of movement, imagining motor imagery might be able to reduce anxiety in a similar way to musical imagery, as this mode of imagery would also require an individual to engage in sustained focus and attend to generating and maintaining this imagery in their mind. Therefore, the involvement of motor imagery when people deliberately imagine music could further enhance the emotive effects.

Visual imagery might be involved in the musical imagery experience too. Presicce and Bailes (2019) provided evidence of visual imagery being involved in the music listening experience, where participants listened to piano pieces and reported their music-induced visual imagery, as well as their engagement with the music pieces. Visual imagery has been suggested to be one of the mechanisms involved in the induction of emotions in music listening, due to the interaction this type of imagery has with music (Juslin, 2013). But musical imagery might have a greater impact on anxiety reduction compared to visual imagery. In contrast to musical and motor imagery, visual imagery is largely static, and so visual imagery interventions may well lack the additional benefits of imagining dynamic stimuli. Music is self-propelling, in that the next note in the sequence is inevitable and needs to happen for the temporally unfolding melody to occur. However, there is no compulsion for a mental image of a static object to be attended to through time. If people are instructed to imagine immobile objects as a coping mechanism for anxiety, it might prove more difficult to direct one's attention away from anxiety-triggering stimuli. Additionally, the emotion inducing properties of music that can extend to musical imagery highlight the emotional potence of musical imagery, which has the potential to be greater than visual imagery.

In summary, the potential for VMI to be an effective intervention for anxiety reduction is based on the argument that there are specific properties of musical imagery that might have a powerful impact on cognitive and affective mechanisms involved in anxiety. Specifically, VMI might be able to direct one's attention away from anxiety-triggering stimuli and towards the music being imagined, minimising the opportunity for anxiety-related schemas to negatively impact information processing in this situation. Deliberately imagining music could also occupy the same parts of working memory as negative thoughts that maintain anxiety, thus limiting the resource available for these thoughts. Lastly, the ability of VMI to regulate emotions in a positive direction is particularly beneficial for anxiety, seeing as it is widely suggested that negative emotions are one of the main elements in anxiety (Kenny, 2010). Moving on, there is a need to understand the efficacy of mental imagery interventions for anxiety. The following chapter explores the outcomes imagery interventions have on anxiety, summarising the types of study designs used in these intervention studies, the effects of imagery interventions on anxiety and the quality of the studies being used to test these methods. Despite several studies investigating imagery-based interventions for anxiety, no systematic review relating to this topic has been published. This prompted the subsequent chapter, which will systematically review research examining the effects of imagery interventions on anxiety reduction.

# Chapter 4
# A Systematic Review of Imagery-based Interventions for Anxiety

Having introduced imagery-based interventions, proposed VMI as a new intervention to reduce anxiety in Chapter One, and discussed the rationale behind the potential effectiveness of this method in Chapter Three, the purpose of this chapter is to conduct an in-depth examination of the already existing imagery-based interventions for anxiety. Following in line with previous investigations into the effectiveness of interventions for anxiety mentioned in Chapter One including CBT (Golshani et al., 2020; Slais et al., 2018; van Dis et al., 2020) and music listening (Panteleeva et al., 2017), a systematic review of imagery-based interventions for anxiety reduction was performed. The review focused on methods that use the deliberate imagination of sensory stimuli to reduce anxiety. After systematically searching through four databases (Web of Science, Scopus, Medline and PsychInfo) using a combination of search terms related to anxiety and imagery, 23 papers were included in the review. The overall findings from the systematic review are discussed in this chapter, shedding light on what it might mean for the investigation into the anxiolytic effects of VMI in this thesis, as well as future research into imagery-based interventions for anxiety.

## 4.1 Introduction

### 4.1.1 Overview of imagery-based interventions for anxiety

With anxiety being a commonly occurring mental health problem, there is an abundance of treatment methods studied within the literature of anxiety interventions including mindfulness-based interventions (Borquist-Conlon et al., 2019), relaxation and prayer therapy (Sadeghimoghaddam et al., 2019) and virtual reality interventions (Maples-Keller et al., 2017). Imagery interventions have also been used and it is important to learn more about the overall nature of imagery-based interventions for anxiety, in order to establish whether there is sufficient evidence to support the effectiveness of this approach (NICE, 2014). If an intervention is not evidence-based or demonstrates no clear effective outcomes for anxiety relating to the treatment method, there is a reduced chance of this intervention activity being offered to reduce anxiety. In terms of the outcomes of studies investigating imagery-based interventions for anxiety, there have been varied results with some studies showing how imagery interventions can have a positive effect on anxiety reduction (Horne et al., 1999;

Howland et al., 2017), whereas others have produced inconsistent findings (Alam et al., 2016; Danhauer et al., 2007). The type of imagery methods included in these studies could explain the differences in these outcomes, as these imagery methods utilise imagery in different ways. However, before the various imagery methods are discussed, it is worthwhile to acknowledge the significance of imagery-based interventions through a comparison with conventional anxiety interventions (e.g., CBT).

### 4.1.2 Importance of imagery-based interventions

NICE (2014) recommends evidence-based psychological interventions as primary treatment methods for anxiety and CBT is the most frequently used conventional intervention for anxiety. Thus, comparing imagery-based interventions with CBT may help to elucidate the potential benefits of this method. To begin, imagery interventions are associated with fewer side effects in comparison to CBT. In the literature surrounding the use of CBT for anxiety, the side effects that occur due to this form of therapy are often overlooked (Schermuly-Haupt et al., 2018). When Schermuly-Haupt et al. (2018) looked at side effects in CBT, focusing on the frequency and type of side effect, they found that nearly 50% of the patients undergoing CBT reported at least one side effect as a result of this therapy, including distress and worsening of symptoms. These authors also found that the longer people received CBT, the more side effects that were reported. For imagery methods, however, because of the difference in the functionality between this form of treatment and CBT (being that CBT primarily focuses on altering the type of thoughts individuals have, whereas imagery interventions are based on distraction away from those thoughts), it is less likely that the side effects mentioned above might occur with imagery interventions. This is because people might be more prone to experiencing distress and having their existing symptoms deteriorate in CBT, as they would have to relive the thoughts contributing to the anxiety. Thus, presenting an intervention with fewer side effects compared to other established methods increases the likelihood of the method being offered to individuals with anxiety (if proven effective).

Further to this, there are long waiting times for individuals accessing this form of therapy through the NHS, with a survey by MIND (2013) reporting that more than half of the people who require talking therapies (such as CBT) wait over three months, whilst one in 10 individuals wait over a year. An alternative to this lengthy waiting time is to access CBT through private healthcare, but these costs are high and so this can be acknowledged as a shortcoming of this treatment method. This in turn results in inequalities in relation to the access to CBT for specific groups. For instance, individuals who have a low socioeconomic status have difficulty receiving CBT sessions due to its unaffordability (Delgadillo et al., 2018). Imagery-based interventions, on the other hand, are a relatively cheaper option, and potentially just as effective, for people who cannot access CBT.

Following on from this, there is an abundance of research that has looked at the use of imagery in reducing anxiety (Mizrahi et al., 2012; Nguyen & Brymer, 2018; Prinz et al., 2019; Rees, 1995; Shenefelt, 2013), but a definitive view on the effectiveness of this method has not yet been offered. Conducting a systematic review to explore the use of imagery in the treatment of anxiety can provide a clearer insight into what these research studies indicate overall about imagery-based interventions for anxiety, what the most optimal types of imagery interventions are, and can highlight potential moderators of intervention effectiveness.

### 4.1.3 Types of imagery-based interventions for anxiety

When treating anxiety, there are three commonly used imagery methods that differ from one another; imaginal exposure, imagery rescripting and the deliberate imagination of stimuli. To begin, imaginal exposure consists of an individual imagining an anxiety-inducing stimulus or event, until anxiety levels are reduced (Pearson et al., 2015). The functionality of this method can be explained using the habituation theory, which states that through non-associative learning, a response an individual has to a specific stimulus would be reduced once the individual has been repeatedly exposed to this stimulus (Benito & Walther, 2015). Thus, in relation to imaginal exposure for anxiety, it is suggested that anxiety levels would be reduced due to continuously imagining the anxiety-inducing stimulus (or event), therefore resulting in a weaker connection between the anxiety stimulus and the negative response. Another method is imagery rescripting, which involves the alteration of existing mental imagery that contributes to the maintenance of anxiety. For instance, Lee and Kwon (2013) examined whether imagery rescripting is an effective treatment method for social phobia through a randomised controlled trial (RCT), where participants either received separate imagery rescripting and cognitive restructuring sessions or clinical interviewing and cognitive restructuring sessions. The participants in the imagery group had greater significant improvements from their pre to post-intervention social phobia assessments compared to the control group, and these findings were maintained at a three-month follow-up point. In addition to altering negative self-images that social phobia patients have, it is important to mention that imagery rescripting has been commonly applied in the treatment of PTSD, previously categorised as an anxiety disorder (according to the DSM; APA, 2000), and has proven successful at reducing symptoms associated with PTSD in most cases (Arntz et al., 2013; Arntz et al., 2007; Long & Quevillon, 2009).

Further to imaginal exposure and imagery rescripting, another technique used in imagery-based interventions involves the deliberate imagination of stimuli (of various modes such as visual and auditory; Apóstolo & Kolcaba, 2009), which is how VMI is intended to be used as an intervention method in this thesis. An example of an imagery intervention used in this way is guided imagery. Chapter One discussed how guided imagery interventions for anxiety reduction encourages individuals to generate mental images with the hope of making people feel more relaxed (Chiaramonte et al., 2014). Evidence has shown how the act of deliberately imagining stimuli can reduce anxiety (Karagozoglu et al., 2013), and Holmes and Mathews (2010) propose that this technique is effective due to the relationship mental imagery has with emotions. Negative emotions are one of the central themes in anxiety and so mental imagery can work to induce more positive emotions through three mechanisms; 1) by directly acting upon the emotional systems responding to sensory signals, 2) by having the same or similar effect on emotions as perceived stimuli and 3) by accessing previous emotional memories (Holmes & Mathews, 2010). Moreover, researchers have pointed to the effectiveness of using imagery in this way through the combination of imagery with existing treatment methods to enhance the overall effect of these interventions, with examples including generating imagery whilst listening to music (Hammer, 1996) and nature-based imagery (Nguyen & Brymer, 2018). Not only are there various types of imagery methods that can be used for anxiety treatment, there are also potential moderators that might influence the intervention outcomes.

### 4.1.4 Moderator variables

Spielmans and Flückiger (2018) presented a meta-analysis of moderators of psychotherapy interventions, highlighting how the presence of uncontrolled moderator variables can often explain heterogenous results in psychotherapy meta-analyses, with examples including the training of therapists, sample representativeness and the dosage of treatment methods. The role of moderating variables should also be considered in relation to anxiety interventions. For instance, Kuckertz et al. (2014) demonstrated how attention bias can moderate the efficacy of attention modification programs in the treatment of social anxiety, and Arch and Ayers (2013) suggested that variables associated with participants' mental health, including anxiety sensitivity, diagnostic severity and baseline depression symptoms, can affect the outcomes of group CBT, compared to mindfulness-based stress reduction for anxiety disorders. Despite this evidence investigating different intervention methods for different anxiety types, these studies indicate that moderator variables are present, regardless of the type of intervention an individual receives. Thus, the acknowledgement of the presence of moderator variables in imagery-based interventions for anxiety is important.

When considering potential variables that might moderate the effect of imagery-based interventions on anxiety reduction, a starting point would be to inspect the dosage of treatment that individuals receive, which includes the duration and number of treatment sessions. Spielmans and Flückiger (2018) discussed the concept of dose-response relationships in their meta-analysis mentioned previously, pointing out that even though there is a variety of dose-response relationships in psychotherapy (Baldwin et al., 2009; Hansen et al., 2003), many studies fail to recognise that the duration of treatment is not consistent between interventions, and thus do not consider the potential effect that this could have on intervention outcomes. For example, participants in one study might receive one dose of the intervention session (lasting 10 minutes) and show no significant reduction in anxiety, whereas another group of individuals might receive weekly intervention sessions (lasting 30 minutes) for four weeks and have greatly reduced anxiety. Therefore, the dosage of the intervention received is a variable that should be considered when comparing findings across imagery-based interventions.

Additionally, the type of imagery method used could be another moderator variable. It was mentioned earlier in this chapter that there are three main types of imagery-based interventions (imaginal exposure, imagery rescripting and the deliberate imagination of stimuli), and for this systematic review, the focus was on the deliberate imagination of stimuli. But there is variation within that type of method too, including guided imagery, training in mental imagery and positive imagery. Even though each of those examples includes the act of deliberately imagining stimuli, there are differences within the activities in the methods that could increase or decrease the likelihood of one activity having a positive effect on anxiety reduction. Moreover, the mode of imagery included in these studies is an additional example of a potential moderator variable. A reason for this could be due to how the vividness of various modes of imagery might differ from one another. The vividness of an individual's mental imagery can affect how well an imagery-based intervention method could work, so in some instances, it might be that individuals find it more difficult to produce vivid images of specific modes of imagery compared to others. If that is the case, then those individuals could be more likely to have poorer imagery episodes, in relation to vividness, which would reduce the effectiveness of an imagery intervention.

Despite studies examining mental imagery for anxiety reduction in this way, there have been no systematic reviews or syntheses of the existing evidence. As a result, there is no consensus about the overall effectiveness of imagery-based interventions for anxiety reduction. There are also various elements of mental imagery interventions (such as guided imagery and mental imagery training) that have inconclusive findings, such as which mode of imagery is most commonly used (as well as whether a difference in the effectiveness of the method is dependent on the mode of imagery), how imagery is used in interventions where individuals deliberately imagine stimuli and the content of the imagery in these intervention methods. Furthermore, the risk of bias present in the imagery intervention studies could affect the outcome of the imagery methods. Intervention studies with high levels of risk of bias that might arise as a result of various factors, including the participant randomisation process and measurement of the intervention outcome (Sterne et al., 2019), are likely to negatively impact the validity of the results. Therefore, it was deemed advantageous for a systematic review of imagery-based interventions for anxiety to be conducted, focusing exclusively on the type of imagery intervention that involves voluntarily imagining stimuli.

### 4.1.5 Aims

The main aim of the systematic review in this chapter is to synthesise evidence of imagery-based interventions for anxiety. By conducting a systematic review on studies that investigate the anxiolytic effects of imagery-based interventions, the review would be the first to provide a comprehensive report on the existing literature concerning this topic. Additionally, this review aims to provide insights into the quality of the studies that look at imagery-based methods for anxiety reduction through an assessment of the risk of bias within and across the studies. As there is no evidence of an existing systematic review of imagery-based interventions for anxiety reduction, this also suggests that no conclusions about the quality of studies investigating this phenomenon have been drawn. Overall, this review aims to shed light on imagery-based intervention studies by summarising the findings of studies that involve the deliberate use of imagery to reduce anxiety. Studies were included following the PICO (Population, Intervention, Comparator and Outcome) framework (see below) and included participants from any type of population (P), that tested the effectiveness of an imagery-based intervention (I) incorporated a control or comparison condition (C) and measured an anxiety outcome (O) using a valid measure of anxiety. The main research question in this review is whether voluntary mental imagery-based interventions are effective at reducing anxiety.

## 4.2 Method

### 4.2.1 Eligibility criteria

The PICO framework was used to develop a search strategy tool. One researcher (MU) screened all of the articles to determine whether the specified inclusion criteria for the review were met (before the second researcher [CH] screening occurred). If the papers had no relevance to the topic of the review, or if they met any of the exclusion criteria, they were excluded. Inclusion criteria were as follows:

- P - Any type of population (e.g., clinical and non-clinical participants)
  - Any type of anxiety
- I - Imagery-based intervention study that involves the deliberate imagination of stimuli
  - Combined imagery intervention studies had to include a separate imagery condition
  - Any type of study design
- C - Presence of a control group
- O - Any valid measure of anxiety as an outcome (e.g., State-Trait Anxiety Inventory [STAI]; Spielberger et al., 1983)

Exclusion criteria were as follows:

- Not an empirical study
- Not peer-reviewed
- Not written in English
- No valid anxiety measure used
- No complete set of results
- No access to the full text available
- Participants under the age of 18
- Tested effects of imagery on individuals with PTSD and OCD
- Used imagery methods including imaginal exposure, imagery rescripting and systematic desensitization

### 4.2.2 Information sources and search strategy

This systematic review was conducted in line with the Cochrane Collaboration guidelines (Higgins et al., 2020) and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement (Moher et al. 2009). The following databases were used when searching for papers (see Appendix E.1 for full search strategy): Web of Science, Scopus, Medline and PsychInfo. The search terms were related to imagery and anxiety, and were selected based on existing systematic reviews of anxiety (Chen et al., 2012; Schwartz et al., 2019). ‘Imagery’ was the only term used to encompass the imagery aspect of papers, as other systematic reviews that have focused on imagery interventions have done so too (Bernardy et al., 2011; Hadjibalassi et al., 2018). Additionally, most of the imagery intervention studies specifically use the term ‘imagery’ as opposed to ‘images’ or ‘imagination.’ The terms were combined in this way:

- Anxiety OR worry OR stress OR fear AND imagery
- Phobi* OR panic AND imagery
- Agoraphobia OR selective mutism AND imagery
- Separation anxiety disorder AND imagery

Search limits placed on searches included papers published from January 1st 1900 to March 21st 2019 and titles only. After the papers were identified, they were transferred to EndNote Online for the title and abstract screening phases.

### 4.2.3 Study selection

Figure 4.1 documents the selection process of the studies from the searching stage, through to the final studies that were included at the full-text screening stage. After searching the specified databases, the papers that contained the key search terms were transferred to Endnote Online. Duplicates were removed using the ‘remove duplicates’ function and further papers were removed by hand. One researcher (MU) screened the titles and abstracts simultaneously, then the second researcher (CH) screened the titles and abstracts of 20% of the papers, resulting in an inter-rater agreement of kappa = .79. After, the papers were considered for full-text screening by both reviewers, based on whether the inclusion criteria were met. An inter-rater agreement of kappa = .81 was obtained. Discrepancies were discussed and amended accordingly.

### 4.2.4 Data extraction

A data extraction form (Appendix E.2) was developed based on Cochrane’s data collection form template for reviews of interventions that include RCTs and non-RCTs. This form was used as it would allow this review to meet the methodological expectations of Cochrane intervention reviews when collecting (as well as analysing) data.

### 4.2.5 Data items

Data extraction was completed using a Microsoft Excel spreadsheet and divided into three sections based on general study design details, intervention details and outcome details. The data items are listed below.

**Study design details**: Design, control condition, sample size, sample type, gender, age, recruitment method, setting and location

**Intervention details:** Imagery method, delivery of intervention, mode of imagery, contents of imagery method, imagery instructions, delivery (group vs alone), length of study, number of sessions, length of session (minutes), dosage (session length x number of sessions), follow-up assessments (Yes/No), follow-up length and extra intervention information

**Outcome details:** Type of anxiety, outcome, primary or secondary measure, anxiety measure, validity of anxiety measure, reliability of anxiety measure, time points tested and drop out information

### 4.2.6 Quality Assessment

Risk of bias was assessed by the main researcher (MU) in accordance with the revised Cochrane Risk of Bias (RoB 2) tool. Included in the assessment was risk of bias occurring due to the randomisation process, deviations from the intended interventions (intervention assignment and intervention adherence), missing outcome data, the measurement of the outcome and selection of the reported result. The risk of bias for each quality assessment point was rated using either of these options—high risk of bias, some concerns, or low risk of bias—then based on those ratings, the studies received an overall risk of bias judgment.

### 4.2.7 Summary measures

For this review, the main measure of interest was self-reported anxiety, with studies measuring anxiety either before or after the intervention, as well additional follow-up assessments after the initial post-intervention measure.

### 4.2.8 Narrative Synthesis

Results from this systematic review are presented using a narrative synthesis approach, where the findings are described (and no further analyses are performed[2]).

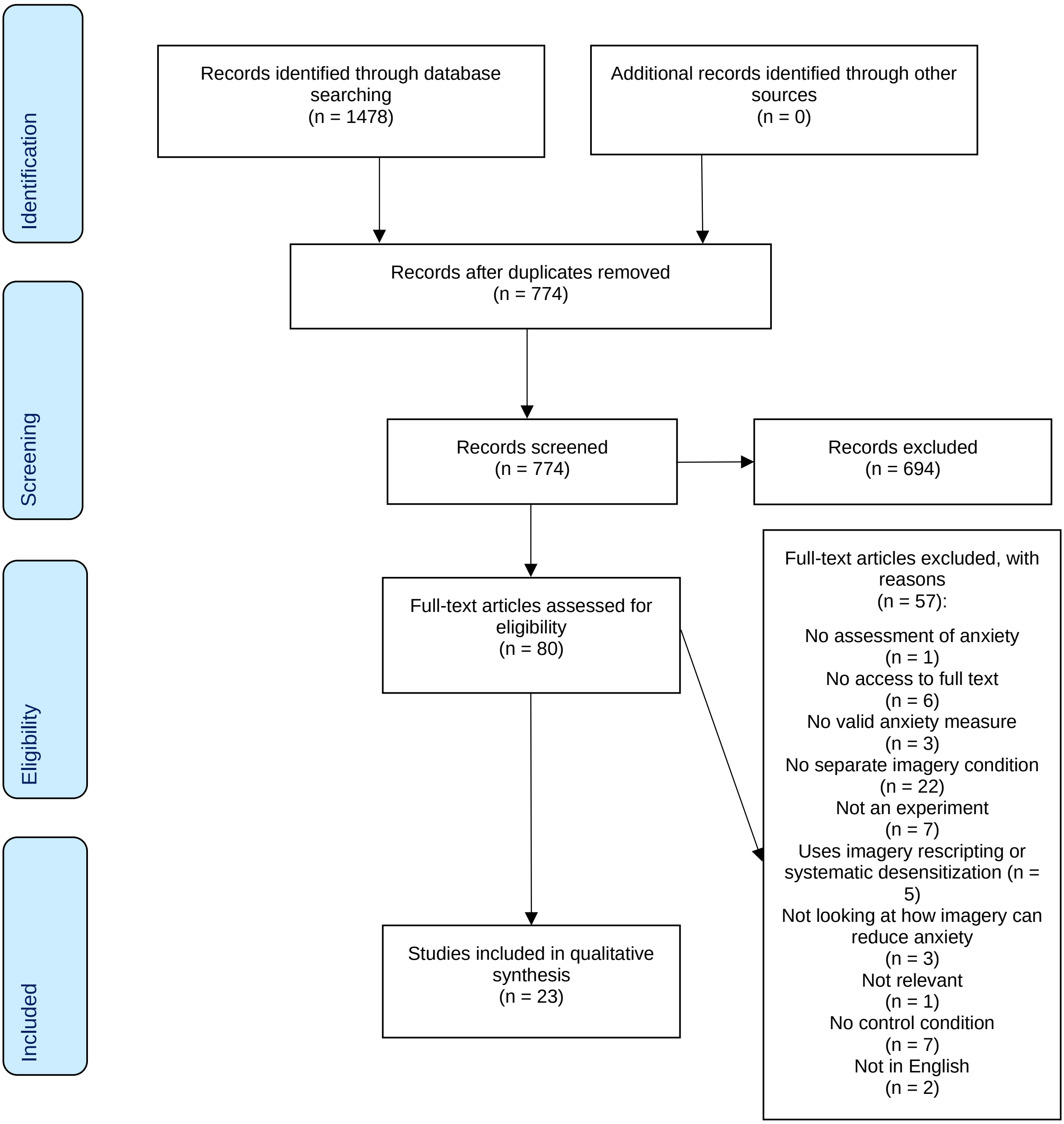
[2] Potential further analyses, such as a meta-analysis, were not performed as there was too much variability across the studies.

## 4.3 Results

### 4.3.1 Study selection

After the papers from each database were transferred to one folder in EndNote Online (totalling 1478), 704 duplicates were removed. Both the titles and abstracts of 774 papers were screened simultaneously by the primary researcher (MU) to see if the eligibility criteria were met (marking them with a ‘Y’ for inclusion and ‘N’ for exclusion). A second researcher (CH) reviewed the titles and abstracts of 20% of the papers, as well as all of the included papers at a full-text screening level. 80 papers were included for full-text screening and 23 papers were included in the qualitative synthesis (57 full-text articles were excluded for various reasons, presented in Figure 4.1).

Figure 4.1 *PRISMA flow diagram for study selection*



### 4.3.2 Study characteristics

Of the 23 studies that were reviewed, all followed a pre-test post-test design apart from one study, which used a post-test only design (Thomas & Sethares, 2010). The main study designs used were RCTs, single-blinded RCT, quasi-RCT, quasi-experimental design, and repeated measures design. Collectively, there were 1872 participants included in the review, ranging from 12 to 225 (*Mdn* = 69) participants per study, and the majority of the sample was made up of females (65%), although the gender balance did vary within each study. One study included all males (Jing et al., 2011) and three studies included all females (Danhauer et al., 2007; Jallo et al., 2014; Khojasteh et al., 2016). Overall, the ages of participants in the studies ranged from 18 to 90 years old and there were six countries where the studies were conducted (seven studies did not state the location); Australia (*n* = 1), China (*n* = 1), Germany (*n* = 3), India (*n* = 1), Iran (*n* = 6), United States of America (USA; *n* = 4). The sample type varied between the studies and this is presented in Table 4.1.

#### 4.3.2.1 Intervention characteristics

Five types of imagery methods were used in the studies reviewed; guided imagery (*n* = 16), coping imagery (*n* = 1), positive imagery (*n* = 1), training in mental imagery (*n* = 4) and visual imagery therapy (*n* = 1). Different modes of imagery were used amongst the studies too, however 11 studies did not include information about the mode of imagery in the intervention; multisensory imagery (*n* = 4), visual (*n* = 2), visual, olfactory and auditory (*n* = 3), visual, auditory, olfactory and tactile (*n* = 1), visual, olfactory, auditory, gustatory and tactile (*n* = 1) and visual and other non-specified modes (*n* = 1). In terms of delivery, most of the studies made use of audio methods including CDs or audiotapes (*n* = 18), one study used audio-visual methods, another used a written script that was read, and three studies did not state the type of delivery method. Additionally, most of the studies delivered the intervention to the participants alone (*n* = 13), with only 13% of the studies delivering the imagery interventions in a group setting (*n* = 3) - seven studies did not state the method of delivery. The dosage of imagery intervention was calculated by multiplying the number of imagery sessions by the length of each session, and ranged between 15 and 1680 minutes, with the mean intervention dosage across studies being 317.16 minutes. Only four of the selected studies included follow-up assessments (the dosage of these studies ranged between 18 and 90 minutes, with the mean intervention dosage being 68 minutes).

**4.3.2.2 Outcome measures**

A variety of anxiety outcome measures were used in these studies with 20 studies assessing anxiety as a primary measure, and three measuring anxiety as a secondary measure. The anxiety types were behavioural, cognitive, competitive state, general, health, perioperative, postoperative, somatic, state, test, and trait anxiety. When dividing the anxiety outcomes into groups based on whether the anxiety assessed was experienced in that present moment (state), in general (trait) or both (state and trait), there were significant anxiety reductions in 60% of the 10 studies that assessed trait anxiety, 25% of the eight studies investigating state anxiety and 40% of the five studies looking at state and trait anxiety. For the assessment of anxiety, all of the selected studies used questionnaires to determine whether there were any significant changes in anxiety following the imagery intervention. The STAI (including the Six-item short-form State-Trait Anxiety Inventory; STAI-6) were the most commonly used questionnaires ($n$ = 12), followed by the Beck Anxiety Inventory ($n$ = 3), the Hospital Anxiety and Depression Scale ($n$ = 3), the Achievement Anxiety Test ($n$ = 1), Competitive State Anxiety Inventory ($n$ = 1), Depression, Anxiety, and Stress Scales ($n$ = 1), the German Illness Attitudes Scale ($n$ = 1), Hamilton Anxiety Scale ($n$ = 1), Numeric Visual Anxiety Scale ($n$ = 1), the Pregnancy-Related Anxiety Questionnaire - Revised ($n$ = 1), the Suinn Test Anxiety Behavior Scale ($n$ = 1), the Test Anxiety Scale ($n$ = 1) and the Trimodal Anxiety Questionnaire ($n$ = 1).

Table 4.1 *Study characteristics of included studies*

| Authors | Design | Sample size | Sample type | Age | Gender | Location |
|---|---|---|---|---|---|---|
| Afshar et al. (2018) | RCT | 70 | Hemodialysis patients | 18-70 years old | Most were male | Iran |
| Alam et al. (2016) | Single-blinded RCT | 155 | Adults pending staged excisional surgery for basal or cutaneous squamous cell carcinoma of the face | *M* = 62.7 (Guided imagery), *M* = 62.4 (Relaxing music), *M* = 64.2 (Control group) | 90 males and 65 females | Not stated |
| Apóstolo & Kolcaba (2009) | Quasi-experimental design | 60 | Short-term hospitalised depressive patients | 19-58 years old (*M* = 40.38, *SD* = 10.53) | 40 males and 20 females | Not stated |
| Asgharipour et al. (2017) | Controlled clinical trial | 40 | Patients with first and second-degree burns (not those with self-immolation) | 20-40 years old | 18 males and 22 females | Iran |
| Beizaee et al. (2018) | Quasi-randomised controlled clinical trial | 80 | Patients on hemodialysis | 35-65 years old (*M* = 47.21, *SD* = 8.34) | 47 males and 33 females | Iran |
| Danhauer et al. (2007) | RCT | 170 | Women undergoing colposcopy | 18-60 years old (*M* = 28.4, *SD* = 9.6) | All female | USA |
| Foji et al. (2015) | RCT | 62 | Patients undergoing coronary angiography | 35.15-69.12 years old (*M* = 57.06, *SD* = 8.9) | 37 males and 25 females | Iran |
| Forward et al. (2015) | Single blind RCT | 225 | Elective joint replacement patients | 38-90 years | Mixture of males and females | USA |
| Harris & Johnson (1983) | Pre-test post-test design | 63 | Test anxious students | Not stated | Equal across groups | Not stated |
| Jallo et al. (2014) | RCT | 72 | Pregnant African American women | 18-39 years old (*M* = 24.26, *SD* = 0.64) | All female | USA |
| Jing et al. (2011) | Pre-test post-test repeated measures design | 12 | Not stated | 19.8 +/- 1.2 years old | All male | China |
| Khojasteh et al. (2016) | RCT with pre-test and post-test design | 75 | Nulliparous women during pregnancy | 18-35 years old | All female | Iran |

| | | | | | | |
|---|---|---|---|---|---|---|
| Kiley et al. (2018) | RCT | 69 | Mental health workers | 18 years old and over | 12 males, 52 females (5 participants with missing data) | Not stated |
| Marshall & Gibson (2017) | Randomised pre-test post-test design | 19 | Acrobatic gymnastics | *M* = 13.2, *SD* = 2.7 | 6 males and 13 females | Not stated |
| Mhaske et al. (2018) | Comparative study | 35 | Moderate chronic obstructive pulmonary disease patients | Not stated | Not stated | India |
| Skodzik et al. (2017) | Randomised pre-test post-test | 71 | Individuals with high trait worry | 18-30 years old (TMI: *M* = 22.11, *SD* = 2.77, Control: *M* = 21.44, *SD* = 2.70) | TMI = 85.70% female, Control = 83.30% female | Germany |
| Skodzik et al. (2018) | Pre-test post-test | 112 | Individuals with high trait worry | 18-30 years old (*M* = 22.02, *SD* = 3.38) | 17 males and 95 females | Germany |
| Sloman (2002) | Randomised pre-test post-test control group clinical trial | 56 | Community patients with advanced cancer | 27-79 years old (*M* = 54.5) | 30 males and 26 females | Australia |
| Tavakolizadeh et al. (2018) | RCT | 50 | In-patients with Acute Coronary Syndrome | 35-80 years old (*M* = 58.16) | 60% males and 40% females | Iran |
| Thomas & Sethares (2010) | Prospective, quasi experimental, post-test-only design | 121 | Patients scheduled for elective total joint arthroplasty | 43-88 years old (*M* = 67.9 +/- 10) | 37 males and 84 females | Not stated |
| Thompson & Coppens (1994) | Randomised experimental design | 41 | People undergoing magnetic resonance imaging | 18-80 years old (GI group: *M* = 52, *SD* = 17, Control group: *M* = 42, *SD* = 14) | 15 males and 26 females | USA |
| Tolgou et al. (2018) | Pre-test post-test repeated measures design | 59 | Students | 18-50 years old (*M* = 22.43, *SD* = 4.45) | 23 males and 126 females | Germany |
| Walker et al. (1987) | Randomised independent groups | 55 | Low and high trait anxious students (first year psychology) | 17-40 years old (*M* = 19.7, *SD* = 3.7) | 16 males and 39 females | Not stated |

### 4.3.3 Results of individual studies

The main intervention details and outcomes are presented in Table 4.2 below.

Table 4.2 *Intervention details and outcomes*

| Authors | Imagery method | Delivery of intervention | Mode of imagery | Delivery (group vs alone) | Dosage (minutes; length of session x number of sessions) | Follow-up assessments (Yes/No) | Anxiety type | Primary or secondary outcome | Outcome |
|---|---|---|---|---|---|---|---|---|---|
| Afshar et al. (2018) | Guided imagery | CD with headphones | Not stated | Alone | 600 | No | State and trait anxiety | Primary | Significant difference between post-test mean scores of state anxiety ($p < .001$) and trait anxiety ($p < .001$). |
| Alam et al. (2016) | Guided imagery | Audio recording with earphones | Not stated | Alone | Approximately 66.26 | No | Perioperative anxiety | Primary | No consistent difference in anxiety levels between groups. |
| Apóstolo & Kolcaba (2009) | Guided imagery | Audiotaped CD | Visual, olfactory, and auditory | Alone | 210 | No | Anxiety | Primary | Treatment group had significantly lower levels of anxiety than the control group after 10 days of guided imagery intervention ($F = 11.76$, $p = .00$). |
| Asgharipour et al. (2017) | Guided imagery | CD | Not stated | Alone | 120 | No | Severity of anxiety | Primary | Post-test scores showed significant between-group differences. |
| Beizaee et al. (2018) | Guided imagery | Audio recording with headphones | Visual, olfactory, and auditory | Alone | Unable to calculate | No | Severity of anxiety | Primary | Anxiety significantly lower in the intervention group compared with the control group ($X^2 = 6.96$, df |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | = 3, *p* = .03). |
| Danhauer et al. (2007) | Guided imagery | CD | Not stated | Alone | 40 | No | State anxiety | Primary | No significant between-group differences in post-procedure state anxiety in the unadjusted model. |
| Foji et al. (2015) | Guided imagery | Audio recording | Not stated | Not stated | 18 | No | State-trait, state, and trait anxiety | Primary | No significant differences. |
| Forward et al. (2015) | Guided imagery | Audio program (mp3 player and headphones) | Not stated | Alone | 72-80 | Yes | Preoperative and postoperative anxiety | Primary | Guided imagery group had significantly larger improvements than did the usual care group in anxiety. Day 1 postoperative: $p < .001$ Day 2 postoperative: $p < .0001$ |
| Harris & Johnson (1983) | Coping imagery | Not stated | Not stated | Groups of eight | 480 | No | Test anxiety | Primary | At post-treatment, all four treatment groups scored significantly lower than the waiting list control group, $p < .05$. |
| Jallo et al. (2014) | Guided imagery | CD | Multisensory imagery | Alone | 1680 | No | State and trait anxiety | Secondary | No significant difference between the two groups. |
| Jing et al. (2011) | Guided imagery | Guided imagery CD and tape player (voice recording) | Visual, auditory, olfactory, and tactile | Alone | 15 | No | State anxiety | Primary | No significant difference between the guided imagery group and music group with regard to state anxiety. |

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|---|---|---|---|---|---|---|---|---|---|
| Khojasteh et al. (2016) | Guided imagery | Video CD | Visual and potentially other modes (not specified in detail) | Alone | 840 | No | Anxiety | Primary | The mean anxiety scores were significantly different among the three groups after the intervention (*p* < .001). |
| Kiley et al. (2018) | Guided imagery | MP3 player | Not stated | Alone | 72-180 | No | State anxiety | Primary | Guided imagery group saw an average decrease of 3.56 state anxiety points per person, whereas the control group score decreased by an average of 1.75. This 1.81 point difference between the two groups was statistically significant (*p* = .001). |
| Marshall & Gibson (2017) | Imagery training | Written script (to read) | Not stated | Not stated | 120 | No | Competitive state anxiety including cognitive anxiety and somatic anxiety | Primary | Imagery did not significantly reduce cognitive anxiety, *p* > .05, or somatic anxiety, *p* > .05. |
| Mhaske et al. (2018) | Visual imagery therapy | Not stated | Involves all of the sense | Not stated | 600 | No | Anxiety | Primary | Significant differences found in post-intervention measures between the groups, *p* < .0001. |
| Skodzik et al. (2017) | Training in mental imagery | Audiotape (using headphones) | All sensory modalities | Not stated | 90 | Yes | State and trait anxiety | Secondary | No significant result for state anxiety, *F*(1, 69) = 1.93, *p* < .17. |
| Skodzik et al. (2018) | Training in mental imagery | Audiotape (using headphones) | All sensory modalities | Not stated | 90 | Yes | State and trait anxiety | Secondary | Training in mental imagery leads to decreases in state anxiety, *p* = .02. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sloman (2002) | Guided imagery | Tape recorders and cassettes | Not stated | Alone | 1260 | No | Anxiety | Primary | No significant result, *p* = .057 |
| Tavakolizadeh et al. (2018) | Guided imagery | CD and headphones | Visual | Not stated | 96 | No | State and trait anxiety | Primary | Trait anxiety scores in the experimental group significantly reduced after the intervention (*p* < .05), while the reduction in the state anxiety scores in this group was not significant compared to the control group (*p* >.05). Meanwhile, general anxiety scores in the experimental group were significantly reduced compared to the control group (*p* < .05). |
| Thomas & Sethares (2010) | Guided imagery | Audio tape | Visual, auditory, and olfactory | Alone | 20 | No | State and trait anxiety | Primary | No significant difference between guided imagery and control group. |
| Thompson & Coppens (1994) | Positive imagery | Not stated | Visual, olfactory, and auditory, gustatory, and tactile | Group | 18 | Yes | Health anxiety | Primary | Illness anxiety decreased significantly in all conditions after the film to post-intervention. |

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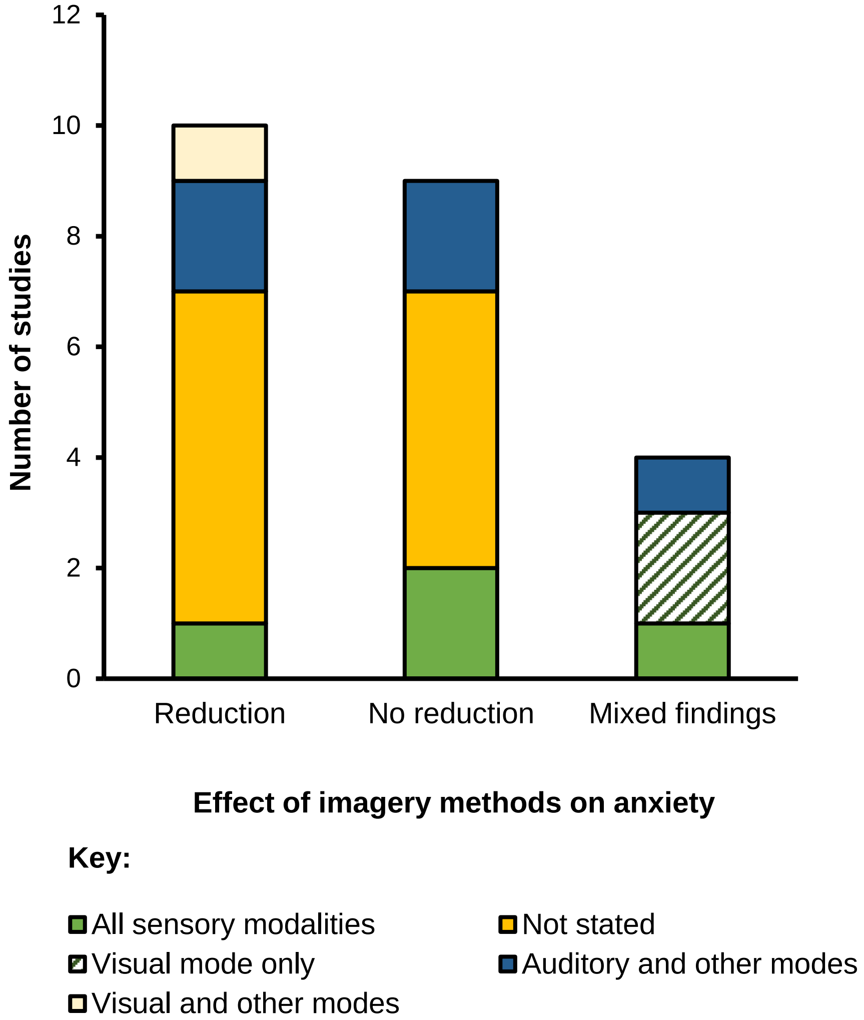
|---|---|---|---|---|---|---|---|---|---|
| Tolgou et al. (2018) | Cognitive imagery training | Tape | Visual | Groups of eight | N/A | No | Somatic, cognitive, behavioural, state, and trait anxiety | Primary | Both treatment groups significantly decreased levels of cognitive anxiety from pre-treatment to post treatment $F(1, 51) = 7.78$, $p <. 007$). |
| Walker et al. (1987) | Guided imagery | CD with headphones | Not stated | Not clearly stated, but most likely alone | 320 | No | Anxiety | Primary | There was no significant interaction between group and time ($p = .667$). |

### 4.3.4 Synthesis of results

#### 4.3.4.1 Overall findings

Overall, a mixture of findings was obtained, relating to whether imagery-based interventions significantly reduced anxiety. 44% of the studies found that imagery methods could significantly reduce anxiety, 39% found no significant decreases in anxiety following the imagery treatment and 17% presented a mixture of findings. This can be seen in Figure 4.2 below.

Figure 4.2 *The effect of imagery methods on anxiety reduction, including the mode of imagery*



#### 4.3.4.2 Moderator variables

##### 4.3.4.2.1 Type of intervention

As mentioned previously, there were five imagery methods used in the studies reviewed; guided imagery (*n* = 16), coping imagery (*n* = 1), positive imagery (*n* = 1), training in mental imagery (*n* = 4) and visual imagery therapy (*n* = 1). The anxiety outcomes in these studies demonstrated how coping imagery, positive imagery and visual imagery therapy showed significant decreases in anxiety when comparing pre and post-intervention measures, with coping imagery showing the largest effect. For the guided imagery and training in mental imagery studies, the findings were mixed, with some studies presenting results in support of imagery methods reducing anxiety, as well as imagery interventions not having a significant effect on anxiety reduction. Overall, evidence is mixed as to whether the type of intervention might be a moderator.

##### 4.3.4.2.2 Dosage

Interestingly, the study with the lowest imagery intervention dosage significantly reduced anxiety (Jing et al., 2011) whereas the study with the highest dosage did not (Jallo et al., 2014), compared to the control conditions. The study with the median dosage showed that the imagery intervention could significantly reduce trait anxiety but not state anxiety, compared to a control group (Tavakolizadeh et al., 2018).

##### 4.3.4.2.3 Mode of imagery

For the studies that produced significant findings, there was no evidence of a single modality of imagery being able to significantly reduce anxiety. Instead, the review showed that there was only evidence of anxiety reduction when several modes of imagery were used in a variety of combinations. Additionally, there were instances where some of the studies that produced significant results for anxiety reduction did not provide enough detail about the modality of images, but for the studies that did provide a thorough description about the mode of imagery used, visual, olfactory and auditory imagery were specifically stated (Apóstolo & Kolcaba, 2009; Beizaee et al., 2018).

#### 4.3.4.3 Sample type

There was a variety of sample types across the included studies (see Table 4.1), with three sample types occurring more than once: hemodialysis patients (9%), elective joint replacement (9%) and high trait worriers (9%). When considering whether there were any patterns in relation to the effect imagery had on anxiety reduction depending on the type of participant sample used, the imagery methods significantly reduced anxiety for the hemodialysis patients, but the methods were not effective for reducing anxiety in patients undergoing elective joint replacement or high trait worriers.

#### 4.3.4.4 Intervention effects at follow-up

Only four of the selected studies included follow-up assessments (that were separate from immediate post-intervention measures) varying from one day to five weeks later (Forward et al., 2015; Skodzik et al., 2018; Skodzik et al., 2017; Tolgou et al., 2018). The effects of the intervention methods in these studies remained stable, with one study demonstrating how imagery still managed to reduce anxiety levels after a seven-day follow-up period (Tolgou et al., 2018).

### 4.3.5 Risk of bias

Figure 4.3 visually depicts the risk of bias across the studies and Table 4.3 shows the risk of bias within studies (including the overall risk of bias judgment). These assessments were made based on the six items the studies were assessed against using the RoB 2; randomisation process, assignment to intervention, adherence to intervention, missing outcome data, outcome measurement and selection of results reported. Across the studies, the main source of bias came from the participants not adhering to the intervention they received, and the outcome measurement received the least amount of bias. For the total risk of bias judgment (for all of the studies), 91% of the studies received a high risk of bias rating[3] and 9% were rated as having some concerns.

[3] It is important to mention that for a study to receive an individual rating of 'high risk of bias,' the study would have to include at least one 'high risk of bias' rating across the six categories the studies were rated against. So for example, a study with 5 low risk of bias ratings and 1 high risk of bias, and a study with 5 high risk of bias ratings and 1 low risk of bias rating would both receive an overall high risk of bias rating.

Figure 4.3 *Risk of bias across studies*

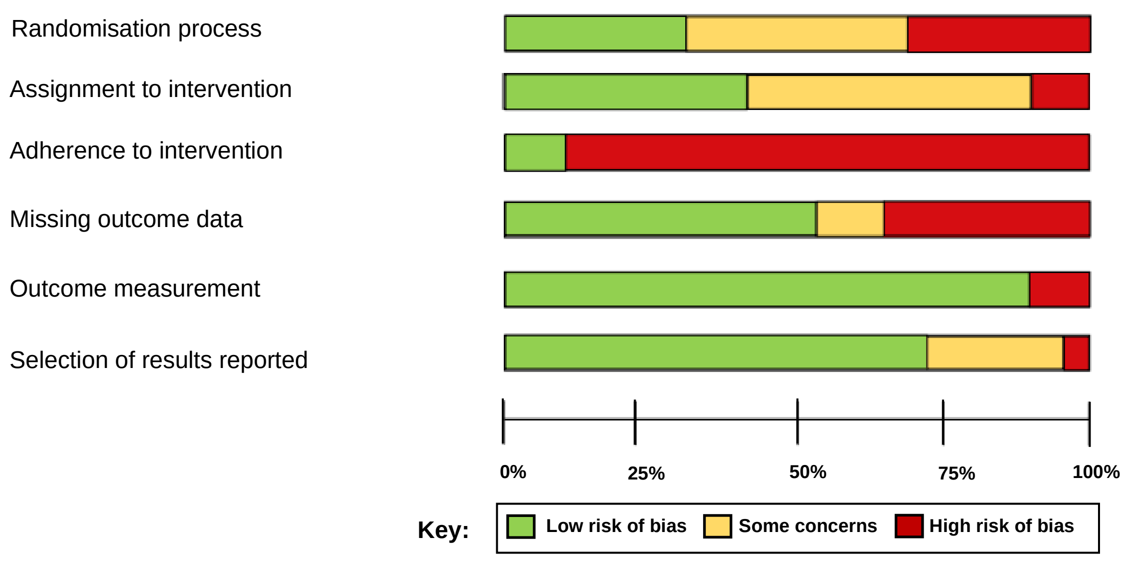


Table 4.3 *Risk of bias within studies*

| Authors | Randomisation process | Intervention assignment | Intervention adherence | Missing outcome data | Outcome measurement | Selection of reported results | Overall risk of bias |
|---|---|---|---|---|---|---|---|
| Afshar et al. (2018) | Low | Low | High | Low | Low | Low | High |
| Alam et al. (2016) | Low | Low | High | High | Low | Low | High |
| **Apóstolo** & Kolcaba (2009) | High | SC | High | SC | Low | Low | High |
| Asgharipour et al. (2017) | SC | SC | High | Low | Low | Low | High |
| Beizaee et al. (2018) | Low | SC | High | Low | Low | Low | High |
| Danhauer et al. (2007) | Low | SC | High | Low | Low | Low | High |
| Foji et al. (2015) | SC | SC | High | High | Low | SC | High |
| Forward et al. (2015) | Low | SC | Low | Low | Low | Low | SC |
| Harris & Johnson (1983) | SC | SC | High | Low | Low | SC | High |
| Jallo et al. (2014) | Low | High | High | Low | Low | Low | High |
| Jing et al. (2011) | High | SC | High | High | Low | Low | High |
| Khojasteh et al. (2016) | High | Low | High | High | Low | Low | High |
| Kiley et al. (2018) | High | Low | Low | High | Low | Low | High |
| Marshall & Gibson (2017) | Low | SC | High | SC | Low | Low | High |
| Mhaske et al. (2018) | SC | SC | High | Low | High | High | High |
| Skodzik et al. (2017) | SC | SC | Low | High | Low | Low | High |
| Skodzik et al. (2018) | SC | Low | Low | Low | Low | Low | SC |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sloman (2002) | High | Low | High | SC | Low | Low | High |
| Tavakolizadeh et al. (2018) | SC | Low | High | Low | Low | Low | High |
| Thomas & Sethares (2010) | High | Low | High | Low | Low | SC | High |
| Thompson & Coppens (1994) | SC | Low | High | Low | Low | SC | High |
| Tolgou et al. (2018) | SC | Low | High | High | Low | SC | High |
| Walker et al. (1987) | High | High | High | High | High | Low | High |

*Note*. SC = Some concerns.

## 4.4 Discussion

This systematic review aimed to synthesise the evidence relating to imagery-based interventions for anxiety reduction and, to the best of the researcher's knowledge, is the first review to do so. After searching four databases, 23 articles were included in the final review and a descriptive and narrative approach was adopted to synthesise the findings of the studies. The main findings of the systematic review are summarised and discussed in more detail below, as well as the limitations of the published research and implications of the review.

A mixture of results was obtained regarding whether imagery methods could significantly reduce anxiety compared to a control activity, with a substantial number of studies providing evidence in support of the claim (44%), whilst others showed no significant decreases in anxiety (39%). There were different types of anxiety investigated across these studies, including state, trait, perioperative, postoperative, test, health, competitive, somatic, cognitive, and behavioural anxiety. When these anxiety outcome types were separated into groups based on whether they were a form of state or trait anxiety, the results indicated that imagery-based interventions were more effective at reducing trait anxiety, compared to state anxiety. There were clear differences between the type of imagery methods used and their ability to reduce anxiety, with suggestions that coping imagery, positive imagery and visual imagery therapy have positive effects on anxiety reduction, whereas studies including the training in mental imagery and guided imagery have mixed effects. These differences were also found for the dosage of the intervention and the mode of imagery used, as the lowest dosage of imagery treatment reduced anxiety (Jing et al., 2011), but the study with the highest dosage did not (Jallo et al., 2014). Also, the studies that produced significant findings for anxiety reduction used multimodal imagery as opposed to a single mode of imagery. Within the make-up of this multimodal imagery, auditory imagery was always included. This could indicate that to obtain a significant reduction in anxiety, an imagery-based intervention should consider the inclusion of a form of auditory imagery.

There was also variability within the type of participants included in the samples such as patients undergoing hemodialysis, women undergoing colposcopy and high trait worriers. A small number of sample types occurred more than once, but the only sample type that consistently saw significant findings for anxiety reduction was hemodialysis patients. Regarding follow-up assessments of the effect of imagery-based interventions on anxiety reduction, four articles in the review included follow-up assessments, showing that anxiety levels remained stable from the post-intervention assessment points to the follow-up assessment points. Finally, the assessment of the quality of studies (measured through the risk of bias) indicated that the highest level of bias was found for how well participants adhered to their assigned intervention and the least amount of bias was for the outcome measurement, followed by whether there was any bias in the reporting of the results. The randomisation process of assigning participants to their intervention groups shared an equal distribution of bias across the three levels (low risk of bias, some concerns and high risk of bias), whilst there was not a high risk of bias for the assignment to intervention. There was evidence to suggest that most of the results were not biased by missing outcome data and when the quality of the studies was assessed individually, the majority of the studies were rated as having a high risk of bias (91%). With this, it would be suggested for future imagery intervention studies to focus carefully on ensuring that individuals are adhering to their assigned intervention properly, as this is where the highest level of bias was found across studies.

Explanations for why imagery-based interventions can reduce anxiety were discussed in the preceding chapters, including a consideration of the relationship imagery can hold with emotion and the role of emotion in experiences of anxiety. Holmes and Mathews (2010) suggested that it is possible for imagery to reduce anxiety yet the overall findings from the studies in this review suggest that this might not always be the case, but there are several possible reasons to explain the varied outcomes. Firstly, it could be that imagery interventions are best used for gradual anxiety reduction as opposed to immediate changes. This suggestion relates specifically to the findings showing how imagery methods were more effective for trait anxiety compared to state anxiety. The variance in the intervention dosage across the studies, as well as the issues of whether or not participants adhered to the intervention, may also account for the mixed outcomes.

For the studies that found significant anxiety reductions, these imagery methods were used - coping imagery, positive imagery and visual imagery. However, it cannot be concluded that these methods would consistently reduce anxiety as there was only one study per imagery method included in this review. As there was such variability (across the results) with respect to specific imagery methods, with the same method producing results to show that imagery interventions did and did not reduce anxiety (Afshar et al., 2018; Alam et al., 2016), this could be accounted for by differences in the way the intervention was conducted. For instance, some guided imagery methods taught the individuals how to visualise a calming environment through the imagination of a relaxing and safe place where they could imagine various scenes using multisensory imagery (Jing et al., 2011). But other participants were instructed to create an imagination of encountering another individual they could share their life with, in addition to relaxing environments like landscapes (Apóstolo & Kolcaba, 2009). Despite the activity being the same, the difference in the content of the imagery sessions can alter the extent to which the imagery can affect one's emotions, and consequently the alleviation of anxiety.

For the intervention dosage, there were differences regarding whether anxiety was significantly reduced or not. When looking at the results of the studies that had the lowest and highest intervention dosage, the lowest dosage (15 minutes) significantly reduced anxiety, whereas the study with the highest intervention dosage (1680 minutes) did not. For the 44% of studies included in the review that demonstrated evidence of anxiety reduction, the mean intervention dosage (when combining the number of sessions with the length of each session) was 334 minutes. It could be that there is an optimum dosage level for imagery-based interventions to be effective at decreasing anxiety, demonstrating an inverted-U relationship, whereby too much or too little of the imagery intervention is sub-optimal. Although, this might depend on the type of anxiety being targeted. For example, as trait anxiety is a relatively stable experience (Gidron, 2013) and state anxiety relates to short-term anxiety, trait anxiety might require a higher dosage. It is also important to note that some studies administered the intervention dose on one occasion, whereas others administered the intervention several times. As Spielmans and Flückiger (2018) suggested, there are different dosage-response relationships in psychotherapy, with some intervention methods achieving the greatest anxiety reduction with a dosage-response relationship that is positive (the higher the dosage, the better the response), or with one that is negative (the lower the dosage, the better the response). Therefore, imagery-based interventions could be more effective if a negative dosage-response relationship is applied.

Moreover, there was no evidence to conclude that a specific mode of imagery was consistently able to reduce anxiety. This is because most studies combined multiple imagery modes in the interventions, and thus made it difficult to determine whether it is the combination of those modes of imagery that contributes towards the anxiety reduction or a specific mode of imagery that makes the most significant contribution towards anxiety reduction. Additionally, many studies did not provide sufficient intervention details, of which the mode of imagery was one.

The lowest risk of bias across studies came from the reporting of the outcomes, potentially due to the consistent use of standardised measures to assess anxiety across the studies (including reliable and valid questionnaires). The overall judgment of the study quality for each study demonstrated that 91% of the studies were rated as having a high risk of bias, due to several studies lacking sufficient information regarding details about the general study design, as well as the intervention activities. However, it is worth noting that for a study to be rated as having a high risk of bias, at least one of the six domains (which the studies are judged against) in the risk of bias assessment would have to be rated as having a high risk of bias. So even if a study received five low risk of bias ratings and one high risk of bias rating, the overall rating for the study would be high risk of bias. This is a major limitation of the studies investigating imagery-based interventions for anxiety and so it would be recommended for future research to ensure that enough information is included in the reporting of the studies.

### 4.4.1 Limitations in the published research

The main limitations arising from this review relate to the quality of the studies, specifically the risk of bias deriving from how well the participants adhered to their assigned intervention groups. From the assessment of the quality of studies included in the review, 87% had a high risk of bias for the intervention adherence section. This high level suggests that it was very unlikely that the participants responded to the assigned intervention in the expected manner. For example, there were some instances where some studies were single-blinded, and this could have presented as problematic due to potential cases of social desirability bias in the participants' responses to the anxiety assessments, as well as demand characteristics from the researcher. To overcome this problem, future investigations into imagery-based treatment methods for anxiety reduction ought to select a study design that involves the double blinding of both the participants and researcher. The heterogeneity of the different types of interventions, including the type and dosage of imagery methods, as well as the lack of precision regarding the forms of mental imagery used, might also limit some of the conclusions that can be drawn. Researchers in this area need to report more details about their interventions in line with the Cochrane guidelines.

### 4.4.2 Implications of the systematic review

Conducting this systematic review highlighted that there is a small pool of studies that have examined the effect of imagery-based interventions using the deliberate imagination of stimuli to reduce anxiety. The review also demonstrated how coping imagery, positive imagery and visual imagery therapy have alleviated anxiety, but due to the small number of studies utilising this method, it cannot be confidently concluded that these imagery methods would consistently reduce anxiety, however, the current results are promising. Therefore, it is suggested that more work into this intervention method is needed to replicate these findings (to determine whether the results are reliable). Additionally, the systematic review identified several ways to improve the study design for investigations that might be conducted in the future.

A common shortcoming apparent in the studies was a lack of detail included in the intervention description, specifically for the mode of imagery and content of the imagery methods. One of the most important intervention detail points in the data extraction stage of the review was the mode of imagery. As discussed in Chapter One, VMI could be used in an intervention setting for anxiety reduction, so there is a need to learn more about auditory imagery in this setting. Yet, it is not possible to determine the efficacy of auditory imagery from the findings in this systematic review as not only was there a lack of studies that used this mode of imagery, but the mode of imagery often went unreported in the articles (*n* = 11). In addition to that, there was variability across studies regarding the description of the imagery method content. Some studies described the content of the imagery sessions in detail, whereas others either did not include any details or used descriptions that were too simplistic, such as “visual imagery meditation is a gentle, but powerful technique that focuses and directs the imagination in proactive, positive ways” (Mhaske et al., 2018, p. 319). For future work, it is important for researchers to specify the mode of imagery instructed or used in the studies (so that it is possible to differentiate between the types of imagery that might be able to alleviate anxiety), and provide descriptive details about what is involved in the intervention methods. This is essential for others to be able to easily replicate these studies to provide supporting evidence, and further strengthen the claim that imagery-based interventions are effective at reducing anxiety (if that is what the results show).

### 4.4.3 Conclusion

In summary, this systematic review appears to be the first to synthesise evidence of the effect of imagery-based interventions on anxiety reduction from studies that include individuals deliberately imagining stimuli of various sensory modes. Overall, the main findings (in relation to the application of imagery methods for anxiety reduction) revealed that there is substantial evidence (i.e., nearly half of the studies) supporting their beneficial effects. However, there are also numerous studies that have failed to be supportive, although, a number of factors have been outlined that may account for these disparate findings. Therefore, taken together, the mixed findings do not necessarily devalue the potential effectiveness of imagery-based interventions for anxiety, but instead point to important future avenues of research.

In particular, it is important to note that of the 44% of studies in the review that showed significant reductions in anxiety, 13% included auditory imagery. But auditory imagery was used in combination with other modes of imagery, therefore it remains unknown whether auditory imagery contributed to the effect of imagery on anxiety reduction. Because of that, more work is needed to explore whether imagery of an auditory nature can have significant impacts on anxiety reduction. The following chapter in this thesis is the first experimental investigation into this phenomenon, as it looks at the feasibility of VMI training then collects preliminary data regarding the effect of VMI on anxiety, as well as mood.

# Chapter 5
# An Exploratory Investigation into Voluntary Musical Imagery Training, and the Effects of Voluntary Musical Imagery on Anxiety and Mood

The review of anxiety interventions in Chapter One highlighted that there is no evidence of an existing VMI-based intervention for anxiety. Therefore, the study in this chapter acts as a starting point for investigating the effects of VMI on anxiety. The main aim of this chapter is to first look at whether it is possible to train non-musicians to voluntarily imagine music through a four-day VMI training programme and assess the feasibility of this training, as the findings from the survey in Chapter Two showed that individuals with high levels of anxiety do not find it difficult to deliberately control forms of auditory imagery. Chapter Three provided the rationale for the potential effectiveness of VMI by focusing on how this activity can target both cognitive and affective factors that add to the development and maintenance of anxiety. Therefore, this chapter also investigates whether there might be any relationships between VMI and anxiety, as well as mood, compared to an active control task. To study these research aims, participants completed baseline measures of musical imagery experience and trait anxiety, and they were trained in VMI and given the opportunity to practise completing the control activity. Using an Experience Sampling Method (ESM), the participants were instructed to complete the VMI and control tasks at random time points across two days, via prompts. After, the participants completed post-training VMI ability assessments and were interviewed about their experiences of the training programme.

## 5.1 Introduction

### 5.1.1 Developing a voluntary musical imagery intervention for anxiety

The problematic nature of anxiety has led to the development of interventions to treat this experience such as CBT (Jolstedt et al., 2018) and mindfulness-based interventions (Navarro-Haro et al., 2019). Several researchers investigating the design of interventions for mental health problems have acknowledged the need for these treatment methods to be developed based on the underlying mechanisms of these mental health concerns (e.g., Beck & Haigh, 2014), as well as targeting factors that can improve adaptive responses for these problems (Iacoviello & Charney, 2014). Interventions that target the underlying mechanisms that act as the agents behind dysfunctional mental health can minimise the effect of these mechanisms. For example, in CBT for anxiety, this type of therapy targets the biased beliefs mechanism in the GCM (Beck & Haigh, 2014), by altering the way in which individuals think about information they are presented with in potentially anxiety-inducing situations, in order to reduce dysfunctional information processing. This in turn minimises the chances of individuals engaging in maladaptive behaviours to cope with the anxiety that can arise from the negative interpretation of the stimuli. The result of this interaction is the alleviation of anxiety.

VMI is offered as a potential anxiety intervention in this thesis on the premise that deliberately imagining music might be able to target the focus mechanism in the GCM, by directing an individual's focus towards the music being imagined instead of any potential anxiety-triggering stimuli. This sustained focus and attention being used in the VMI experience could reduce the chances of anxiety stimuli activating its associated schema, which can lead to dysfunctional information processing and the use of maladaptive behaviours as a coping mechanism for anxiety. VMI might also have a beneficial emotional impact on anxiety. According to Holmes and Mathews (2010), mental imagery can evoke the same emotions that perceived stimuli can. In this case, VMI might have the potential to improve mood and regulate emotions in the same way as music listening (Groarke & Hogan, 2019; Sakka & Juslin, 2018).

When observing the potential anxiolytic effects that VMI might have, it is important to examine these effects in comparison to a control activity. This would allow one to be sure that if there are any effective outcomes in relation to VMI reducing anxiety, these effects can be attributed to the VMI intervention method. The demonstration of significant anxiety reducing effects in comparison to other activities also increases the credibility of the results. Previous mental imagery intervention studies have used wait list control groups (Skodzik et al., 2017), where participants receive the same intervention as the experimental group but at a later time, whilst others have opted for participants receiving usual care (Blackwell et al., 2018). As VMI is not yet an established intervention method, and the most appropriate target population for this method is unknown, this thesis intends to explore who would benefit most from using VMI to reduce anxiety by testing the VMI method on a sample of people who vary in regard to their level of trait anxiety. Therefore, it is not possible to determine what the best form of usual care would be for all of these individuals. Instead, there are benefits to using an active control. When Skodzik et al. (2018) tested the effects of training in mental imagery on the reduction of pathological worry, these researchers used an active and non-therapeutic control, which was thinking in verbal thoughts. This task required participants to think about situations in a verbal and abstract way. In line with this study, an active control can be adopted in the testing of the effects of VMI on anxiety, with individuals being able to complete an activity that can control for time and attention (Kinser & Robins, 2013) in a similar way to deliberately imagining music.

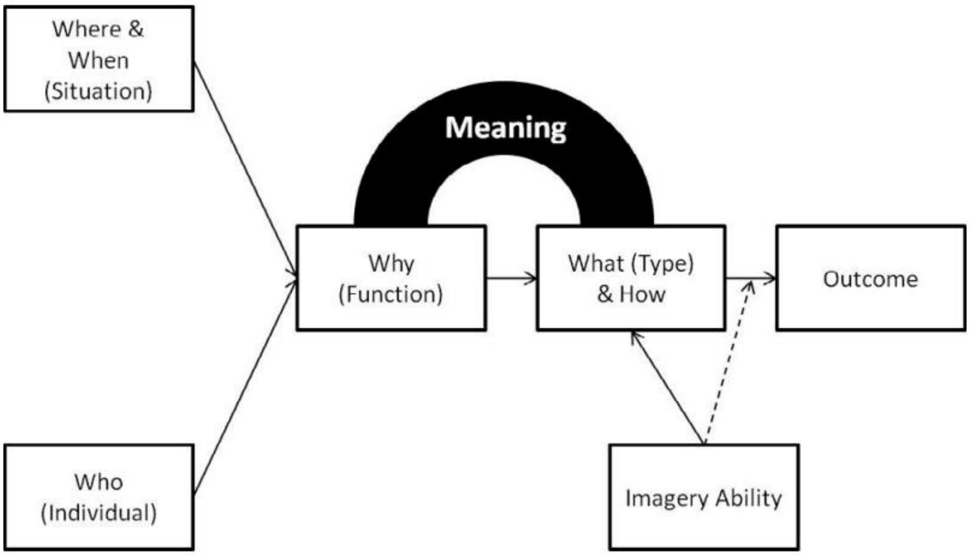
The recommended active control to use in the investigation of VMI for anxiety reduction can be considered in regard to the content of musical imagery. It has been previously found that people most commonly imagine music with lyrics (Beaman, 2018; Halpern & Bartlett, 2011), and so it can be recommended for the control activity to have verbal content in anticipation of individuals being more likely to imagine lyrical music instead of instrumental songs. This task would need to be accessible, easy to learn and adaptable to the equivalent duration of deliberately imagine music. For this reason, the verbal fluency task (VFT) presents as a good option.

Developed by Spreen and Straus (1988), this test requires individuals to think of as many words as possible beginning with a specific letter for a set amount of time (normally 60 seconds). This task can be conducted in any setting, is easy to understand and can control for time in the same way as VMI, as individuals can be instructed to complete both activities for the same duration. Additionally, the VFT can address similar mechanisms that the VMI could target, in relation to anxiety. As discussed in Chapter three, deliberately imagining music requires an individual to focus on maintaining the music that is being imagined, leading to their sustained attention being directed towards this piece of music. With there being evidence of individuals with attention deficits performing poorly on VFTs compared to a match control group (Andreou & Trott, 2013), this suggests that the VFT is an activity that would also require people to focus their attention on this activity in order to complete it. Individuals would also need to have control over various cognitive processes including selective attention and mental set shifting (Patterson, 2011) for the VFT, similar to how VMI involves voluntarily attending to the music that is being imagined and where applicable, being able to easily switch to doing this task.

Further to the importance of including control components when testing the effectiveness of interventions for anxiety, it is common practice for these interventions to assess the effects of potential treatment methods on other mental health variables as well. For example, Saadatmand et al. (2013) used a randomised placebo-controlled study to examine how a nature-based audio intervention can impact anxiety, agitation, and stress in people who are on ventilation support. van Straten et al. (2008) also used a RCT to examine the effectiveness of an internet-based self-help intervention for reducing anxiety, work-related stress, and depression. Looking at the effects of anxiety interventions on mood might also be useful, based on the rationale that underpins the effectiveness of these activities. Groarke and Hogan (2019) have assessed the effects of music listening interventions for anxiety on mood, most likely because of the emotional impact of music, being that music can regulate emotions and mood in a positive direction (Croom, 2015). This reasoning can also be applied to the VMI intervention that is being investigated in this thesis. Chapter Three discussed how cognitive and affective mechanisms are fundamental factors involved in the functionality of the potential effectiveness of the VMI intervention. Therefore, if the use of VMI can lead to improvements in mood states, by increasing the presence of positive mood, it would corroborate the suggestion that affective mechanisms play an important role in the reduction of anxiety (in addition to cognitive mechanisms), but also that looking at anxiety from a multidimensional perspective, as opposed to singular, is a useful way to understand the phenomenon, in line with the approach of the Biopsychosocial model (Engel, 1977).

Also, Chapter One shed light on how variance in musical training is one of the main individual differences in musical imagery ability, with individuals who have more musical training performing better at mental imagery tasks involving pitch imagery and imagery for every-day sounds (Aleman et al., 2000), having more accurate perceptions of musical imagery loudness (Bishop et al., 2013), and experiencing clearer and move vivid musical imagery (Campos & Fuentes, 2016). Controlling for the effects that individual differences in musical training might have on VMI as an intervention method would be worthwhile, to ensure that this factor does not affect the outcome of the VMI method. With relevance to this, the Revised Applied Model of Deliberate Imagery Use (RAMDIU) offered by Cumming and Williams (2013) assists in the development of effective imagery interventions, mainly directed towards the use of mental imagery in dance, sport, rehabilitation and exercise. As seen in Figure 5.1, the model is used to demonstrate how people can use deliberate mental imagery to achieve specific outcomes but above all, the RAMDIU highlights how imagery ability is an important element in imagery interventions that could potentially affect the desired outcomes. If an individual has poor mental imagery abilities, in terms of how well they can control their deliberate imagery, as well as how vivid and clear the imagery might be, the poor imagery abilities could lead to a reduced likelihood of the desired outcome being achieved. When applying the RAMDIU to using VMI for anxiety reduction, if people are unable to have controllable and vivid musical imagery experiences, it would not be likely for this method to have an effective impact on their anxiety. A decision was taken, therefore, to use a sample consisting of individuals who have limited musical training. Additionally, it would be important to see whether it is possible to improve the ability of deliberately imagining music in people who might have an increased chance of experiencing poorer VMI episodes, such as non-musicians. A similar suggestion was made by Wright et al. (2014), who found that imagery training can improve imagery ability in golfers, when imagery was used to enhance golf performance.

Figure 5.1 *The Revised Applied Model of Deliberate Imagery Use (Cumming & Williams, 2013, p. 71)*




There is precedence for researchers investigating potential imagery-based interventions to first train individuals to be proficient in the imagery activity that will be used in the intervention using a mental imagery training programme, before applying the imagery method in an intervention setting (Stefanello et al., 2010). In the study by Skodzik et al. (2017), there was interest in training people in mental imagery, as well as testing the effect of this method on the reduction of worry. The authors designed a mental imagery training programme whereby participants engaged in the practice of generating and maintaining vivid images of future events in their lives (both positive and negative). The practice of mental imagery occurred in the training sessions, as well as over the course of seven days (after the initial session) through prompts from the researchers. Through pre and post-imagery training assessments, the findings demonstrated that training in mental imagery can improve one’s ability in deliberately imagining multimodal stimuli, as the participants generated more vivid and detailed images after mental imagery training, compared to before receiving training in mental imagery. Following on from these findings, Skodzik et al. (2018) used this method to solely assess the effects of training in mental imagery on the reduction of pathological worry and found promising results - training in mental imagery significantly reduced worry activity.

The consideration of these design aspects of the VMI intervention for anxiety highlights the potential for imagery ability to have an impact on the effectiveness of the intervention method. Therefore, training people (specifically non-musicians) in VMI using a VMI training programme, before applying this method as an intervention, would be a recommended approach.

### 5.1.2 Designing a voluntary musical imagery training programme

To improve one's ability to voluntarily imagine music, practising this activity might be one of the best ways to do so. In the musical realm, studies indicate that an increase in the practice of an instrument is associated with higher attainment levels (Ericsson et al., 1993; Williamon & Valentine, 2010). This concept also extends to the imagery domain, where researchers have shown how imagery ability (of various modes) can be improved through imagery practice. For example, motor imagery is seen as an important element in sports, and so several studies have focused on improving motor imagery ability through the practice of imagining motion-related imagery. Hammond et al. (2012) investigated the effects of a motivational general-mastery imagery intervention on imagery ability in golfers and produced results highlighting how motor imagery practice (through the intervention) can improve motor imagery ability in individuals who play golf. These findings are also replicated in other sporting activities, whereby the improvement of motor imagery was demonstrated through the practice of motor imagery in softball (Calmels et al., 2004) and synchronised skaters (Cumming & Ste-Marie, 2001).

When looking at how the practice of musical instruments can assist with music performance, and motor imagery with sports performance, a clear overlap between the two modes is the element of rehearsal. Therefore, this repeated practice could also be a vital element required in the improvement of imagery ability. Being repeatedly exposed to the imagining of the stimuli can allow people to have the opportunity to improve the clarity, vividness, and controllability of the imagery in each attempt. The extension of this concept to the current study could be that the deliberate mental rehearsal of music in the mind can be incorporated into the training methods that would be used in the VMI training programme. The beneficial aspect of this relates to the repeated practice allowing individuals to strengthen their VMI, focusing on improving parts of the music that they might have weaker imagery for.

There is evidence of several methods being used to train individuals to deliberately imagine music. Firstly, musicians often engage in aural skills training, which Demirbatır (2014) states can allow musicians to improve in their ability to recognise and analyse musical components, to address sounds based on the type of musical structure they are (such as rhythm, pitch and tempo), and in musical notation. Despite being a suitable VMI training method, this approach has been developed for musicians specifically, limiting the potential effectiveness of training non-musicians with this method. The aims of aural skills training are different to the goals of VMI training in this study, as the VMI training programme intends to improve the ability of deliberately imagining music in non-musicians. Therefore, a different musical imagery training method is needed, that is designed for individuals irrespective of their musical training.

Other approaches include the Pitch Imagery Arrow Task (PIAT), which was introduced by Gelding et al. (2015). Gelding et al. (2015) primarily aimed to train musicians and non-musicians how to imagine music, with a specific focus on pitch imagery. The PIAT trains pitch imagery in people using a staircase design, whereby individuals are presented with a pitch sequence and an arrow to indicate where there is a scale step in the imagined pitches. Participants are then asked to state whether the last imagined tone corresponds to an audible probe that is played. Despite being a method that can be used to train musical imagery in people with various levels of musical training, one limitation of this approach is that this training method only focuses on pitch imagery, which is not the only element of music that can be included in musical imagery episodes. Thus, the PIAT fails to accommodate the training of other elements of the music that individuals can imagine, such as timbre (Bailes, 2007) and tempo (Jakubowski et al., 2016). A potential method that could be offered instead of aural skills training and the PIAT is the volume fader task, previously applied by Bailes and Bigand (2004) to follow mental imagery for classical music. This task works by encouraging people to use an image-tracking paradigm, through which individuals follow a piece of music, alternating between listening to and imagining the music using a volume fader. Even though the objective of the volume fader task in Bailes and Bigand's (2004) study was to track people's mental images for classical music pieces, and thus not related to musical imagery training purposes, it is well-suited for the aims of this VMI training study. The volume fader task could allow participants to practise voluntarily imagining music by alternating between listening to and imagining music, providing them with complete control over their VMI training and providing them with an opportunity to become aware of the weaker mental images they might have for specific sections of the music.

In addition to training the participants to voluntarily imagine music, it would be useful to see whether it is possible for individuals to practise this technique in their everyday life. In Skodzik et al.'s (2017) study, where participants received mental imagery training, the researchers used an ESM to allow individuals to practise the deliberate mental imagery that they were trained in during their daily lives. This same approach can be applied to the present study. Using ESM to study momentary behaviour has been suggested to be beneficial for the study of naturally occurring behaviours by O'Connor and Ferguson (2008). There are three different forms of ESM that can include participants completing diary entries at certain times during the day (interval-contingent), completing diary entries in response to specific events occurring (event-contingent), or entries being completed in response to random prompts (signal-contingent). For the purpose of this study, it could be recommended to use a combination of interval-contingent and signal-contingent types of ESM, as these approaches can allow data to be collected across a wide time frame and also allow for the observation of the direct effects occurring in response to the completion of an activity (when prompted). Advantages of ESM relate to the fact that this method can decrease retrospective bias, depending on how the questions are constructed, and researchers can study momentary behaviours in naturalistic settings. For instance, individuals can report their anxiety and mood levels after being prompted to either deliberately imagine music or complete the VFT. As this thesis is interested in investigating naturally occurring anxiety, as opposed to induced anxiety, this makes ESM a good approach to capture the possible effect of VMI on that type of anxiety. Following the VMI training, the training programme and its everyday implementation will need to be evaluated in relation to whether the training method can improve one's ability to voluntarily imagine music.

### 5.1.3 Assessing voluntary musical imagery

To assess the impact of the mental imagery training programme on individuals' mental imagery ability, Skodzik et al. (2017) measured the participants' mental imagery ability before and after being trained in mental imagery using the shortened form of Bett's questionnaire upon mental imagery (Sheehan, 1967). Taking pre and post-VMI training measures of VMI ability, in the same way as Skodzik et al. (2017) did for pre and post-mental imagery training, would provide an insight into whether training in VMI can improve VMI ability. Moran (1993) previously stated that there are specific aspects of mental imagery that should be targeted when measuring one's imagery–the controllability and vividness of the auditory imagery, and the accuracy of the imagery in comparison to the perceived sound–and this can be applied to musical imagery ability. Self-report measures have been used in various imagery domains to learn more about the experiences of mental imagery. For example, Stefanello et al. (2010) used the Sports Imagery Questionnaire to assess motor imagery ability in dart throwers. For musical imagery, researchers have presented questionnaires focusing on the experience, including the controllability and vividness of musical imagery episodes (Halpern, 2015). Floridou et al. (2015) developed the Involuntary Musical Imagery Scale (IMIS) to assess individual differences in INMI. Within this questionnaire, the frequency and duration of INMI episodes are assessed, as well as four main factors relating to individual differences in INMI that concern the negative valence, movement-related responses, personal reflections, and the helpfulness of INMI. The IMIS is a reliable and validated questionnaire (Liikkanen & Jakubowski, 2020) that only looks at musical imagery, and so appears to be fitting for this study. But as this questionnaire addresses music imagined in an involuntary manner, and with Weir et al. (2015) finding no associations between the experience of imagining music involuntarily and how accurately one can voluntarily imagine music, this means that other questionnaires measuring musical imagery of a voluntary nature should be considered, in addition to the IMIS.

Willander and Baraldi (2010) developed the Clarity of Auditory Imagery Scale (CAIS) in response to issues raised with existing imagery scales, specifically that items assessing auditory imagery ability do not acknowledge the distinction between the vividness and clarity of auditory imagery, like the Betts' Questionnaire upon Mental Imagery (Betts, 1909). The CAIS overcomes this limitation, as the questionnaire assesses the vividness and clarity of auditory imagery as separate phenomena. However, the CAIS fails to recognise an important element in the experience of musical imagery, the controllability of the imagery (Cotter, 2019). Fortunately, another questionnaire that assesses the vividness, in addition to the controllability, of auditory imagery has been developed - the Bucknell Auditory Imagery Scale (BAIS). This self-report questionnaire, developed by Halpern (2015), collects information about the general vividness and controllability of voluntary auditory imagery (with some questions relating to musical imagery), and initially presents as a promising method to measure musical imagery ability. However, there is a limited number of items included in the questionnaire that address auditory imagery that is musical. Also, despite self-report questionnaires being a leading method in the assessment of mental imagery (Willander & Baraldi, 2010), there are disadvantages associated with these self-report techniques. For instance, there might be individual differences relating to how each participant interprets rating scales included in the questionnaires. Additionally, even with the questions in the BAIS that focus on musical imagery, these questions do not cover the entire breadth of the VMI experience, and they only measure the subjective experience of musical imagery. Therefore, there is a need to consider the potential use of more objective measures to assess VMI ability in addition to the questionnaires, so that the VMI experience can be thoroughly assessed.

As mentioned previously, another aspect of auditory imagery that can be assessed is the accuracy of the mental image (Moran, 1993). So, a different way in which the accuracy of VMI can be measured objectively is through an imagination-continuation paradigm, previously adopted by Weir et al. (2015). This method involves presenting individuals with musical excerpts interpolated with silent sections, where they would be prompted to continue imagining the music whenever they encounter a silent gap. With its use being applied to studies that have ranged from investigating the accuracy of pitch and timing judgements whilst deliberately imagining music (Weir et al., 2015) to determining whether individuals can accurately imagine music when prompted to (Burgoyne et al., 2013), the imagination-continuation paradigm can be used in the present study. Reasons for the application of this method in the assessment of musical imagery ability include this approach allowing one to assess how an individual imagines music as it is happening, and it is not a specialised task based on musical training or other factors that might bias performance in this activity. There is also evidence showing how individuals can spontaneously imagine music when listening to music excerpts that have silent gaps (Kraemer et al, 2005), highlighting how it is possible for people to imagine music in these conditions.

Further to this, other important elements of auditory imagery, such as temporal characteristics, can be considered when assessing one's ability to imagine auditory stimuli. In both past and more recent times, researchers have opted for mental chronometry to measure how people perceive temporal characteristics of musical imagery (Repp, 1999; Wöllner & Williamon, 2007). The chronometric task is a type of mental chronometry activity that involves tapping along to the beat of a piece of music as it is imagined in the mind. Clark and Williamon (2012) applied this idea by comparing tempi (produced by tapping to the beat) of live and imagined music performances, as a way to objectively assess musical imagery ability in music performance students. Bishop et al. (2013) also adopted a tapping task in the study of musical expertise and one's ability relating to the loudness of musical imagery, where participants were asked to tap along to the rhythm of imagined pieces. Assessing an individual's ability in this manner presents as another plausible method to be adopted by the current study.

### 5.1.4 Aims and predictions

This study aimed to test whether it is possible to train non-musicians to voluntarily imagine music. To do this, a four-day VMI training programme was designed where non-musicians were trained in the deliberate imagination of music and completed a control task (day one), were prompted to complete these activities on individual days during their daily lives using an ESM (days two and three), then underwent VMI ability assessment and were interviewed about the study (day four). Additionally, anxiety and mood measures were compared between the two ESM days (VMI vs verbal control task) to determine whether voluntarily imagining music was associated with different levels of self-reported anxiety and mood, in comparison to an active control task.

Following the literature above discussing how training in mental imagery (of various modes) can improve imagery ability (Skodzik et al., 2017), it was hypothesised that training in VMI would improve VMI ability. There were also three secondary predictions relating to the feasibility of VMI training; the difficulty of the training sessions will decrease across training trials, the amount of time spent needing to physically listen to music in the VMI training activity will decrease as individuals progress, and previous musical imagery experience will predict variance in VMI ability assessment outcomes. For the findings relating to anxiety and mood reports during the ESM stage, it was predicted that VMI would be associated with decreases in anxiety as well as increases in positive mood, compared to the verbal control activity. These predictions were formulated based on the rationale provided behind the potential effectiveness of VMI for anxiety reduction, being that this method might be able to target cognitive mechanisms that contribute towards the development of anxiety, as well as the effects that mental imagery has on affective variables (Holmes & Mathews, 2010).

## 5.2 Method

### 5.2.1 Participants

34 psychology undergraduate students were recruited from the University of Leeds (33 females and one male) using an online participant recruitment scheme (Appendix F.1), where the students received 15 course credits in exchange for study participation. The ages of the students ranged from 18 to 21 years old (*Mdn* = 19, *M* = 19.1, *SD* = .8). Exclusion criteria consisted of individuals who were under the age of 18, had hearing loss, or belonged to any of the following categories: previous or current music student, identify as a musician or had five or more years of formal musical training. These criteria were used as there was

interest in an adult sample, people with hearing loss would have difficulty in the activities that involved music listening, and it is already established that individuals with musical training are better at deliberately imagining music (Aleman et al., 2000; Bishop et al., 2013; Campos & Fuentes, 2016). The participants were randomly assigned to one of two groups for the training session when they completed the pre-VMI training tasks (discussed further in section 5.2.5.1 below). This research received ethical approval from the Faculty of Arts, Humanities and Cultures Research Ethics Committee (approval code: PVAR 16-087) on 16th October 2017 (Appendix F.2).

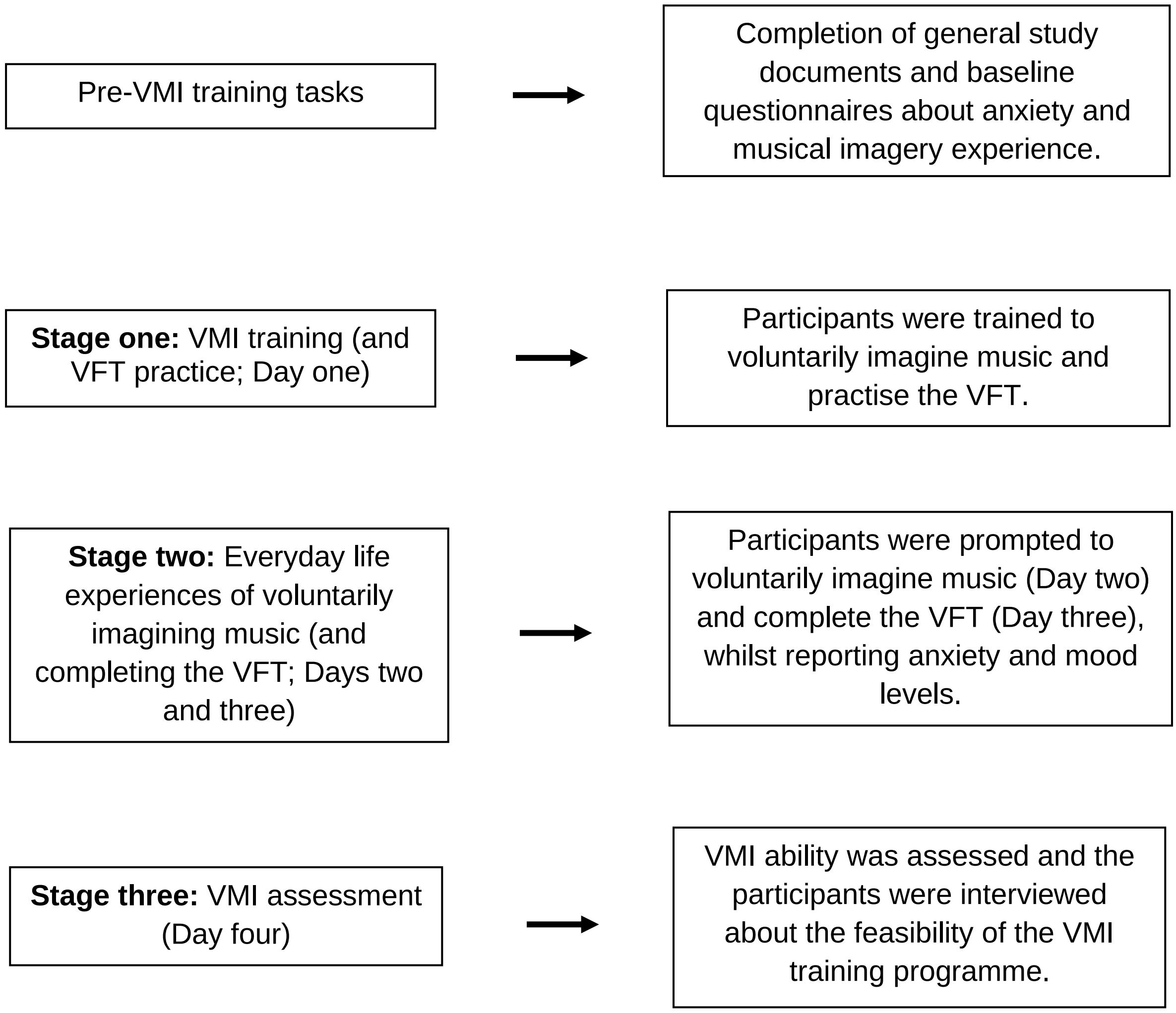
### 5.2.2 Overall design

A repeated measures design was used, with the main independent variable being condition (with two levels: VMI and VFT). Further information about the dependent variables measured in each stage of the study can be found below in the relevant sub-sections (5.2.5.1 - Stage one design, 5.2.6.1 - Stage two design and 5.2.7.1 - Stage three design).

### 5.2.3 Overall procedure

Participants completed a four-day training programme, with the primary aim being to train non-musicians to deliberately imagine music (Figure 5.2 presents a schematic diagram of this training programme). Before the participants completed the training programme, they provided their consent to participate and information about their previous musical imagery and anxiety experiences was collected. The participants also completed a music selection criteria form and selected a piece of music to use for this study. For the training element, the participants were invited to a music studio at the University of Leeds where they were trained to voluntarily imagine music and practise completing a VFT in stage one. In stage two, these activities were incorporated into their daily lives and information about their experiences in completing these tasks, and associated anxiety and mood levels, was collected. Stage three involved the assessment of the participants' VMI ability and completion of an interview that primarily related to the training of VMI. Further information about the details of the activities in each stage of the training programme can be found in these sections: 5.2.4.2 (Pre-VMI training procedure), 5.2.5.5 (Stage one procedure), 5.2.6.4 (Stage two procedure) and 5.2.7.5 (Stage three procedure).

Figure 5.2 *Schematic diagram of the four-day VMI training programme*




*Note*. General study documents included the information sheet, consent form, anonymous identification (ID) document and the music selection criteria form. The days in stage two were counterbalanced, so that half of the participants completed the VMI activities on day two, whereas the other half of the participant sample completed the VFT on day two.

### 5.2.4 Pre-voluntary musical imagery training tasks

The objective of this stage was to inform the participants about the study, gain their consent to participate and collect information about their general musical imagery experiences and trait anxiety. This section also allowed participants to select music pieces to use in this study.

#### 5.2.4.1 Materials

The participants received an information sheet (Appendix F.3), a consent form (Appendix F.4), an anonymisation ID document (Appendix F.5) and a music selection criteria form (Appendix F.6) electronically, via the online participant recruitment scheme.

##### 5.2.4.1.1 Music selection criteria form

The criteria in this form related to four themes; the likability of the music, the music's ability to evoke happiness, the familiarity of the music piece and memories associated with the music. The questions that were about the music likability, familiarity of the music and whether the music made the participants feel happy were rated on a Likert scale from 1 to 10, with 1 being the lowest rating and 10 being the highest rating. The memory question addressed whether participants had any memories associated with the music and was presented in the form of a multiple-choice question, with two responses to choose from - 'Yes' or 'No.' These criteria were chosen to ensure that the selected music pieces did not have a negative impact on the participants' mood (by using music that the participants liked and made them feel happy) and to keep the difficulty of the VMI training task at a low level by using familiar music. Further to this, minimising the number of memories associated with the chosen music piece would reduce the chances of this being a confounding variable, influencing the type of mood experienced by the participants. For instance, memories of a positive nature associated with music might be more likely to lead to positive mood outcomes (Janata et al., 2007; Juslin & Västfjäll, 2008). In addition to these criteria, the duration of the selected music pieces had to be three minutes or less to ensure that the training session did not last any longer than two hours.

##### 5.2.4.1.2 Standardised measures

The participants' musical imagery experiences (both involuntary and voluntary) were recorded, and baseline musical imagery ability was assessed (pre-VMI training programme) to see whether these could predict performance on the VMI ability assessment tasks. The IMIS (Floridou et al., 2015; Appendix D.2) and the BAIS (Halpern, 2015; Appendix A) were used to assess this experience and these questionnaires will be briefly discussed here, as an in-depth description of both questionnaires has been provided in Chapter Two (p. 47). The IMIS is a self-report questionnaire that assesses the INMI experience, addressing four key themes of INMI episodes: negative valence, movement, personal reflections, and the helpfulness of INMI. There are also questions that measure the frequency and duration of INMI. For this sample, there was a good level of internal consistency, ($\alpha$ = .89). The BAIS assesses individuals’ experiences of voluntarily imagining auditory information, by measuring the vividness and controllability of the imagery through the two scales (each with 14 items); the BAIS-V (Appendix A.1) and BAIS-C (Appendix A.2) scales. The items included in the questionnaire require participants to imagine a scenario where a specific type of sound is described. For the BAIS-V, participants are asked to rate how vivid the image is and for the BAIS-C, participants are asked to rate how easy it is to switch from an image of one sound to the image of another sound. The levels of internal consistency for both the vividness (α = .81) and controllability (α = .78) scales were high.

Additionally, the participants’ trait anxiety was assessed using the State-Trait Anxiety Inventory-Trait Scale (STAI-T; Spielberger et al., 1983). Similarly, with the IMIS and the BAIS, this questionnaire was discussed in detail in Chapter Two (p. 45), so a summary will be provided here. The STAI-T (Appendix D.4) measures the general experience of anxiety using 20 items in the form of a Likert scale from 1 (*Almost never*) to 4 (*Almost always*). The questions included in the questionnaire focus on four main themes–tension, nervousness, worry and apprehension–and the participants are asked to rate how they generally feel in response to the items. Scores from this questionnaire can range between 20 (lowest) and 80 (highest). There was a high level of internal consistency in this sample, α = .94. All of the questionnaires were presented using the online survey tool, Online Survey (found at www.onlinesurveys.ac.uk).

#### 5.2.4.2 Procedure

The participants provided their consent to participate and created anonymous ID codes that were assigned to their data, using the anonymous ID form. The music selection criteria form was completed, and participants were instructed to select a piece of music to use in this study, according to the specified criteria. After, the participants completed the IMIS, BAIS and the STAI-T. To avoid response bias in relation to anxiety from the participants, the questionnaires were presented in this specific order and the study information did not emphasise anxiety as a prominent theme.

### 5.2.5 Stage one: Voluntary musical imagery training (and verbal fluency task [VFT] practice)

#### 5.2.5.1 Design

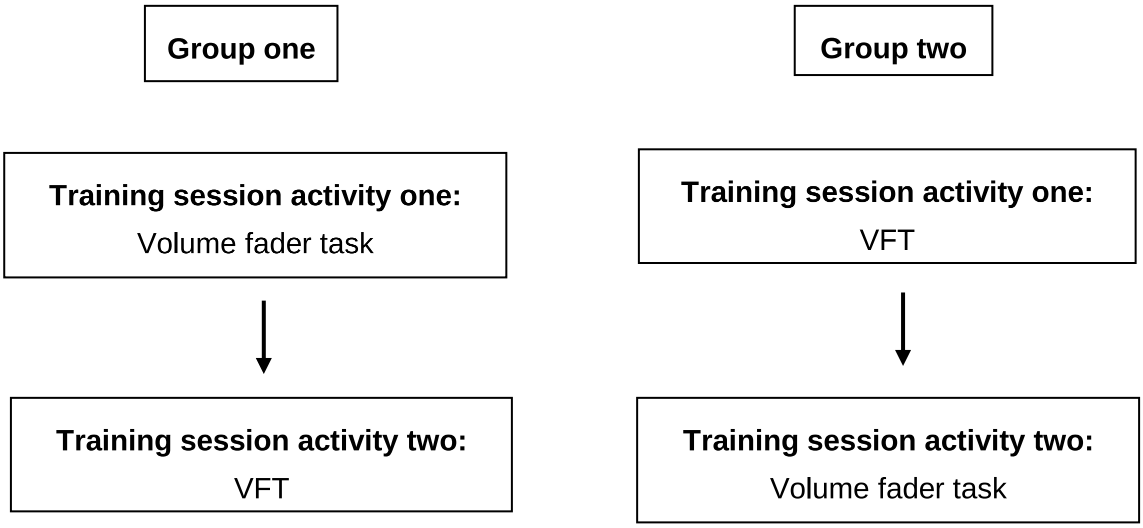
The main purpose of the first stage of the VMI training programme was to train the participants to voluntarily imagine music using a volume fader task and to allow them to practise completing the VFT. Additionally, baseline measures of music likability and mental chronometry ability (from the chronometric task) were collected, to be compared to post-VMI training assessments in stage three. The independent variable was condition with two levels, VMI and VFT. The primary dependent variables were the discrepancy between the total number of taps whilst listening to and imagining the self-selected piece of music (in the pre-VMI training session) and the discrepancy between the perceived tempo whilst listening to and imagining the music (in the pre-VMI training session).

The amount of time spent listening to music during the volume fader task, the perceived task difficulty and the likability of music were secondary dependent variables. The difficulty of the tasks was measured to monitor the participants' experience of the volume fader task, specifically functioning as an indicator of whether there were improvements in the ease of the activities across trials. Additionally, measuring task difficulty was used to determine whether the volume fader task might be too difficult to implement in future VMI training or practice programmes. The anxiety and mood levels reported during and at the end of the day were also additional dependent variables. The order in which the participants completed the activities in the training session was counterbalanced to overcome order effects, with group one completing the volume fader task first, whilst group two completed the VFT first (shown in Figure 5.3). Participants were randomly assigned to each group after giving consent to participate in the study.

#### 5.2.5.2 Materials

A variety of rating scales and questionnaires were given to the participants to collect information about their experiences of completing the volume fader and verbal fluency tasks. The items in the rating scales and questionnaires are discussed further in sections 5.2.5.2.1 and 5.2.5.2.2. All of the questions were presented using Online Survey apart from the trial difficulty questions (for the volume fader and verbal fluency tasks), which the participants completed using Microsoft Word 2016.

Figure 5.3 *The counterbalanced order of the training session activities*




*Note*. VFT = Verbal fluency task.

#### 5.2.5.2.1 Rating scales

There were three rating scales: for music likability (Appendix F.7) and the difficulty of the volume fader task (Appendix F.8) as well as the VFT (Appendix F.9). The music likability rating scale ranged from 1 (*Not very much*) to 10 (*Extremely*) and was used to collect baseline measures relating to how much the participants' liked their selected pieces of music before the training programme. This would then be compared with post-VMI training music likability ratings. This pre-post VMI training comparison was used to ensure that the training programme did not harm the participants' enjoyment of their selected music pieces. During the volume fader and verbal fluency tasks, the participants used difficulty rating scales to rate the difficulty of the trials. The scale ranged from 1 (*Not very difficult*) to 10 (*Extremely difficult*). Analysis of these data focused on the difficulty ratings in the first trial compared to the last trial, with interest in seeing whether the perceived difficulty of the tasks reduced across trials, as the participants progressed through the training activities.

#### 5.2.5.2.2 Volume fader task and verbal fluency task questionnaires

The volume fader task questionnaire (Appendix F.10) included six questions that assessed the difficulty of the trials, the clarity of the musical imagery, musical elements that might have been focused on while imaging the music (as well as the ease of focus on these elements when instructed to do so), and additional techniques that were used in the VMI episodes. For the VFT questionnaire (Appendix F.11), four questions collected information about the difficulty of the task, the number of words the participants thought of, additional techniques that might have been used to assist with this activity and whether the participants imagined visual imagery at the same time.

**5.2.5.3 Stimuli**

The participants were asked to select their own pieces of music to use in this study, according to specified criteria which included choosing a song that they like, are familiar with, makes them feel happy, have no memory associations and is no longer than three minutes. There was a specific focus on music that promotes a positive mood as opposed to music that makes people feel relaxed, as Västfjäll et al. (2012) state that inducing positive mood states is more important when trying to alleviate anxiety. This is based on the notion that for music to have beneficial effects on one's mental health, music that evokes positive emotions should be used (Leventhal & Patrik-Miller, 2000). A list of the songs the participants selected, and the song provided by the researcher, is located in Appendix F.12.

**5.2.5.4 Equipment**

The Clock application on an Apple iPhone 6 was used for the chronometric and verbal fluency tasks. Within this mobile phone application, the stopwatch kept a track of the duration of time spent tapping during the chronometric tasks and the timer was used in the VFT to notify the participants when the task had been completed (once one minute had passed).

The equipment used in the music studio included two desktop screens, three speakers, a volume fader board, and a PC keyboard, which can be seen in Figure 5.4 below. There was also sound proofing material on two sides of the studio walls, to minimise external auditory interference. A piece of opaque material was used to cover the screen during the volume fader task, as the music waveforms displayed on the screen could provide visual cues to assist the participants when deliberately imagining music. The programme Logic Pro X recorded data from the volume fader task to graphically depict the movement of the volume fader board when the participants imagined and listened to music (Figures 5.5).

Figure 5.4 *VMI training equipment in the music studio*

Figure 5.5 *Images of the volume fader board*

**A** **B**

*Note*. The first volume fader to the far left in these images was used in this study and is raised in image A (representing when individuals listened to the music) and lowered in image B (to show when music was being imagined).

**5.2.5.5 Procedure**

The training session lasted up to two hours and involved four activities: music likability rating, the pre-VMI training chronometric task, the volume fader task and the VFT. The participants were told that the study aimed to look at individuals' experiences of mental imagery, with specific focus on musical imagery and verbal tasks. After, the participants were provided with a brief definition of musical imagery ("Musical imagery involves imagining music in the mind") and rated how much they liked their piece of music using the music likability scale.

Next, the pre-VMI training chronometric task was completed, which involved participants tapping along to the beat of their selected music. In order for the participants to understand what was required of them in this activity, they first practised the task by listening to a piece of music provided by the researcher and tapped along to the beat of this piece with the researcher. After this practice of beat tapping, the participants were directed to focus on the desktop screen in front of them, where the website Tempo Tap (www.tempotap.com) was displayed. The participants were asked to tap along to the beat of their self-selected music piece for as long as possible (using the space bar on the keyboard), while listening to the song, and to alert the researcher when they had finished tapping by saying "finished." Following this, the participants tapped along to the beat of the same music piece using the space bar, but while imagining the music, and repeated this activity twice. Tempo Tap recorded the total number of taps completed, the tempo of the tapping pattern (represented by beats per minute) and the tapping duration for each attempt. The mean number of taps and tempi recorded were calculated from the attempts at tapping while imagining music.

After rating the likability of the music and completing the mental chronometry tasks, the participants completed the volume fader and verbal fluency tasks. The volume fader task was used to train the individuals to voluntarily imagine music using Logic Pro X and a volume fader board, to present the music and record volume fader movements. In this task the participants first listened to the entire duration of the music, then imagined the music piece after. To do this, the participants were instructed to start the playback of the music with the volume fader raised, and lower the volume fader to the bottom so that the sound was muted whenever they wanted to imagine music, then raise the fader up again whenever they wanted to listen to the music (to check if their mental image for the piece was correct). The combination of listening to the entire piece of music, then attempting to imagine this piece, formed one trial. The participants completed one practice trial (with the researcher present), then three compulsory trials (without the presence of the researcher). During the compulsory trials (and subsequent trials after those) the desktop screen was covered with an opaque material. The participants were told to complete as many trials as they felt were necessary after the three compulsory trials, in order to reach a point where they could imagine as much of the music as possible without having to listen to the music. After each trial (excluding the practice trial), the participants rated how difficult they found the activity and completed the volume fader task questionnaire. These questions related to the difficulty of the training session (to determine whether the volume fader task would be deemed too difficult to use for future implementation), the clarity of the musical imagery produced (to see how the clarity of their musical imagery changed over time), musical elements that the participants might have focused on (to get a clearer insight into what the participants were imagining), and additional techniques that were used or could have been used to assist in their VMI experience.

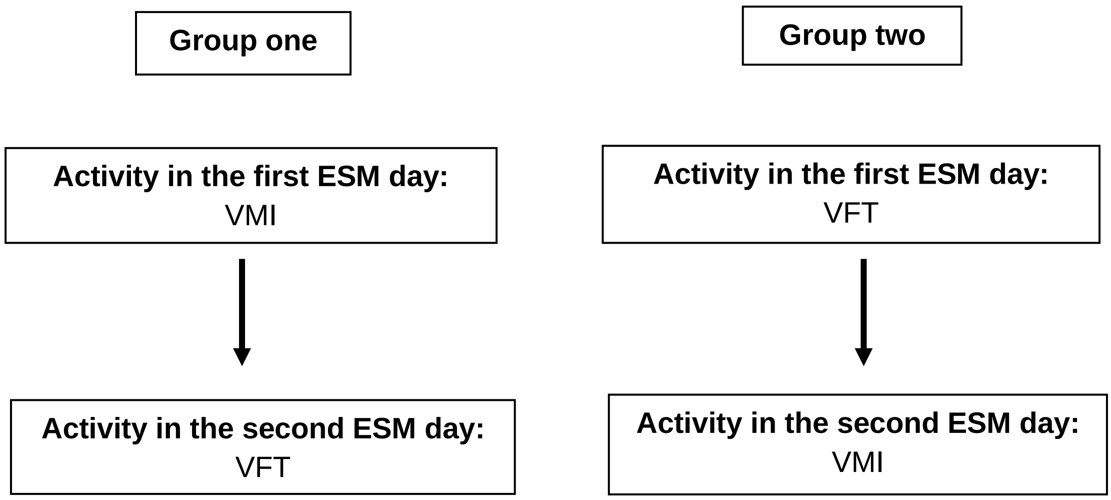
In the VFT, the participants were asked to think of as many words as they could beginning with a specific letter for one minute and keep a count of the number of words they came up with. The participants first completed the task mentally then verbally, following a similar structure to the volume fader task. The combination of these two versions of the VFT (mentally and verbally) formed one trial. There was one practice trial (using the letter ‘P’) and three experimental trials (using the letters ‘F,’ ‘A’ and ‘S’). The participants completed the VFT questionnaire after the first and third trials but rated the difficulty of the activity after each trial. After completing the tasks, the researcher gave the participants instructions for the following two ESM days via email (Appendix F.13).

### 5.2.6 Stage two: Everyday life experiences of voluntarily imagining music (and completing verbal fluency tasks)

#### 5.2.6.1 Design

The purpose of this stage was for participants to practise deliberately imagining music and completing the VFT during their daily lives, whilst answering questions about these attempts as well as reporting their anxiety and mood levels. The independent variable was condition (VMI and VFT). The main dependent variables were anxiety change (taken from the anxiety ratings before and after completing the activity), mood, and the end of day mood and anxiety. The order of ESM days was dependent on the group the participants were assigned to at the start of the study, as seen in Figure 5.6 below.

Figure 5.6 *The counterbalanced order of the VMI and control days during stage two*




*Note*. Participants who were assigned to group one in the training sessions were also assigned to group one in the ESM stage.

**5.2.6.2 Materials**

**5.2.6.2.1 Voluntary musical imagery questions**

For the VMI questions (Appendix F.14) that were given to the participants during the ESM stage, 21 questions were asked at each of the first five contact points. These questions were grouped into three different categories - general information, the experience of deliberately imagining music, and anxiety and mood. For general information, the participants provided details about the date and time of completion of the questions, the text message number, their anonymous ID code and the name of the music piece imagined (to ensure it was the same as the piece they were trained with in stage one). Most of the questions in the experience of deliberately imagining music section required the participants to state whether they could successfully imagine the music, how many attempts it took, whether they could remember the lyrics correctly (if applicable), their current sound environment and when the music was last heard out loud. The participants were also asked about the vividness of their musical imagery compared to the vividness of hearing the music, how difficult it was to imagine the music, the ease of and how distracting imagining music was compared to the activity they were doing before (as well as what that activity was), and whether they listened to the music before imagining it. For anxiety and mood, the questions focused on current anxiety state, change in mood (if any) and the mood experienced while imagining compared to listening to music. Two additional items were added to the sixth (last) contact point to assess the degree of anxiety and mood at that point (which would represent the end of day mood and anxiety reports).

#### 5.2.6.2.2 Verbal fluency task questions

For the VFT questions (Appendix F.15), there were 16 questions in the first five contact points that collected details about general information, completing the VFT, anxiety and mood. The questions relating to general information were the same as those in this category for the VMI questions, except the participants were not asked to name any pieces of music. Questions concerning the completion of the VFT collected information from the participants regarding whether they could think of at least ten words, if there was any repetition of words, their current sound environment, the previous activity before completing the VFT and how easy it was to complete the VFT following this previous activity (as well as how distracting the VFT was from the preceding activity), and the difficulty of the VFT. For anxiety and mood, the questions were the same as those included in the VMI section. The same two additional items relating to end of day mood and anxiety mentioned previously in the VMI question section (5.2.6.2.1) were also included in the sixth contact point.

### 5.2.6.3 Equipment

The participants used their mobile phones to receive the text messages from the researcher and used the timer application, when applicable.

### 5.2.6.4 Procedure

The second stage of the VMI training programme involved the everyday practice of VMI and the active control (the VFT) using an ESM approach over two days. Preliminary data on anxiety and mood that were associated with these activities were also collected. On the VMI day, the participants were contacted via text message at six random points between 8am and 8pm (e.g., 09:50, 11:45, 13:00, 14:05, 18:00 and 19:40) using Text Local - an online text scheduling service (www.control.txtlocal.co.uk). Six time points were used to cover a variety of points during the testing days. Each text message contained a website link (Appendix F.16) which led to a set of instructions informing the individuals to imagine the self-selected piece of music that they were trained with in stage one for two minutes (as this was a short duration that could also be used for the VFT), using the timer application on their mobile phones. Subsequently, the participants answered questions relating to these attempts. The instructions for the VMI day were to “Start the 2-minute timer on your phone and imagine the piece of music (from this study) in your mind. You can listen to the music before your attempt (if needed). After you complete the activity, complete the questions below."

The format of the VFT day was similar to the VMI day except the contact times were different (08:15, 11:30, 12:30, 13:45, 15:55 and 18:35), and the participants were told to complete VFTs, instead of imagining music. On this day, the first three texts instructed the participants to think of as many words as they could beginning with the letters 'F' (text one), 'A' (text two) and 'S' (text three), then the next three texts asked the participants to think of as many words as they could relating to a specific word - 'line' (text four), 'shape' (text five) and 'egg' (text six) for two minutes (using the timer application on their mobile phones). Here is an example of the instructions for the VFT day: "Start the 2-minute timer on your phone and think of as many words as you can in your mind beginning with 'S.' Count them and complete the questions below." These activities occurred wherever the participants were when they received the text messages and lasted approximately five minutes for each contact point - totalling 30 minutes for each ESM day.

### 5.2.7 Stage three: Voluntary musical imagery assessment

#### 5.2.7.1 Design

The purpose of this stage was to assess the participants' ability to voluntarily imagine music through a post-VMI training chronometric task (with which the data were compared to the data from the pre-VMI training chronometric task in stage one), and an imagination-continuation task. The main dependent variable in the post-VMI training chronometric task was the discrepancy between the total number of taps while listening to and imagining the self-selected piece of music (in the post-VMI training session) and the discrepancy between the perceived tempo while listening to and imagining the music (in the post-VMI training session). For the imagination-continuation paradigm, the dependent variable was the performance accuracy. The participants were also interviewed about their study participation, to gather more information on the feasibility of VMI training using the methods in this study.

#### 5.2.7.2 Material

##### 5.2.7.2.1 Imagination-continuation task questions

To assess the accuracy of the participants' performance on the imagination-continuation task, there was one main question with two sub-questions (Appendix F.17). The main question addressed whether the music was introduced at the correct position in the music snippet, in the form of a multiple-choice question with participants being able to respond with a ‘Yes’ or ‘No’ answer. Then the sub-questions related to how confident participants felt in their responses, ranging on a scale from 1 (*Not confident*) to 10 (*Extremely confident*), and the position of the music when it was reintroduced, with participants stating whether the music came in too early or too late.

#### 5.2.7.2.2 Interview questions

A semi-structured interview, including 13-15 questions (Appendix F.18), was used to collect feedback from the participants about the feasibility of VMI training. The main fifteen questions were related to the overall experience of the study, the type of methods used in the training of VMI, imagining music during their daily life, mood, and anxiety. The questions were presented in this order, as the primary aim of the study was to determine the feasibility of VMI training with the methods used, whereas the effects of VMI (and the VFT) on anxiety and mood were secondary in this study. The additional questions were formulated based on the participants’ responses to the ESM questions and an example of such is “You often reported the vividness of your musical imagery as fairly high, can you describe what sort of elements you focus on when imagining music?”

The questions covering the overall experience of the study focused on the participants’ general feelings about their participation, as well as the most positive and negative aspects of the study. The volume fader task questions were based on how well this method worked when training individuals to voluntarily imagine music and whether this task should be used again for future VMI training or practice. The participants were also asked about other methods that could be used to train people to deliberately imagine music, the most difficult part of the study, and whether there could be any improvements made to the VMI training programme.

To learn more about the participants’ experience of imagining music in daily life, they were asked about their musical imagery experiences (both voluntary and involuntary) before, during and after the study. These questions addressed techniques used when imagining music, how the study might have assisted in their musical imagery experience, any challenges the participants might face when imagining music in the future and specific reasons for imagining music. The questions relating to anxiety and mood prompted the participants to think more about these types of feelings in depth and whether there was a noticeable difference in anxiety and mood when imagining music, compared to completing the VFT. The participants received a debrief form via email once they had completed the study (Appendix F.19).

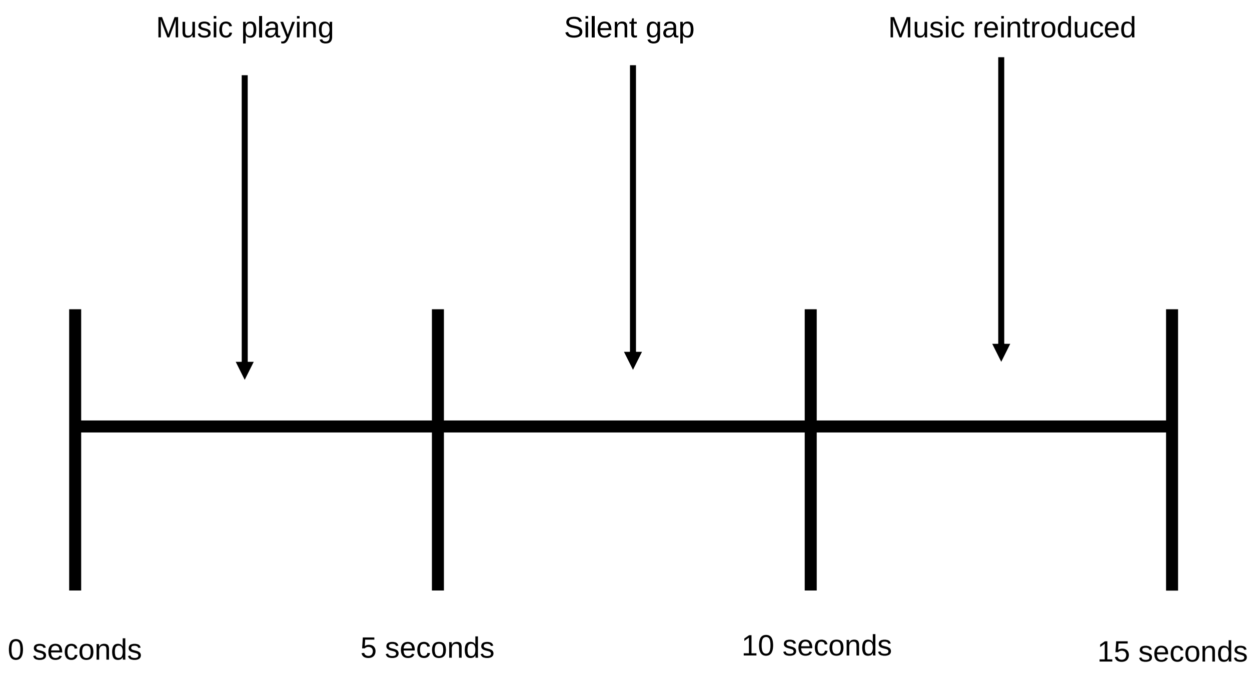
**5.2.7.3 Equipment**

A stopwatch was used from the Clock application on an Apple iPhone 6 in the post-VMI training chronometric task to record the duration of tapping, and the Voice Memos application was used to audio record the interview.

**5.2.7.4 Stimuli**

Ten randomly selected excerpts (lasting 15 seconds) from the original self-selected music piece were used in the imagination-continuation task. The edited music snippets followed this format - music was played for five seconds, followed by a silent gap for the next five seconds, then the music was reintroduced for the last five seconds (as seen in Figure 5.7 below). The snippets were recorded using the VirtualDJ programme and each excerpt could either have the music in the last five seconds of the edited snippet introduced at the correct position (expected position), too early (whereby the presented music would come in earlier than would normally be expected in relation to the track) or too late (the presented music would come in later than would normally be expected).

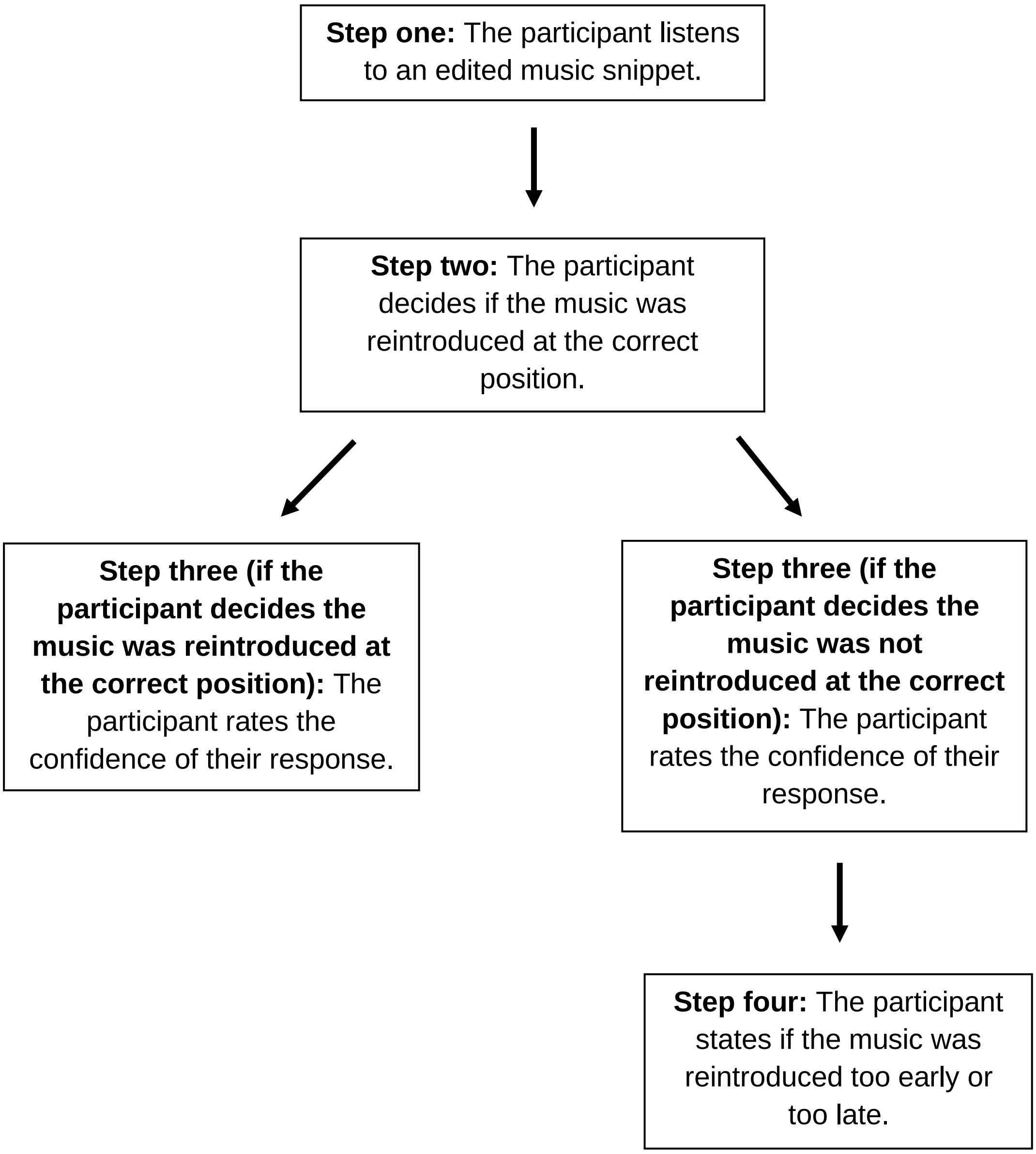
Figure 5.7 *Timeline of the edited music snippet*



#### 5.2.7.5 Procedure

For the final stage, the participants were invited back to the music studio where they completed the post-VMI training chronometric task and an imagination-continuation task, to assess how well they could voluntarily imagine music. The post-VMI training chronometric task was similar to the pre-VMI training chronometric task performed in stage one, except the participants only tapped along to the beat of imagined music (as opposed to heard music) and repeated this activity twice. For the imagination-continuation task, the participants were presented with 10 15-second snippets (interpolated with silent gaps) taken from their self-selected music pieces. They were instructed to listen to the edited snippets and to imagine the music's continuation whenever they encountered silence. After listening to the snippets, the participants answered questions about whether the music was reintroduced at the correct position, how confident they were in that response, and whether the music came in too early or too late (if they decided that the music was not reintroduced at the correct position). Figure 5.8 visually depicts this task. Following these activities, the participants rated how much they liked their music pieces, using the post-VMI training music likability rating scale, and were interviewed about their study participation. This final stage lasted for approximately 45 minutes.

Figure 5.8 *A schematic diagram of a trial in the imagination-continuation task*




## 5.2.8 Data analysis

### 5.2.8.1 Voluntary musical imagery ability assessment

To assess VMI ability, data taken from the chronometric tasks in stages one and three, as well as the imagination-continuation task (stage three) were used. A paired samples t-test was used to determine if there was a significant difference in the discrepancy between the mean number of taps whilst listening to music and the mean number of taps whilst imagining music in the pre-VMI training chronometric task, compared to the discrepancy between the mean number of baseline taps whilst listening to music and the mean number of taps whilst imagining music in the post-VMI training chronometric task (Equations 1 and 2 show how these discrepancy figures were calculated). A paired samples t-test was also used to assess the discrepancy between the mean tapping tempo whilst listening to music and imagining music in the pre-VMI training chronometric task, compared to the discrepancy between the mean tapping tempo whilst listening to music and imagining music in the post-VMI training chronometric task (Equations 3 and 4 show how these discrepancy figures were calculated). Data from the imagination-continuation task were analysed using a chi-square goodness of fit test to determine the accuracy of the participants' performance in this task.

$\bar{x}$ taps pre-VMI training (whilst imagining music) - Baseline measure of the number of taps (whilst listening to the music) (1)

$\bar{x}$ taps post-VMI training (whilst imagining music) - Baseline measure of the number of taps (whilst listening to the music) (2)

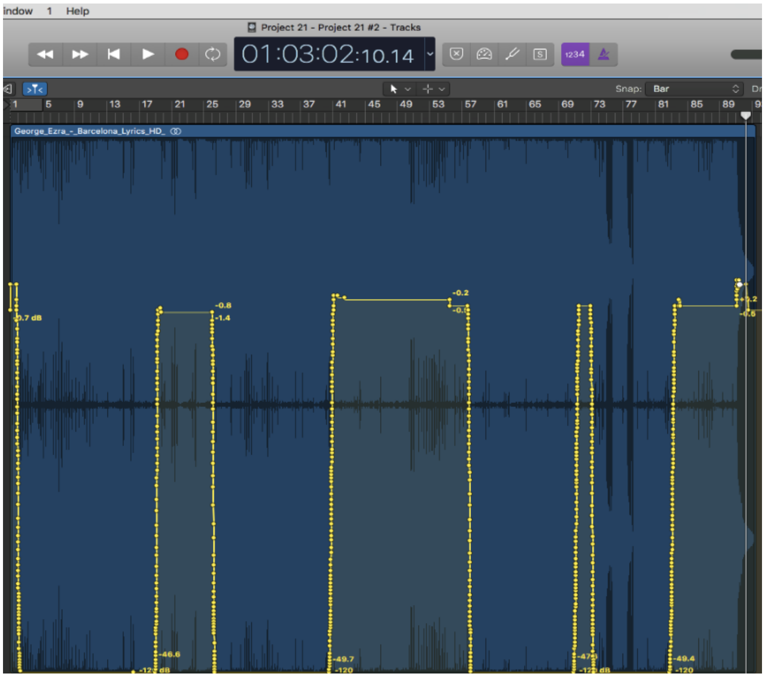
$\bar{x}$ tapping tempo pre-VMI training (whilst imagining music) - Baseline measure of the tapping tempo (whilst listening to the music) (3)

$\bar{x}$ tapping tempo post-VMI training (whilst imagining music) - Baseline measure of tapping the tempo (whilst listening to the music) (4)

#### 5.2.8.2 Feasibility of voluntary musical imagery training

The analyses conducted on the data relating to the feasibility of VMI training focused on attributes of the VMI training programme that would contribute towards the future implementation of the VMI training method. As it was predicted that the perceived task difficulty would decrease during the training activities, a paired samples t-test assessed the perceived level of difficulty of the training activities, by comparing the difficulty ratings in the first trial to the last trial for each activity. Another paired samples t-test was conducted to compare the percentage of time spent listening to music in the first trial of the volume fader task to the last trial of that task. These percentages were calculated before the statistical analyses were conducted. The duration of time spent listening to music (in seconds) in each trial was taken from the data recorded in Logic Pro X. A screenshot from a volume fader task trial can be seen in Figure 5.9 below, depicting the movement of the volume fader graphically. The yellow-tinted segments, formed by two vertical yellow lines, represent the amount of time spent listening to music (in seconds). These segments indicate when the volume fader was raised and lowered, with the raising movement being the yellow line on the left of the segment and the lowering movement being the yellow line on the right. The point at which the volume fader was raised and lowered corresponded to a certain time point in the piece of music (which is displayed towards the top of the screenshot). With that, the amount of time that the volume fader was raised for at each instance (which indicated that the participant was listening to the music) was recorded. These durations were added together, then divided by the total duration of the music piece (in seconds). From there, the percentage of time spent listening to music was calculated by multiplying that answer by 100. All of these analyses were conducted using SPSS.

Figure 5.9 *A screenshot of a volume fader task training trial in Logic Pro X*




**5.2.8.3 Voluntary musical imagery, anxiety and mood**

The purpose of the analyses of the anxiety and mood data was to see if any relationships between VMI and anxiety, as well as mood, could be established, and how these potential relationships might differ compared to the relationships with the VFT. The anxiety and mood reported at the end of each ESM day was compared against one another using a paired samples t-test in SPSS. For instances of missing data (where individuals had not rated their current level of anxiety or mood), those cases were not entered into the analyses.

Hierarchical linear modelling was used to analyse ratings of anxiety and mood that were collected across the six contact points on each day. Separate models were created with the two main outcome variables being anxiety change and mood. The anxiety change variable was formed by calculating the difference between the anxiety rated after and before the ESM activities. The participants rated their anxiety on a scale from 1 (*Not very anxious*) to 9 (*Extremely anxious),* and so the difference calculated would provide a number between -8 (representing the greatest decrease in anxiety) and +8 (representing the greatest increase in anxiety). The models for anxiety change and mood had a two-level hierarchical structure, where the Level 1 variables captured within-person relations between condition and task difficulty (the day-level predictors) and the outcome variables (anxiety change and mood). For both the anxiety and mood hierarchical linear models (HLMs), the Level 1 predictor variables were condition (VMI or control) and task difficulty. The Level 2 variable, which was trait anxiety, captured between-person variability and these variables are displayed in Table 5.1. The Level 1 variables (condition, which was uncentered and task difficulty, which was group centered) were modelled as random, as it was assumed that the within-person variables would vary from day to day. The Level 2 continuous variable (trait anxiety) was grand mean centered. There were also two blocks of testing, where the first block tested the effects of the Level 1 variables (condition and task difficulty) on the outcome variables (anxiety change and mood), then the second block included the Level 2 variable (trait anxiety) in the HLM. HLM dealt with missing data when the models were created before the analyses were conducted. These missing data came from participants who did not complete all of the ratings for anxiety and mood.

Table 5.1 *Variables entered into each model in the HLM analyses*

| Outcome variable | Level 1 variable | Level 2 variable |
|---|---|---|
| Anxiety change | Condition | Trait anxiety |
| | Task difficulty | |
| Mood | Condition | Trait anxiety |
| | Task difficulty | |

**5.2.8.4 Musical imagery ability**

To learn more about previous musical imagery experience and performance on musical imagery tasks, multiple regression analyses were used to test whether musical imagery experience could predict performance on the VMI assessment task (which was the imagination-continuation task).

#### 5.2.8.5 Music likability

A paired samples t-test was used to see if there were any significant differences between the pre- and post-VMI training music likability ratings.

#### 5.2.8.6 Interview

Interviews were audio recorded and transcribed, then content analysis (Krippendorff, 2013) was used to identify key topics within the data. These topics related to reflections on all aspects of the VMI training programme, the volume fader task (as the VMI training method), VMI in daily life and the effects of VMI on anxiety and mood.

## 5.3 Results

### 5.3.1 Descriptive statistics

Descriptive statistics for the study variables are presented in Tables 5.2 and 5.3. The mean trait anxiety score was 48.06 (*SD* = 11, ranging between 30 and 75). The mean vividness of auditory imagery score was 4.17 (*SD* = .80, ranging between 2.71 and 6.21), and the mean controllability of auditory imagery score was 4.32 (*SD* = .79, ranging between 1.85 and 5.54). The mean frequency of INMI in this sample was 4.03[4] (*SD* = .90, ranging between 1 and 6).

Table 5.2 *Descriptive statistics for the study outcome variables relating to training in VMI*

| Study variable | Mean (SD) |
|---|---|
| **Duration of VMI** | |
| Discrepancy between taps whilst listening to and imagining music pre-VMI training | 71.97 (77.83) |
| Discrepancy between taps whilst listening to and imagining music post-VMI training | 42.91 (71.23) |
| **Musical imagery tapping tempo** | |
| Discrepancy between tapping tempo whilst listening to and imagining music pre-VMI training | 1.42 (10.14) |

[4] 4 on the IMIS represents experiencing INMI several times a week.

| | |
|---|---|
| Discrepancy between tapping tempo whilst listening to and imagining music post-VMI training | 4.34 (19.09) |
| **Task difficulty** | |
| Difficulty of first VMI trial | 5.21 (1.65) |
| Difficulty of last VMI trial | 3.85 (2.30) |
| Difficulty of first VFT trial | 7.09 (1.16) |
| Difficulty of last VFT trial | 5.15 (1.50) |
| **Percentage of time spent listening to music during VMI training task** | |
| First trial | 37.94 (14.57) |
| Last trial | 27.79 (15.40) |

Table 5.3 *Descriptive statistics for the study outcome variables relating to the effects of condition on anxiety and mood*

| Variable | VMI Mean (SD) | VFT Mean (SD) |
|---|---|---|
| Anxiety change | .14 (.98) | .31 (1.04) |
| End of day anxiety | 2.85 (1.87) | 3.48 (1.91) |
| Mood | .40 (1.16) | -.24 (.99) |
| End of day mood | 1.21 (1.82) | .36 (1.85) |

*Note.* For anxiety change, negative values represent decreases in anxiety and positive values represent increases in anxiety. For end of day anxiety and mood, values between one and four represent decreases in these variables, five represents no change and values between six and nine represent increases. For mood, negative values represent increases in negative mood and positive values represent increases in positive mood.

### 5.3.2 Feasibility of voluntary musical imagery training

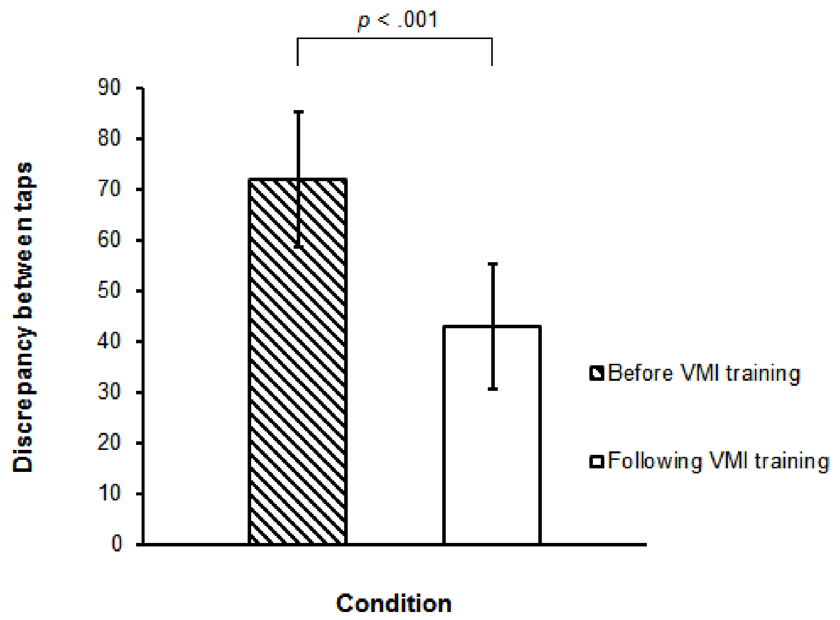
To test the main hypothesis relating to the feasibility of VMI training, predicting that VMI training would improve VMI ability, analyses were conducted to compare the data between the pre and post-VMI training chronometric tasks, and assess the accuracy of performance in the imagination-continuation task. Additional tests were carried out to explore other aspects of the feasibility of VMI training such as the perceived difficulty of the training sessions, and how the amount of time spent listening to music (compared to deliberately imagining music) changed across trials in the volume fader task.

#### 5.3.2.1 Chronometric task

##### 5.3.2.1.1 Duration of voluntary musical imagery

A paired samples t-test compared the discrepancy between the baseline number of taps whilst listening to music and the mean number of taps whilst imagining music in the pre-VMI training condition to the post-VMI training condition. The test showed that there was a significant difference between the mean values for the discrepancy between the number of taps recorded whilst listening to and imagining the music in the pre-VMI training condition (*M* = 71.97, *SD* = 77.83), compared to the discrepancy between the number of taps whilst listening to and imagining the music in the post-VMI training condition (*M* = 42.91, *SD* = 71.23), $t(33) = 4.19$, $p < .001$, $d = .76$, seen in Figure 5.10.

Figure 5.10 *Mean discrepancy of taps whilst listening to and imagining music*




*Note.* A figure to show the mean discrepancy of taps whilst listening to and imagining music before and following training in VMI, with error bars representing the standard error of the mean.

##### 5.3.2.1.2 Tapping tempo

A paired samples t-test was used to determine if there was a significant difference between the discrepancy of tapping tempo in the baseline measure (whilst listening to music) and imagining music in the pre and post-VMI training conditions. No significant difference was found between the mean values for the discrepancy between the tapping tempo whilst listening to and imagining the music in the pre-VMI training stage (*M* = 1.42, *SD* = 10.14), compared to the post-VMI training stage (*M* = 4.34, *SD* = 19.09), *t*(33) = -.66, *p* = .52, *d* = .17.

#### 5.3.2.2 Imagination-continuation task

A chi-square goodness of fit test looked at the performance accuracy on the imagination-continuation task. The test indicated that the number of correct responses (*n* = 251) was significantly higher than the number of incorrect responses (*n* = 89), $X^2$ (*n* = 340) = 77.19, *p* < .001, *d* = 1.08.

#### 5.3.2.3 Task difficulty

Two paired samples t-tests assessed whether the perceived task difficulty changed across the training activities (the volume fader and the verbal fluency tasks). For the volume fader task, there was a significant difference between the mean difficulty ratings in the first trial (*M* = 5.21, *SD* = 1.65), compared to the mean difficulty ratings in the last trial (*M* = 3.85, *SD* = 2.30), *t*(33) = 3.98, *p* < .001, *d* = .86. The same was found for the VFT, as there was a significant difference between the mean difficulty ratings in the first trial (*M* = 7.09, *SD* = 1.16) compared to the mean difficulty ratings in the last trial (*M* = 5.15, *SD* = 1.50), *t*(33) = 8.70, *p* < .001, *d* = 1.75.

#### 5.3.2.4 Percentage of time spent listening to music in the volume fader task

The number of trials completed in the volume fader task ranged between 3 and 6 (*M* = 4, *SD* = 0.8). For the entire data set, the percentage of time spent listening to music in the first training trial ranged between 11.58% and 73.10%, and between 5.90% and 68.20% in the last trial. To determine whether there was a significant decrease in the percentage of time spent listening to music across trials during VMI training, a paired samples t-test was used. This test showed that there was a significant decrease in the percentage of time spent listening to music during the training session from the first trial (*M* = 37.94, *SD* = 14.57) to the last trial (*M* = 27.79, *SD* = 15.40), *t*(33) = 6.35, *p* < .001, *d* = 1.07.

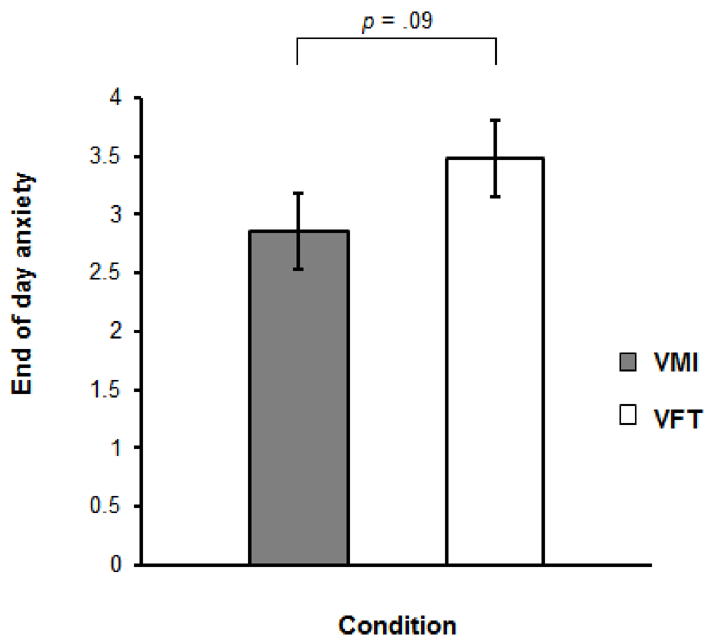
### 5.3.3 Voluntary musical imagery, anxiety and mood

The secondary hypotheses predicted that there would be a main effect of condition on anxiety and mood, showing that VMI is associated with reductions in anxiety and increases in positive mood, relative to the control task. Analyses were conducted on the end of day anxiety and mood ratings, as well as anxiety and mood changes across the day.

#### 5.3.3.1 Effects of condition on anxiety

A paired samples t-test compared the end of day anxiety reported in each condition and found no significant difference between VMI ($M$ = 2.85, $SD$ = 1.87) and the VFT ($M$ = 3.48, $SD$ = 1.91), $t(32) = -1.76$, $p = .09$, $d = .31$ (seen in Figure 5.11).

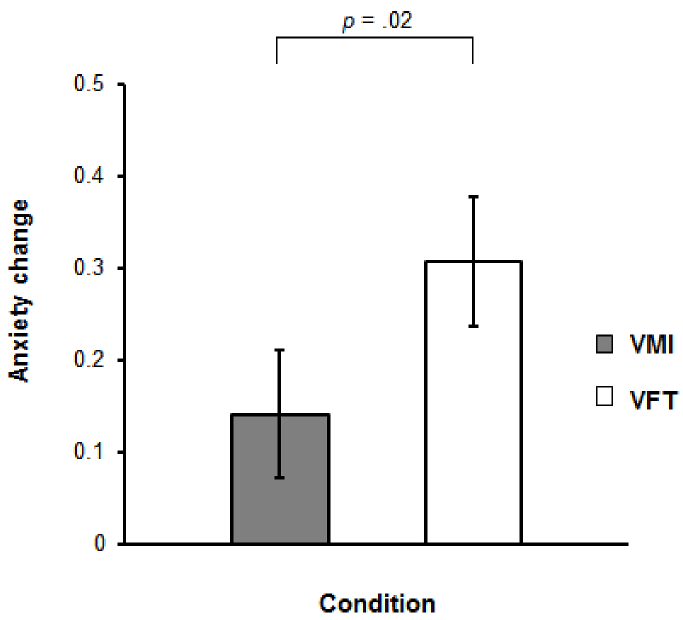
Figure 5.11 *Mean end of day anxiety ratings per condition (VMI vs VFT)*




*Note*. A figure to show the mean end of day anxiety ratings in each condition, with error bars representing the standard error of the mean.

Hierarchical linear modelling was used to assess the effect of condition (VMI vs VFT) on anxiety change. The model found a significant main effect of condition on anxiety change score, showing that VMI was associated with a smaller increase in anxiety compared to the VFT, $b$ = .30, $p$ = .02, $d$ = .95, (as seen in Figure 5.12). Task difficulty was also entered into the model as a Level 1 variable, but there was no main effect of task difficulty ($b$ = -.01, $p$ = .87, $d$ = .06). Trait anxiety was entered into the model as a Level 2 variable, and this variable was not a significant moderator, $b$ = -.004, $p$ = .61, $d$ = .18. Further to this, there was interest in seeing whether the anxiety change ratings in the VMI condition were significantly different from zero (which represented no change in anxiety). An independent t-test showed that there was a significant difference in the anxiety change ratings ($M$ = .14, $SD$ = .92) compared to zero ($M$ = 0, $SD$ = 0), $t(197)$ = 2.03, $p$ = .04, $d$ = -.20.

Figure 5.12 *Mean anxiety change in each condition (VMI vs VFT)*

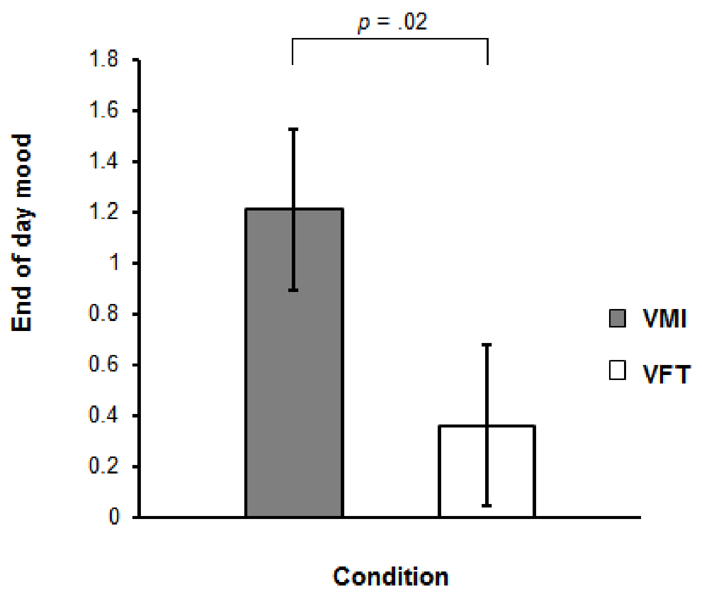



*Note*. A figure to show the mean anxiety change ratings during the ESM days, with error bars representing the standard error of the mean. Positive scores on the y-axis represent increases in anxiety, zero represents no change in anxiety and negative scores represent decreases in anxiety.

### 5.3.3.2 Effects of condition on mood

The mood reported at the end of the day in each condition was also compared using a paired samples t-test. This test showed that the mood reported at the end of the day was significantly more positive on the VMI day ($M$ = 1.21, $SD$ = 1.82), compared to the VFT day ($M$ = .36, $SD$ = 1.85, $t(32)$ = 2.45, $p$ = .02, $d$ = 1.55 (Figure 5.13). Further to this, there was interest in seeing whether there were any relationships between the end of day mood and trait anxiety in each condition. A Pearson Product-Moment Correlation showed that the end of day mood reports were not related to trait anxiety in the VMI condition, $r(33)$ = -.22, $p$ = .22, or the VFT condition, $r(33)$ = -.09, $p$ = .63.

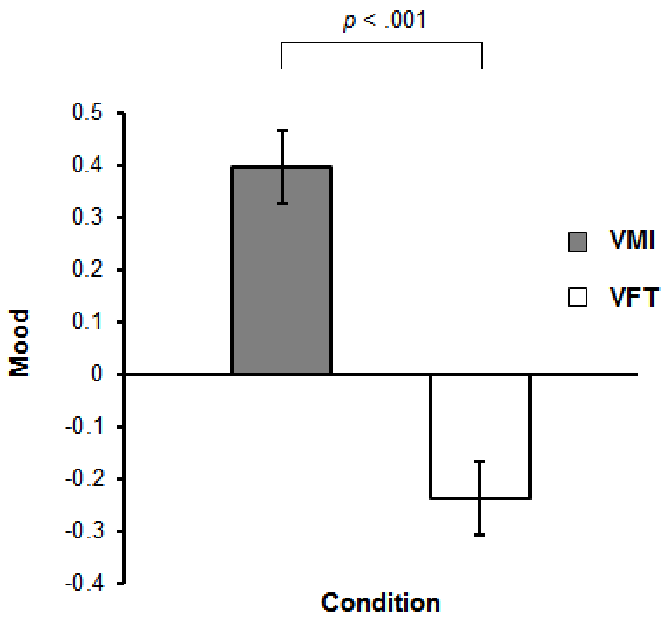
Figure 5.13 *Mean end of day mood ratings per condition (VMI vs VFT)*




*Note*. A figure to show the mean end of day mood ratings in each condition, with error bars representing the standard error of the mean. Positive scores equal positive mood (the scale ranged from -4, representing the greatest increase in negative mood, to +4, representing the greatest increase in positive mood).

HLM was used to determine whether there was a significant main effect of condition on mood ratings and found a significant main effect of condition. This model demonstrated that VMI was associated with increases in positive mood, $b$ = -.64, $p$ <.001, $d$ = 2.09 (shown in Figure 5.14). Task difficulty was also entered into the HLM as a Level 1 variable. There was a significant main effect of task difficulty on mood, *b* = -.09 *p* = .01, *d* = 1.06, showing that increases in positive mood were associated with lower task difficulty. When trait anxiety was entered into the model at level 2, it was not a significant moderator, *b* = -.02, *p* = .10, *d* = .60. Table 5.4 contains the coefficients, standard errors, and p values for the HLM analyses.

Figure 5.14 *Mean mood ratings in each condition (VMI vs VFT)*




*Note*. A figure to show the mean mood ratings on the ESM days, with error bars representing the standard error of the mean. Positive scores on the y-axis represent increases in positive mood, zero represents no change in mood and negative scores represent increases in negative mood.

Table 5.4 *Effects of condition (VMI vs VFT) and task difficulty on anxiety and mood variables, with trait anxiety as a Level 2 variable*

| HLM effect | Symbol | Coefficient | *SE* | *p* |
|---|---|---|---|---|
| *Intercept: Anxiety change* | $\beta_{00}$ | -.14 | .14 | .34 |
| Condition | $\beta_{10}$ | .30 | .10 | **.02*** |
| Task difficulty | $\beta_{10}$ | -.01 | .04 | .87 |
| Trait anxiety | $\beta_{11}$ | -.004 | .008 | .61 |
| *Intercept: Mood* | $\beta_{00}$ | 1.04 | .25 | < .001 |
| Condition | $\beta_{10}$ | -.64 | .14 | **< .001*** |
| Task difficulty | $\beta_{10}$ | -.09 | .03 | **.01*** |
| Trait anxiety | $\beta_{11}$ | -.02 | .01 | .10 |

*Note*. HLM = Hierarchical linear modelling; Symbol = Hierarchical linear modelling symbol; Coefficient = Unstandardized coefficient; *SE* = Standard error. * p < .05

### 5.3.4 Relationship between musical imagery experience and voluntary musical imagery ability

There was interest in determining whether self-reported musical imagery experiences (measured using the BAIS-V, BAIS-C, and INMI-F) could predict baseline duration and tempo outcomes while imagining music. In the first multiple regression analysis, the outcome variable was the mean duration of VMI in the pre-VMI training session and the predictor variables were BAIS-V, BAIS-C, and INMI-F. The mean tapping tempo while imagining music pre-VMI training was the outcome variable in the second multiple regression analysis and the predictor variables were BAIS-V, BAIS-C, and INMI-F. For the mean baseline duration while deliberately imagining music, there was a significant model, $F(3, 30) = 3.06$, $p = .04$, $R^2 = .23$. BAIS-C independently predicted variance in the duration of VMI, $\beta = 65.27$, $p = .01$. There was no significant model for the mean baseline tempo while deliberately imagining music, $F(3, 30) = 1.88$, $p = .15$, $R^2 = .16$ (see Table 5.5 below).

### 5.3.5 Music likability

A paired samples t-test did not show any significant differences between how much the participants liked the pieces of music before the study ($M$ = 8.29, $SD$ = .97), and after the study ($M$ = 8.12, $SD$ = 1.09), $t(33)$ = 1.06, $p$ = .30, $d$ = .17.

Table 5.5 *Coefficients for the multiple regression analyses examining whether musical imagery variables could predict baseline duration and tapping measures in VMI, pre-VMI training*

| Variable | *B* | *SE* | β | *t* | *p* |
|---|---|---|---|---|---|
| Mean duration of VMI | | | | | |
| BAIS-V | -27.89 | 22.31 | -.23 | -1.25 | .22 |
| BAIS-C | 65.27 | 22.52 | .53 | 2.90 | **.01*** |
| INMI-F | 16.46 | 17.21 | .15 | .96 | .35 |
| Mean tapping tempo of VMI | | | | | |
| BAIS-V | -13.10 | 8.27 | -.31 | -1.59 | .12 |
| BAIS-C | 2.04 | 8.34 | .05 | .25 | .81 |
| INMI-F | 11.68 | 6.38 | .31 | 1.83 | .08 |

*Note*. BAIS-V = Vividness of auditory imagery, BAIS-C = Controllability of auditory imagery and INMI-F = INMI frequency. * p < .05.

### 5.3.6 Feedback on voluntary musical imagery training programme

Five key topics emerged from the content analysis of the interview data: 1) Reflections on all aspects of the VMI training programme, 2) VMI training method (Volume fader task), 3) VMI in daily life, 4) Effects of intervention activities on anxiety and 5) Effects of intervention activities on mood. These key topics, along with the number of participants that expressed each opinion, are shown in Table 5.6**.**

*5.3.6.1 Reflections on all aspects of the voluntary musical imagery training programme*

The participants reported a mixture of opinions about the components of the VMI training programme that related to all aspects of the programme, including the training of VMI and practice of VFT in stage one, the ESM activities in stage two and the VMI assessment tasks in stage three. The highest number of participant reports was found for how the VFT was difficult ($n$ = 23), as shown in this quote from the interview data:

"Erm, because it's just hard to think of words on the spot, so like if you had more time I would probably think of loads. But it's just hard to like . . . I don't have very good imagination, so it's hard to think of different words." Participant #1

Following this, the VMI training programme was deemed as enjoyable (*n* = 14), interesting (*n* = 14) and good (*n* = 11) overall. Positive reflections of the training programme also related to how the VMI training programme was engaging (*n* = 4), helpful (*n* = 2) and made people more aware of the act of deliberately imagining music (*n* = 2). The less favoured opinions of the training programme mainly focused on how the ESM section was disruptive (*n* = 11), the programme was time consuming (*n* = 7) and contained too many repetitive questions (*n* = 3). Repeatedly listening to and imagining the music in the volume fader task was perceived as negative by some people (*n* = 2) and contributed towards some participants liking their pieces of music less (*n* = 4), as Participant #1 stated how they "Like the song less now, because I've heard it so many times."

#### *5.3.6.2 Voluntary musical imagery training method (Volume fader task)*

The consensus about the volume fader task being used to train people to deliberately imagine music was that it improved VMI ability (*n* = 22) and that it was good (*n* = 20). A number of participants reported that this task was helpful (*n* = 10) and able to improve temporal aspects of VMI (*n* = 5), specifically relating to how well the participants could imagine their selected pieces of music in time. There was an emphasis on how important rehearsal (*n* = 4) is in the training of VMI, as well as self-control (*n* = 5); Participant #1 said that "It is quite easy to like control it [VMI], so you might think that you don't know it [VMI], but you actually do. So you have to have a bit of self-control," Participant #11 highlighted how "If you have control over making it [VMI] quieter or louder, you could maybe test yourself at your own pace instead of it being something else . . . somebody else controlling it" and Participant #30 stated that they "Thought it was really good because it was kind of like in your control, so you knew each time when you needed more help or less help . . . so yeah I found it really good." Some participants suggested that visual elements (*n* = 5) might be helpful in VMI training, as Participant #19 said that having "Something visual to look at" could be beneficial, whilst Participant #26 proposed the use of additional "Visual imagery" in the training of VMI. In contrast to these opinions, the minority of participants felt that the volume fader task was difficult (*n* = 3) and led to no improvements in VMI accuracy (*n* = 1).

*5.3.6.3 Voluntary musical imagery in daily life*

The experience of VMI in the participants' daily lives (including previous and prospective use) also emerged as a topic. Reasons for deliberately imagining music were because the participants reported that it was an easy activity (*n* = 5), enjoyable (*n* = 3), could reduce stress (*n* = 3), entertaining (*n* = 2) and could reduce anxiety (*n* = 2). Participants also stated that they deliberately imagine music to keep their minds occupied (*n* = 1) and to continue the musical imagery experience of episodes that started off as INMI (*n* = 2). To maintain the musical imagery in the mind, participants focused on memorising the lyrics of songs (*n* = 5), when applicable, simultaneously tapping along to the beat of the music (*n* = 4) and singing the song out loud (*n* = 2). There were suggestions of using VMI to remember songs (*n* = 8) and help with musical performances[5] (*n* = 7), but the minority of participants stated that this activity can be difficult (*n* = 3), distracting (*n* = 2), and challenging (*n* = 1). Even though there is evidence that the volume fader task helped with VMI training, the VMI task was seen as stressful by a few individuals (*n* = 3), with Participant #19 stating how "it did stress me out when I had to suddenly imagine this piece of music, especially if I wasn't able to listen to it."

*5.3.6.4 Effects of intervention activities on anxiety and mood*

Although most of the key topics from the interview data related to feedback on the VMI training programme, the participants did reflect on the effects of the intervention activities on anxiety and mood. For anxiety, most people reported how VMI had no effect on anxiety (*n* = 7), followed by how the activity was able to decrease anxiety (*n* = 5), and a few people found that VMI increased anxiety (*n* = 2). The participants reported how there were no effects of VFT (*n* = 5) on anxiety. Most of the participants found that VMI increased the presence of positive mood (*n* = 12), whilst VFT increased negative mood (*n* = 5).

Table 5.6 *Key topics in interview data*

| Key topic | Term (*n*) |
|---|---|
| Reflections on all aspects of the VMI training programme | **Positive reflections**<br>Enjoyable (14)<br>Interesting (14)<br>Good (11)<br>Mental chronometry task was hard (4)<br>Helpful (2)<br>Easy (1)<br>Engaging (1)<br><br>**Negative reflections**<br>VFT was difficult (23)<br>ESM was disruptive (11) |

[5] Musical performances here are not considered as professional performances, but in reference to casual end of term plays the participants have performed in.

| | |
|---|---|
| | Time consuming (7)<br>Reduced song likability (4)<br>Repetitive questionnaires (3)<br>Difficult (2)<br>Interrupting (2)<br>Song repetition negative (2) |
| | **Neutral comments**<br>Made more aware of VMI (2) |
| VMI training method (volume fader task) | **Positive**<br>Improve VMI ability (22)<br>Good (20)<br>Helpful (10)<br>Improve temporal aspects of VMI (5)<br>Optimum method (2) |
| | **Negative**<br>Difficult (3) |
| | **Neutral comments**<br>Self-control (5)<br>Visual elements (5)<br>Rehearsal (4)<br>No VMI accuracy improvement (1) |
| VMI in daily life | **Positive**<br>Easy (5)<br>Enjoyable (3)<br>Reduce stress (3)<br>Entertaining (2)<br>Reduce anxiety (2)<br>Escape (1) |
| | **Negative**<br>Difficult (3)<br>Stressful (3)<br>Distracting (2)<br>Challenging (1) |
| | **Neutral**<br>Remember songs (8)<br>Memorise lyrics (5)<br>Musical performances (5)<br>Tap along (4)<br>INMI (2)<br>Sing aloud (2)<br>Distracting (1)<br>Keep mind occupied (1) |
| Effect of intervention activity on anxiety | **VMI**<br>No effect (7)<br>Decrease anxiety (5)<br>Increase anxiety (2) |
| | **VFT**<br>No effect (5) |
| Effect of intervention activity on mood | **VMI**<br>Increase positive mood (12)<br>No effect (3) |
| | **VFT**<br>Increase negative mood (5)<br>No effect (3)<br>Increase positive mood (1) |

*Note*. VMI = Voluntary musical imagery; VFT = Verbal fluency task.

## 5.4 Discussion

### 5.4.1 Feasibility of voluntary musical imagery training

The findings relating to whether individuals can be trained to voluntarily imagine music showed improvements in the participants' VMI ability, following training in VMI. This was evidenced by the participants being able to imagine music for longer durations in the chronometric task after VMI training (as the discrepancy between the number of taps whilst listening to and imagining music decreased following training). Also, despite the imagination-continuation task only functioning as a post-training assessment of VMI, the participants had higher than chance levels of accurate responses, compared to inaccurate. The participants also reported in the interview data that training in VMI improved their VMI ability. These results supported the main hypothesis that training in VMI can improve VMI ability.

These findings can be explained by the fact that individuals were trained to voluntarily imagine music. Skodzik et al. (2017) have previously demonstrated how training in mental imagery can lead to improvements in the ability to deliberately imagine multisensory imagery, as evidenced by improvements in the vividness of the participants' mental imagery following the training they received. The main aspect of the training that contributes towards the improvements in the ability to imagine music is that these non-musicians were encouraged to deliberately engage in VMI, an activity that might not be that common within their daily lives. As highlighted earlier in the introduction, the repeated practice of voluntary mental imagery can increase one's ability for that activity, as was the case in this study. The participants in this study also emphasised the importance of being able to repeatedly practise deliberately imagining music as contributing greatly towards the improvement in VMI ability, in the interview data. This is further reiterated through the characteristics of the VMI training activity, the volume fader task, as this activity allowed the participants to repeatedly practise imagining music using the volume fader aspect, and for as many trials as they deemed necessary. This meant that the participants were able to become aware of the areas in the music that they had weaker mental imagery for. From this, the participants would have been able to focus on strengthening those weaker images whenever they reimagined the music. Further to these findings, the results showed no change in the tempo of the imagined music following VMI training. The finding indicates that the participants were imagining music at the same or similar speeds in both instances (pre and post-VMI training), which corroborates previous findings of tempo being preserved in musical imagery for familiar music (Jakubowski et al., 2015). The results also demonstrated how one's ability to control deliberate auditory imagery could predict variance in the duration of time participants could continuously deliberately imagine music. Namely, it was found that the better an individual is at controlling their auditory imagery episodes, the longer they would be able to deliberately imagine music for. This reflects the importance of control in VMI.

Other promising results relating to the feasibility of VMI training concerned the difficulty of the training activities and the amount of time spent listening to music in the VMI training task. Firstly, the perceived task difficulty of both the VMI training activity and the VFT decreased across trials (from the first to the last trial), supporting the hypothesis that the perception of task difficulty would decrease as participants progressed through the training session. This reduction implied that as the participants practised these activities, they found them easier to complete, potentially due to the repeated exposure to the tasks. Secondly, as the participants progressed through the VMI training activity, they listened to less music and imagined more music across the trials. This might have occurred due to participants becoming more familiar with their musical imagery after repeatedly engaging in this activity. These two findings are important factors contributing towards the future implementation of the VMI training method, as they suggest that not only is it possible for individuals to imagine music more as the volume fader task is completed, but it is not likely for these tasks to be deemed as too difficult for others to complete. Additionally, there were no significant changes in how much the participants' liked their music following the study, which shows that there was no significantly negative impact of the VMI training programme on positive feelings towards the music.

### 5.4.2 Anxiety and mood

Measures of anxiety focused on direct changes in anxiety following each intervention activity and at the end of each day. The analysis for anxiety change showed that even though anxiety levels increased in relation to both tasks, the anxiety increase for VMI was significantly smaller than in the control task. These increases might have been apparent for both activities, due to the participants' perceived task difficulty, but it is important to highlight that task difficulty did not account for the difference between the two conditions. When comparing this change in anxiety to zero (representing no change in anxiety), there was a slight significant increase in anxiety, but the effect size was small. The association of VMI with lower momentary levels of anxiety was shown to be just as effective for individuals with low trait anxiety, compared to those with high trait anxiety. Despite these findings, the levels of anxiety reported at the end of the day were lower for the VMI day, compared to the control day, but this result was not significant. Thus, these findings partially supported the hypothesis that predicted an association of VMI with decreases in anxiety. However, VMI has only been shown to be associated with smaller increases in anxiety compared to the control task, which might have been perceived as stressful. The VFT was associated with higher levels of anxiety than the VMI, and participants reported that completing the VFT led to increases in negative mood.

These preliminary findings demonstrating that the increases in anxiety when deliberately imagining music were lower, than for the control task, can be considered in the context of the cognitive account of anxiety. The third chapter in this thesis addressed the mechanisms behind the potential effectiveness of VMI, by outlining the main characteristics of deliberately imagining music and considering how these features can target the mechanisms that the GCM (Beck & Haigh, 2014) suggests can lead to the development and maintenance of anxiety. The GCM also recommends mechanisms to target when developing interventions for anxiety which are focus, beliefs, maladaptive behaviour, and situation. Due to VMI being an activity that requires individuals to consciously initiate the deliberate imagination of music, as well as be in control of keeping this musical imagery in their mind (Cotter, 2019), this activity would have allowed individuals to intentionally change the direction of their focus, so that they are attending to the music being imagined for the two minutes that they were instructed to do it for. An inconsistency in the extent to which the VMI intervention has had a significant impact on experienced anxiety can be explained by the type of anxiety that was assessed. Lower anxiety levels were only associated with VMI when anxiety was measured directly before and after deliberately imagining music, but not with the anxiety reported at the end of the day. It could be that VMI might only have effective outcomes on anxiety on a short-term basis. Another contributing factor to the results could be due to other uncontrolled events occurring throughout the day, impacting the effectiveness of VMI, and therefore affecting the overall anxiety that was measured at the end of the day.

For mood, VMI was associated with increases in positive mood both immediately after imagining music and at the end of the day, in comparison to the verbal control task, and trait anxiety levels did not moderate this relationship. There were also more participants who reported that VMI increased their positive mood in the interview data. Thus, these findings supported the hypothesis predicting that VMI would be associated with positive mood. Explanations for these results can be centred around the suggestion that mental imagery can have a positive impact on mood and emotions (Holmes et al., 2006; Holmes et al., 2009b; Pictet al., 2011). It could be that musical imagery had similar effects as music listening on mood, being that various studies have already shown how music listening is associated with improvements in mood (Groarke & Hogan, 2019), and individuals report listening to music to regulate their mood (Schäfer et al., 2013).

### 5.4.3 Implications of the findings

The main practical implication that stemmed from the findings presented in this study is that VMI is a trainable activity. The participants were able to voluntarily imagine music for longer durations following training in VMI and had a higher chance of scoring accurately in one of the VMI ability assessment tasks (the imagination-continuation task), thus demonstrating the potential of VMI training. Additionally, the training task difficulty ratings decreasing during the training sessions implied that individuals who might undergo this training in the future are not likely to find it too difficult. For the development of a VMI intervention for anxiety, it was vital to first determine the feasibility of VMI training, and so this study allows for the design of a VMI intervention for anxiety that can incorporate a VMI training or practice element that would make use of the methods used in this study (specifically the volume fader task). For instance, an investigation into a VMI intervention being developed for anxiety might include a VMI training element and observation of individuals using VMI for state anxiety reduction during their daily lives. The importance of this trainable demonstration also suggests that the VMI training method can be used for individuals who might want to practise deliberately imagining music. Voluntarily imagining music involves voluntary attentional control, and so engaging in frequent practice of this activity can allow for people to improve their voluntary attentional control (which involves being able to deliberately shift and focus one’s attention according to specific goals; Muris et al., 2008).

The preliminary findings concerning VMI being related to lower levels of anxiety compared to the control, and having a relationship with positive mood, allow for the continuation of the investigation into the potential effects of VMI on anxiety and mood. The purpose of including questions relating to anxiety and mood was to obtain an early indication of the anxiolytic and mood improving effects that VMI might have, before the main VMI intervention study in this thesis (which is found in Chapter Six). The fact that the findings shed light on these potential effects, and do not present VMI as an intervention activity that is likely to negatively impact people’s anxiety or mood, provides an early indication of the effects that might be found in the VMI intervention study. Additionally, with trait anxiety not being a significant moderating variable for the relationship between VMI and anxiety change, and thus showing that VMI might be just as effective for people with low trait anxiety compared to high trait anxiety, it implies that VMI could be used by anyone with anxiety which is what the VMI intervention method is intended to do. Lastly, from a theoretical point of view, the findings on VMI being associated with positive mood are consistent with research that has shown that mental imagery can have a powerful impact on affective mechanisms (Holmes & Mathews, 2010).

### 5.4.4 Limitations

Despite producing encouraging results, there are limitations to this study. Some of these shortcomings relate to characteristics of the sample; being that the sample size was small, the participants were mostly female and of a young age (*Mdn* = 20 years). These factors restrict the generalisability of the findings, mainly because the participants may not be representative of the target population of interest (which is the general population). Using a sample consisting of predominantly females might have also contributed to underlying gender differences influencing the results. Firstly, Mclean et al. (2011) previously reported that females are more likely to have anxiety disorders compared to males and Gao et al. (2020) also found this gender difference in sub-clinical experiences of anxiety. This could therefore explain why the anxiety ratings on the VMI day were lower than the ratings for the VFT, but nevertheless still represented increases. Additionally, being disturbed during the course of daily life to conduct a task is likely to be associated with an increase in anxiety. Thus, evidence of the impact of each intervention (VMI and the control) to reduce anxiety is likely to have been subsumed as a result of higher levels of anxiety than would otherwise occur.

Another limitation was related to the number of trials completed in the VMI training activity. The participants were asked to complete three compulsory trials, then had the choice to continue completing as many trials as they wanted after (so they could be in a position where they could imagine as much of the music as possible without having the need to listen to the music as frequently as before). For the whole sample, the number of trials completed ranged from three to six (*M* = 4). This could be problematic as the participants were not engaging in a lot of trials using the volume fader task, and none of the participants were able to imagine the music for its entire duration during the training - the lowest percentage of time spent listening to music in a trial was 5.9%, which indicated that the highest percentage of time that music was imagined for was 94.1%, and not 100%. Even though useful results were obtained regarding the training of VMI, it might be helpful to allow the number of trials completed in the volume fader task for future instances to be entirely self-directed. This might encourage the participants to work harder at attempting to imagine the music for the entire duration (which was the goal).

### 5.4.5 Future directions

Further to the implications of these findings, future work ought to be developed based on the methods used in this training study. As there is variance in the ability for people to voluntarily imagine music (Aleman et al., 2000; Campos & Fuentes, 2016), the volume fader task can be used in instances where individuals seek to practise deliberately imagining music. Responses from the interview data highlight how useful this task was for the participants to practise their VMI, so this presents another opportunity where the task might be beneficial. This could be in cases where musicians might want to try different approaches for improving their VMI, or if people are using VMI as an anxiety-alleviating method and want to practise it beforehand. Despite the volume fader task being carried out in a music studio in this study, this does not need to be the case in future research. There is potential for this task to be adapted into a digital format, potentially through a mobile phone application (app).

The findings in relation to VMI being associated with improvements in mood shed light on potential individuals with other psychological disorders that might benefit from this proposed intervention method. Depression, a mental health problem that often co-exists with anxiety (Choi et al., 2020), is associated with negative mood (Manczak et al., 2019). Boumparis et al. (2016) conducted a systematic review and showed how targeting this aspect of depression has proven beneficial in existing psychotherapies such as reminiscence therapy (Zhou et al., 2012), which involves using multiple senses to recall memories. Therefore, VMI might also be helpful in the treatment of the negative affect found in depressive patients. With the demonstration of VMI having a relationship with positive mood, future investigations into VMI as an intervention for mental health problems could focus on using this method to reduce the number of depressive symptoms individuals experience.

Another point of exploration relates to the most effective type of music that could be recommended when people use VMI to reduce anxiety. Although it is widely acknowledged that musical preference can impact the effectiveness of music listening therapies for anxiety (Davis & Thaut, 1989), there are specific musical features that can enhance the effect this method has on anxiety reduction. For example, physiological measures are used in mental health intervention research as a way of gauging the effectiveness of treatment methods for anxiety, such as reduced heart rate (Chalmers et al., 2014). When considering some of these measures in relation to the effect music listening might have on them, music has been shown to reduce heart rate (Pittman & Kridli, 2011). In terms of musical features that relate to reduced heart rate, Edworthy and Waring (2006) have shown how music with slow tempi, between 50 and 60 beats per minute, is associated with a lower heart rate. As this VMI training study showed that the tempo the participants were imagining their music at was not significantly different from their perception of tempo when listening to the music, thus demonstrating how tempo is preserved in VMI, future work can seek to investigate whether altering specific musical features might have stronger impacts on the reduction of anxiety when using VMI.

### 5.4.6 Conclusion

To conclude, the purpose of this study was to investigate the feasibility of training non-musicians in deliberately imagining music and to collect preliminary data on the effects VMI might have on anxiety and mood. The main findings demonstrated how VMI is a trainable activity and highlighted how the VMI training method—the volume fader task—could be employed in future scenarios where VMI training or practice is needed. The findings relating to anxiety and mood were the first pieces of evidence to show the potential for VMI to be associated with lower levels of state anxiety and increases in positive mood, although these effects were found in comparison to the verbal control task that was seen as potentially stress-inducing by the participants. Considering this finding, and the trend for lower end of day anxiety levels associated with VMI than with the control, there is potential to examine whether VMI could serve as a beneficial intervention once participants have more time to get used to the intervention. Therefore, these findings allow for progression onto the next research stage in this thesis, which involves primarily investigating whether VMI can reduce anxiety and increase positive mood.

# Chapter 6
# The Effects of Voluntary Musical Imagery on Anxiety and Mood

Chapters One and Four in this thesis have highlighted how imagery interventions have been used for anxiety reduction, focusing on multimodal imagery (Apóstolo & Kolcaba, 2009; Beizaee et al., 2018; Jing et al., 2011). Chapter Five was the first to suggest that VMI may be associated with lower levels of anxiety and increases in positive mood, compared to a verbal control task. Thus, the purpose of this chapter is to study the effect of a VMI intervention on anxiety reduction, comparing this activity with an active control. Secondary aims include testing the effects of VMI on positive and negative mood, as well as assessing how difficult the participants perceive the intervention activities to be, which activity is most preferred and whether the study affects the likability of self-selected music. To address these aims, participants were introduced to VMI and the control activity, specifically the verbal fluency task (VFT), and practised these activities in a studio session. As VMI was shown to be a trainable activity in Chapter Five using the volume fader task, this same task was integrated into this study as a way to practise VMI rather than being further tested as a training tool. Next, the participants incorporated VMI into their lives for three days then completed the VFT for another three days. These activities were completed for a longer period of time in this study, compared to this activity in the previous chapter, to monitor the effects on anxiety over a longer duration. During these six days, an Experience Sampling Method (ESM) was used to assess the participants' anxiety and mood ratings in response to the musical imagery and verbal fluency tasks. After, the participants were interviewed about deliberately imagining music as an intervention method for anxiety using the same feedback method in the VMI training feasibility study in Chapter Five.

## 6.1 Introduction

### 6.1.1 Treating anxiety

As outlined in Chapter One, anxiety is a common mental health experience (Clark & Beck, 2010) associated with several problems like dysfunctional emotion regulation (Cisler & Olatunji, 2012) and poor quality of life (Geraedts et al., 2015; Mendlowicz & Stein, 2000; Norberg et al., 2008; Sudhir et al., 2012). The common and problematic nature of anxiety accounts for why there is a need for anxiety interventions. Specifically, this is to reduce the frequent occurrence of anxiety and its negative impact. Chapter One also highlighted how one of the most prominent perspectives from which this problem has been viewed is the cognitive perspective (Beck, 1976; Beck & Haigh, 2014). This view of anxiety places an emphasis on the relationship between cognitive and behavioural processes, and how these processes can lead to anxiety symptoms.

The Generic Cognitive Model (GCM), proposed by Beck and Haigh (2014), specifically states that biases in information processing are key features in the development of anxiety. The way in which information is processed is controlled by schemas (formed of beliefs and expectations) that individuals have for everyday events. The GCM also posits that within schemas, there are four main mechanisms that interact when exposed to a potentially anxiety-triggering event: focus, biased beliefs, situation, and maladaptive behaviour. If any of these mechanisms are affected by anxiety-triggering events, there will be negative biases in the processing of information and consequently result in anxiety symptoms. Further to this, an implication of the GCM, as suggested by Beck & Haigh (2014), is that targeting any of these four mechanisms can alleviate anxiety, but the more factors an intervention is based on, the more effective this intervention method is likely to be. The VMI intervention offered in this chapter is intended to target the focus mechanism, which would then alter the perception of the anxiety event and offer a technique to manage anxiety, thereby interrupting the cycle of maladaptive behaviour.

CBT has been offered as an evidence-based treatment method, developed in line with the mechanisms that the cognitive viewpoint of anxiety states are vital in the maintenance of this problem (Fenn & Byrne, 2013). This type of therapy works on the premise that therapists can help anxious individuals modify their anxiety-related thoughts and behaviours, in order to reduce their symptoms (Wong et al., 2016). The effectiveness of CBT for anxiety has been seen in several studies that aim to alleviate anxiety, ranging from treating panic (Bilet et al., 2020) to social anxiety in adults (Scaini et al., 2016), children and adolescents (Mayo-Wilson et al., 2014). Yet, despite the majority of the results showing anxiolytic effects, there are still some cases where CBT does not alleviate anxiety. This could be due to individual differences among people undergoing CBT that can inhibit the effectiveness of the method. An example of such might include the level of interest an individual has in this type of therapy, as low interest could lead to minimal effort being used to complete the CBT activities. Due to an inconsistency in the effectiveness of interventions for every individual, there is a need for a variety of anxiety interventions. Imagery-based interventions are another example of a treatment method that can target the main mechanisms presented in the GCM.

Imagery interventions involve the use of mental imagery to assist in the treatment of anxiety. In terms of addressing components of the GCM, these intervention methods can alter what an individual pays attention to in their environment. For instance, if an anxious person deliberately imagines a visual scene of a sun setting by the sea, they are likely to pay attention to visualising this image in their mind and direct their focus away from the anxiety-triggering event or stimuli in their environment. As a result of this, there would be a reduction in the negative thoughts one has and consequently less maladaptive behaviour. Additionally, Holmes and Mathews (2005) suggest that mental imagery can regulate emotions in a positive direction. This emotional aspect of mental imagery further strengthens the potential of this method for reducing anxiety, as imagery can increase the presence of positive emotions (Nelis et al., 2012), which is a feature that is absent in anxiety (Kenny, 2010).

Evidence of imagery interventions for anxiety has shown how guided imagery can reduce preoperative anxiety in children as well as adults (Álvarez-García & Yaban, 2020). Mhaske et al. (2018) also investigated the effectiveness of imagery methods, finding that visual imagery and progressive relaxation can improve post-intervention anxiety ratings. However, the systematic review of imagery-based interventions for anxiety presented in Chapter Four highlighted the need for further research into imagery interventions for anxiety to establish a consistent conclusion about the overall benefit of these methods. Also, in spite of the known anxiolytic effects of music listening, as well as the potential efficacy of imagery-based interventions to reduce anxiety, the review showed that intentionally re-playing music in the form of musical imagery has not been explored. This lack of evidence into the musical mode of imagery being used in anxiety interventions, as well as the unclear nature of the overall effectiveness of imagery interventions for anxiety in general, presents the opportunity for a musical imagery intervention for anxiety to be investigated.

### 6.1.2 Voluntary musical imagery intervention for anxiety

As it has been acknowledged that there is a need for a variety of treatment methods for anxiety, to overcome the problem of some interventions not being effective for all users, developing a VMI intervention can contribute to increasing the treatment options that are available. In relation to the causal mechanisms stated in the GCM, VMI can reduce anxiety by altering where an individual directs their attention. As highlighted in the example above with visual imagery, the same concept can be applied to musical imagery. Deliberately imagining a song would require people to focus on the music being imagined instead of potentially anxiety-triggering stimuli in their environment. This musical imagery should distract them from the harmful stimuli and reduce their negative thoughts, as they are not focusing on the anxiety-provoking situation. The distraction away from stimuli that can trigger anxiety would reduce the likelihood of anxiety-related schemas being activated, and thus limit the opportunity for negative interpretations of the stimuli.

In comparison to CBT, VMI has the advantage of being an intervention method that is characterised by self-control. Firstly, not only do the anxious people have control over the music that is imagined, but this activity requires individuals to be in control of maintaining the musical imagery in their mind. Moreover, individuals have to complete additional work in between CBT sessions that is vital for achieving positive outcomes. This requires extra enthusiasm from anxious individuals, and if someone undergoing CBT is not willing to engage in these additional tasks, it would negatively impact how well CBT can reduce their anxiety. VMI, on the other hand, adopts a personalised approach, as people can select their own music to imagine, which increases the chances of these individuals being willing to complete this activity. There are also other features of VMI that could make this method more effective than CBT. This relates to the dynamic nature of VMI that can lead to anxious individuals having an increased chance of dissociating from their current situation, as sustained attention that is often directed towards the negative thoughts that maintain anxiety (Paloș & Viscu, 2014) would be rediverted to the music that is being imagined. Lastly, the deliberate imagination of music occupies working memory (Kalakoski, 2001; Logie & Edworthy, 1986), which should limit the number of negative thoughts an individual can have, as verbal thoughts use working memory as well (Baddeley & Hitch, 1974). It is also worthwhile acknowledging the affective impact of VMI in relation to anxiety. There is evidence that demonstrates how mental imagery can regulate emotions in a positive direction (Wilson et al., 2018) and how positive mood states, like happiness, are associated with musical imagery (Bailes, 2015). As negative emotions and moods associated with anxiety further reinforce the anxiety experience, developing an intervention method, such as VMI, to target this emotional problem can increase the presence of positive emotions within anxious individuals. Therefore, taken together, this study presents the novel exploration of the VMI intervention for anxiety reduction.

This VMI intervention study builds on the VMI training feasibility study outlined in Chapter Five, in a similar way to the design of studies by Skodzik and colleagues (2017; 2018). These researchers investigated the potential of a mental imagery training intervention for worry (whilst also looking at the effects on anxiety), by first presenting a proof of principle study to examine the feasibility of a mental imagery training programme (Skodzik et al., 2017), then conducting a mental imagery training intervention study (Skodzik et al., 2018). In line with the approach these researchers adopted, Chapter Five consisted of a feasibility study to test whether it was possible to train non-musicians to voluntarily imagine music using newly suggested methods, while also providing preliminary evidence on the relationship VMI might have with anxiety and mood, compared to a control activity. The control activity was the VFT, which involves individuals being given a letter and having to think of as many words as possible beginning with that letter. The study design in Chapter Five followed the format below:

- Pre-VMI training tasks (Assess trait anxiety and musical imagery experiences)
- Stage one (Train non-musicians to voluntarily imagine music and practise the VFT)
- Stage two (Use an ESM approach to prompt participants to practise VMI and the VFT during their daily lives over two days, whilst answering questions about these attempts and whether the intervention activities affected their anxiety and mood)
- Stage three (Assess participants’ ability to deliberately imagine music and collect feedback on the methods used for VMI training through an interview)

From this study, it was concluded that the VMI training activity (which was the volume fader task) was a suitable method to train individuals to deliberately imagine music. VMI was also found to be associated with significantly fewer increases in anxiety and positive mood improvements, compared to the control activity. Thus, this chapter primarily explores whether VMI can reduce anxiety following a similar format to the study in Chapter Five, but with different purposes for each stage:

- Pre-VMI intervention tasks (Assess trait anxiety and depression)
- Stage one (Participants practise intervention activities - VMI and the VFT)
- Stage two (Use an ESM approach to prompt participants to practise VMI and the VFT during their daily lives over six days, while answering questions about whether those intervention activities affected their anxiety and mood)
- Stage three (Collect feedback on VMI and VFT as intervention methods for anxiety reduction through an interview)

As mentioned, the VMI intervention study follows the same format as the VMI training feasibility study, in that there are three main stages with a pre-study task section, except the purpose of each stage was altered to fit the main research question in this study. The aim of this study is to test whether VMI can reduce anxiety, with an additional focus on the effects of VMI on mood, in comparison to the VFT. The same control task from the previous chapter was used in this study but modified in order to try and equalise task difficulty with the VMI.

As the version of the VFT that involved thinking of as many words as possible beginning with a specific letter was perceived as easier in the VMI training feasibility study, this version was adopted in this VMI intervention study. The objective of stage one was to provide the participants with an opportunity to practise deliberately imagining music and completing the VFT. Stage two aimed to assess the effects of VMI and the VFT on anxiety and mood over a six-day period using an ESM. This included cued and non-cued sampling responses of anxiety and mood reports in relation to deliberately imagining music and completing the VFT. It was important to test the effects of these activities over a longer duration of time, in comparison to two days in the VMI training feasibility study, to allow participants to have more experience with these intervention activities. Additionally, the effect of VMI on anxiety in Chapter Five was only marginal, so it could be that the intervention might need longer to take effect. There were also no differences in the time points at which anxiety and mood ratings were measured in the VMI training study, thus, there was interest in seeing whether there are changes over time at different time points across the day. Additionally, measuring anxiety and mood over a longer period of time would contribute towards making the results obtained more ecologically valid. In the final stage of the intervention study, the participants were interviewed about the intervention activities and their impact on anxiety and mood.

### 6.1.3 Aims and predictions

The main aim in this study looks at whether VMI can reduce anxiety, compared to a control activity (the VFT). Additional interest focuses on potential associations between VMI and mood, the participants' perception of task difficulty, activity preference and whether the study affects the likability of the music the participants chose to use. Secondary focus on mood was included based on the preliminary findings relating to the association between VMI and positive mood from the VMI training feasibility study. As this present study used the version of the VFT that the participants perceived as easier in the VMI training feasibility study, task difficulty was included as an additional measure to see if this version of the VFT reduced the likelihood of VFT being associated with negative mood and increases in anxiety. The last aim is to assess whether there is a difference in intervention activity preference, as preferred activities could be more likely to positively impact anxiety and mood. In addition to this, it was important to capture the effect of the study (if any) on music likability, to check that the intervention did not adversely affect how much the participants liked the music they chose to imagine.

Based on the discussions above about how VMI can direct one's attention away from negative stimuli and towards the music being imagined, whilst also regulating emotions in a positive direction, it was hypothesised that VMI would be associated with significant reductions in anxiety. With Holmes and Mathews (2005) discussing how imagery shares a special relationship with emotions, which can extend to mood, and the VMI training feasibility study showing how VMI is associated with positive mood, it was predicted that there would be a positive relationship between VMI and positive mood. For the secondary outcome variables, participants were predicted to prefer the VMI activity more and find this task less difficult due to associations with positive mood being established for VMI in the VMI training feasibility study.

## 6.2 Method

### 6.2.1 Participants

The participants consisted of 50 women, 14 men and one non-binary individual, with an age range between 18 and 69 years old (*Mdn* = 23, *M* = 24.22, *SD* = 8.68). G*Power 3.1 was used to calculate the sample size, using a priori, a significance level of .05, power of .95 and a medium effect size. This calculation determined that 54 participants would be needed. However, a further 11 participants were recruited after testing 54 participants, totalling 65 participants, to compensate for partial data from the ESM part of the study. Participants were recruited using a volunteer sampling method, as recruitment advertisements were circulated via university mailing lists (Appendix G.1), posters on noticeboards (Appendix G.2), social media (Appendix G.3), and the student participation pool for psychology undergraduates at the University of Leeds (Appendix G.4). As a reward for participating, the psychology students who were recruited via the participation pool received 15 course credits and the other participants were entered into a prize draw to have a chance of winning £40. Exclusion criteria included any individuals who were under the age of 18 (as there was only interest in an adult sample) and had hearing loss (as music listening activities were included in the study). This research received ethical approval from the Faculty of Arts, Humanities and Cultures Research Ethics Committee (FAHC 18-064) on 18th March 2019 (Appendix G.5).

### 6.2.2 Design

A repeated measures design was used, with the independent variable being condition with two levels (VMI vs VFT). The primary dependent variables were anxiety change, end of day anxiety and state anxiety, whilst the secondary dependent variables were end of day mood, positive mood, and negative mood. Further dependent variables included task difficulty, task preference and music likability. The order of tasks in stages one and two were counterbalanced, with one half of the participants completing all of the VMI-related tasks first, whereas the other half completed VFT-related tasks first (this is discussed in more detail below in sections 6.2.6.2 and 6.2.6.3). The participants were not aware of this information.

### 6.2.3 Materials

The participants received an information sheet (Appendix G.6) and a consent form (Appendix G.7) to inform them about the nature of this study and gain their consent for participation. They were also given an anonymous ID form to create anonymous ID codes that were assigned to their data sets (Appendix G.8). Participants selected their own music for this study using the music selection criteria form (Appendix G.9) to ensure it was a piece that made them feel happy, one they were familiar with, that they liked a lot, had no specific memories associated with and was not longer than three minutes.

Trait anxiety and depression were assessed using the State-Trait Anxiety Inventory-Trait Scale (STAI-T; Spielberger et al., 1983; Appendix D.4) and the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977; Appendix D.5), two measures that have been previously discussed in this thesis (pp. 45-46). However, as a brief reminder, the STAI-T is a self-report questionnaire that assesses one's general experience of anxiety using 20 items in the form of a Likert scale from 1 (*Almost never*) to 4 (*Almost always*). These questions address worry, tension, nervousness and apprehension, and the participants are asked to rate how they generally feel in response to the items. The scores participants can receive range between 20 and 80 and the lower the score, the lower one's trait anxiety. There was a high level of internal consistency in this scale for this sample, $\alpha = .91$. The CES-D is also a 20-item self-report questionnaire, that measures the severity of depressive symptoms over the past week. Each question has four possible responses: 1) Rarely or none of the time (Less than 1 day), 2) Some or a little of the time (1-2 days), 3) Occasionally or a moderate amount of time (3-4 days) and 4) Most or all of the time (5-7 days). Scores can range between 0 and 60, with higher scores indicating more severe depressive symptoms. This questionnaire had a high level of internal consistency, $\alpha = .90$. There were also additional background questions that collected information about the participants' diagnoses of clinical anxiety and depression (Appendix G.10). The participants received a debrief form via email, once they had completed the study (Appendix G.11).

#### 6.2.3.1 Six-item short-form State-Trait Anxiety Inventory (STAI-6; Marteau & Bekker, 1992)

This questionnaire is the shortened version of the State-Trait Anxiety Inventory (STAI) that assesses state anxiety and is used in situations where it would be more efficient, compared to the original STAI questionnaire. This was the case in this study, as it would be too much of a burden for the participants to complete the state scale of the STAI (consisting of 20 questions) six times a day for six days, in addition to other questions. The Six-item short-form State-Trait Anxiety Inventory (STAI-6) consists of six statements that relate to the extent to which an individual feels calm, tense, upset, relaxed, content, and worried. Participants are asked to respond to each question in relation to how they currently feel, and these responses are rated on a scale from 1 (*Not at all*) to 4 (V*ery much*). An example of a question follows: ‘I feel calm.’ Scores in this questionnaire can range between 20 and 80 and a healthy score, according to Spielberger (1983), is approximately between 34 and 36. Tluczek et al. (2009) have provided evidence in support of the STAI-6 being a valid measure when correlated with the original state version of the STAI, and having a high level of internal consistency, $\alpha = .88$. The STAI-6 can be found in Appendix G.12.

#### 6.2.3.2 Background Questions

To acquire information about the participants’ musicianship, a range of questions were asked that related to whether they had experiences in formal music training, as a musician and studying music (Appendix G.13). A music likability question was used to assess the likability of self-selected music pieces (to determine whether the study had affected the participants’ perception towards how much they liked the music), where 1 represented ‘Not at all’ and 10 represented ‘Extremely’ (Appendix F.7). Task difficulty was assessed using a difficulty rating question. This question asked the participants how difficult they found both the VMI and verbal fluency tasks on a scale from 1 (*Not very difficult*) to 10 (*Extremely difficult*).

#### 6.2.3.3 Experience Sampling Method (ESM) questions

The ESM section of the study occurred in stage two and included a set of questions in a sampled episode that the participants were repeatedly sent over the course of six days (three of which were VMI days and the other three were the control days). The questions are discussed in more detail in sections 6.2.3.3.1 and 6.2.3.3.2. For each sampled episode completed, the participants had to record the date and time, provide their anonymous ID code, and state the text message number (Appendix G.14).

#### 6.2.3.3.1 Anxiety and mood

Anxiety and mood ratings (Appendix G.15) were recorded at the start and end of each ESM day. As there was interest in measuring the start and end of day anxiety in a simple way, an anxiety rating question was formulated, based on existing measures. As the STAI and other established anxiety questionnaires that are reliable and valid, such as the Beck Anxiety Inventory (Beck et al., 1988) and the Hospital Anxiety and Depression Scale-Anxiety (Zigmond & Snaith, 1983), have consistently developed anxiety questionnaires with items in the form of a Likert scale that range from responses consistent with not having very much anxiety to having a lot of anxiety, the participants were asked to rate how anxious they felt on a scale from 1 (*Not very anxious*) to 9 (*Extremely anxious*). This format was also applied when creating the start and end of day mood rating questions. The participants were asked to rate their overall mood on a scale from -4 (*Extremely negative*) to +4 (*Extremely positive*).

#### 6.2.3.3.2 Voluntary musical imagery and verbal fluency task questions

There were two sets of questions that were given to the participants during the ESM stage, depending on whether the participants were instructed to complete the study activities (prompted vs not prompted). In the instances where the participants were prompted to deliberately imagine music, there were six questions relating to anxiety, mood, and the difficulty of the activity. For anxiety, the participants were asked to rate their current anxiety before and after voluntarily imagining music on a scale from 1 (*Not very anxious*) to 9 (*Extremely anxious*) and complete the STAI-6 after the VMI activity. The questions regarding mood required the participants to state how much the VMI affected both their positive and negative moods on a scale from 1 (*Greatly reduced*) to 9 (*Greatly increased*), whilst also providing a brief reason behind these ratings. Finally, the participants were asked to rate how difficult it was to imagine the music on a scale from 1 (*Not very difficult*) to 10 (*Extremely difficult*), and this questionnaire is located in Appendix G.14.

When the participants completed the ESM task without receiving instructions to voluntarily imagine music (not prompted), there were four questions. The participants were asked to complete the STAI-6 and questions relating to whether they had deliberately or spontaneously imagined music since the last point of contact with the researcher (without being prompted to). The participants were also asked about when they last heard their self-selected piece of music out loud.

The questions for the VFT days followed a similar format to that of the VMI day. The same questions on the VMI day were used in instances where the participants were instructed to complete the verbal task (except the wording was changed so that the questions related specifically to the VFT instead of deliberately imagining music; Appendix G.14).

#### 6.2.3.4 Interview questions

Once the participants had completed the study, they were interviewed using a semi-structured approach in order to understand people's experiences of using VMI and VFT during their everyday lives. This interview structure was used to allow participants to elaborate on their responses. With the researcher being able to formulate new questions based on those responses, it also allowed for the opportunity to collect additional data that is relevant to the purpose of the interview. Participants were first asked about their experience of deliberately imagining music within the two-week period between the ESM session and the interview stage, including why they decided to voluntarily imagine music and if that activity affected any feelings of anxiety. Next, the questions were related to the use of VMI and VFT for anxiety reduction. These items specifically focused on the preferred activity, prospective use of these activities for anxiety reduction, and recommendations of the activities. The final set of questions addressed the participants' past and future experiences of VMI, including explanations for previously deliberately imagining music and whether the study affected their decision to voluntarily imagine music in the future. The last question asked the participants if they had any additional comments before the interview came to an end. The interview schedule can be found in Appendix G.16.

### 6.2.4 Stimuli

The participants were asked to select one piece of music in accordance with the music selection criteria form, being informed that the music will be used in the study activities (specifically the VMI tasks). As mentioned previously, the participants had to make sure that they liked the music a lot, it made them feel happy, they were familiar with the song, it had no specific episodic memory associations and was three minutes long or less. There were 63 discrete tracks selected, with one music piece being selected twice. The list of songs selected can be found in Appendix G.17.

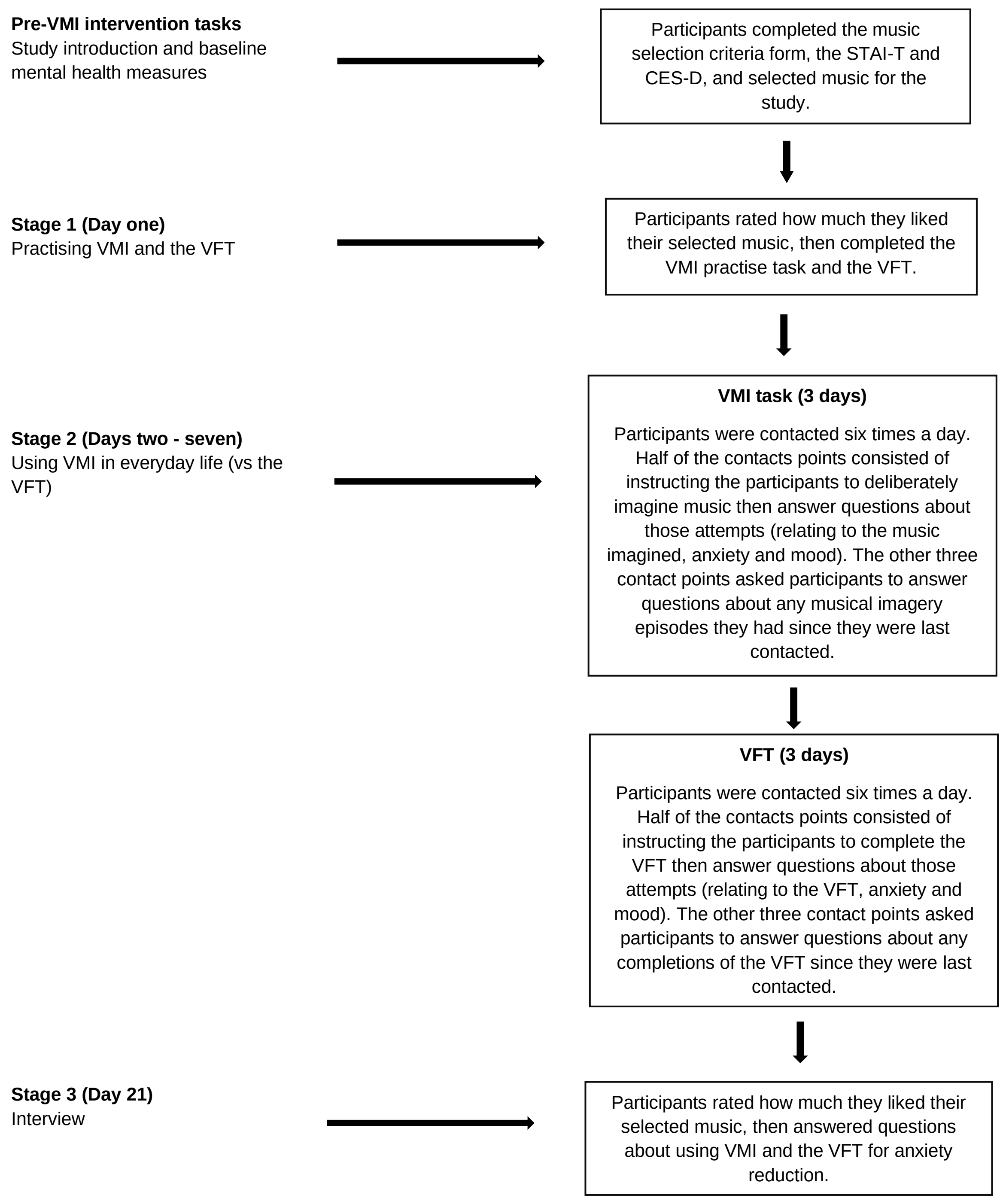
### 6.2.5 Equipment

As this study followed a similar format to the VMI training feasibility study (found in Chapter Five), the same set of equipment was used in stage one in both studies. This set of equipment has already been presented in detail in Chapter Five (p. 126), so it will only be briefly discussed in this chapter. Stage one occurred in a sound-proofed music studio, which included two desktop screens, three speakers, a volume fader board, and an opaque cloth (to cover the desktop screen at certain times). The programme Logic Pro X was used to record data from the volume fader task. In stage two, the participants used their personal mobile phones and a pair of headphones (optional). Stage three made use of the desktop PC setup in the music studio and an audio recorder on a mobile phone.

### 6.2.6 Procedure

There were four sections in this study that took place over 21 days - pre-VMI intervention tasks and stages one, two and three (as seen in Figure 6.1). The pre-VMI intervention section was mainly used for participants to provide their consent and complete the STAI-T and the CES-D, while stage one was developed to allow participants to practise the verbal fluency and musical imagery tasks. In stage two, the musical imagery and verbal fluency activities were incorporated into the participants' daily lives, whilst they answered questions about these tasks and whether they subsequently impacted their anxiety and mood. Stage three involved the participants being interviewed about the use of VMI and the VFT for anxiety reduction. Each part of the study is discussed in further detail below.

Figure 6.1 *Overall study procedure*




*Note*. This schematic diagram presents a visual outline of the overall procedure in this study, including the pre-VMI intervention tasks, as well as stages one, two and three activities. The activities in stages one and two were counterbalanced according to groups. Participants in group one completed the VMI tasks first, whereas individuals in group two completed the VFTs first.

**6.2.6.1 Pre-voluntary musical imagery intervention tasks: Study introduction and baseline mental health measures**

The aim of this section was to introduce the participants to the study, obtain their consent to participate, measure their trait anxiety, depression, and their musicianship. After showing initial interest in taking part in the study, participants were sent study forms via email - the information sheet, consent form, anonymous ID document and the music selection criteria form. The information sheet provided the participants with an overview of the study, and the participants were asked to sign the consent form and return it via email within one week of receipt, if they wished to partake in the study. An anonymous ID code was created for the participants using their birth month, the first two letters of their favourite food and their favourite subject at school. The music piece was selected using the music selection criteria form.

Once the forms above were completed and returned via email, the participants were sent a website link to complete the STAI-T and the CES-D, as well as answer questions about clinical anxiety and depression. In addition to the mental health questions, the participants were asked about their musical engagement, specifically focusing on whether they were previous or are current music students, are musicians or have received six or more years of formal music training. This information was obtained as there are suggestions that musicians are better at voluntarily imagining music compared to non-musicians (Campos & Fuentes, 2016). In addition to this, six or more years of formal music training has been suggested to be the baseline for people to be deemed as a musician in psychological research (Zhang et al., 2020). Online completion of these questions lasted approximately seven minutes.

**6.2.6.2 Stage one: Practising voluntary musical imagery and the verbal fluency task (Day one)**

The purpose of stage one was for the participants to familiarise themselves with deliberately imagining music and the VFT (with the session lasting between 45 and 60 minutes), before implementing these activities into their daily lives. The participants were invited to the music studio at the University of Leeds and were asked to complete three activities; rate the liking of their musical selection, practise imagining their chosen music and complete the VFT. First, the participants were briefly introduced to the concept of musical imagery and then rated how much they liked their music piece using the music likability rating scale. Next, they completed the volume fader task to practise voluntarily imagining music, and they practised the VFT (following the same methods in stage one of the third study, found in Chapter Five; p. 128). The main differences between the version of these tasks in this study compared to the VMI training feasibility study were that the participants were only required to rate the difficulty of each trial in between trials, and the purpose of these activities in this study was for individuals to practise them.

The participants were randomly assigned to either group one or group two when they gave their participatory consent and then the order of the session activities was counterbalanced. The format of the order of activities followed so that individuals in group one completed the VMI task first then the VFT, whereas group two individuals completed the VFT first then the VMI task second. At the end of the session, the participants were provided with a summary of the next stages of the study, then received an email later that evening to remind them about stage two (Appendix G.18).

#### 6.2.6.3 Stage two: Using voluntary musical imagery in everyday life (vs the verbal fluency task; Days two - seven)

For this stage, the participants completed the VMI and the verbal fluency activities over six days using an ESM approach, with the primary intention being to see how each of those activities affected, if at all, the participants' anxiety and mood ratings. This activity occurred wherever the participants were when they received the text messages, e.g., at home or at the library. Three days consisted of the VMI activity then the participants completed the VFT on the other three days, with the activities lasting approximately 35 minutes on each day (when totalled together). These days were counterbalanced across the participant sample so that for group one, the VMI days were from days two to four and the VFT days were days five to seven, whereas the VFT days were on days two to four and the VMI days were on days five to seven for group two (as shown in Figure 6.2).

The participants received eight text messages at quasi-random points between 8am and 8pm, with the time points being generated using a random time generator (www.randomlists.com/random-time). This time frame was chosen based on time frames that have been used in previous musical imagery studies that include ESM - 8am to 8pm (Byron & Fowles, 2015), 8am to 10pm (Negishi & Sekiguchi, 2020) and 8am to 11pm (Floridou & Müllensiefen, 2015). Table 6.1 presents two examples of the quasi-random time points generated for two participants on day one. An additional text message was sent on the last ESM day at 8.30pm that provided the participants with a link to complete the STAI-T and the CES-D. Across the entire ESM stage, the participants received 36 individual time points for the text messages to be sent. Each text message contained a link to a webpage with instructions, and the participants were told to keep their mobile phones and a pair of headphones on them at all times during the time frame on those days. On the first ESM day, the first text message was sent at 8am and the instructions in the website link asked participants to rate their overall anxiety and mood at the start of the day. Then the participants were periodically instructed to voluntarily imagine music (via three text messages) at random time points, when receiving this instruction - ‘Start the 2-minute timer on your phone and imagine the piece of music (from this study) in your mind. You can listen to the music before your attempt (if needed).’ Before each attempt, the participants rated their anxiety, then after deliberately imagining music, they answered six questions relating to that task.

The first such prompt was sent between 8am and 10am, the second between 12.01pm and 2pm, and the third between 4.01pm and 6pm. The participants were informed at the end of stage one that they could voluntarily imagine music at other points during the day (without being prompted to), but it was vital that they kept a tally of the number of times this occurred. The other three text messages did not instruct the participants to deliberately imagine music, but instead asked the participants about their musical imagery experiences since the last point of contact. These text messages were sent between 10.01am and 12pm, 2.01pm and 4pm, and 6.01pm and 8pm, in the same way mentioned above (i.e., one unique time for each participant). The participants were required to answer four questions relating to whether these unprompted musical imagery episodes occurred since the last contact point. As seen by the hours stated above, the text messages that did and did not prompt the individuals to deliberately imagine music were interspersed, so that the same type of text message was never presented immediately after another.

Table 6.1 *An example of the individual times participants received text messages on Day one*

| Text message number | Time sent (Participant A) | Time sent (Participant B) |
|---|---|---|
| 1 | 8:00 | 8:00 |
| 2 | 8:55 | 8:30 |
| 3 | 10:40 | 10:30 |
| 4 | 13:00 | 13:30 |
| 5 | 15:00 | 15:10 |
| 6 | 16:30 | 16:05 |
| 7 | 18:55 | 19:55 |
| 8 | 20:00 | 20:00 |

For the next three ESM days, the participants were instructed to complete the VFT and answer questions relating to that task in the same way as previously discussed with the VMI task. The participants were emailed every evening to remind them of their instructions for the following day, regarding receiving the text messages. These instructions were as follows:

*Dear participant X,*

*Tomorrow you will be contacted at 8 random points between 8am and 8pm via text message, therefore it is necessary for you to keep your phone by your side at all times during this specified time frame. Each time you receive a text message, there will be a link for you to follow. Click on this link and read the instructions.*

The last text message on the final ESM day required participants to complete the STAI-T and the CES-D. After the seventh day, the participants were told that they would not be required to complete any activities for this study until they returned to the music studio on Day 21 for the final stage of the study. This was the format for participants in group one but for group two, the order of the days was counterbalanced so that the first three days were VFT days and the last three days were VMI days. The details of the text messages used in this stage can be found in Appendix G.19.

#### 6.2.6.4 Stage three: Interview (Day 21)

The purpose of this stage was to gather feedback on VMI for anxiety reduction through a semi-structured interview. The participants were also debriefed about the underlying aims of the study following the interview.

The participants were invited to the music studio at the University of Leeds (where stage one took place) on Day 21. First, the participants rated how much they enjoyed their piece of music, then they were interviewed, whilst also being audio recorded (with permission from the participant). Finally, the participants were verbally debriefed about the study and sent a debrief form electronically via email.

### 6.2.7 Data analysis

The primary research questions related to whether there would be a main effect of condition on anxiety and mood, and so it was hypothesised that reductions in anxiety and increases in positive mood would be associated with the VMI condition. As in the VMI training feasibility study in Chapter Five, hierarchical linear modelling was used to statistically analyse the anxiety and mood data, and several HLMs were created for each outcome variable - anxiety change, end of day anxiety, state anxiety, end of day mood, positive mood and negative mood. The models for anxiety change, end of day anxiety, state anxiety, end of day mood, positive mood and negative mood had a two-level hierarchical structure, with Level 1 capturing the within-person relations between the day-level predictors (condition and task difficulty) and the day-level dependent variables (anxiety change, end of day anxiety, state anxiety, end of day mood, positive mood and negative mood), and Level 2 capturing between-person variability (trait anxiety and depression). The Level 1 variable condition was uncentered, task difficulty was group centered, and both were modelled as random, as it was assumed that each of the within-person variables would vary from day to day. The Level 2 continuous variables (trait anxiety and depression) were grand mean centered (Table 6.2 outlines the variables that were entered into Level 1 and Level 2 in each HLM). There were also two main blocks of analyses, where the first block tested the effects of the Level 1 variables (condition and task difficulty) on the outcome variables, then the second block included the Level 2 variables (trait anxiety and depression) in the HLM. HLM accounted for the instances of missing data (which were due to participants not completing questions) when creating the models. The data were handled differently, depending on whether they were taken from responses in contact points where participants were instructed to imagine music or complete the VFT (prompted), compared to when they were asked to answer questions about any musical imagery or verbal fluency tasks they had completed without receiving instructions to do so (not prompted).

Data for the anxiety change score, positive mood and negative mood outcome variables were collected from the contact points instructing individuals to deliberately imagine music or complete the VFT. To calculate an anxiety change score, anxiety ratings that were reported after being instructed to either deliberately imagine music or complete the VFT were subtracted from anxiety ratings reported before completing those tasks. As the participants were instructed to deliberately imagine music and complete the VFT three times a day on the allocated days, each participant could have produced a total of 18 anxiety change scores (nine scores for each condition). These scores could range from -8 (representing the greatest reduction in anxiety) to +8 (which represented the greatest increase in anxiety). One score was also collected for the positive mood variable in response to a positive mood rating question, with the scores ranging between 1 (*Greatly decreased*) to 9 *(Greatly increased*). This was the same for the negative mood outcome variable. As positive and negative moods were only rated after the participants were directed to complete the VMI and verbal fluency tasks, a total of 18 positive mood ratings and 18 negative mood ratings could be reported (with nine in each condition).

Data for the state anxiety ratings were taken at every contact point (irrespective of whether the participants were instructed to voluntarily imagine music or complete the VFT). To produce state anxiety scores, these scores were calculated from the STAI-6 questionnaire that was administered during the six contact points in the day. As this stage took place over six days, 36 state anxiety scores could be calculated per participant (18 for each condition). End of day anxiety and mood scores were taken from the corresponding questions, resulting in one score that ranged between 1 (*Not very anxious*) to 9 (*Extremely anxious*) for anxiety, and one score ranging between -4 (*Extremely negative*) to +4 (*Extremely positive*) for mood. Six end of day scores could be reported for anxiety and six for mood, with three scores for each condition.

There was also interest in seeing if there was a significant difference in the mean ratings of task difficulty in the VMI and VFT conditions, whether there was a significant difference between the likability of the self-selected music before and after the study, and if the participants preferred one of the study activities (VMI or VFT) more, compared to another. To address this, three paired samples t-tests were used. For these analyses, the task difficulty ratings that were collected whenever the participants were instructed to deliberately imagine music were compared to the difficulty ratings for the VFT. A mean difficulty score was calculated from those ratings, resulting in one mean difficulty score for each condition. Additionally, the music likability ratings collected after the study were compared to the likability ratings reported before the study. For the task preference analysis, the number of times participants either deliberately imagined music or completed the VFT without receiving instructions to do so was collected and a mean score was calculated for each condition.

Further to this, there was interest in monitoring anxiety and mood across each individual day, as well as across more than one day of completing the instructed tasks. Therefore, two rules were created in relation to data inclusion, in order to ensure that the data captured these changes throughout and across the testing days. The rules for data inclusion were:

1. Participants must have completed at least two of each type of response on each day. These response types related to whether the individuals were instructed to either deliberately imagine music or complete the VFT and answer questions about those attempts (prompted), or if the responses were related to the participants' experience (if any) of musical imagery or completing the VFT without being told to do so (not prompted).

2. Participants must have completed responses on at least two VMI days and two VFT days.

Table 6.2 *Variables entered into each model in the HLM analyses*

| Outcome variable | Level 1 variable | Level 2 variable |
|---|---|---|
| Anxiety change | Condition<br>Task difficulty | Trait anxiety<br>Depression |
| End of day anxiety | Condition | Trait anxiety<br>Depression |
| State anxiety | Condition | Trait anxiety<br>Depression |
| End of day mood | Condition | Trait anxiety<br>Depression |
| Positive mood | Condition | Trait anxiety<br>Depression |
| Negative mood | Condition | Trait anxiety<br>Depression |

Scores for trait anxiety, state anxiety and depression were calculated according to the instructions from the questionnaires used to measure these variables. For the STAI-T, each question has a weighted score between 1 (representing low anxiety) and 4 (representing high anxiety). There are 20 items in total and for nine of the items, scores are reversed so that 4 = 1, 3 = 2, 2 = 3 and 1 = 4. In these items, 4 (before being reversed) would therefore represent low trait anxiety and 1 would represent high trait anxiety. After the necessary scores are reversed, a total STAI-T score is calculated by summing these individual scores together. For the STAI-6, the six questions also have a weighted score between 1 and 4. Three of the questions are positive (calm, relaxed and content) and the other three are negative (tense, upset and worried). For the positive items, the scores are reversed so that 1 = 4, 2 = 3, 3 = 2 and 4 = 1. Once the necessary scores are reversed, each score is added together and this total is multiplied by 20/6, creating a total state anxiety score. For the CES-D, each response is assigned a numerical value: Rarely or none of the time (less than one day) = 0, Some or a little of the time (1-2 days) = 1, Occasionally or a moderate amount of time (3-4 days) = 2 and Most or all of the time (5-7 days) = 3. Scores are reversed for four of the items, so that the reversed scores are: Rarely or none of the time (less than one day) = 3, Some or a little of the time (1-2 days) = 2, Occasionally or a moderate amount of time (3-4 days) = 1 and Most or all of the time (5-7 days) = 0. After, the scores are added together.

For missing data in these questionnaires, the STAI-T states that any instances of more than two missing data points can lead to reduced validity of the score. Because of that, a trait anxiety score for any participants who had more than two instances of missing data was not calculated. For the STAI-6 and CES-D, any cases of missing data led to total state anxiety and depression scores not being calculated for that individual. An anxiety change score was also calculated for the anxiety change analyses, by taking the anxiety rating after completing the activity (VMI or VFT) away from the anxiety rating before the activity. The anxiety change scores ranged between -8 (representing the greatest decrease in anxiety) to +8 (representing the greatest increases in anxiety), and 0 represented no change in anxiety.

Interviews were audio recorded and then transcribed. Content analysis (Krippendorff, 2013) was used to identify key topics within the data, relating to the use of VMI and VFT as an intervention for anxiety.

## 6.3 Results

### 6.3.1 Descriptive statistics

Descriptive statistics for the main outcome variables are shown in Table 6.3. The baseline mean trait anxiety score in this sample was 45.28 (*SD* = 9.86*,* ranging between 25 and 70) and the baseline mean depression score was 15.61 (*SD* = 9.39, ranging between 1 and 49). In this sample, 22.2% (*n* = 12) of the participants reported having an anxiety disorder and 20.4% (*n* =11) had been diagnosed with clinical depression. Additionally, 25 of the participants were classed as musicians.

Table 6.3 *Descriptive statistics for the main outcome variables*

| Variable | VMI Mean (SD) | VFT Mean (SD) |
|---|---|---|
| **Anxiety** | | |
| Anxiety change | -0.2 (0.88) | 0.1 (1.08) |
| End of day anxiety | 2.27 (1.76) | 2.36 (1.83) |
| State anxiety | 36.67 (12.02) | 37.72 (7.071) |
| | | |
| **Mood** | | |
| End of day mood | 1.68 (1.77) | 1.31 (1.81) |
| Positive mood | 5.74 (1.44) | 5.18 (1.13) |
| Negative mood | 3.98 (1.44) | 4.54 (1.22) |

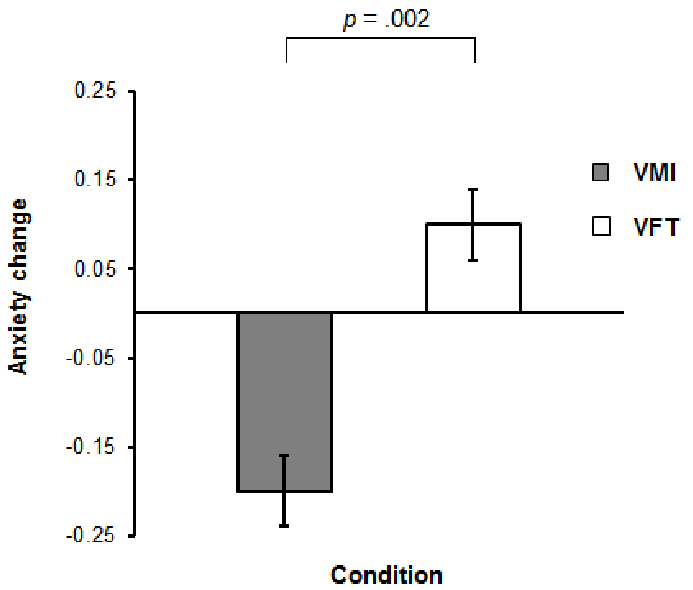
*Note*. Decreases in anxiety and mood are represented in a variety of ways, according to the outcome variable. For anxiety change and end of day mood, negative values represent decreases in these variables. Values between 1 and 4 represent decreases in the end of day anxiety, positive and negative mood. Scores between 20 and 36 represent low state anxiety (Spielberger et al., 1983).

## 6.3.2 Anxiety

### 6.3.2.1 Effect of condition on anxiety change

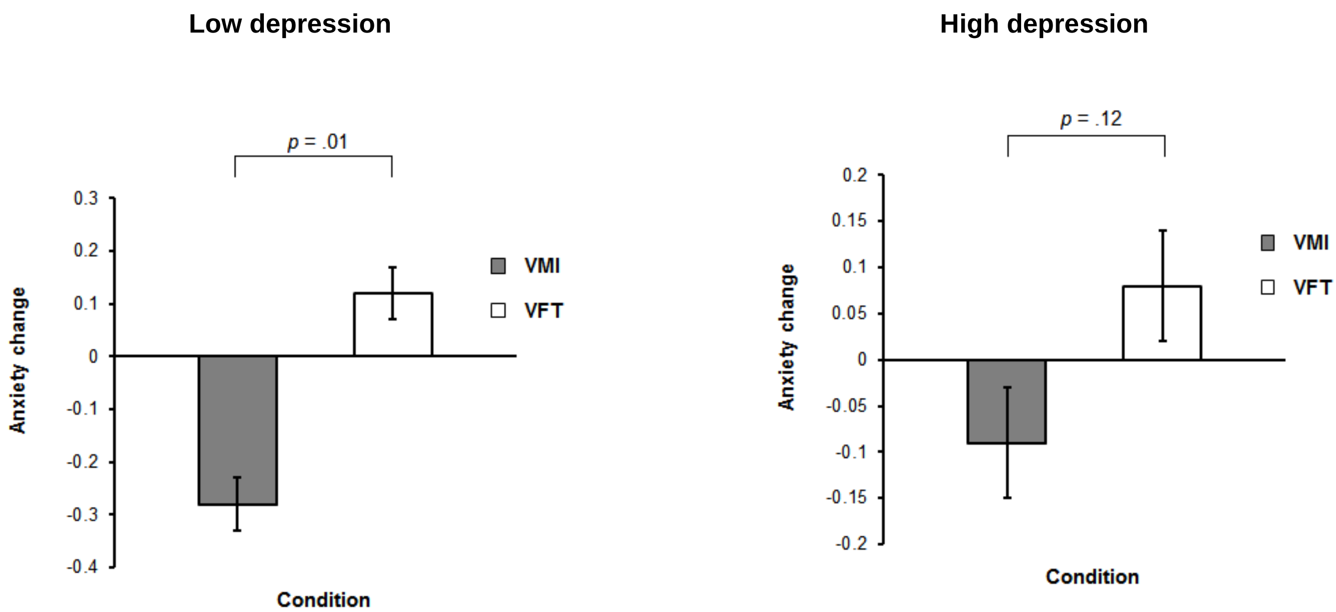
Hierarchical linear modelling was used to look at the effect of condition (VMI vs control) on anxiety change. The model found a significant effect of condition on the anxiety change scores ($b$ = .29, $p$ = .002, $d$ = .95), showing that while VMI was associated with decreases in anxiety, the control condition was not (seen in Figure 6.2 below). Task difficulty was also entered into the model as a Level 1 variable and found to be significant ($b$ = .05, $p$ = .002, $d$ = .96). When trait anxiety and depression were separately entered into the model as Level 2 variables, trait anxiety did not significantly affect the model ($b$ = -.01, $p$ = .06, $d$ = .53), but depression was a significant cross-level moderator ($b$ = -.02, $p$ = .02, $d$ = .67). To decompose this depression interaction, two new Level 2 files were created so that one file only had data for participants who scored below the median depression score in this sample, which was 15, and one file included data for participants who had a depression score of equal to or higher than 15. The HLM analysis showed a significant effect of condition on anxiety change score for those with lower depression levels, $b$ = .41, $p$ = .01, $d$ = .87, but not with higher depression levels, $b$ = .18, $p$ = .12, $d$ = .44 (as seen in Figure 6.3).

Figure 6.2 *Effects of VMI vs VFT on mean anxiety change scores*




*Note.* This figure shows the mean anxiety change score in each condition, with error bars representing the standard error of the mean. Negative values on the y-axis represent decreases in anxiety, positive values represent increases in anxiety and zero represents no change in anxiety.

Figure 6.3 *Effects of VMI vs VFT on mean anxiety change scores in low and high depression groups*

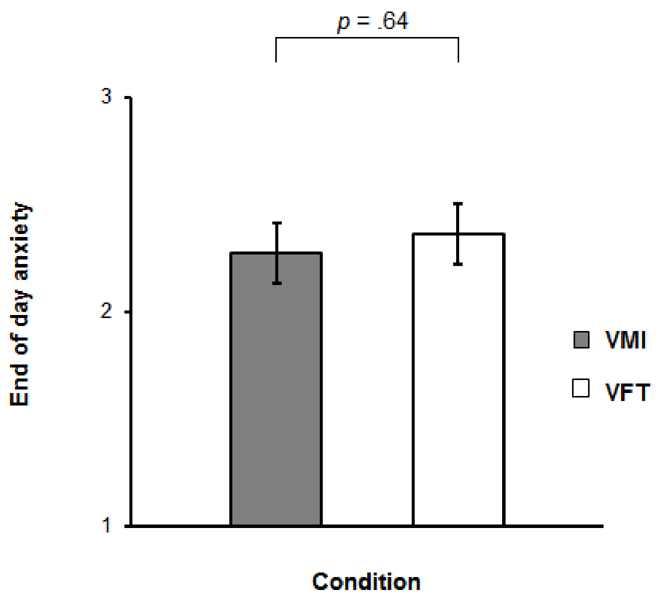


*Note*. These figures show the mean anxiety change scores per condition in the individuals with low and high levels of depression, with error bars representing the standard error of the mean.

#### 6.3.2.2 Effect of condition on end of day anxiety

Hierarchical linear modelling was also used to determine whether there was a main effect of condition (VMI vs VFT) on the end of day anxiety ratings. There was no significant effect of condition on the end of day anxiety ratings, $b$ = .08, $p$ = .66, $d$ = .12, shown in Figure 6.4. When trait anxiety and depression were separately entered into the model as Level 2 variables, neither of these variables were significant moderators (trait anxiety, $b$ = .02, $p$ = .29, $d$ = .29, and depression, $b$ = .04, $p$ = .06, $d$ = .54).

Figure 6.4 *Effects of VMI vs VFT on mean end of day anxiety ratings*

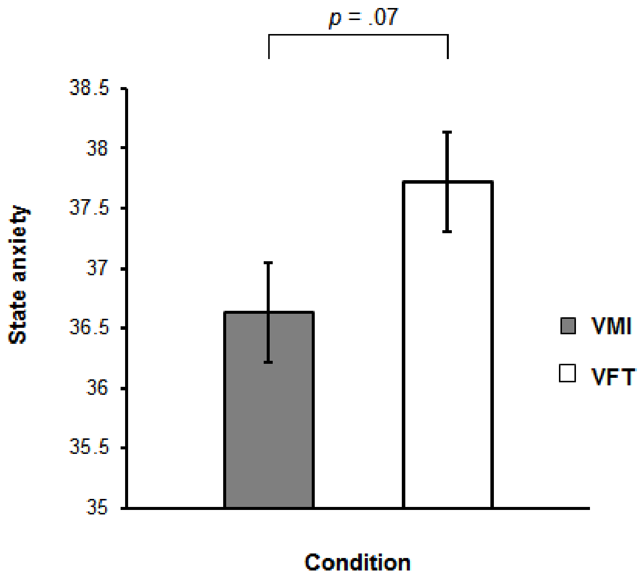



*Note.* The mean end of day anxiety ratings in each condition, with error bars representing the standard error of the mean is displayed in this figure. The y-axis represents the rating options, which ranged from 1 to 9 in the anxiety question, with 1 representing low anxiety, 9 representing high anxiety and 5 representing no change in anxiety.

#### 6.3.2.3 Effect of condition on state anxiety

Next, the effect of condition on state anxiety ratings were analysed using hierarchical linear modelling. There was no significant effect of condition on the state anxiety ratings, $b$ = 1.17, $p$ = .07, $d$ = .52, shown in Figure 6.5. When trait anxiety and depression were separately entered into the model as Level 2 variables, the analysis did not show any significant results for trait anxiety ($b$ = -.03, $p$ = .64, $d$ = .13) or depression ($b$ = -.05, $p$ = .40, $d$ = .23).

Figure 6.5 *Effects of VMI vs VFT on mean state anxiety*



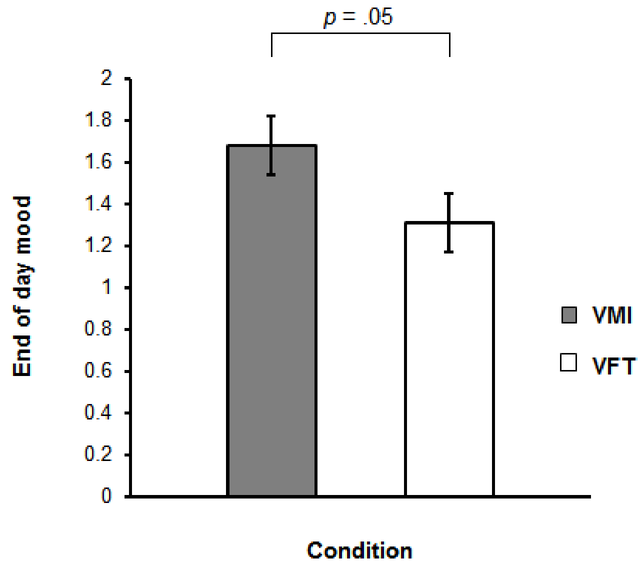

*Note.* The mean state anxiety ratings in each condition are displayed in this figure, with error bars representing the standard error of the mean. The y-axis shows the state anxiety scores which ranged from 0 to 80, with 0 representing low state anxiety and 80 representing high state anxiety.

### 6.3.3 Mood

#### 6.3.3.1 Effect of condition on end of day mood

To test if there was a main effect of condition on the end of day mood ratings, HLM was used. There was a significant effect of condition on the end of day mood ratings, $b$ = -.37, $p$ = .05, $d$ = .56, showing that VMI was associated with positive end of day mood ratings compared to the control intervention (which is depicted in Figure 6.6). When trait anxiety and depression were separately entered into the model as Level 2 variables, the analysis did not show that trait anxiety ($b$ = -.01, $p$ = .59, $d$ = .15) or depression ($b$ = -.01, $p$ = .63, $d$ = .13) were significant moderators.

Figure 6.6 *Effects of VMI vs VFT on mean end of day mood ratings*

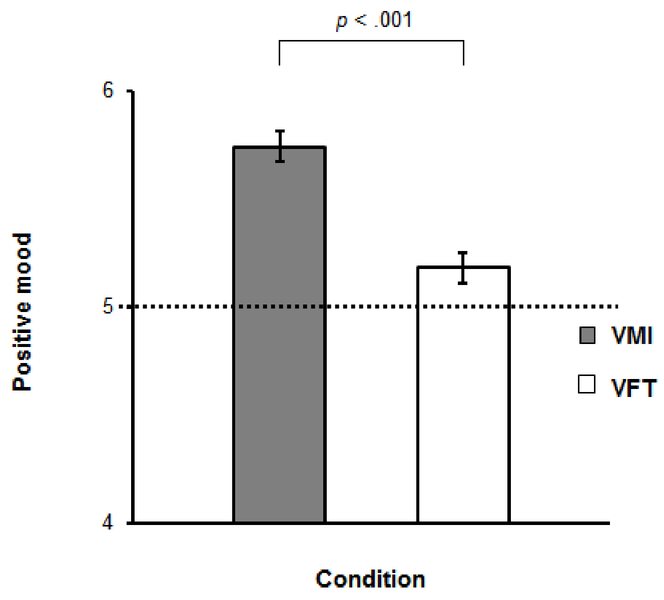



*Note.* Display of the mean end of day mood ratings in each condition, with error bars representing the standard error of the mean. The y-axis represents the rating options, which ranged from -4 (representing extremely negative mood) to +4 (representing extremely positive mood) in the end of day mood question. Zero represents no change in end of day mood.

**6.3.3.2 Effect of condition on positive mood**

HLM analyses were applied to see if there was a main effect of condition (VMI vs VFT) on positive mood. The model showed that there was a significant effect of condition on positive mood ratings, $b$ = -.55, $p$ < .001, $d$ = 1.65, demonstrating that VMI was associated with increases in positive mood (see Figure 6.7). When trait anxiety and depression were separately entered into the model as Level 2 variables, these variables were not significant moderators (trait anxiety, $b$ = -.01, $p$ = .54, $d$ = .05, and depression, $b$ = .01, $p$ = .36, $d$ = .25).

Figure 6.7 *Effects of VMI vs VFT on mean positive mood ratings*

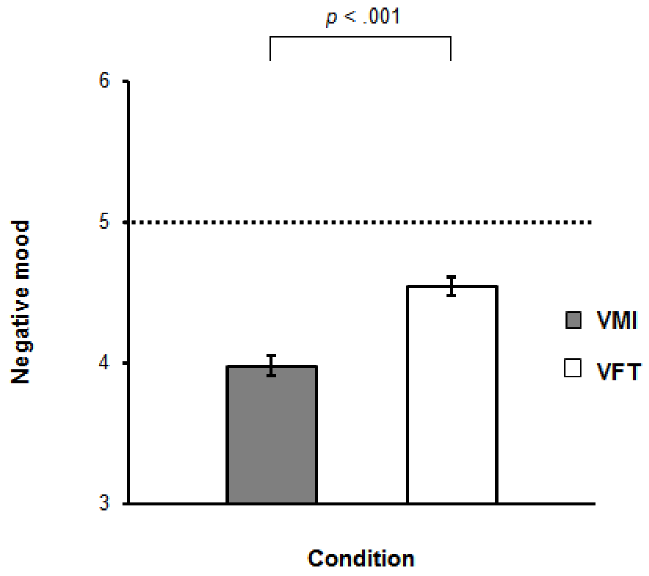



*Note.* This figure shows the mean positive mood ratings in each condition, with error bars representing the standard error of the mean. The y-axis shows the rating options, which ranged from 1 to 9 in the positive mood question, with 1 representing the greatest reduction in positive mood, 9 representing greatest increase in positive mood and 5 representing no change in positive mood (shown by the dotted line).

**6.3.3.3 Effect of condition on negative mood**

There was a significant effect of condition on the negative mood ratings, showing that VMI was associated with decreases in negative mood ($b$ = .57, $p$ < .001, $d$ = 1.96), as seen in Figure 6.8. When additional HLM models were created with Level 2 variables (trait anxiety and depression), trait anxiety ($b$ = .005, $p$ = .63, $d$ = .13) and depression ($b$ = -.003, $p$ = .76, $d$ = .08) were not significant moderators. Table 6.4 contains the symbols, coefficients, standard errors, and p values for all of the HLM analyses.

Figure 6.8 *Effects of VMI vs VFT on mean change in negative mood ratings*




*Note.* The mean negative mood ratings in each condition, with error bars representing the standard error of the mean are displayed in this figure. The y-axis shows the rating options, which ranged from 1 to 9 in the negative mood question, with 1 representing greatest reductions in negative mood, 9 representing greatest increases in negative mood and 5 representing no change in negative mood (shown by the dotted line).

Table 6.4 *Effects of condition (VMI vs VFT) on anxiety and mood variables, with trait anxiety and depression as Level 2 variables*

| HLM effect | Symbol | Coefficient | *SE* | *p* |
|---|---|---|---|---|
| *Intercept: Anxiety change* | $\beta_{00}$ | -.46 | .14 | .001 |
| Condition | $\beta_{10}$ | .29 | .09 | **.002*** |
| Task difficulty | $\beta_{20}$ | .05 | .02 | **.002*** |
| Trait anxiety | $\beta_{11}$ | -.01 | .007 | .06 |
| Depression | $\beta_{11}$ | -.02 | .008 | **.02*** |
| | | | | |
| **Low depression group** | | | | |
| *Intercept: Anxiety change* | $\beta_{00}$ | -.70 | .20 | .002 |
| Condition | $\beta_{10}$ | .41 | .14 | **.01*** |

| | | | | |
|---|---|---|---|---|
| **High depression group** | | | | |
| *Intercept: Anxiety change* | $\beta_{00}$ | -.27 | .17 | .14 |
| Condition | $\beta_{10}$ | .18 | .11 | .12 |
| | | | | |
| *Intercept: End of day anxiety* | $\beta_{00}$ | 2.18 | .34 | < .001 |
| Condition | $\beta_{10}$ | .08 | .18 | .66 |
| Trait anxiety | $\beta_{11}$ | .02 | .02 | .29 |
| Depression | $\beta_{11}$ | .04 | .02 | .06 |
| | | | | |
| *Intercept: State anxiety* | $\beta_{00}$ | 35.31 | 1.60 | < .001 |
| Condition | $\beta_{10}$ | 1.17 | .62 | .07 |
| Trait anxiety | $\beta_{11}$ | -.03 | .06 | .64 |
| Depression | $\beta_{11}$ | -.05 | .06 | .40 |
| | | | | |
| *Intercept: End of day mood* | $\beta_{00}$ | 2.07 | .33 | < .001 |
| Condition | $\beta_{10}$ | -.37 | .19 | **.05*** |
| Trait anxiety | $\beta_{11}$ | -.01 | .02 | .59 |
| Depression | $\beta_{11}$ | -.01 | .03 | .63 |
| | | | | |
| *Intercept: Positive mood* | $\beta_{00}$ | 6.28 | .23 | < .001 |
| Condition | $\beta_{10}$ | -.55 | .11 | **< .001*** |
| Trait anxiety | $\beta_{11}$ | -.01 | .01 | .54 |
| Depression | $\beta_{11}$ | .01 | .01 | .36 |
| | | | | |
| *Intercept: Negative mood* | $\beta_{00}$ | 3.42 | .23 | < .001 |
| Condition | $\beta_{10}$ | .57 | .10 | **< .001*** |
| Trait anxiety | $\beta_{11}$ | .005 | .01 | .63 |
| Depression | $\beta_{11}$ | -.003 | .01 | .76 |

*Note*. HLM = Hierarchical linear modelling; Symbol = Hierarchical linear modelling symbol; Coefficient = Unstandardized coefficient; *SE* = Standard error. * $p \leq .05$

### 6.3.4 Task difficulty

Analyses were conducted on the perceived task difficulty to see if there was a significant difference between the two conditions (VMI and VFT). A paired samples t-test found a significant difference between the mean difficulty rating for VMI ($M$ = 3.44, $SD$ = 1.66) and VFT ($M$ = 3.98, $SD$ = 1.23), $t(53) = -2.12$, $p$ = .04, $d$ = .26, showing that VFT was found to be significantly more difficult than the VMI task.

### 6.3.5 Task preference

To investigate if there was a significant difference in the preference for the two intervention tasks, a paired samples t-test was conducted to analyse the mean number of times the participants decided to complete each activity without being prompted to do so by the researcher. The analysis showed that there was no significant difference between the mean number of times the participants voluntarily imagined music ($M$ = 2.28, $SD$ = 4.18), compared to completing the VFT ($M$ = 2.84, $SD$ = 4.83), $t$(53) = -1.36, $p$ = .18, $d$ = .20, without being prompted by the researcher.

### 6.3.6 Music likability

A paired samples t-test was used to determine if there was a difference between the pre and post-VMI intervention likability ratings of the self-selected pieces of music, which ranged on a scale from 1 (*Not at all*) to 10 (*Extremely*). The analysis showed that the likability of the music was significantly lower at the end of the study ($M$ = 8.52, $SD$ = 1.13) than when participants began the study ($M$ = 8.78, $SD$ = .90), $t$(57) = 1.97, $p$ = .05, $d$ = .24.

### 6.3.7 Feedback on intervention activities

The content analysis of the interview data revealed five key topics: 1) Reflections on the intervention activities, 2) Reasons for choosing to use intervention activities, 3) Reasons for not choosing to use intervention activities, 4) Effect on anxiety and 5) Effect on mood. These key topics, as well as the number of participants who expressed opinions relating to those topics, are shown in Table 6.5.

#### *6.3.7.1 Reflections on the intervention activities*

The most frequently reported opinion about the VMI activity was that it allowed people to feel good ($n$ = 7), and participants stated that VMI allowed them to focus their mind on other things ($n$ = 5) which as a consequence, pushed negative thoughts out of their conscious awareness ($n$ = 2):

"At the time I was experiencing negative thoughts in general about work and university work, listening to music . . . imagining the music in my head kind of made me forget that those negative thoughts were there and pushed them out of my conscious awareness because I was focusing on doing something else, rather than focusing on the thoughts that were swirling around in my mind." Participant #35

Following on from this, deliberately imagining music was often compared to mindfulness (*n* = 4) and being similar to a meditative process (*n* = 3). An important feature of VMI was that it allowed some participants to feel like they had control over their mental activity (*n* = 2), which was described as leading to various positive impacts such as making people feel calmer (*n* = 1) and relaxed (*n* = 5). There were, however, a few negative outcomes as a result of deliberately imagining music, as some participants reported feeling irritated (*n* = 3). One participant did report feeling stressed as a result of the activity, demonstrated in this quote by Participant #43 "At points it was stressing me out because I was constantly listening to [imagining] the song, so I didn't like the song as much in the end because I kept on listening to [imagining] it."

Compared to VMI, the participants seemed to have fewer reflections on the general nature of the VFT. Although, the participants' opinions on VFT did overlap with views about the VMI, as there were responses relating to this activity being seen as a challenge (*n* = 3), a distraction (*n* = 5), having mindfulness aspects (*n* = 1) and having the capability to focus people (*n* = 4). Reports of VFT being a challenging task was thought of in a positive light, stated by Participant #13 "Yeah so the focus came from the challenge aspect of the VFT so there was almost an emphasis on how effectively and efficiently you could do that task." There were also more reports of the focal element:

"I felt a lot more focused when I was doing the VFT than when I was doing the mental imagery because it was a very clear task that was almost like a challenge . . . like how much or how effectively can you do this, rather than the mental imagery task which was simply just do this." Participant #13

When reflecting on the VFT, SOME participants did state that it was not a fun task (*n* = 2), was quite stressful (*n* = 2) and required too much effort to complete (*n* = 1).

*6.3.7.2 Reasons for choosing to use intervention activities*

More people provided reasons for using VMI for anxiety (*n* = 46), compared to completing the VFT (*n* = 12). The participants seemed to want to use VMI for anxiety reduction mostly because it was helpful (*n* = 11), calming (*n* = 12), reduced stress (*n* = 11), was easier (*n* = 3), made people feel more relaxed (*n* = 6) and reduced anxiety (*n* = 16). Many of the reasons for using VMI related to this activity having a positive emotional impact on the participants' mental health (*n* = 19), as seen in this quote by Participant #54, ". . . for the simple reason that I'm imagining something I like and has positive associations for me. I suppose the verbal is . . . I'm not really emotionally invested in it, whereas the music one brings up emotional investment.” Participant #49 said “Well for me music is quite emotional . . . it triggers emotions and yeah I like sound, so that affects my mood and the piece of music I chose, I found it very uplifting.” There were also some mentions of how VMI can help with sleep (*n* = 1) and is seen as being a meaningful activity (*n* = 2), “I think when people are kind of calm and happy then their sleep is better, so if they imagine it on an evening before they go to sleep then it might help with the quality of their sleep” by Participant #51 and “It doesn’t feel like you’re just doing an arbitrary task, it feels like you’re doing something that means something to you” by Participant #35. There were also reports of how people chose to deliberately imagine music because this activity adopted a more personalised approach (*n* = 2). There were similar reasons for VFT being chosen, such as this activity being calming (*n* = 2), distracting (*n* = 1), allowing one to focus (*n* = 4) and reducing negative thoughts (*n* = 3). But the participants did report completing the VFT because it was a quick activity (*n* = 1), challenging (*n* = 3) and could keep the mind occupied (*n* = 1).

*6.3.7.3 Reasons for not choosing to use intervention activities*

Overall, more participants reported reasons for not choosing to complete the VFT (*n* = 26, compared to VMI (*n* = 10). The main reasons why individuals did not want to use VMI for anxiety reduction were because participants had difficulty imagining the music (*n* = 2), perceived the activity as not challenging enough (*n* = 1), did not enjoy imagining music (*n* = 2), found VMI unhelpful (*n* = 2), repetitive (*n* = 1) and unnatural (*n* = 1). The VFT condition was also reported to be hard (*n* = 6) and unnatural (*n* = 2), but there were several other reasons including requiring too much effort to complete (*n* = 3), adding additional pressure to people (*n* = 3) and making people feel frustrated (*n* = 1). Unlike the VMI activity, people chose to not complete the VFT because this task was seen as too challenging (*n* = 1) and there were several instances where the VFT made participants feel stressed (*n* = 8), with Participant #51 stating that “When I knew that I was going to be doing the VFT, I kind of felt a bit stressed and a bit anxious. Whereas imagining the music, it didn’t make me feel stressed or anxious” and this participant also reported that it “adds a bit of stress and pressure to the person,” whilst Participant #50 said that “If I didn’t think of a word it would stress me out more.” Some participants also seemed to think that completing the VFT would have no effect on their mood (*n* = 2) or make them feel relaxed (*n* = 4), two concepts that are associated with anxiety.

*6.3.7.4 The effect of intervention activities on anxiety*

The participants reported that deliberately imagining music reduced anxiety more (*n* = 25) than the VFT (*n* = 1). Some of these effects can be seen here in examples extracted from the interview transcripts:

"I think when I was anxious and I tried to imagine it [the music], because I was focusing on that, that one task, I was able to kind of not focus on anything else. It was a distraction but in a good way. It reduced my anxiety." Participant #58

Participant #58 also said that **"**Because I think being able to just keep all your attention on one thing, well at least for a few minutes, [can] reduce anxiety or any overwhelming thoughts you have about anything else that is stressful in your life."

Interestingly, there were reports of VMI increasing anxiety (*n* = 2), but not for the VFT. For both conditions, the participants reported an equal frequency for the activities having no effect on anxiety, VMI (*n* = 8) and VFT (*n* = 8), and there was an instance where a participant reported not seeing any impact on anxiety because they were not anxious whilst completing the activity:

"But for me it didn't really have an effect because there wasn't any anxiety for it to have any effect, but I think, generally, imagining the music is easier than doing the VFT so for me that was better, personally." Participant #36

*6.3.7.5 The effect of intervention activities on mood*

In terms of reports on specific effects of the intervention activities on mood, participants stated that both VMI and the VFT improved mood. There were more frequent reports for mood improvement in the VMI condition (*n* = 11), compared to the VFT condition (*n* = 1).

Table 6.5 *Key topics in the interview data*

| Key topics | VMI (*n*) | VFT (*n*) |
|---|---|---|
| Reflections on the intervention activities | Feel good (7) | |
| | Distraction (6) | Distraction (5) |
| | Focus (5) | Focus (4) |
| | Relaxing (5) | |
| | Mindfulness (4) | Mindfulness (1) |
| | Irritating (3) | |
| | Meditative (3) | |
| | Challenge (2) | Challenge (3) |
| | In control (2) | |
| | Reduce negative thoughts (2) | |
| | Calmer (1) | |
| | Check in with oneself (1) | |
| | Exercise (1) | |
| | Healing method (1) | |
| | Passive activity (1) | |

| | | |
|---|---|---|
| | Useful (1) | |
| | | Difficult (3) |
| | | Helpful (2) |
| | | Not fun (2) |
| | | Stressful (2) |
| | | Easy (1) |
| | | Enjoyable (1) |
| | | Too much effort required (1) |
| Reasons for choosing to use intervention activities | Improve mood (19) | Improve mood (1) |
| | Reduce anxiety (16) | Reduce anxiety (2) |
| | Calming (12) | Calming (2) |
| | Helpful (11) | |
| | Reduce stress (11) | Reduce stress (1) |
| | Short break (7) | |
| | Relaxing (6) | |
| | Upbeat music (4) | |
| | Distracting (3) | Distracting (1) |
| | Easy (3) | Easy (1) |
| | Focus (3) | Focus (4) |
| | Fun (3) | Fun (2) |
| | Energetic (2) | |
| | Meaningful activity (2) | |
| | Personalised approach (2) | |
| | Reduce negative thoughts (2) | Reduce negative thoughts (3) |
| | Boredom (1) | |
| | Desired (1) | |
| | Emotional investment (1) | |
| | Favourite songs (1) | |
| | Feeling lonely (1) | |
| | Improve sleep (1) | |
| | Interesting (1) | |
| | No increase in anxiety (1) | |
| | Reduce pressure (1) | |
| | | Challenge (3) |
| | | Keeps you occupied (1) |
| | | Quick (1) |
| Reasons for not choosing to use intervention activities | Hard (2) | Hard (6) |
| | Not enjoyable (2) | |
| | Not helpful (2) | |
| | Unnatural (2) | Unnatural (2) |
| | Not challenging (1) | |
| | Repetitive (1) | |
| | | Increase stress (8) |
| | | Not relaxing (4) |
| | | Adds pressure (3) |
| | | Increase anxiety (3) |
| | | No effect on anxiety (3) |
| | | Too much effort (3) |
| | | No effect on mood (2) |
| | | Boring (1) |
| | | Challenging (1) |
| | | Frustrating (1) |
| Effect on anxiety | Reduce anxiety (25) | Reduce anxiety (1) |
| | No effect on anxiety (8) | No effect on anxiety (8) |
| | Increase anxiety (2) | |
| Effect on mood | Improve mood (11) | Improve mood (1) |

*Note*. This table shows the key topics in the interview data, with the number of participants who expressed each opinion about the tasks listed under the VMI and VFT columns.

## 6.4 Discussion

### 6.4.1 Anxiety and mood

This VMI intervention study aimed to examine the effects of VMI on daily anxiety levels, whilst also looking at potential effects on mood. It was predicted that VMI would be associated with reductions in anxiety and increases in positive mood, compared to the verbal control activity (the VFT). The analyses relating to anxiety partially supported this hypothesis, as there were significant reductions in anxiety following the deliberate imagination of music, but VMI was not related to any decreases in state or end of day anxiety. Additionally, the qualitative findings from the interview data highlighted how participants reported a mixture of opinions on the beneficial impact of VMI on anxiety and mood, with some stating that VMI had a positive impact whilst others did not. VMI was found to be associated with increases in positive mood both during and at the end of the day, and thus supported the mood hypothesis. These findings were obtained in comparison to the verbal control task, and are an extension of the results from the VMI training feasibility study, as that study was suggestive of lower levels of anxiety than the active control after participants voluntarily imagined music, but not for end of day anxiety, and increases in positive mood.

As mentioned earlier in this chapter, the GCM (Beck & Haigh, 2014) states that the main mechanisms to address when developing an anxiety intervention are situation, focus, bias beliefs, and maladaptive behaviour. If an individual is encouraged to focus on stimuli that are not related to a potentially anxiety-triggering event, then previously held schemas for those anxiety events will not be activated. As a result, it is less likely for negative biases to occur in the processing of information that people are presented with, and this may reduce the need for individuals to engage in maladaptive behaviour as a coping mechanism, as there would be no anxiety. Therefore, if participants had negative thoughts before being instructed to deliberately imagine music, it is theorised that the VMI may have distracted the participants' attention away from these thoughts and towards the music being imagined. This would activate schemas associated with the act of imagining music, including the song that is being imagined. Because it is suggested that deliberately imagining music is not a threatening event, it is not likely for the participants to have displayed maladaptive behaviour as a result of imagining music. Furthermore, with VMI being a dynamic process that requires sustained focus through time, this means that individuals will direct most of their attention towards the music that is imagined. The idea of VMI being able to direct where one focuses their attention, and thus function as a distraction-based activity, is further supported by Lawrence and Schwartz-Metter (2019). These researchers previously explored mental imagery and verbal thoughts in rumination and distraction, in relation to depressed individuals. In one study, they investigated whether imagery or verbal thoughts experienced during episodes of induced distraction and rumination would correlate with changes in mood. They showed that mental imagery-based distractions were more likely to reduce negative mood than verbal thoughts, suggesting that this occurred due to an increase in the demand for cognitive load when deliberately generating mental imagery, compared to verbal thoughts. The relationship imagery shares with mood that was demonstrated in Lawrence and Schwartz-Metter's (2019) study, as well as this VMI intervention study, can also be considered in light of similarities between mental imagery and its analogous counterpart - music listening.

Holmes and Mathews (2005) have previously suggested that mental imagery has affective outcomes, being that imagery can elicit similar emotions that are experienced in the real-life stimuli - which in this case is listening to music (Holmes & Mathews, 2010). Juslin and Västfjäll (2008) suggest that music listening can evoke emotions through several mechanisms such as emotional contagion (experiencing the emotions that are expressed within the music) and evaluative conditioning (experiencing emotions that are associated with particular pieces of music). Thus, it could be argued that the VMI may have evoked emotions in the same way that music would. A result of this may have led to an increase in the regulation of participants' emotions in a positive direction, which is an important effect as some forms of anxiety, like social anxiety, are associated with decreased positive mood (Hughes et al., 2006). This explanation may also account for why VMI correlated with positive mood. Moreover, more participants reported associations with positive mood in the interview data, compared to the VFT and thus supported the prediction that VMI would be associated with increases in positive mood. Following on from this, mental imagery that is perceived as positive increases the chances of ambiguous events being interpreted as positive (Holmes et al., 2008; Nelis et al., 2012). In the interview data, there were several instances where participants repeatedly described the VMI experience as positive. With this, any ambiguous events that might ordinarily trigger anxiety in individuals might have been interpreted as being positive, and thus allowed the individual to experience a positive mood.

It is also important to highlight the circumstances in which a significant reduction in anxiety was observed. This was namely for measures of instant anxiety change rather than end of day anxiety. Thus, the timepoint at which anxiety was measured, following the deliberate imagination of music, is likely to account for these findings. For the instance where VMI significantly reduced anxiety, a comparison of anxiety directly before to directly after deliberately imagining music was measured. With state anxiety being assessed across each day, and end of day anxiety being measured at the end of the day, the difference between these assessment points and the direct measure is that there was the opportunity for other variables outside of the researcher's control to affect anxiety levels during the day. For example, individuals might have been exposed to events during the day that could have negatively impacted their anxiety levels (such as going for a job interview or a meeting with a manager). With this, it could be suggested that VMI might only prove effective for short-lived experiences of anxiety. This might explain why VMI was only associated with decreases in anxiety when anxiety was measured directly after deliberately imagining music, and not during or at the end of day anxiety. Future research could further investigate the most effective types of short-term anxiety relief using VMI, when external factors are controlled.

Following on from these findings, depression was shown to be a significant moderator in regard to the relationship between condition and anxiety change. When decomposing this depression interaction, individuals with fewer depressive symptoms were more likely to display reductions in anxiety after imagining music. This indicates that with respect to depression, VMI may work best for people with fewer symptoms. It is possible that this finding may be explained by the underlying mechanisms behind anxiety and depression. One of the main similarities between anxiety and depression that could potentially account for depression being a significant moderating variable for anxiety change, but not for mood, relates to the cognitive mechanisms associated with these problems. Anxiety is characterised by an increased presence of intrusive negative thoughts (Armstrong et al., 2011) and depression is associated with rumination (Mezo & Baker, 2012), which involves individuals repeatedly rehearsing and focusing their attention on negatively valenced information about previous and current problems (APA, 2013). This overlap in dysfunctional mental activity could suggest that the mechanisms behind VMI being able to reduce anxiety relates more to cognitive mechanisms, than the affective mechanisms that have been offered. Depression is characterised by low mood (NICE, 2009), so it would be expected to see people with excessive depressive symptoms displaying more positive mood ratings after deliberately imagining music, but that was not evident. Additionally, trait anxiety did not affect how well VMI reduced anxiety, showing that the outcome of this intervention is not dependent on the severity of anxiety. Yet these findings might reflect the restricted range of trait anxiety scores, especially as the mean trait anxiety score was 45.28 (which is closer to the lowest possible trait anxiety score (20) compared to the highest possible trait anxiety score (80). It would be important for future research to explore if trait anxiety may moderate the effectiveness of the VMI intervention in a broader range of participants, in terms of the level of anxiety they might have.

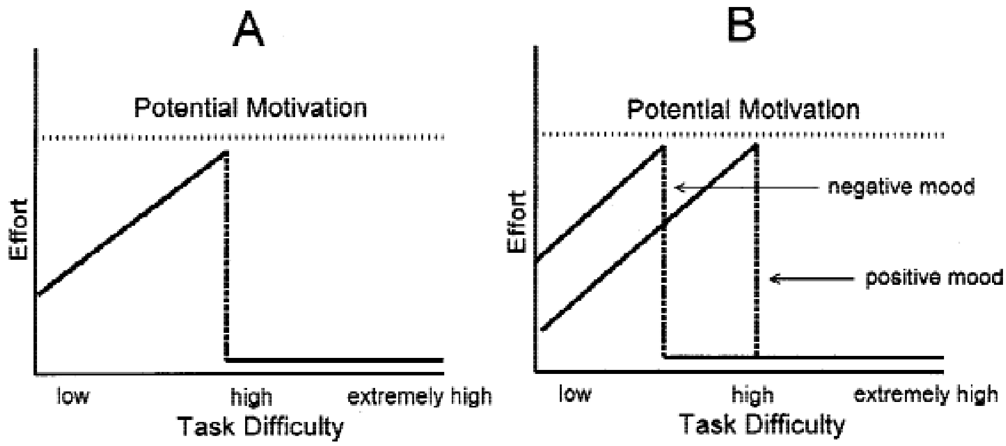
### 6.4.2 Task difficulty

Participants found the VMI activity easier to complete, compared to the VFT. As the VFT was shown to be associated with increases in negative mood, this could account for why individuals found this activity harder. Gendolla and Krüsken (2001) investigated the interaction between mood and task difficulty on cardiovascular and electrodermal reactivity in active coping. Within this paper, the authors offered a figure (Figure 6.9) adapted from Wright (1998)—who looked at the impact of both task difficulty and ability beliefs on cardiovascular adjustments—to depict how mood, task difficulty and effort mobilisation relate to one another. The figure shows how when a task is difficult, people with negative moods will use less effort in this activity because they perceive the demand (effort required) of the task as too high at a faster rate, compared to people in positive moods. The interaction in the figure can account for why VFT was perceived as more difficult. As participants perceived completing the VFT as a difficult task, it is likely that this might have lowered participants' mood at a faster rate. However, the current intervention study was not designed to explicitly test the relationships between mood and task difficulty in this context. Therefore, this represents another fruitful avenue for future research.

### 6.4.3 Task preference

The quantitative data showed how there was no significant difference between the mean number of times participants chose to deliberately imagine music, compared to choosing to do the VFT. Interestingly, the interview data suggests otherwise, as more participants provided reasons for choosing to deliberately imagine music, as opposed to completing the VFT. It is difficult to provide an overall conclusion as to whether participants preferred one activity over another, due to these two types of data conceptualising task preference differently. With a higher number of participants providing reasons for voluntarily imagining music, it would be expected for there to be more instances of individuals choosing to imagine music, without being prompted to do so. The lack of significance in relation to the quantitative findings could potentially be explained by other factors such as participants liking the music piece less whilst completing the study and thus becoming reluctant to imagine that piece of music, unprompted.

Figure 6.9 *The interaction between task difficulty, mood state and effort*




*Note*. Adapted figure from Wright (1998) offered by Gendolla and Krüsken (2001) to show the relationship between task difficulty and effort mobilization (A), and the impact of mood on this relationship (B; p. 550).

### 6.4.4 Music likability

Participants liked the self-selected pieces of music less after completing the study, which was not the case for the likability ratings from the VMI training feasibility study in Chapter Five. It is important to note, however, that the difference between the mean music likability rating scores before (8.78) and after the study (8.52) was small (a difference of .26, which is less than one scale degree of difference). The mean likability ratings were also very high in both instances, as the highest rating option was 10. This finding could have occurred due to participants being instructed to deliberately imagine the same piece of music over a longer period of time, and thus grew bored of it.

### 6.4.5 Limitations

The main limitations of this study relate to the interview data and the generalisability of the results. With the interview intending to collect feedback on the intervention activities, the questions the participants were asked did require them to reflect on their experience of deliberately imagining music and completing the VFT. As there was a two-week gap between these activities and the interviews, the accuracy of this reflection would depend on the strength of the participants' memories of these activities. There is a chance that the participants might have forgotten the memories they held for their musical imagery episodes during this time period, so there is a possibility that the participants might not have recalled accurate reflections of these experiences. It could have also been possible for there to be a bias in their responses, relating to extremely positive or extremely negative effects of voluntarily imagining music or completing the VFT. Dolcos et al. (2004) have shown how people have stronger memories for positive and negative arousing stimuli, compared to neutral stimuli, so individuals might have been more likely to focus on the positive or negative effects of a particular activity, due to selective memory.

Another limitation focuses on the use of change scores to assess the effects that VMI and the VFT had on momentary anxiety. The analyses conducted on the immediate effects of VMI and the VFT on anxiety only highlight whether there are significant differences between the change scores, whilst not showing the magnitude of the change. This limits conclusions that can be made regarding the strength of these effects. Additionally, it is possible that there was an overestimate of the effect size used when calculating the sample size required to obtain a significant result. A medium effect size ($d$ = .5) was entered into G*Power, but it would have been better to use a small effect size ($d$ = .2), based on the findings from the study in the preceding chapter. If a small effect size was used in the sample size calculation, 327 participants would have been needed in this study and when comparing this to the number of people who took part ($n$ = 64), it suggests that there were not enough participants (and thus power) to detect a small effect size.

### 6.4.6 Implications of the findings

Theoretical implications relate to providing evidence that partially support the mechanisms offered by the GCM that explain the occurrence of anxiety. Part of the rationale behind the potential for VMI being an effective anxiety reduction intervention was based on the idea that deliberately imagining music can target the focus mechanism from the GCM. This focus mechanism works on the basis that the stimuli an individual focuses their attention on can determine the type of information processing that will occur after being exposed to these stimuli, and consequently whether anxiety symptoms will develop. With the fact that VMI was shown to be associated with reductions in anxiety, this finding can support the claim that the act of deliberately imagining music required the participants to focus on the music they imagined, instead of other potentially threatening stimuli in their environment. This is further supported by the interview data, as several participants reported seeing VMI as an activity that can distract them and allow them to focus their attention on the music. Further to this, the moderating effects of depression is an interesting finding and is worthy of further investigation.

There are also practical implications of the current findings. Now that there is evidence of VMI being able to reduce naturally occurring anxiety levels in comparison to a comparable control activity, more research ought to be conducted on the application of VMI to address clinical levels of anxiety, as well as in experimental paradigms where anxiety is induced. This study made use of a practical and easily replicable design, whereby anxiety and mood levels were measured at frequent intervals across the day using an ESM approach. There was also little evidence of this VMI intervention method having a negative impact on the participants. Therefore, researchers interested in investigating intervention effects of VMI for other mental health problems, as well as potential physical problems, can use these findings as a starting point as it shows that VMI can be helpful in an intervention setting.

### 6.4.7 Conclusion

To summarise, this study aimed to test whether VMI can be utilised to alleviate anxiety and improve mood. Through the combination of an experimental approach and ESM, this intervention study demonstrated how deliberately imagining music has positive effects on anxiety reduction and increases positive mood in individuals, compared to a verbal control task in naturalistic settings. Therefore, these findings provide evidence of the anxiolytic and mood improvement effects that deliberately imagining music might be able to achieve in the real world. Future research ought to investigate whether these beneficial effects are maintained from regular use of VMI using longer term study designs.

# Chapter 7
# General Discussion

This thesis explored the potential effectiveness of VMI as an intervention method for reducing anxiety using a four-study approach summarised in Figure 7.1. Several important themes emerged from the key findings in each of the studies and the purpose of this chapter is to discuss these themes. The themes related to the explanations behind the anxiolytic effects of anxiety, the recommended target population for this intervention, individual differences in the musical imagery experience that relate to anxiety, and the future application of VMI in intervention settings. Implications of these findings, as well as limitations and areas for future research, are considered.

Figure 7.1 *A schematic diagram of the PhD thesis*

**Primary thesis research question:**

Is Voluntary Musical Imagery an Effective Intervention for Anxiety?

↓

**Chapter One:**

Review of the literature on anxiety and musical imagery

↓

**Chapter Two:**

Exploring the relationship between musical imagery and anxiety

↓

**Chapter Three:**

Explaining the rationale behind the potential effectiveness of VMI as an anxiety intervention

↓

**Chapter Four:**

Systematically reviewing imagery-based intervention studies for anxiety reduction and assessing the quality of these studies

↓

**Chapter Five:**

Training non-musicians in VMI and collecting preliminary data on the effects of VMI on anxiety and mood

↓

**Chapter Six:**

Testing the effects of VMI on anxiety and mood

↓

**Chapter Seven:**

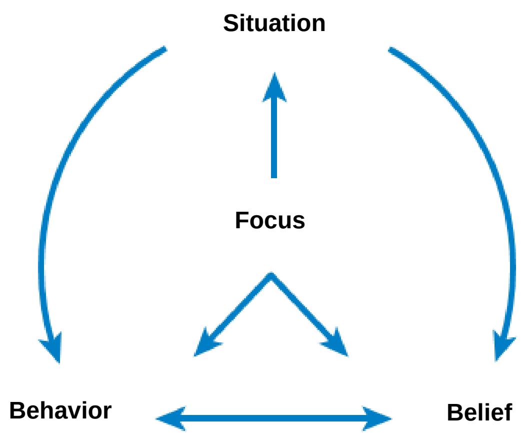
Critically analysing the effects of VMI on anxiety, exploring key themes to emerge from the research

## 7.1 Possible accounts for the effects of voluntary musical imagery

The anxiolytic effects of VMI, as compared to an active control, were demonstrated in the VMI training feasibility (Chapter Five) and intervention (Chapter Six) studies. In the training study, participants reported lesser anxiety after deliberately imagining music, compared to the control task, and in the intervention study, the participants' anxiety was reduced immediately after deliberately imagining music. When the participants were interviewed, some individuals explicitly stated that VMI reduced their anxiety and used this as their reasoning for choosing to voluntarily imagine music. These findings support the predictions that VMI would be associated with decreases in anxiety.

As discussed earlier, the GCM (Beck & Haigh, 2014) suggests that four mechanisms should be addressed in the development of anxiety interventions - focus, situation, biased beliefs, and maladaptive behaviours (seen below in Figure 7.2). VMI works on the assertion that the deliberate imagination of music will reduce anxiety by targeting the focus mechanism, which determines what stimuli an individual pays attention to in their environment. By encouraging people to voluntarily imagine music, this method would work by directing one's attention towards the musical imagery they are purposely initiating and keeping in their mind, as opposed to the harmful stimuli that might trigger anxiety, thus acting as a distraction. This focus of attention on imagining the music could interact with the remaining three mechanisms, directing the type of information processing that occurs. Focusing one's attention on the musical imagery, and not the anxiety stimuli, would reduce the likelihood of the anxiety schemas that relate to these types of stimuli being activated. As the GCM states, schemas are argued to play an important role in anxiety, determining the way in which information is processed based on the beliefs associated with particular stimuli. Thus, the anxiety schemas being inactive when exposed to anxiety stimuli would contribute to reducing the likelihood of biased beliefs causing dysfunctional information processing. This is because deciding to focus on imagining music instead of the anxiety stimuli would reduce the occurrence of negative biases in the processing of information. Therefore, according to this model, normal information processing will occur, and schemas associated with musical imagery experiences might be activated instead. The reduction of negative biases in information processing will also decrease the maladaptive behaviour that individuals normally display when trying to cope with anxiety. In spite of this, it is important to mention that the ESM approach used in the VMI training and intervention studies was designed to capture naturally occurring anxiety, and so individuals did not feel anxious during every instance when they were instructed to imagine music and rate their anxiety levels. Nevertheless, a small but significant reduction in state anxiety levels was observed across participants. This implies that high levels of anxiety may not be necessary for the VMI intervention to take effect.

Figure 7.2 *A visual depiction of the GCM (Beck & Haigh, 2014, p. 14)*




The key finding of VMI being associated with lesser anxiety than the control activity provides partial support for accounts offered from the cognitive perspective of anxiety, specifically that VMI has the ability to target the focal mechanism of the GCM, being able to direct people's attention towards focusing on the deliberate generation and maintenance of the music. Beck and Haigh (2014) do suggest that the four mechanisms of the GCM interact with one another in the anxiety experience, so further research would be needed to see if VMI has the capacity to impact the remaining three mechanisms; biased beliefs, maladaptive behaviours and the current situation. Additionally, if it was shown that VMI had the ability to impact maladaptive behaviour, and thus have a potential effect on behaviour change in anxiety, it would also be interesting to find out more about the specific mechanisms of action that might be involved in the VMI method for anxiety reduction. Michie et al. (2018) emphasised the importance of mechanisms of action in behaviour change techniques and by learning more about this for VMI specifically, it would single out these specific mechanisms that allow VMI to be an effective method. There are also other avenues for future research relating to the focus mechanism in the GCM and its role in the VMI intervention method. It would be beneficial to learn more about whether there are certain parts of music that individuals are more likely to deliberately imagine, when aiming to reduce their anxiety. Huovinen and Tuuri (2019) outlined various structures of musical imagery episodes that were highlighted by individuals describing their (sometimes voluntary) experiences of 'cherished' musical imagery. An example of this includes imagining different sections of the song, instead of following the full trajectory of the original piece of music. Also, research has shown how the musical content of INMI for popular music is often focused around a song's chorus (Beaman & Williams, 2010; Halpern & Bartlett, 2011; Hyman et al., 2013). Therefore, by isolating specific musical imagery structures and testing the effects of these structures on anxiety reduction, compared to free-form musical imagery episodes, could bring to light potential moderator variables that can enhance the effect of the VMI intervention.

Moving on, the findings that demonstrated a relationship between VMI and positive mood were also significant and important, as they illustrate the role that affective mechanisms may have in the alleviation of anxiety. This is with reference to how the GCM impacts affective systems, as well as how mental imagery can improve mood (Holmes & Mathews, 2010). The GCM states that each psychological disorder has a specialised mode, which is a network consisting of various schemas and systems including affective, cognitive, motivational, and behavioural components relating to that specific disorder. The schemas found in the anxiety mode control the way in which information is processed (Beck & Haigh, 2014). This processing of information impacts the rest of the systems in the mode. For the affective system, the interpretation of the information that people are presented with will govern the type of emotional response an individual has (Beard & Amir, 2010). So, if an individual is exposed to anxiety-triggering stimuli, the associated schema would be activated and lead to negative biases in the interpretation of this information. As an aftereffect, the affective system will be impacted by this, resulting in emotional distress that is often associated with anxiety (Kassel et al., 2007). As stated above, when people deliberately imagine music, their focus is on the musical imagery that is being generated and maintained. This suggests that anxiety-related schemas will be inactive, whilst schemas for musical imagery will be activated instead. As VMI is associated with positive mood, this indicates that it is not likely for negative biases to occur in the processing of this activity. Elimination of the negative biases in information processing can decrease the likelihood of people experiencing emotional distress that is usually linked to anxiety, and instead promote positive feelings. Thus, these findings reinforce connections between the GCM and affective mechanisms in the anxiety experience.

The association of the VMI intervention with improved mood can also be explained in relation to the impact of music listening on mood. Many studies have demonstrated music's positive effect on mood (e.g., Särkämö et al., 2008; Zimmermann et al., 2019). Therefore, it would be expected for similar effects to arise when imagining music as when listening to music, even though the imagined music may lack the affective intensity of the music being listened to. These findings are also broadly consistent with other work looking at the positive impact music can have on emotion-related problems such as stress (Giordano et al., 2020; Knight & Richard, 2001).

### 7.1.1 Short-term effects

Despite the VMI training feasibility and intervention studies providing evidence in support of VMI being associated with lower levels of anxiety compared to the control activity, as well as reductions in anxiety, these findings were only evident after the immediate deliberate imagination of music, as opposed to across or at the end of the day. The fact that these short-term effects were found in both studies is in line with findings from a study by Huovinen and Tuuri (2019). These researchers used an interview approach to study the experience of pleasant musical imagery at a detailed level, focusing on the structure of these imagery episodes as well as the experiential content. One of their notable findings was how one of the participants reported that their pleasant musical imagery led to relief-like effects immediately after imagining music. Even though the researchers did not include details about the volitional aspects of the musical imagery episodes, the short-term effects in this thesis extend these findings.

Explanations for these short-term effects concern the way in which VMI is designed to have an impact on anxiety, which is different to established treatment methods like CBT. In comparison to CBT, where there is a therapeutic goal of altering thoughts and behaviour that occur in relation to anxiety over a period of time, VMI is intended to act as a temporary distraction away from potential anxiety-triggering stimuli. There is an emphasis on the momentary nature of VMI, deliberately imagining music in a given moment, whereas CBT involves individuals attending therapy sessions and completing tasks outside of these sessions to alleviate their anxiety. Therefore, there is an increased chance of CBT producing long-term effects on anxiety, due to the structural functionality of this treatment method. The way in which the studies were designed in this thesis is also a contributing factor, as they primarily focused on immediate effects of VMI on anxiety. The participants were only prompted to imagine music at set times and not complete any additional activities related to the use of VMI as an intervention for anxiety. Additionally, the measures of anxiety were collected on the same days when the VMI tasks were completed. Another possible reason for uncovering an immediate effect of the VMI intervention, but not one that was significant across the course of the day, relates to the time course associated with the emotional response to music. The effectiveness of music-based interventions for anxiety are primarily based on music having a powerful impact on emotions, being that they can regulate emotions in a positive direction (Cook et al., 2017a). Emotions are experienced in the present time, so the finding of short-term effects on anxiety (and thus emotion) is consistent with VMI working as a quick-relief intervention. Future research can explore this idea, to see whether short-term effects are replicated. There could also be further studies conducted to investigate whether it is possible to achieve longer-term effects of VMI on anxiety.

As there is no pre-existing evidence of the effects of VMI on anxiety, there were no clear indications as to whether VMI would be most effective for instant or prolonged anxiety reduction. Further to this, even though the systematic review in Chapter Four showed that imagery-based interventions were most effective for trait compared to state anxiety, it is important to reiterate that there were no explicit mentions of musical imagery being used in any of those intervention studies, and the majority of the reviewed studies did not include follow-up assessments after the initial post-anxiety measure. The current findings show that the VMI intervention is likely to work for episodes of ephemeral anxiety, once trained, so participants should consider using VMI when they anticipate an anxiety episode or once they experience anxiety. A good comparison might be taking an analgesic if someone has or anticipates a headache approaching, so individuals may use VMI as part of their psychological toolbox of coping mechanisms.

It is also worthwhile considering whether there are similarities between the type of effect VMI has on anxiety compared to music listening therapies, as it was suggested in Chapter Three that VMI might display anxiolytic effects due to having the ability to regulate and evoke emotions in the same way as music listening. Music listening interventions have also revealed immediate reductions in anxiety through the comparison of pre and post-intervention measures. For example, music listening therapies can reduce state anxiety during chemotherapy (Demiray, 2020) and preoperative anxiety (Lee et al., 2012). The pre and post-intervention assessments in these studies tend to occur immediately before and after the activity, which is in line with how anxiety was measured in the VMI training feasibility and intervention studies. A benefit of assessing anxiety in this way is that researchers can be sure that the effects observed are directly in response to the intervention activity the individuals completed and not extraneous variables. However, these simple measures of anxiety directly before and after completing the intervention activity can only provide evidence to demonstrate the immediate effect on anxiety. The GCM does acknowledge that there is a difference in the effect interventions have on anxiety (as well as other psychological disorders), being that some interventions result in brief symptomatic relief without having an impact on the recurrence of the problem, whereas other interventions have long-lasting effects, but the model does not explain why such a difference occurs. It would be interesting to explore these potential differences further, as there might be important underlying mechanisms that either hinder the capability of an intervention to achieve these durable effects or increase the chances of such effects occurring. The systematic review in Chapter Four highlighted how there is a gap in the literature relating to the durability of imagery-related interventions, as few studies included follow-up assessments after the initial post-intervention anxiety measure. Therefore, conducting research into the effectiveness of imagery interventions for longer periods of time can shed light on whether it is recommended to use these types of intervention methods for long-lasting changes in anxiety, specifically focusing on trait anxiety. It might also be useful to explore whether differences in the dosage of the intervention activities could increase the likelihood of longer-term effects being obtained. This might be in the form of testing the inclusion of booster sessions or prolonged single use, as well as seeing if there is a minimum period of time needed to achieve a positive outcome. Additionally, there is a need to explore the extent to which VMI can have positive effects on objective markers of anxiety (e.g., heart rate and galvanic skin response), as these types of assessments would strengthen the robustness of the potential intervention effects.

## 7.2 Target population for voluntary musical imagery intervention

The associations between VMI and anxiety that were found in both the VMI training and intervention studies did not differ between individuals with low or high trait anxiety, thus implying that the VMI intervention method can be effective for individuals with any level of anxiety (in terms of symptom severity). The survey in Chapter Two also showed that people who have higher levels of trait anxiety do not report problems with the deliberate control of auditory imagery. These findings are vital to this thesis as they indicate that it is not likely for people with anxiety to struggle with the deliberate imagination of music, which is the intervention method being offered. Therefore, based upon the current findings, VMI presents as a viable intervention method that can be used for less extreme to more severe cases of anxiety.

These findings of VMI being equally effective for individuals with low and high trait anxiety are particularly relevant regarding an issue in the field of anxiety interventions. There is an acknowledgement of the fact that despite there being established effective anxiety interventions such as CBT (DiMauro et al., 2013; Watanabe et al., 2010) and pharmacotherapy (Koen & Stein, 2011), the success rate of these treatment methods is not always 100%. This highlighted the need for there to be an increase in the intervention options available for users if other methods have failed to improve their anxiety. With levels of trait anxiety not being shown to determine the effectiveness of VMI for anxiety reduction, VMI can thus be seen as a potential treatment option for the individuals who have not found improvements in their anxiety after using other interventions. This therefore suggests that restrictions to future study samples, regarding the severity of one's anxiety, are not warranted. However, the findings in this thesis do not demonstrate the effectiveness of VMI for anxiety in relation to the various clinical anxiety disorders as most of the participants in the current studies had sub-clinical levels of anxiety. This thesis did not restrict the participant pool to people who only have anxiety disorders, because there was no pre-existing evidence to suggest that VMI would be able to reduce symptoms in anxiety disorders. Now that the studies in this thesis have established that VMI can be effective for people with both low and high trait anxiety, exploring whether this relationship is present in clinical anxiety could provide insights into the potential clinical application of this method.

Interestingly, depression moderated the effect of VMI on anxiety change in the VMI intervention study, as deliberately imagining music was more effective for anxiety reduction in individuals with fewer depressive symptoms. Even though this thesis intended to primarily explore the potential effectiveness of VMI for anxiety, there was secondary interest in the effect this activity might have in relation to depression, due to the frequent comorbidity between these two disorders (Choi et al., 2020). The suggestion that reducing anxiety in individuals with depression using VMI might be more effective for those who have fewer symptoms has implications for the use of VMI in instances where individuals might present with both anxiety and depression. This finding implies that VMI might not be the best treatment method for individuals who present with both anxiety and depression. Other key findings in this thesis also contribute to this result, as the survey in Chapter Two showed that the more depressive symptoms an individual had, the less able they were at controlling their deliberate auditory imagery. It could have been that as depressed individuals are more likely to have trouble with controlling their deliberate auditory imagery, they might have struggled with controlling the voluntary generation and maintenance of musical imagery in the intervention study. As a result, it might have been harder for those individuals to keep the musical imagery in their mind, thus weakening the effects of the imagery. Other key findings on depression and musical imagery in the survey showed that people with more depressive symptoms perceive their INMI episodes as negative and items used to assess the negative subscale in the Involuntary Musical Imagery Scale (IMIS; Floridou et al., 2015) include feelings of irritability, in response to spontaneously imagining music. Even though there is no evidence of VMI being associated with negative mood, this finding in relation to depression and INMI suggests that negative side effects associated with musical imagery in people with depression might relate to feelings of irritability. Potential limitations of the use of VMI to reduce anxiety in individuals with an increased number of depressive symptoms result in those individuals experiencing increased irritability, a trait that is already associated with depression (Crowe et al., 2006; Fava et al., 2010; Verhoeven et al., 2011). Future work can study the use of VMI as an intervention for anxiety in people who present with anxiety and depression comorbidities, to explore whether VMI for anxiety reduction in people with severe depression should be advised against. Moreover, future research can also look at the application of VMI for individuals needing to improve their mood, as a dominant finding in the literature is that music is regularly listened to in order to improve mood (Schäfer et al., 2013). The findings in this thesis showed that VMI could improve mood (and this relationship was established for people with varying levels of trait anxiety and depression). Therefore, investigations into VMI as a mood improvement tool for the general population would be worthwhile.

## 7.3 Individual differences in musical imagery experiences

Following on from the recommended target population, the literature review in Chapter One acknowledged that individual differences exist in both the experience of anxiety and musical imagery. For instance, the type of thought control strategies used to control unwanted thoughts differ based on the type of anxiety one has as individuals with GAD using the worry and punishment strategies more (Coles & Heimberg, 2005; Wells & Carter, 2009). In the musical imagery domain, the more musical training individuals have, the better they are at imagining music (Aleman et al., 2000; Weir et al., 2015), the more accurate their perception of the loudness of musical imagery (Bishop et al., 2013) and the more clear and vivid their musical imagery episodes are (Campos & Fuentes, 2016). There has been, however, little exploration into how individual differences in anxiety and musical imagery relate to each other. But findings from the survey reported in this thesis demonstrated evidence of differences in the everyday musical imagery experiences of people with increased anxiety, in relation to those with low levels of anxiety.

Firstly, the finding that people with high trait anxiety report experiencing more frequent INMI shows that people with anxiety are familiar with musical imagery. The valence of these musical imagery episodes was reported to be more negative by people with high trait anxiety, suggesting that spontaneously imagining music is more likely to be a negative experience for them. The negative valence associated with INMI could be due to the spontaneous aspect of INMI, as individuals do not have control over the initiation of the imagery (Cotter, 2019). From this, anxious individuals might see parallels between being unable to control the experience of INMI, including the initiation, maintenance and ending of the musical imagery, with the feeling of having reduced control over negative thoughts that occupy their minds during anxiety. There is little research to show what type of valence is associated with VMI specifically, but in contrast to the findings demonstrated for INMI in the survey, the VMI training and intervention studies highlighted how deliberately imagining familiar, liked music is associated with positive mood. This presents the deliberate imagination of music as an activity that can be enjoyable for people with various intensities of anxiety, and sheds light on the positive valence of this type of mental imagery. This is a favourable outcome, as the potential intervention method being offered to assist in coping with anxiety is not associated with negativity.

People can also experience INMI as helpful in various ways (Floridou et al., 2015). The helpful subscale in the IMIS is formed of questions that ask respondents about the capability of INMI to help when they are trying to complete activities and whether INMI assists in focusing one’s attention on these activities. The positive effects of musical imagery are also presented in the survey findings, where those with higher levels of anxiety reported more instances of perceiving INMI as helpful. This implies that INMI could be a beneficial activity for focusing one’s mind. This is particularly relevant for the rationale behind the potential effects of VMI on anxiety reduction, as it suggests that INMI can focus the mind of anxious individuals and serve as a distraction mechanism, potentially away from negative thoughts that maintain the anxiety. As mentioned earlier, the focus mechanism is one of the main mechanisms that the GCM (Beck & Haigh, 2014) states should be targeted when developing interventions for anxiety. Previous studies have suggested that mental imagery can be used as a distraction (Briggs et al., 2016; Cahalan et al., 2016), so this finding is consistent with that claim. However, it is interesting to see that anxious individuals can perceive such an experience as negative, yet beneficial at the same time.

The survey also provided an insight into individual differences regarding how anxiety severity, the control of unwanted thoughts, and the vividness, as well as controllability, of deliberate auditory imagery relate to one another. It was predicted that individuals with high trait anxiety would exhibit poorer control over their auditory imagery. However, the survey did not provide any evidence to support this hypothesis. Important implications arise, as it shows that the severity of anxiety people experience might not affect their ability to control their musical imagery when trying to reduce their anxiety.

## 7.4 Application of voluntary musical imagery as an intervention for anxiety

The most important finding from this thesis is the evidence demonstrating the anxiety alleviating effects of VMI, providing a clear answer to the main research question in this thesis. Recommendations for the application of VMI as an anxiety intervention can be made, as a result of the thesis demonstrating the anxiolytic effects of VMI. This relates to the most effective way to use this method, how future studies should be designed, and important factors to consider for the music being imagined. But before this is discussed, there are some limitations in this research that should be highlighted.

The effectiveness of the VMI method was found in comparison to a control activity, which was a verbal fluency task (VFT), thus showing that the VMI method was more effective than the VFT when reducing anxiety. But the findings do not indicate how effective VMI might be in comparison to other established anxiety interventions like CBT, guided imagery or music listening therapies. It can be recommended for future research into the application of VMI to compare the anxiolytic effects of VMI against other anxiety interventions, in addition to the effect sizes of the outcomes, now that it has been established that VMI is associated with decreases in anxiety. It is also worth noting another potential shortcoming of the data collected in this thesis. Self-report methods were used, whereby participants had to record their anxiety and mood levels through questionnaire responses. This type of data collection could allow for the opportunity of response bias to arise in the participants' reporting of their anxiety and mood levels, as there is a reliance on the participants to provide truthful responses. Therefore, it is difficult to decipher whether these responses were truthful or if there were cases of social desirability bias, where the participants were answering in the way they thought the researcher would have wanted. Despite this response bias being a potential limitation of the data collected, the fact that there were lower levels of anxiety and mood across both the VMI training feasibility and intervention studies when deliberately imagining music, compared to the VFT, allows for a degree of confidence in the conclusion of the findings. Although, the studies were designed in a way to reduce the likelihood of participants realising that the main topic of interest was to test the effects of VMI as an anxiety intervention, and thus minimise the chances of obtaining artificial responses. For this, the study aims were not revealed to the participants until the debriefing stage, each participant acted as their own control and the studies were advertised with an equal emphasis on musical and verbal activities. With reference to an earlier suggestion in this chapter, using objective methods to measure anxiety such as blood pressure, heart rate and cortisol levels could reduce the chances of response bias impacting the reported anxiety levels.

Future research into musical imagery and anxiety should continue testing the effects of VMI on anxiety, with the purpose of demonstrating the reliability of VMI as an intervention method. As the VMI training feasibility study showed variation in how well people can imagine music, and with this being related to performance on VMI assessment tasks, there might be a need for individuals to have the opportunity to practise this activity before applying it as an anxiety-reducing method. This is to avoid any instances of VMI having a negative impact, if there are individuals who might struggle to deliberately imagine music. Thus, if researchers are to adopt a similar approach to the study designs in this thesis, namely using the VMI training activity (the volume fader task) to allow people to practise imagining music, careful consideration will need to be taken regarding the purpose of these methods and how they can be adapted to be suitable for use during everyday life. The main aspect of the VMI training activity that can be applied to future studies is the importance of being familiar with the music to be imagined, which can be reinforced through the practise of VMI. It can be recommended for prospective VMI intervention studies to be designed in a way that would allow individuals to practise deliberately imagining music whenever they wish to, using elements from the volume fader task. For the VMI training feasibility and intervention studies, this task was carried out in a music studio. However, this would not be the most optimal method for this task if it was to be used in a natural setting. Therefore, the accessibility of this method for everyday use will need to be adjusted.

Transforming the way in which VMI is used in an intervention setting into a more attainable method can be done by incorporating VMI into a mobile phone application (app). *MoodMission* is an example of an evidence-based app that is designed to help people overcome feelings of anxiety and low mood, by offering users CBT strategies (Bakker et al., 2018). In *MoodMission*, people report how they are feeling and in response, *MoodMission* offers a personalised CBT strategy to help improve their mental health problem. The VMI method can be used in the same way as Bakker et al. (2018) in *MoodMission*, in that the VMI intervention activity can be administered using an app. Within this potential VMI app, individuals can have self-control over their practice of deliberately imagining music and the songs they choose to use. Users of this app can also be provided with instructions on how to deliberately imagine music and monitor their VMI progress as well as changes in their anxiety and mood. Once this VMI app has been developed, this approach can be pilot tested to determine if it is feasible.

Moving on, carrying out the studies in this thesis highlighted how there is a lack of self-report questionnaires available that solely assess VMI, and so future research can focus on the assessment of VMI. The online survey in Chapter Two sought to examine relationships between the musical imagery and anxiety experience, and an important element of the VMI training feasibility study in Chapter Five was to assess musical imagery ability. This was necessary for the research in this thesis, given the importance of being able to establish whether musical imagery ability was correlated with performance on VMI assessment tasks. Mental imagery questionnaires that measure various modes of imagery (including auditory) have been offered, such as the shortened form of Bett's Questionnaire Upon Mental Imagery (Sheehan, 1967), as well as questionnaires that specifically focus on auditory imagery including the Clarity of Auditory Imagery Scale (Willander & Baraldi, 2010) and the Bucknell Auditory Imagery Scale (BAIS; Halpern, 2015). For musical imagery studies, several researchers have opted for the IMIS (Floridou et al., 2015), including Farrugia et al. (2015) who established links between the INMI experience and cortical structure, as well as Cotter et al. (2016) who found that the frequency of INMI is correlated with various traits including neuroticism, openness to experience and positive schizotypy. Other studies have made use of the BAIS (Halpern, 2015), in instances where there was interest in the musical imagery experience of individuals with Autism (Bacon et al., 2020), and highlighting how differences in auditory imagery relate to the sensorimotor system (Lima et al., 2015). For this study specifically, the IMIS and BAIS were the pre-established scales used to acquire information about people's experience of musical imagery.

Indeed, the only questionnaire that exclusively focuses on auditory imagery that is musical is the IMIS. But it is important to point out that this questionnaire only addresses musical imagery that is involuntary. However, researchers have presented behavioural paradigms to assess VMI. Examples of these paradigms include the imagination-continuation paradigm (Bailes & Bigand, 2004; Weir et al., 2015) which involves assessing the accuracy of musical imagery when individuals listen to music excerpts interpolated with silent gaps, and mental chronometry tests (Clark & Williamon, 2012), where individuals can tap along to music they imagine. A limitation of these behavioural approaches is that the imagination-continuation paradigm assesses musical imagery that occurs immediately after music listening (which might not always happen in real-life settings) and mental chronometry tests cannot assess how vivid and clear the musical imagery is. Taking these points into account, further work could focus on the development of a test that only assesses musical imagery that is voluntary, by combining both self-report and behavioural approaches. This test can incorporate the three elements of musical imagery ability that are vital in the assessment of this experience - the controllability, vividness, and accuracy of VMI (Moran, 1993). With reference to the earlier discussion of the VMI method being incorporated as part of an app, this test could potentially be used to provide an indication of the minimum amount of VMI practice needed for an individual to engage in before using this method to reduce anxiety or improve mood.

On the topic of imagery methods, Huovinen and Tuuri (2019) used an interview approach to learn more about the experience of pleasant musical imagery. As discussed previously, these researchers discovered how people use specific techniques when imagining parts of a song for the purpose of enjoyment. The findings in the thesis show an anxiolytic effect of VMI, and the literature can assist in understanding why these effects occur, but it is not clear which specific parts of the musical imagery have the greatest contribution to this effect. Future research can be conducted to see whether there are distinct aspects of VMI that can be imagined to achieve the greatest reduction in anxiety. A similar approach to that of Huovinen and Tuuri (2019) could be used, whereby individuals are encouraged to imagine music and then discuss this experience with a researcher immediately after the musical imagery episode has occurred.

The main result from the systematic review was that the findings relating to the effectiveness of imagery-based interventions for anxiety are mixed. This means that more research into imagery interventions for anxiety should be conducted to form a conclusive argument for or against the use of imagery to reduce anxiety. For future VMI studies, the assessment of the risk of bias in the systematic review pinpointed aspects in the design of imagery interventions for anxiety that need to be addressed. The highest level of bias across the reviewed studies was found for whether participants adhered to their assigned intervention conditions, and the lowest level of bias was found for the measurement of the outcome variables. When relating these findings to the risk of bias in the VMI training and intervention studies, the risk of bias due to deviations from the intended intervention (VMI and the VFT) was low. The measurements that were put in place to ensure that the participants completed the intended intervention activities consisted of questions that related specifically to those activities. For instance, participants were asked about the vividness of their musical imagery, the ease of switching from previous activities to VMI and how difficult it was to think of the words during the VFT. It was also unlikely for there to have been high levels of bias in the measurements of the outcomes in these studies, as appropriate and valid self-report methods were utilised. Additionally, because the study was advertised with an equal emphasis on VMI and VFT (as opposed to revealing that the VFT was a control task), there was a reduced chance for their awareness of these activities affecting how they responded to the anxiety and mood measures. Future intervention studies that aim to test the effects of deliberately imagining music on anxiety should take care in making sure that there are measures put in place (such as asking participants questions that directly relate to the intervention activity) to reduce bias arising from whether the participants adhered to their assigned interventions (Sterne et al., 2019).

In addition to this, other recommendations for the application of VMI revolve around the music that will be imagined. The research in this thesis provided an insight into the importance of individuals having the choice to deliberately imagine more than one piece of music. As seen in the VMI training feasibility study, there was no difference in the likability of the songs the participants selected for the study after completing the four-day training programme. However, the participants reported liking their music selections less after the VMI intervention study. The main difference between these two studies that could have contributed towards this discrepancy could be the length of the study. Participants were instructed to deliberately imagine music for one day in the training study, whereas the participants were prompted to imagine music for three days in the intervention study. The purpose of increasing the number of days participants were asked to voluntarily imagine music in the VMI intervention study was so that it could be possible to see how this activity impacts anxiety over a longer period of time, and to also make the results more ecologically valid. From the responses collected in the interview data in the VMI intervention study, some participants specifically reported how being instructed to imagine the same song over three days resulted in a reduction in the enjoyability of the music, due to the repetitiveness. It is important to note that the decision to ask participants to select one piece of music was driven by the study design, rather than the suggestion that VMI would only be effective for anxiety in cases where individuals deliberately imagined the same piece of music. The implication of the reduced likability of music after repeatedly imagining the same song is that there should be a variety of song choices when people intend to use VMI to reduce their anxiety. This is to limit the occurrence of any negative side effects being associated with the act of voluntarily imagining music. Future studies into the investigation of the anxiolytic effects of VMI can focus on promoting the use of more than one music piece that individuals like a lot, are familiar with, make them feel happy and are associated with as few specific memories as possible. This is in line with the criteria used to select the pieces of music in the VMI training and interventions studies.

## 7.5 Conclusion

To conclude, a novel VMI-based intervention for anxiety reduction was devised and found to be effective, in comparison to a verbal control task. Through a series of studies that explored potential relationships between anxiety and musical imagery (including the meaning of these relationships in relation to using VMI as an anxiety intervention), reviewed imagery-based interventions for anxiety, and assessed the effectiveness of VMI for anxiety and mood, key findings emerged that answered the main research question, which is whether VMI is an effective intervention for anxiety. These findings shed light on the consistency between VMI potentially targeting the focus mechanism that contributes to the development and maintenance of anxiety. By establishing this connection, this thesis recognises the importance of the focus mechanism in reducing the opportunity for negative biases in information processing to occur, which direct the type of emotions and maladaptive behaviours that are displayed. Support was also found for musical imagery being able to improve mood in a similar way to music listening, allowing one to understand why VMI has a positive impact. The VMI training and intervention studies demonstrated how the effectiveness of the VMI method did not depend on one’s level of trait anxiety, leading to the conclusion that voluntarily imagining music is an approach that can be used across the spectrum of trait anxiety. The significance of this finding is that it contributes towards increasing the variety of intervention methods that are available for treating anxiety. Also, individual differences in the musical imagery experience in anxiety were found in this thesis. Specifically, people with high trait anxiety experience more frequent INMI episodes that can be experienced as both negative and helpful at the same time, and do not report difficulty in the control of their deliberate auditory imagery. Finally, future research ought to focus on the continued testing of VMI as an intervention method, potentially incorporating the VMI method into an app and encouraging people to imagine a variety of music pieces that they are familiar with. The assessment of the effectiveness of VMI can be carried out using objective markers, as well as in a clinical sample, and future research should be sure to focus on designing studies that can minimise the potential for bias to arise due to participants not adhering to their assigned interventions. Overall, this thesis presented novel contributions to the field of imagery-based interventions for anxiety, illustrating how consciously playing music in the mind can lead to the reduction of anxiety and improvement in mood states. With accounts being offered for this effect on anxiety and suggestions for future VMI intervention studies, it allows for the continuation of the exploration into this potential anxiety intervention method.

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## List of Abbreviations

ABMTs Attention bias modification treatments

BAIS Bucknell Auditory Imagery Scale

BAIS-C Bucknell Auditory Imagery Scale-control/Auditory imagery controllability

BAIS-V Bucknell Auditory Imagery Scale-Vividness/Vividness of auditory imagery

C Control

CAIS Clarity of Auditory Imagery Scale

CBT Cognitive behavioural therapy

CES-D Center for Epidemiological Studies Depression Scale

CT Cognitive therapy

DSM Diagnostic and Statistical Manual of Mental Disorders

DSM-5 Diagnostic and Statistical Manual of Mental Disorders 5$^{th}$ edition

ERT Emotion Regulation Therapy

ESM Experience Sampling Method

fMRI Functional magnetic resonance imaging

GAD Generalised anxiety disorder

GCM Generic Cognitive Model

Gold-MSI Goldsmiths Musical Sophistication Index

HIV Human immunodeficiency virus

HLM Hierarchical linear model/ Hierarchical linear modelling

I Intervention

iCBT Internet-delivered CBT

ID Identification

IMIS Involuntary Musical Imagery Scale

INMI Involuntary musical imagery

INMI-F Involuntary musical imagery - Frequency

INMI-H Involuntary musical imagery - Help

INMI-M Involuntary musical imagery - Movement

INMI-NV Involuntary musical imagery - Negative valence

INMI-PR Involuntary musical imagery - Personal reflections

ITPRA Imagination, Tension, Prediction, Reaction and Appraisal

NICE National Institute for Health and Care Excellence

O Outcome

OCD Obsessive compulsive disorder

P Population

PIAT Pitch Imagery Arrow Task

PICO Population, Intervention, Comparator and Outcome

PRISMA Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PSQI Pittsburgh Sleep Quality Index

PTSD Post-traumatic stress disorder

RAMDIU Revised Applied Model of Deliberate Imagery Use

RCT Randomised controlled trial

RoB 2 Revised Cochrane Risk of Bias tool

S-A Sleep difficulty due to anxiety

S-MI Musical imagery frequency whilst trying to sleep

SAD Social anxiety disorder

SC Some concerns

SPSS IBM SPSS Statistics 25

SQ Sleep quality

STAI State-Trait Anxiety Inventory

STAI-6 Six-item short-form State-Trait Anxiety Inventory

STAI-T State Trait Anxiety Inventory-Trait scale

TCA Thought control ability

TCA-D Distraction

TCA-P Punishment

TCA-RA Re-appraisal

TCA-SC Social Control

TCA-W Worry

TCQ Thought Control Questionnaire

USA United States of America

VFT Verbal fluency task

VMI Voluntary musical imagery

# Appendix A: Bucknell Auditory Imagery Scale (BAIS; Halpern, 2015)

The BAIS questionnaire that were used in the online survey (Chapter Two) and the VMI training feasibility study (Chapter Five).

## A.1 The Bucknell Auditory Imagery Scale-Vividness (BAIS-V)

The following scale is designed to measure auditory imagery, or the way in which you "think about sounds in your head." For the following items you are asked to do the following:

Read the item and consider whether you think of an image of the described sound in your head. Then rate the vividness of your image using the following "Vividness Rating Scale." If no image is generated, give a rating of 1.

Feel free to use all of the levels in the scale when selecting your ratings.

Please check that you have only selected one answer for each statement.

**Vividness Rating Scale**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| No image present at all | | | Fairly vivid | | | As vivid as the actual sound |

**Vividness Rating**

1. For the first item, consider the beginning of the song "Happy Birthday."
The sound of a trumpet beginning the piece.

2. For the next item, consider ordering something over the phone.
The voice of an elderly clerk assisting you.

3. For the next item, consider being at the beach.
The sound of the waves crashing against nearby rocks.

4. For the next item, consider going to a dentist appointment.
The loud sound of the dentist's drill.

5. For the next item, consider being present at a jazz club.
The sound of a saxophone solo.

6. For the next item, consider being at a live baseball game.
The cheer of the crowd as a player hits the ball.

7. For the next item, consider attending a choir rehearsal.
The sound of an all-children's choir singing the first verse of a song.

8. For the next item, consider attending an orchestral performance of Beethoven’s Fifth.
The sound of the ensemble playing.

9. For the next item, consider listening to a rain storm.
The sound of gentle rain.

10. For the next item, consider attending classes.
The slow-paced voice of your English teacher.

11. For the next item, consider seeing a live opera performance.
The voice of an opera singer in the middle of a verse.

12. For the next item, consider attending a new tap-dance performance.
The sound of tap-shoes on the stage.

13. For the next item, consider a kindergarten class.
The voice of the teacher reading a story to the children.

14. For the next item, consider driving in a car.
The sound of an upbeat rock song on the radio.

## A.2 The Bucknell Auditory Imagery Scale-Control (BAIS-C)

The following scale is designed to measure auditory (musical) imagery, or the way in which you “think about sounds in your head.” For the following pairs of items you are asked to do the following:

Read the first item (marked “a”) and consider whether you think of an image of the described sound in your head. Then read the second item (marked “b”) and consider how easily you could change your image of the first sound to that of the second sound and hold this image. Rate how easily you could make this change using the “Ease of Change Rating Scale.” If no images are generated, give a rating of 1. Please read “a” first and “b” second for each pair. It may be necessary to cover up “b” so that you focus first on “a” for each pair.

Feel free to use all of the levels in the scale when selecting your ratings.

Please check that you have only selected one answer for each statement.

**Ease of Change Rating Scale**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| No image present at all | | | Could change the image but with effort | | | Extremely easy to change the image |

**Change Rating**

1. For the first pair, consider attending a choir rehearsal.
a) The sound of an all-children's choir singing the first verse of a song.
b) An all-adults' choir now sings the second verse of the song.

2. For the next pair, consider being present at a jazz club.
a) The sound of a saxophone solo.
b) The saxophone is now accompanied by a piano.

3. For the next pair, consider listening to a rain storm.
a) The sound of gentle rain.
b) The gentle rain turns into a violent thunderstorm.

4. For the next pair, consider driving in a car.
a) The sound of an upbeat rock song on the radio.
b) The song is now masked by the sound of the car coming to a screeching halt.

5. For the next pair, consider ordering something over the phone.
a) The voice of an elderly clerk assisting you.
b) The elderly clerk leaves and the voice of a younger clerk is now on the line.

6. For the next pair, consider seeing a live opera performance.
a) The voice of an opera singer in the middle of a verse.
b) The opera singer now reaches the end of the piece and holds the final note.

7. For the next pair, consider going to a dentist appointment.
a) The loud sound of the dentist's drill.
b) The drill stops and you can now hear the soothing voice of the receptionist.

8. For the next pair, consider the beginning of the song "Happy Birthday."
a) The sound of a trumpet beginning the piece.
b) The trumpet stops and a violin continues the piece.

9. For the next pair, consider attending an orchestral performance of Beethoven's Fifth.
a) The sound of the ensemble playing.
b) The ensemble stops but the sound of a piano solo is present.

10. For the next pair, consider attending a new tap-dance performance.
a) The sound of tap-shoes on the stage.
b) The sound of the shoes speeds up and gets louder.

11. For the next pair, consider being at a live baseball game.
a) The cheer of the crowd as a player hits the ball.
b) Now the crowd boos as the fielder catches the ball.

12. For the next pair, consider a kindergarten class.
a) The voice of the teacher reading a story to the children.
b) The teacher stops reading for a minute to talk to another teacher.

13. For the next pair, consider attending classes.
a) The slow-paced voice of your English teacher.
b) The pace of the teacher's voice gets faster at the end of class.

14. For the next pair, consider being at the beach.
a) The sound of the waves crashing against nearby rocks.
b) The waves are now drowned out by the loud sound of a boat's horn out at sea.

# Appendix B: Recruitment Material for Anxiety and Musical Imagery Survey

Below are the various advertisement materials that were used for recruiting participants to complete the survey (Chapter Two).

## B.1 University of Leeds mailing list email

RE: Music and well-being online survey (£10 Amazon voucher prize draw in return)

Dear all,

Do you have an interest in music and well-being?

I am advertising a survey exploring this theme with specific focus on music engagement, musical imagery, as well as previous and current experiences of anxiety, depression and sleep. The survey will take approximately 30 minutes to complete.

If you would like to complete the survey, here is the link:
https://leeds.onlinesurveys.ac.uk/music_and_well_being

**Eligibility criteria:**
- Be over the age of 16
- Have no hearing loss

**What do I get in return for completing the survey?**
You will be entered into a prize draw to have a chance of winning a £10 Amazon voucher.

This survey has been ethically approved by the Faculty of Arts, Humanities and Cultures Research Ethics Committee on 11/06/2018 (Ethics approval reference number: PVAR 17-116).

You can unsubscribe from the mailing list at any time by re-visiting https://www.jiscmail.ac.uk/cgi-bin/webadmin?SUBED1=PSYCLEEDS-VOL&A=1, entering your name and email address and clicking ‘Unsubscribe (PSYCLEEDS-VOL)’.

Kind regards,
Michelle Ulor

## B.2 Social Media Post

Facebook

Hello,

I am a postgraduate researcher at the School of Music at the University of Leeds, and I am looking for people who might be interested in completing a survey I have compiled for my research that is about music and well-being (linked below). It lasts approximately 30 minutes. I would appreciate if you can pass this survey on to any family members or friends who might be interested in completing it as well.

In return, you will:
- Be entered into a prize draw to have the chance of winning a £10 Amazon voucher
OR
- If you are a psychology undergraduate student at the University of Leeds, you will receive 2 credits.

Please note that you must be over the age of 16 and have no hearing loss to complete the survey.

If you would like more information, please get in touch: mcmu@leeds.ac.uk.

## B.3 Recruitment through Prolific

**Study title:** Music and well-being

**Study description:** For this survey, you will be asked to complete questions about music (including musical engagement and musical imagery - imagining music), and well-being (current and previous experiences of anxiety and depression).

# Appendix C: Ethical Approval Form for Musical Imagery and Anxiety Survey

The ethical approval form for the musical imagery and anxiety survey.

**Faculty of Arts, Humanities and Cultures Research Ethics Committee**

**University of Leeds**

11 June 2018

Dear Michelle

**Title of study** **Exploring the relationship between experiences of anxiety and musical imagery.**

**Ethics reference** **PVAR 17-116**

I am pleased to inform you that the above research application has been reviewed by the Faculty of Arts, Humanities and Cultures Research Ethics Committee and following receipt of your response to the Committee's initial comments, I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

| Document | Version | Date |
|---|---|---|
| PVAR 17-116 Ethical review form_Michelle Ulor.docx | 1 | 22/05/18 |
| PVAR 17-116 Survey recruitment poster_Michelle Ulor.pdf | 1 | 22/05/18 |
| PVAR 17-116 Survey questions_Michelle Ulor.docx | 1 | 22/05/18 |
| PVAR 17-116 Information sheet_Michelle Ulor_updated.docx | 2 | 05/06/18 |
| PVAR 17-116 Social media and forum posts_survey_Michelle Ulor.docx | 1 | 22/05/18 |

Please notify the committee if you intend to make any amendments to the information in your ethics application as submitted at date of this approval as all changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation and other documents relating to the study, including any risk assessments. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

# Appendix D: Questionnaires

Questionnaires and questions used in the online survey (Chapter Two), VMI training feasibility study (Chapter Five) and VMI intervention study (Chapter Six).

## D.1 Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen et al., 2014)

Below are a set of questions regarding your engagement with music. Read through them and complete in a manner that represents your engagement best.

Please check that you have only selected one answer for each statement.

1 = Completely disagree
2 = Strongly disagree
3 = Disagree
4 = Neither agree nor disagree
5 = Agree
6 = Strongly agree
7 = Completely agree

I spend a lot of my free time doing music-related activities.
I sometimes choose music that can trigger shivers down my spine.
I enjoy writing about music, for example on blogs and forums.
If somebody starts singing a song I don't know, I can usually join in.
I am able to judge whether someone is a good singer or not.
I usually know when I'm hearing a song for the first time.
I can sing or play music from memory.
I’m intrigued by musical styles I'm not familiar with and want to find out more.
Pieces of music rarely evoke emotions for me.
I am able to hit the right notes when
I sing along with a recording.
I find it difficult to spot mistakes in a performance of a song even if I know the tune.
I can compare and discuss differences between two performances or versions of the same piece of music.
I have trouble recognizing a familiar song when played in a different way or by a different performer.
I have never been complimented for my talents as a musical performer.
I often read or search the internet for things related to music.
I often pick certain music to motivate or excite me.
I am not able to sing in harmony when somebody is singing a familiar tune.
I can tell when people sing or play out of time with the beat.
I am able to identify what is special about a given musical piece.
I am able to talk about the emotions that a piece of music evokes for me.

I don't spend much of my disposable income on music.
I can tell when people sing or play out of tune.
When I sing, I have no idea whether I'm in tune or not.
Music is kind of an addiction for me - I couldn't live without it.
I don't like singing in public because I'm afraid that I would sing wrong notes.
When I hear a piece of music I can usually identify its genre.
I would not consider myself a musician.
I keep track of new music that I come across (e.g. new artists or recordings).
After hearing a new song two or three times, I can usually sing it by myself.
I only need to hear a new tune once and I can sing it back hours later.
Music can evoke my memories of past people and places.

**Please circle the most appropriate category:**

I engaged in regular, daily practice of a musical instrument (including voice) for 0 / 1 / 2 / 3 / 4-5 / 6-9 / 10 or more years.

At the peak of my interest, I practiced 0 / 0.5 / 1 / 1.5 / 2 / 3-4 / 5 or more hours per day on my primary instrument.

I have attended 0 / 1 / 2 / 3 / 4-6 / 7-10 / 11 or more live music events as an audience member in the past twelve months.

I have had formal training in music theory for 0 / 0.5 / 1 / 2 / 3 / 4-6 / 7 or more years.

I have had 0 / 0.5 / 1 / 2 / 3-5 / 6-9 / 10 or more years of formal training on a musical instrument (including voice) during my lifetime.

I can play 0 / 1 / 2 / 3 / 4 / 5 / 6 or more musical instruments.

I listen attentively to music for 0-15 min / 15-30 min / 30-60 min / 60-90 min / 2 hrs / 2-3 hrs / 4 hrs or more per day.

The instrument I play best (including voice) is:

## D.2 Involuntary Musical Imagery Scale (IMIS; Floridou et al., 2015)

An earworm or involuntary musical imagery (INMI) is a short section of music that comes into your mind *without effort* (it is involuntary; i.e. it comes even though you did not have any intention to retrieve or remember the music) and then *repeats by itself spontaneously* (i.e. without you consciously trying to replay the music) at least once, on a loop. It may have words or it may just be a melody or a rhythm.

On average, I experience earworms:

i) 1 - Never
ii) 2 - Once a month
iii) 3 - Once a week
iv) 4 - Several times a week
v) 5 - Several times a day
vi) 6 - Almost continuously

**If your response for the first question below is “Never”, please go straight to the bottom of this page and click the 'Next' button.**

For each item there are 5 possible responses. Please select the most appropriate option for each statement from the choices shown below that best describes your earworm experience.

**1** = Never
**2** = Not very often
**3** = Sometimes
**4** = Most of the time
**5** = Always

1. Earworms help me when I'm trying to get things done.
2. It worries me when I have an earworm stuck in my head.
3. When I get an earworm I move to the beat of the imagined music.
4. My earworms agitate me.
5. Personal issues trigger my earworms.
6. I wish I could stop my earworms.
7. The way I move is in sync with my earworms.
8. I find my earworms irritating.
9. When I get an earworm I try to block it.
10. My earworms result from unresolved matters.
11. I find my earworms help me focus on the task that I'm doing.
12. The experience of my earworms is unpleasant.
13. The rhythms of my earworms match my movements.
14. I try hard to get rid of my earworms.
15. The content of my earworms mirrors my state of worry or concern.

16. On average, my earworm (the section of music that is stuck) lasts:
a) Less than 5 seconds
b) Between 5 and 10 seconds

c) Between 10 and 30 seconds
d) Between 30 seconds and 1 minute
e) More than 1 minute

17. On average, one earworm episode (a period of time when one particular tune gets stuck) lasts:
a) Less than 10 minutes
b) Between 10 minutes and half an hour
c) Between half an hour and 1 hour
d) Between 1 and 3 hours
e) More than 3 hours

## D.3 Hearing Loss Question

Do you have any hearing loss?
i) Yes
ii) No

## D.4 State-Trait Anxiety Inventory-Trait Scale (STAI-T; Spielberger et al., 1983)

A number of statements which people have used to describe themselves are given below. Read each statement and then indicate how you ***GENERALLY*** feel using the scale. There are no right or wrong answers.

**1** = Almost never

**2** = Sometimes

**3** = Often

**4** = Almost always

Please check that you have only selected one answer for each statement.

| | | | | |
|---|---|---|---|---|
| I feel pleasant. | 1 | 2 | 3 | 4 |
| I feel nervous and restless. | 1 | 2 | 3 | 4 |
| I feel satisfied with myself. | 1 | 2 | 3 | 4 |
| I wish I could be as happy as others seem to be. | 1 | 2 | 3 | 4 |
| I feel like a failure. | 1 | 2 | 3 | 4 |
| I feel rested. | 1 | 2 | 3 | 4 |
| I am “calm, cool, and collected.” | 1 | 2 | 3 | 4 |
| I feel that difficulties are piling up so that I cannot overcome them. | 1 | 2 | 3 | 4 |
| I worry too much over something that really doesn’t matter. | 1 | 2 | 3 | 4 |
| I am happy. | 1 | 2 | 3 | 4 |
| I have disturbing thoughts. | 1 | 2 | 3 | 4 |
| I lack self-confidence. | 1 | 2 | 3 | 4 |
| I feel secure. | 1 | 2 | 3 | 4 |
| I make decisions easily. | 1 | 2 | 3 | 4 |
| I feel inadequate. | 1 | 2 | 3 | 4 |
| I am content. | 1 | 2 | 3 | 4 |
| Some unimportant thought runs through my mind and bothers me. | 1 | 2 | 3 | 4 |
| I take disappointments so keenly that I can’t put them out of my mind. | 1 | 2 | 3 | 4 |
| I am a steady person. | 1 | 2 | 3 | 4 |
| I get in a state of tension or turmoil as I think over my recent concerns and interests. | 1 | 2 | 3 | 4 |

## D.5 Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977)

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

**1** = Rarely or None of the Time (Less than 1 Day)
**2** = Some or a Little of the Time (1-2 Days)
**3** = Occasionally or a Moderate Amount of Time (3-4 Days)
**4** = Most or All of the Time (5-7 Days)

Please check that you have only selected one answer for each statement.

| | | | | |
|---|---|---|---|---|
| I was bothered by things that usually don’t bother me. | 1 | 2 | 3 | 4 |
| I did not feel like eating; my appetite was poor. | 1 | 2 | 3 | 4 |
| I felt that I could not shake off the blues even with help from my family or friends. | 1 | 2 | 3 | 4 |
| I felt I was just as good as other people. | 1 | 2 | 3 | 4 |
| I had trouble keeping my mind on what I was doing. | 1 | 2 | 3 | 4 |
| I felt depressed. | 1 | 2 | 3 | 4 |
| I felt that everything I did was an effort. | 1 | 2 | 3 | 4 |
| I felt hopeful about the future. | 1 | 2 | 3 | 4 |
| I thought my life had been a failure. | 1 | 2 | 3 | 4 |
| I felt fearful. | 1 | 2 | 3 | 4 |
| My sleep was restless. | 1 | 2 | 3 | 4 |
| I was happy. | 1 | 2 | 3 | 4 |
| I talked less than usual. | 1 | 2 | 3 | 4 |
| I felt lonely. | 1 | 2 | 3 | 4 |
| People were unfriendly. | 1 | 2 | 3 | 4 |
| I enjoyed life. | 1 | 2 | 3 | 4 |
| I had crying spells. | 1 | 2 | 3 | 4 |
| I felt sad. | 1 | 2 | 3 | 4 |
| I felt that people disliked me. | 1 | 2 | 3 | 4 |
| I could not get “going.” | 1 | 2 | 3 | 4 |

## D.6 Anxiety and depression questions

<u>Anxiety</u>
Have you ever been diagnosed with an anxiety disorder?
i) Yes
ii) No

If the answer to the previous question is yes, please state the type of anxiety.

<u>Depression</u>
Have you ever been diagnosed with depression?

i) Yes
ii) No

## D.7 Thought Control Questionnaire (TCQ; Wells & Davies, 1994)

Most people experience unpleasant and/or unwanted thoughts (in verbal and/or picture form), which can be difficult to control. We are interested in the techniques that you generally use to control such thoughts.

Below are a number of things that people do to control these thoughts. Please read each statement carefully, and indicate how often you use each technique by circling the appropriate number. There are no right or wrong answers. Do not spend too much time thinking about each one.

Please check that you have only selected one answer for each statement.

**1** = Almost never

**2** = Sometimes

**3** = Often

**4** = Almost always

When I experience an unpleasant / unwanted thought:

| | | | | |
|---|---|---|---|---|
| I call to mind positive images instead. | 1 | 2 | 3 | 4 |
| I tell myself not to be so stupid. | 1 | 2 | 3 | 4 |
| I focus on the thought. | 1 | 2 | 3 | 4 |
| I replace the thought with a more trivial bad thought. | 1 | 2 | 3 | 4 |
| I don’t talk about the thought to anyone. | 1 | 2 | 3 | 4 |
| I punish myself for thinking the thought. | 1 | 2 | 3 | 4 |
| I dwell on other worries. | 1 | 2 | 3 | 4 |
| I keep the thought to myself. | 1 | 2 | 3 | 4 |
| I occupy myself with work instead. | 1 | 2 | 3 | 4 |
| I challenge the thought’s validity. | 1 | 2 | 3 | 4 |
| I get angry at myself for having the thought. | 1 | 2 | 3 | 4 |
| I avoid discussing the thought. | 1 | 2 | 3 | 4 |
| I shout at myself for having the thought. | 1 | 2 | 3 | 4 |
| I analyse the thought rationally. | 1 | 2 | 3 | 4 |
| I slap or pinch myself to stop the thought. | 1 | 2 | 3 | 4 |
| I think pleasant thoughts instead. | 1 | 2 | 3 | 4 |
| I find out how my friends deal with these thoughts. | 1 | 2 | 3 | 4 |
| I worry about more minor things instead. | 1 | 2 | 3 | 4 |
| I do something that I enjoy. | 1 | 2 | 3 | 4 |
| I try to reinterpret the thought. | 1 | 2 | 3 | 4 |
| I think about something else. | 1 | 2 | 3 | 4 |
| I think more about the more minor problems I have. | 1 | 2 | 3 | 4 |
| I try a different way of thinking about it. | 1 | 2 | 3 | 4 |
| I think about past worries instead. | 1 | 2 | 3 | 4 |
| I ask my friends if they have similar thoughts. | 1 | 2 | 3 | 4 |
| I focus on different negative thoughts. | 1 | 2 | 3 | 4 |

| | | | | |
|---|---|---|---|---|
| I question the reasons for having the thought. | 1 | 2 | 3 | 4 |
| I tell myself that something bad will happen if I think the thought. | 1 | 2 | 3 | 4 |
| I talk to a friend about the thought. | 1 | 2 | 3 | 4 |
| I keep myself busy. | 1 | 2 | 3 | 4 |

# Appendix E: Systematic Review Materials

## E.1 Search strategy

Below is the search strategy used for the systematic review (Chapter Four).

Search strategy:
1. Anxiety OR worry OR stress OR fear
2. Imagery
3. 1 and 2
4. Phobi* OR panic
5. 4 and 2
6. Agoraphobia OR selective mutism
7. 6 and 2
8. Separation anxiety disorder
9. 8 and 2

## E.2 Data extraction form

Items included in the data extraction form for the systematic review.

### 1. Study details

- Authors
- Design
- Control condition
- Sample size
- Sample type
- Gender
- Age
- Recruitment method
- Setting
- Location

### 2. Intervention details

- Imagery method
- Delivery of intervention
- Mode of imagery
- Contents of imagery method
- Imagery instructions
- Delivery (Group vs alone)
- Length of the study
- Number of sessions
- Dosage (Number of sessions x length of sessions)
- Follow-up assessment (Yes/no)
- Follow-up length
- Extra intervention information

### 3. Outcome details

- Type of anxiety
- Outcome
- Primary or secondary
- Anxiety measure
- Is the measure valid?
- Is the measure reliable?
- Time points tested
- Drop out information

### 4. Extra details

- Additional comments

# Appendix F: Voluntary Musical Imagery Training Study Materials

## F.1 Participant recruitment advertisement

The study advertisement details used in the participant pool scheme (University of Leeds).

| | |
|---|---|
| **Study Name** | *15 credits* Mental imagery: musical and verbal |
| **Study Type** | <br>**Multi-Part Study**<br>This is a Multi-Part study.  There are 3 parts. All parts must be signed up for at the same time.<br><br>Part 2 should be scheduled to occur 1 day(s) after Part 1<br>Part 3 should be scheduled to occur 2 day(s) after Part 2<br><br>Part 2 may be scheduled to occur at any time on a different day than Part 1 and that is within the range of acceptable dates.<br>Part 3 may be scheduled to occur at any time on a different day than Part 2 and that is within the range of acceptable dates. |
| **Duration** | 120 minutes (Part 1)<br>60 minutes (Part 2)<br>45 minutes (Part 3) |
| **Credits** | 8 Credits (Part 1)<br>4 Credits (Part 2)<br>3 Credits (Part 3)<br><br>(15 Credits total) |
| **Abstract** | This study is about mental imagery, involving deliberately imagining music and thinking about words. |
| **Description** | This study is investigating mental imagery, focusing specifically on musical and verbal stimuli. It is split into three parts and will take place over four days (Day 1: 2 hours, Day 2: 30 minutes, Day 3: 30 minutes and Day 4: 45 minutes).<br><br>For Day 1, the participants will be invited to the University of Leeds to complete mental imagery activities. On Days 2 and 3, the participants will practise mental imagery activities and complete short questionnaires in their daily life settings. On Day 4, the participants will be invited back to the University of Leeds to complete a computer-based task and the researcher will interview the individuals about their participation in this study. |
| **Eligibility Requirements** | Must have no hearing difficulties, must not be a musician, must not be a previous/current music student and must not have 5+ years of formal |

| | |
|---|---|
| | music training. |

## F.2 Ethical approval form

The ethical approval form for the VMI training feasibility study (Chapter Five).

**Faculty of Arts, Humanities and Cultures Research Ethics Committee**

**University of Leeds**

16 October 2017

Dear Michelle

| | |
|---|---|
| **Title of study** | **Can individuals be trained to imagine musical imagery? A preliminary study.** |
| **Ethics reference** | **PVAR 16-087 amendment Sept 2017** |

I am pleased to inform you that your amendment to the research application listed above has been reviewed by the Deputy Chair of the Faculty of Arts, Humanities and Cultures Research Ethics Committee and I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

| *Document* | *Version* | *Date* |
|---|---|---|
| PVAR 16-087 amendment Sept 2017 Amendment_form (Michelle Ulor).doc | 1 | 22/09/17 |
| PVAR 16-087 amendment Sept 2017 Updated ethical review form (Michelle Ulor).docx | 1 | 22/09/17 |
| PVAR 16-087 Ethical review form (Michelle Ulor).docx | 1 | 23/05/17 |
| PVAR 16-087 Project poster (Michelle Ulor).pub | 1 | 23/05/17 |
| PVAR 16-087 Emails and social media posts (Michelle Ulor).docx | 1 | 23/05/17 |
| PVAR 16-087 Information sheet (Michelle Ulor).docx | 1 | 23/05/17 |
| PVAR 16-087 Consent form (Michelle Ulor).docx | 1 | 23/05/17 |
| PVAR 16-087 Questions used in the study (Michelle Ulor).docx | 1 | 23/05/17 |
| PVAR 16-087 Anonymous ID document (Michelle Ulor).docx | 1 | 23/05/17 |

Please notify the committee if you intend to make any further amendments to the original research as submitted at date of this approval as all changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation, as well as documents such as sample consent forms, and other documents relating to the study. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

## F.3 Information sheet

The information sheet for the VMI training feasibility study.

School of Music
Faculty of Arts, Humanities and Cultures

**Information sheet**

Mental imagery: musical vs verbal

**Identity of researchers:**
**Michelle Ulor** - Postgraduate research student (mcmu@leeds.ac.uk)
**Dr. Freya Bailes** - Supervisor **(**f.bailes@leeds.ac.uk)
**Professor Daryl O'Connor** - Co-Supervisor **(**d.b.o'connor@leeds.ac.uk)

*You are being invited to participate in a postgraduate research project run by a PhD student from the School of Music at the University of Leeds. Below you are provided with information about the study - if unclear about anything or need further information, feel free to ask the researcher.*

**What is the purpose of the project?**
The project aims to look at individuals' experiences of mental imagery, with specific focus on imagining music and verbal fluency tasks.

**Do I have to take part?**
It is not compulsory to take part in this study; therefore, it is up to you to decide whether you want to or not. If you choose to take part, you will be sent a consent form to read through and sign for the researcher to obtain your written consent. You should be aware that you can withdraw from participating (at any time) and your data can be excluded from the study (if this decision is made before the paper is submitted for publication).

**What do I have to do?**
This study will take place over four consecutive days (of your choice). Within those days, you will complete musical imagery and verbal fluency tasks, practice these activities, complete short questions about your practice attempts and give feedback on your overall experience of this study.

Day 1: (takes place at the University of Leeds and lasts approximately 2 hours)
- Completion of musical imagery and verbal fluency tasks.

Day 2: (takes place wherever you are at the time and lasts approximately 5 minutes each time you are contacted)
- Practising imagining music for short durations (2 minutes) via six text message prompts from the researcher and subsequent completion of short questions about these attempts.

Day 3: (takes place wherever you are at the time and lasts approximately 5 minutes each time you are contacted)
- Practising verbal fluency tasks via six text message prompts from the researcher and subsequent completion of short questions about these attempts.

Day 4: (takes place at the University of Leeds and lasts approximately 45 minutes)
- Invited back to the university to complete a computer-based task.
- Verbal debrief of the study and discussion of your experience in participating.

**Where will this research take place?**
It will mainly take place at the University of Leeds on Days 1 and 4, but on Days 2 and 3 (when you are instructed to practise the activities you learnt in the training sessions previously), it will occur wherever you are at that moment in time.

**What are the possible disadvantages and risks of taking part?**
Taking part may be deemed as time consuming and the prompting of imagining mental imagery via text messages could be slightly intrusive.

**What are the possible benefits of taking part?**
The data that will be collected due to your participation will contribute towards increasing one's understanding of how mental imagery can be trained.

**Will my taking part in this project be kept confidential?**
Yes.

**Will I be recorded, and how will the recorded media be used?**
Yes, you will be audio recorded when we discuss your participation experience. Only the researcher will have access to these recordings.

**For further information, please contact any of the researchers listed above.**

## F.4 Consent form

The consent form for the VMI training feasibility study.

School of Music
Faculty of Arts, Humanities and Cultures

**Consent form**
Mental imagery: musical vs verbal

**Identity of researchers:**

**Michelle Ulor** - Postgraduate research student (mcmu@leeds.ac.uk)
**Dr. Freya Bailes** - Supervisor (f.bailes@leeds.ac.uk)
**Professor Daryl O'Connor** - Co-Supervisor (d.b.o'connor@leeds.ac.uk)

**Please read through the points below and tick if you agree:**

1. I confirm that I have read the information sheet for this project. I have a clear understanding of what it is about and have been able to ask the researcher questions if I had any, which were answered to a suitable level. ☐

2. I am aware that my participation is voluntary and I can withdraw:
a) from participating in the study at any point without having to give a reason for my actions ☐

AND

b) my data from this study before the paper gets submitted for publication. ☐

3. I understand that my responses will be confidential and none of my personal details will be presented in any reports or articles after the study has been conducted. ☐

4. I understand that the information collected from me will be used as part of a PhD research project and I agree for my data collected to be used in future research. ☐

5. I am aware that I will be audio recorded in some parts of this study and give my permission for this. ☐

6. I agree to take part in this research project. ☐

| | | |
|---|---|---|
| ____________________ | ______________ | ______________ |
| *Name of participant* | *Date* | *Signature (first initial and surname)* |
| ____________________ | ______________ | ______________ |
| *Lead researcher* | *Date* | *Signature* |

## F.5 Anonymisation identification document

The anonymous identification document for the VMI training feasibility study.

**Anonymous ID form**

Mental imagery: musical vs verbal

**Anonymous ID:** _ _ _ _ _ _
Please write down the day you were born (2 digits), the first two letters of your mother's maiden name and the last two letters of your favourite colour in the space above.

Example: Participant X, born 16/04/90, mother's maiden name is Smith and their favourite colour is blue – Anonymous ID: 16SMUE)

Please provide the following details below:

Mobile phone number:…………………………………………………………………………
Age:……………………………………………………………………………………………...
Gender:…………………………………………………………………………………………

## F.6 Music selection criteria form

The music selection criteria form for the VMI training feasibility study.

**Selection criteria for music**

Mental imagery: musical vs verbal

As part of this study, it is a requirement for participants to select their own piece of music to use. It is important that this music piece fits specific selection criteria to be deemed as suitable for being used in this study. If not, you will be asked to select another piece.

**You should:**

1. Like the piece of music a lot.
2. Be extremely familiar with this piece of music.
3. Feel happy after listening to the piece.
4. Have no memories associated with this piece of music.

Please answer the questions below.

**The piece of music you select must not be longer than 3 minutes.**

**Piece of music**

Song name: ………………………………………………………………………………………..

1. On a scale from 1 **(Not at all)** to 10 **(Extremely)**, how much do you like this piece of music?

1….  2….  3....  4….  5….  6….  7….  8….  9….  10….

2. On a scale from 1 **(Not very familiar)** to 10 **(Extremely familiar)**, how familiar are you with this piece of music?

1….  2….  3....  4….  5….  6….  7….  8….  9….  10….

3. On a scale from 1 **(Not very happy)** to 10 **(Extremely happy)**, how happy does this piece of music make you?

1….  2….  3....  4….  5….  6….  7….  8….  9….  10….

4. Do you have any memories associated with this piece of music? Circle your response below.

a) Yes
b) No

## F.7 Music likability rating scale

The music likability rating scale for the VMI training feasibility and intervention studies.

On a scale from 1 **(Not at all)** to 10 **(Extremely)**, how much do you like this piece of music?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

## F.8 Volume fader task difficulty rating scale

The difficulty rating scale for the volume fader task in the VMI training feasibility study.

On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult was it to imagine this piece of music in your mind?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

## F.9 Verbal fluency task difficulty rating scale

The difficulty rating scale for the VFT in the VMI training feasibility study.

1. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult was it to think of these words?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

## F.10 Volume fader task questions (Training session)

Questions the participants were given during the volume fader task in stage one of the VMI training feasibility study.

1. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult are you finding this training session?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

2. On a scale from 1 **(Not very clearly)** to 10 **(Extremely clearly)**, how clearly were you able to imagine this piece of music in your mind when the slider was down?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

3. What musical element did you focus on, if any?

4. On a scale from 1 **(Not very easy)** to 10 **(Extremely easy)**, how easy did you find focusing on this element?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

5. Have you used any additional techniques to assist with imagining this piece of music in your mind? Select the appropriate answer below.
i) Yes
ii) No

a) If the answer to the previous question was yes, please go into detail below.

6. If you could use any extra techniques to assist you with imagining this piece of music, what would you choose?

## F.11 Verbal fluency task questions (Training session)

Questions the participants were given during the VFT in stage one of the VMI training feasibility study.

1. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult are you finding this training session?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

2. How many words did you think of in your mind?

3. Have you used any additional techniques to assist with imagining this piece of music in your mind? Select the appropriate answer below.
i) Yes
ii) No

a) If the answer to the previous question was yes, please go into detail below.

4. When you thought of the words in your mind, did you imagine any visual imagery at the same time?

## F.12 List of participant-selected songs (and researcher-selected song)

A list of songs the participants chose to use in the VMI training feasibility study and the researcher-selected song.

Amy Winehouse - You're Wondering Now
Arctic Monkey - Mardy Bum
Beyoncé - Irreplaceable
Camila Cabello - Havana
Childish Gambino - California
Dolly Parton - 9 To 5
Ed Sheeran - Barcelona
Ed Sheeran - Galway Girl (x2)
Frank Ocean - Sierra Leone
Future - Wicked
George Ezra - Barcelona
James Blake - Limit To Your Love
Kaytranada feat. Syd - You're The One (Edit)
MAX - Darling
McFly - Five Colours In Her Hair
MKTO - Classic
Omi - Cheerleader
Portugal. The Man - Feel It Still
Randy Newman - You've Got A Friend In Me
Rita Ora - Your Song
Sam Cooke - What A Wonderful World
Spice Girls - Wannabe (x2)
Stevie Wonder - Signed, Sealed, Delivered, I'm Yours
Ta Ku - Higher (Flume Remix)
The Kooks - Seaside
The Kooks - She Moves In Her Own Way
The Marvelettes - Please Mr Postman
The Orwells - Buddy
The Spencer Davis Group - Keep On Running
Unknown - Paradise
Van Morrison - Brown Eyed Girl
War - Low Rider

Researcher-selected song: TD Nasty feat. Clara La San - Where U Wanna Be

## F.13 Email instructions for Experience Sampling Method days

The instructions the participants received via email for the ESM stage of the VMI training feasibility study.

Dear Participant X,

Here is a reminder of the instructions for the second part of the study:

**Day 2:**
On this day, you will be sent six text messages at random points between 8am and 8pm, therefore it is necessary for you to keep your phone and a pair of headphones by your side at all times during this specified time frame. Each time you receive a text message, there will be a link for you to follow. Click on this link and read the instructions.

**Day 3:**
On this day, you will be sent six text messages at random points between 8am and 8pm, therefore it is necessary for you to keep your phone and a pair of headphones by your side at all times during this specified time frame. Each time you receive a text message, there will be a link for you to follow. Click on this link and read the instructions.

Kind Regards,
Michelle Ulor

## F.14 Voluntary musical imagery Experience Sampling Method questions

Questions on the VMI day in stage two of the VMI training feasibility study.

1. Please enter the date and time below.

2. Look at the text message you received and state the texts message number.

3. Please record your five-figure participant code assigned to you on the participant pool, beginning with the number ‘4’.

4. On a scale from 1 **(Not very anxious)** to 10 **(Extremely anxious)**, how anxious are you right now?
1… 2… 3… 4… 5… 6… 7… 8… 10…

5. What is the name of the piece of music you imagined?

6. Were you able to imagine this piece of music? If so, how many attempts did it take for you to successfully do so?

7. If there were lyrics present in this piece of music, were you able to correctly remember all of them? Circle the appropriate choice below. **(Move onto question 7 if there were no lyrics)**.
i) Yes
ii) No

8. What is your current sound environment (for e.g. in a busy supermarket or in the quiet section of a library)?

9. When did you last hear this piece of music out loud?
i) 0 - 30 minutes before
ii) 30 minutes – 1 hour before
iii) 1 – 2 hours before
iv) On the same day
v) Within the last week

10. What activity were you doing just before you imagined this music?

11. On a scale from 1 **(Not very easy)** to 10 **(Extremely easy)**, how easy did you find it to imagine this piece of music in your mind following this previous activity?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

12. What is the reason for that answer?

13. On a scale from 1 **(Not very vivid)** to 10 **(Extremely vivid)**, how similar was the vividness of the music you imagined compared to listening to it out loud?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

14. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult was it to imagine this piece of music in your mind?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

15. On a scale from 1 **(Not very distracting)** to 10 **(Extremely distracting)**, how distracting was imagining this piece of music from other tasks you were doing?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

16. Did you play the music aloud before attempting to imagine it? **(If yes, move onto question 13)**
i) Yes
ii) No

17. Do you think it would have been easier to imagine this piece of music if you heard it out loud before? Circle the appropriate choice below.
i) Yes
ii) No

18. The scale below represents increase in negative mood to increase in positive mood. Please indicate below how much imagining this song affected your mood?

| Increased bad mood | No change in mood | Increased good mood |
|---|---|---|

1… 2… 3… 4… 5… 6… 7... 8... 9...

19. Please describe further the specific type of mood you were in before imagining this piece of music and after.

20. Do you think the mood you experienced whilst imagining this piece of music is similar to the mood that you would experience when listening to the music out loud? Please answer in detail.

21. On a scale from 1 **(Not very anxious)** to 10 **(Extremely anxious)**, how anxious are you right now?
1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

Additional questions:

- On a scale from 1 **(Not present)** to 9 **(Severe)**, please rate how you are currently feeling in regards to anxious mood (consisting of worries, anticipation of the worst, fearful anticipation and irritability). (Note that 5 represents moderate.)

1… 2… 3… 4… 5… 6… 7… 8… 9…

- Using the scale below, please indicate your overall mood today. Note that: -4 represents :( (negative mood) 0 represents :| (neutral mood) +4 represents :) (positive mood)

-4 -3 -2 -1 0 +1 +2 +3 +4

## F.15 Verbal fluency task Experience Sampling Method questions

Questions on the VFT day in stage two of the VMI training feasibility study.

1. Please enter the date and time below.

2. Look at the text message you received and state the texts message number.

3. Please record your five-figure participant code assigned to you on the participant pool, beginning with the number ‘4’.

4. On a scale from 1 **(Not very anxious)** to 10 **(Extremely anxious)**, how anxious are you right now?
1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

5. Were you able to think of at least 10 words? Circle the appropriate choice below.
i) Yes
ii) No

6. Did you think about any word more than once? Circle the appropriate choice below.
i) Yes
ii) No

7. What is your current sound environment (for e.g. in a busy supermarket or in the quiet section of a library)?

8. What were you doing just before you this activity?

9. On a scale from 1 **(Not very easy)** to 10 **(Extremely easy)**, how easy did you find it to complete the task you were set following the previous activity (stated in the question above)?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

10. What is the reason for that answer?

11. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult was this task?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

12. On a scale from 1 **(Not very distracting)** to 10 **(Extremely distracting)**, how distracting was this task from other activities you were doing?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

13. The scale below represents increase in negative mood to increase in positive mood. Please indicate below how much this activity affected your mood?

| Increased bad mood | | | | No change in mood | | | | Increased good mood |
|---|---|---|---|---|---|---|---|---|
| 1… | 2… | 3… | 4… | 5… | 6… | 7... | 8... | 9... |

14. Please describe further the specific type of mood you were in before this activity and after.

15. Do you think the mood you experienced whilst completing this task in your mind would be similar to the mood you would experience if completing the task out loud? Please answer in detail.

16. On a scale from 1 **(Not very anxious)** to 10 **(Extremely anxious)**, how anxious are you right now?
1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

Additional questions:

- On a scale from 1 **(Not present)** to 9 **(Severe)**, please rate how you are currently feeling in regards to anxious mood (consisting of worries, anticipation of the worst, fearful anticipation and irritability). (Note that 5 represents moderate.)

1… 2… 3… 4… 5… 6… 7… 8… 9…

- Using the scale below, please indicate your overall mood today. Note that: -4 represents :( (negative mood) 0 represents :| (neutral mood) +4 represents :) (positive mood)

-4 -3 -2 -1 0 +1 +2 +3 +4

## F.16 Experience Sampling Method text message content

Example of the text message content received on one of the ESM days in the VMI training study. All of the text messages followed the same layout, except the website link was changed accordingly.

Text message ONE: https://leeds.onlinesurveys.ac.uk/esm-day-1-1-copy
Text message TWO: https://leeds.onlinesurveys.ac.uk/esm-day-1-2-copy
Text message THREE: https://leeds.onlinesurveys.ac.uk/esm-day-1-3-copy
Text message FOUR: https://leeds.onlinesurveys.ac.uk/esm-day-1-4-copy
Text message FIVE: https://leeds.onlinesurveys.ac.uk/esm-day-1-5-copy
Text message SIX: https://leeds.onlinesurveys.ac.uk/esm-day-1-6-copy

## F.17 Imagination-continuation task questions

Instructions and questions for the imagination-continuation task in stage three of the VMI training feasibility study.

Now you will complete a spot task, where you will be presented with ten snippets of your self-selected piece of music interpolated with a section of silence. Please read and follow the points below.

1. The snippet will be played to you.
2. When you encounter the silent gap, continue playing the music in your mind.
3. Answer the questions given.
4. Now move onto the next snippet and repeat the same activity.

Was the song reintroduced at the correct position? Please select from the options below.
i) Yes
ii) No

On a scale from 1 **(Not very confident)** to 10 **(Extremely confident)**, how confident are you in this response?

1… 2… 3… 4… 5… 6… 7… 8… 9… 10…

If you answered **no**, please circle the position you believed it came in at:

i) Too early
OR
ii) Too late

## F.18 Interview questions

Interview questions for the interview in the VMI training feasibility study.

**Interview questions**

**Overall experience of the VMI training programme**

1. Can you discuss your experience of participating in this study, how has it been for you?
a) Think about the positive and negative aspects of the study, what were they?

2. Can you remember any instances when you imagined either of your self-selected pieces of music since participating in this study (without being prompted)?
a) Was this a voluntary or involuntary experience?
b) If this was a voluntary experience, please talk me through what you did to help in controlling this activity?

3. Now think back to when you might have imagined music (in general) since beginning participation. Describe how you think the study might have/might not have assisted in this experience.
a) What type of techniques did you engage in during this experience (if any)?
b) Can you explain how these techniques might have helped?

**Questions relating to the VMI training method (Volume fader task)**

4. Please describe your experience of the volume fader task as a method to train yourself to imagine music.
a) What are your thoughts towards this method being applied in future similar settings?
b) Could you discuss other types of methods that you think might be useful to fulfill the goal of training people to imagine music?

5. What part of the training session did you find the most difficult?
a) Do you have any ideas for how this could be approved for future cases?

6. Referring back to the days when you were prompted to complete activities, followed by answering a set of questions relating to that activity.
(Individualised questions formulated based on the participants' responses to questions in the ESM section).

7. On days 3 and 4 (when you had to answer questions about your attempts to deliberately imagine music and complete the verbal fluency tasks) how did you deal with any questions that might have been unclear for you, if there were any?

**Imagining music in daily life**

8. Please describe your experiences of imagining music in your daily life.
a) What challenges do you think there might be to imagining music in your daily life in the future?

9. Think about your ability/experience to deliberately imagine music, in what way do you think this study might/might not have had an effect on this?

**Mood**

10. Overall, can you describe whether these activities had a noticeable effect on your mood?
a) Did you notice that the effect was greater for one activity compared to another? If so, which activity?

**Anxiety**

11. Can you describe your overall anxiety experience before the first day when you received texts compared to the last day?
a) Can you describe the change in your anxiety experience (if any) after the imagining music activities?

**Extra**

12. Prior to participating in this study, describe any time when you remember having purposely imagined music for a specific reason.
a) What did you do in this experience?

13. Since taking part in this study, what type of situations do you think you would purposely imagine music in?

14. Is there anything else you would like to add or comment on further?

## F.19 Debrief Form

The debrief form for the VMI training feasibility study.

**Debrief Form**

Mental imagery: musical vs verbal

**Date of ethical approval:**
(23/05/2017)

**Identity of researchers:**
Michelle Ulor (Postgraduate researcher - University of Leeds)
Dr. Freya Bailes (Project Supervisor - University of Leeds)
Professor Daryl O'Connor (Project Co-supervisor - University of Leeds)

**Thank you for taking part in this study, your contribution is very much appreciated.**

**Purpose of the study:**
The purpose was to investigate whether individuals from the general population can be trained to imagine music. We are interested in developing a novel music-based intervention for anxiety, using voluntary musical imagery (the act of purposely imagining music in the mind). A first step in the development of this intervention has been to test the suitability of different methods to train people to deliberately imagine music, and apply voluntary musical imagery in everyday life.

**Procedure:**
This study involved the participants being trained to imagine music and complete verbal fluency tasks, followed by prompts from the main researcher for those individuals to practise these activities over the next two days, then their ability to imagine music was tested on the final day of the study.

**Please note that your data will remain anonymous and will only be used for the purpose of this investigation. If you would like to withdraw your data at any given time, you are free to do so before this project gets submitted before publication.**

**Contact:**
If you need to contact any the researchers involved in this project at any point, you can do so via the email addresses below:

Michelle Ulor (mcmu@leeds.ac.uk)
Dr. Freya Bailes (f.bailes@leeds.ac.uk)
Professor Daryl O'Connor (d.b.o'Connor@leeds.ac.uk)

# Appendix G: Voluntary Musical Imagery Intervention Study Materials

Recruitment material for the VMI intervention study.

## G.1 University mailing email

**Are you interested in the use of mental imagery for well-being?**

I am a PhD student here at the School of Music and I am looking for people to take part in my study, which explores the effect of mental imagery on well-being (including anxiety and depression).

**Study activities:**
- Practise musical imagery and verbal fluency tasks
- Complete mental well-being questionnaires
- Discuss study experience

This study takes places over a 21-day period, but the length of activities will vary on each day and you will **ONLY** be asked to complete activities on **days 1-7**, and **21**.

**Eligibility criteria:**
- Based in Leeds or nearby areas (if willing to travel)
- 18 years old and above
- Do not have any hearing loss

**Reward:**
You will be entered into a prize draw to have the chance of winning **£40.**

If you are interested in taking part, please email me: mcmu@leeds.ac.uk. It would also be greatly appreciated if this could be passed onto any family members or friends who might be interested.

This study has received ethical approval from the Faculty of Arts, Humanities and Cultures Research Ethics Committee, University of Leeds on 18/03/19 (Ethics reference: FAHC 18-064).

Kind regards,
Michelle Ulor

## G.2 Advertisement poster

# Want to take part in a study about mental imagery and well-being?

**I am a postgraduate researcher interested in the effect of mental imagery on well-being (anxiety and depression)**

**What will happen?**

You will be asked to practise mental imagery activities (imagining music and a mental verbal fluency task), complete well-being questionnaires and discuss your experience of this study

**Where will it happen?**

Mainly at the University of Leeds, but you'll also be contacted to answer questions in your own environment

**What is the reward?**

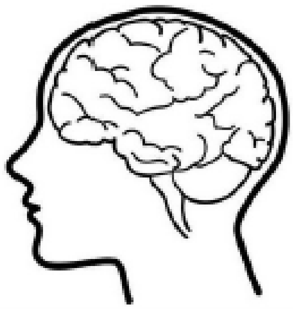
A chance to win £40

**Duration**

Over 21 days (the length of sessions on each day will vary and you will **ONLY** be asked to complete activities on days 1-7, and 21)

**For more information/questions, please contact: mcmu@leeds.ac.uk**

**(This study has been ethically approved by the University of Leeds research ethics committee: FAHC 18-064)**



## G.3 Social Media advertisement

Facebook

Hi everyone! I am currently recruiting participants to take part in my final PhD study which looks at the effect of mental imagery on well-being (anxiety and depression). Study activities will include practising musical imagery and verbal fluency tasks, completing mental well-being questionnaires and discussing your experience of this study over a 21-day period. Please note that the length of sessions will vary on each day (with a maximum length of 35 minutes) and you will only be asked to complete activities on days 1-7, and 21. As a reward for your participation, you will be entered into a prize draw to have the chance of winning £40.

I am looking for people who:
- are based in Leeds (or nearby areas - if you are willing to travel)
- are 18 years old and above
- do not have any hearing loss

Please message me on here if you are interested in taking part and would like more information (or you can email me: mcmu@leeds.ac.uk).

It would also be greatly appreciated if this could be passed onto any family members or friends who might be interested.

This study has received ethical approval from the Faculty of Arts, Humanities and Cultures Research Ethics Committee, University of Leeds (Ethics reference: FAHC 18-064).

## G.4 Participation pool advertisement (University of Leeds)

Advertisement details for the VMI intervention study for the participant pool.

| | |
|---|---|
| **Study Name** | ***15 credits* Mental imagery and well-being study** |
| **Study Type** | **Multi-Part Study**<br>This is a Multi-Part study. There are 3 parts. All parts must be signed up for at the same time.<br><br>Part 2 should be scheduled to occur 1 day(s) after Part 1<br>Part 3 should be scheduled to occur between 18 and 25 day(s) after Part 2<br><br>Part 2 may be scheduled to occur at any time on a different day than Part 1 and that is within the range of acceptable dates.<br>Part 3 may be scheduled to occur at any time on a different day than Part 2 and that is within the range of acceptable dates. |
| **Duration** | 60 minutes (Part 1)<br>150 minutes (Part 2)<br>15 minutes (Part 3) |
| **Credits** | 4 Credits (Part 1)<br>10 Credits (Part 2)<br>1 Credits (Part 3)<br><br>(15 Credits total) |
| **Abstract** | This study is about mental imagery and well-being, involving deliberately imagining music and thinking about words. |
| **Description** | This study is about mental imagery & well-being, and is split into three stages:<br><br>Stage one (day 1):<br>This is a single session that involves a musical and verbal task. It lasts around 45 mins to 1 hour and takes places in a music studio at the School of Music. The studio is open from 10am to 10pm on weekdays and you can decide when you want to come in.<br><br>Stage two (days 2 - 7):<br>For the next 6 days between 8am and 8pm, you'll receive 8 random texts throughout the day. The texts will instruct you to complete an activity that you practised in the first testing session for two minutes, then answer some brief questions after. It should take approximately 3 minutes to complete each time, totalling |

| | |
|---|---|
| | roughly 24 minutes on each day. This will take place wherever you are when you receive the text, e.g. at work or at home. Then there is a two week break where you do not do anything.<br><br>Stage three (day 21):<br>This is the last day of the study and you are invited back to the music studio at the School of music to answer some well-being questions and discuss your study participation. Again, the studio is open from 10am - 10pm on weekdays and this session lasts around 10/15 minutes.<br><br>(When selecting slots for part 2, you only need to choose one). |
| **Eligibility Requirements** | No hearing difficulties and over the age of 18 |
| **Preparation** | You will be asked to complete some well-being questionnaires and select a piece of music for this study. |

## G.5 Ethical Approval form

The ethical approval form for the VMI intervention study (Chapter Six).

**Faculty of Arts, Humanities and Cultures Research Ethics Committee**

**University of Leeds**

18th March 2019

Dear Michelle

**Title of study** **Musical and verbal interventions for anxiety**

**Ethics reference** **FAHC 18-064**

I am pleased to inform you that the above research application has been reviewed by the Faculty of Arts, Humanities and Cultures Research Ethics Committee and following receipt of your response to the Committee's initial comments, I can confirm a favourable ethical opinion as of the date of this letter. The following documentation was considered:

| Document | Version | Date |
|---|---|---|
| FAHC 18-064 Summary of edits made to ethics application_Michelle Ulor.docx | 1 | 14/03/19 |
| FAHC 18-064 Ethical review form_Michelle Ulor_updated.docx | 2 | 14/03/19 |
| FAHC 18-064 Selection criteria for music_Michelle Ulor | 1 | 19/02/19 |
| FAHC 18-064 Information sheet_Michelle Ulor_updated.docx | 2 | 14/03/19 |
| FAHC 18-064 Consent form_Michelle Ulor_updated.docx | 2 | 14/03/19 |
| FAHC 18-064 Interview question themes_Michelle Ulor | 1 | 19/02/19 |
| FAHC 18-064 Debrief form_Michelle Ulor_updated.docx | 2 | 14/03/19 |
| FAHC 18-064 Anonymous ID document_Michelle Ulor | 1 | 19/02/19 |
| FAHC 18-064 Experience sampling method questions_Michelle Ulor | 1 | 19/02/19 |

Please notify the committee if you intend to make any amendments to the information in your ethics application as submitted at date of this approval as all changes must receive ethical approval prior to implementation. The amendment form is available at http://ris.leeds.ac.uk/EthicsAmendment.

Please note: You are expected to keep a record of all your approved documentation and other documents relating to the study, including any risk assessments. This should be kept in your study file, which should be readily available for audit purposes. You will be given a two week notice period if your project is to be audited. There is a checklist listing examples of documents to be kept which is available at http://ris.leeds.ac.uk/EthicsAudits.

We welcome feedback on your experience of the ethical review process and suggestions for improvement. Please email any comments to ResearchEthics@leeds.ac.uk.

## G.6 Information sheet

The information sheet for the VMI intervention study.

School of Music
Faculty of Arts, Humanities and Cultures

**Information sheet**

Musical and verbal interventions for anxiety

**Identity of researchers:**
**Michelle Ulor** - Postgraduate researcher (mcmu@leeds.ac.uk)
**Dr. Freya Bailes** - Supervisor (f.bailes@leeds.ac.uk)
**Professor Daryl O'Connor** - Co-Supervisor (d.b.o'connor@leeds.ac.uk)

*You are being invited to participate in a research project run by a postgraduate researcher from the School of Music at the University of Leeds. Below you are provided with information about the study - if you are unclear about anything or need further information, feel free to contact the researcher.*

**What is the purpose of the project?**
The purpose of this PhD research project is to investigate alternative interventions for anxiety, with a focus on imagery-based activities.

**Do I have to take part?**
It is not compulsory to take part in this study; therefore, it is up to you to decide whether you want to or not. If you choose to take part, you will be sent a consent form to read through and sign for the researcher to obtain your written consent. You should be aware that you can withdraw from participating in this study and your data from when you give your consent to take part, to one month after you have completed the study.

**What do I have to do?**
This study will last for approximately three weeks - please note that you will **NOT** be completing study activities on every day during that time frame. Over the course of the study you will be asked to answer questions relating to previous and current experiences of anxiety and depression and practise a verbal task and deliberately imagining music. Additionally, you will be prompted to complete these activities and short questions about those attempts at random points over six days, then you will be interviewed about your study participation. A brief description of what will happen is outlined below:

Stage 1: Day 1 - takes place at the University of Leeds (lasts approximately 45 mins - 1 hour)
- Practise a verbal task and deliberately imagining music.

Stage 2: Days 2 - 7 - completed wherever you are when you receive the activity instructions (lasts approximately 35 minutes per day)

- Practise deliberately imagining music or completing the verbal task for short durations (2 minutes) when randomly contacted via text message and answer brief questions about each attempt on your phone. (The 35 minutes per day represent a total from multiple short contact questions).

Stage 3: Day 21 - takes place at the University of Leeds (lasts approximately 15 minutes)
- Answer questions about your general experience of anxiety.
- Interviewed about study participation.

***Please be aware that you will not be required to do anything between days 8 and 20***

**Where will this research take place?**
It will mainly take place at the University of Leeds on days 1 (stage 1) and 21 (stage 3), but for days 2 to 7 (stage 2), it will occur wherever you are at that moment in time.

**What are the possible disadvantages and risks of taking part?**
Taking part may be deemed as time consuming and being asked to complete the study activities via text messages could be slightly intrusive.

**What are the possible benefits of taking part?**
The data that will be collected due to your participation will contribute towards the development of an alternative intervention for anxiety. Additionally, participants will be entered into a prize draw to have a chance of winning £40 for participating, unless they are psychology undergraduate students at the University of Leeds - they will receive 6 course credits.

**Will my taking part in this project be kept confidential?**
Yes.

**Will I be recorded, and how will the recorded media be used?**
Yes, you will be audio recorded during the interview in stage 3. The main researcher will be the only person to have access to these recordings.

**As you will be asked questions relating to mental well-being, specifically anxiety and depression, the following websites might be of interest if you would like to seek support. Please note that you do not have to answer any questions that you might deem to be upsetting.**

www.mind.org.uk
https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/

**For further information about the study, please contact any of the researchers listed above.**

## G.7 Consent form

The consent form for the VMI intervention study.

UNIVERSITY OF LEEDS

School of Music
Faculty of Arts, Humanities and Cultures

**Consent form**
Musical and verbal interventions for anxiety

**Identity of researchers:**
**Michelle Ulor** – Postgraduate researcher (mcmu@leeds.ac.uk)
**Dr. Freya Bailes** – Supervisor (f.bailes@leeds.ac.uk)
**Professor Daryl O'Connor** - Co-Supervisor (d.b.o'connor@leeds.ac.uk)

**Please read through the points below and mark the box with X if you agree:**

1. I confirm that I have read the information sheet for this project. I have a clear understanding of what it is about and have been able to ask the researcher questions if I had any, which were answered to a suitable level. ☐

2. I am aware that my participation is voluntary, and I can withdraw:
a) from participating in the study at any point without having to give a reason for my actions. ☐

And

b) my data from this study before it gets submitted for publication. ☐

3. I understand that my responses will be anonymous and none of my personal details will be presented in any reports or articles after the study has been conducted. ☐

4. I understand that the information collected from me will be used as part of a PhD research project and I agree for my data collected to be used in future research. ☐

5. I understand that I can withdraw my data from this research up to one month after participation. ☐

6. I am aware that I will be audio recorded in some parts of this study and give my permission for this. ☐

7. I agree to take part in this research project. ☐

| ______________________ | ________________ | ________________ |
|---|---|---|
| *Name of participant* | *Date* | *Signature* |
| ______________________ | ________________ | ________________ |
| *Lead researcher* | *Date* | *Signature* |

## G.8 Anonymisation identification document

The anonymous ID document for the VMI intervention study.

**Anonymous ID form**

Musical and verbal interventions for anxiety

**Anonymous ID:** _ _ _ _ _ _

Please write down your birth month (2 digits), the first two letters of your favourite food and the first two letters of your favourite subject at school in the space above.

Example: Participant X, born 05/05/1998, favourite food is pasta and their favourite subject at school was Geography – Anonymous ID: 05PAGE

Please provide the following details below:

Mobile phone number: ……………………………………………………………………………
Age: ………………………………………………………………………………………….
Gender: ……………………………………………………………………………………

## G.9 Music selection criteria form

The music selection criteria form for the VMI intervention study.

**Selection criteria for music**

Musical and verbal interventions for anxiety

As part of this study, it is a requirement for participants to select their own piece of music to use. It is important that this music piece fits specific selection criteria to be deemed as suitable for this study. If not, you will be asked to select another piece.

**You should:**

1. Like the piece of music a lot.
2. Be extremely familiar with this piece of music.
3. Feel happy after listening to the piece.
4. Have no specific memories associated with this piece of music.

Answer the questions below.

**The piece of music you select must not be longer than 3 minutes.**

**Piece of music**

Song name: ………………………………………………………………………………..

1. On a scale from 1 **(Not at all)** to 10 **(Extremely)**, how much do you like this piece of music?

1….  2….  3....  4….  5….  6….  7….  8….  9….  10….

2. On a scale from 1 **(Not very familiar)** to 10 **(Extremely familiar)**, how familiar are you with this piece of music?

1….  2….  3....  4….  5….  6….  7….  8….  9….  10….

3. On a scale from 1 **(Not very happy)** to 10 **(Extremely happy)**, how happy does this piece of music make you?

1….  2….  3....  4….  5….  6….  7….  8….  9….  10….

4. Do you have any specific memories associated with this piece of music? Circle your response below.

a) Yes
b) No

## G.10 Anxiety and depression diagnoses questions

The anxiety and depression diagnoses questions for the VMI intervention study.

Anxiety

4. Have you ever been diagnosed with an anxiety disorder?
i) Yes
ii) No

a) If the answer to the previous question is yes, please state the type of anxiety disorder. If no, move on to question 5.

b) When did you receive this diagnosis?

c) Do you still have this disorder?

Depression

7. Have you ever been diagnosed with an anxiety disorder?
i) Yes
ii) No

a) If the answer to the previous question is yes, when did you receive this diagnosis? If no, move on to question 8.

b) Is your depression still present?

## G.11 Debrief form

The debrief form for the VMI intervention study.

**Debrief Form**

Musical and verbal interventions for anxiety

**Date of ethical approval:**
18/03/2019

**Identity of researchers:**
Michelle Ulor (Postgraduate researcher - University of Leeds)
Dr. Freya Bailes (Project Supervisor - University of Leeds)
Professor Daryl O'Connor (Project Co-supervisor - University of Leeds)

**Thank you for taking part in this study, your contribution is greatly appreciated.**

**Purpose of the study:**
The purpose was to study the effect of voluntary musical imagery on the reduction of anxiety, as well as extra measures such as depression and mood, as I am interested in developing an alternative music intervention for anxiety, with specific focus on voluntary musical imagery (the act of purposely imagining music in the mind).

**Procedure:**
This study involved the participants deliberately imagining of music and completing the verbal fluency task (which was the control activity) on day 1, followed by prompts from the main researcher to practise these activities over days 2 to 7 (whilst answering questions about each attempt). Measures of general anxiety and depression experiences were taken before the main study activities on day 1 and after on day 8. Two weeks later, follow-up assessments of trait anxiety were taken, and the participants were interviewed about their study participation.

**Please note that your data will remain anonymous and will be used as part of my PhD research project. The data will also be made available to other researchers by inclusion in a data repository, but none of the data that will be available to view will contain any of your personal details, nor will it allow for you to be recognised. If you would like to withdraw your data at any given time, you are free to do so up until one month after your participation.**

**As you were asked questions relating to mental well-being, specifically anxiety and depression, the following websites might be of interest if you would like to seek support.**
www.mind.org.uk
https://www.nhs.uk/conditions/stress-anxiety-depression/mental-health-helplines/

**Contact:**
If you need to contact any the researchers involved in this project at any point, you can do so via the email addresses below:

Michelle Ulor (mcmu@leeds.ac.uk)
Dr. Freya Bailes (f.bailes@leeds.ac.uk)
Professor Daryl O'Connor (d.b.o'Connor@leeds.ac.uk)

## G.12 Six-item short-form State-Trait Anxiety Inventory (STAI-6; Marteau & Bekker, 1992)

The STAI-6 questions used in the VMI intervention study.

Using the items below, select a response that matches how you are feeling right now. Please ensure that only one response is selected per row.

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| Not at all | Somewhat | Moderately | Very much |

1. I feel calm.
2. I am tense.
3. I feel upset.
4. I am relaxed.
5. I feel content.
6. I am worried.

## G.13 Music identity questions

The music identity questions used in the VMI intervention study.

Below are a set of questions about your previous and current music engagement. Please select the most appropriate answers.

10. Are you a musician?
- Yes
-No

11. Have you ever been a previous music student?
- Yes
- No

12. Are you a current music student?
- Yes
- No

13. Have you received six or more years of formal music training?
- Yes
- No

## G.14 Experience Sampling Method questions (Voluntary musical imagery and verbal fluency task)

ESM questions for the VMI and VFT tasks in the VMI intervention study, for instances where participants are prompted and not prompted to complete those activities.

**VMI questions**

Prompted to complete activity

1. On a scale from 1 **(Not very anxious)** to 9 **(Extremely anxious)**, how anxious are you right now?
1… 2… 3… 4… 5… 6… 7… 8… 9…

2. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult was it to imagine this piece of music?
1…. 2…. 3…. 4…. 5…. 6…. 7…. 8…. 9…. 10….

3. On a scale from 1 **(Greatly reduced)** to 9 **(Greatly increased)**, how has imagining music affected your positive mood?
1… 2… 3… 4… 5… 6… 7… 8… 9…

3.a) Can you explain why?

4. On a scale from 1 **(Greatly reduced)** to 9 **(Greatly increased)**, how has imagining music affected your negative mood?
1… 2… 3… 4… 5… 6… 7… 8… 9…

4.a) Can you explain why?

5. Using the items below, select a response that matches how you are feeling right now after deliberately imagining music?

| | Not at all | Somewhat | Moderately | Very much |
|---|---|---|---|---|
| I feel calm | 1 | 2 | 3 | 4 |
| I am tense | 1 | 2 | 3 | 4 |
| I am upset | 1 | 2 | 3 | 4 |
| I am relaxed | 1 | 2 | 3 | 4 |
| I feel content | 1 | 2 | 3 | 4 |
| I am worried | 1 | 2 | 3 | 4 |

6. On a scale from 1 **(Not very anxious)** to 9 **(Extremely anxious)**, how anxious are you right now after imagining this piece of music?
1… 2… 3… 4… 5… 6… 7… 8… 9…

Not prompted to complete activity

1. Using the items below, select a response that matches how you are feeling right now.

| | Not at all | Somewhat | Moderately | Very much |
|---|---|---|---|---|
| I feel calm | 1 | 2 | 3 | 4 |
| I am tense | 1 | 2 | 3 | 4 |
| I am upset | 1 | 2 | 3 | 4 |
| I am relaxed | 1 | 2 | 3 | 4 |
| I feel content | 1 | 2 | 3 | 4 |
| I am worried | 1 | 2 | 3 | 4 |

2. a) Have you deliberately imagined music since the last point of contact to help cope with any anxiety? **If no, move onto question 3a.**
   i) Yes
   ii) No

   b) If yes, how many times did you deliberately imagine music since the last point of contact? **If no, move onto the next question.**

   c) Have you heard this piece of music out loud since the last point of contact?
   i) Yes
   ii) No

3. a) Did you spontaneously imagine music since the last point of contact?
   i) Yes
   ii) No

   b) If yes, have you heard this piece of music out loud since the last point of contact?
   i) Yes
   ii) No

4. a) Did you notice a change in your anxiety after deliberately or spontaneously imagining music? Please select one option below (if your answer is yes, choose from deliberately or spontaneously)
   i) Yes
   - Deliberately
   - Spontaneously

   ii) No

   b) If the answer to the previous question is yes, how would you describe the change in your anxiety?
   i) Increase in anxiety
   ii) No change in anxiety
   iii) Reduction in anxiety

**VFT questions**

<u>Prompted to complete activity</u>

1. On a scale from 1 **(Not very anxious)** to 9 **(Extremely anxious)**, how anxious are you right now?

1…  2…  3…  4…  5…  6…  7…  8…  9…

2. On a scale from 1 **(Not very difficult)** to 10 **(Extremely difficult)**, how difficult was it to think of these words?
1…. 2…. 3…. 4…. 5…. 6…. 7…. 8…. 9…. 10….

3. On a scale from 1 **(Greatly reduced)** to 9 **(Greatly increased)**, how has thinking of these words affected your positive mood?
1… 2… 3… 4… 5… 6… 7… 8… 9…

3.a) Can you explain why?

4. On a scale from 1 **(Greatly reduced)** to 9 **(Greatly increased)**, how has thinking of these words affected your negative mood?
1… 2… 3… 4… 5… 6… 7… 8… 9…

4.a) Can you explain why?

5. Using the items below, select a response that matches how you are feeling right now after completing the verbal fluency task?

| | Not at all | Somewhat | Moderately | Very much |
|---|---|---|---|---|
| I feel calm | 1 | 2 | 3 | 4 |
| I am tense | 1 | 2 | 3 | 4 |
| I am upset | 1 | 2 | 3 | 4 |
| I am relaxed | 1 | 2 | 3 | 4 |
| I feel content | 1 | 2 | 3 | 4 |
| I am worried | 1 | 2 | 3 | 4 |

6. On a scale from 1 **(not very anxious)** to 9 **(extremely anxious)**, how anxious are you right now after thinking of these words?
1… 2… 3… 4… 5… 6… 7… 8… 9…

<u>Not prompted to complete the activity</u>

1. Using the items below, select a response that matches how you are feeling right now.

| | Not at all | Somewhat | Moderately | Very much |
|---|---|---|---|---|
| I feel calm | 1 | 2 | 3 | 4 |
| I am tense | 1 | 2 | 3 | 4 |
| I am upset | 1 | 2 | 3 | 4 |
| I am relaxed | 1 | 2 | 3 | 4 |
| I feel content | 1 | 2 | 3 | 4 |
| I am worried | 1 | 2 | 3 | 4 |

2. a) Have you completed the verbal fluency task since the last point of contact?
   i) Yes
   ii) No

b) If the answer the previous question is yes, how many times did you complete the verbal fluency task since the last point of contact **If no, move onto the next question.**

3. a) Did you notice a change in your anxiety after completing the verbal fluency task? Please select one option below:
   i) Yes
   ii) No

b) If yes, how would you describe the change in your anxiety?
   i) Increase in anxiety
   ii) No change in anxiety
   iii) Reduction in anxiety

## G.15 Anxiety and mood questions (Start and end of the day)

Anxiety and mood rating questions given to the participants at the start and end of each ESM day in the VMI intervention study.

Start of the day

**Anxiety**

5. On a scale from 1 **(Not very anxious)** to 9 **(Extremely anxious)**, please indicate how anxious you feel overall at the start of this day.

1 2 3 4 5 6 7 8 9

Not very anxious

Extremely anxious

**Mood**

6. On a scale from -4 **(Extremely negative)** to +4 **(Extremely positive)**, please indicate your overall mood for the start of this day.

-4 -3 -2 -1 0 +1 +2 +3 +4

Extremely negative

Extremely positive

End of the day

**Anxiety**

5. On a scale from 1 **(Not very anxious)** to 9 **(Extremely anxious)**, please indicate how anxious you feel overall at the end of this day.

1 2 3 4 5 6 7 8 9

Not very anxious

Extremely anxious

**Mood**

6. On a scale from -4 **(Extremely negative)** to +4 **(Extremely positive)**, please indicate your overall mood for the end of this day.

-4 -3 -2 -1 0 +1 +2 +3 +4

Extremely negative

Extremely positive

## G.16 Interview questions

The interview questions for the VMI intervention study.

**Interview questions**

**Voluntary use of study activities for anxiety reduction during stages 2 (ESM) and 3 (follow-up assessment)**

1. Have you voluntarily imagined music, or done the verbal fluency task over the last two weeks between our last contact and today?
   ***If a participant used both, ask whether they noticed if one was used more than the other***

   - What can you remember about your reasons for this?

   - Can you describe how this activity affected any feelings of anxiety, if at all?

   - If you did not continue using either of these activities, can you explain why?
   ***Ask this question if the participant did not use either of those activities between the two-week gap***

**General use of study activities for anxiety reduction (voluntary musical imagery vs verbal fluency task)**

2. Did you prefer using voluntary musical imagery or the verbal fluency task for anxiety reduction during this study?
   - Why do you think that is?

3. What is the likelihood of using either of these activities (voluntary musical imagery or the verbal fluency task) to reduce your anxiety in the future?
   - Can you describe how you would use this method? For example, would you use it whilst you were experiencing anxiety, or would you use it in a pre-emptive manner?

4. Can you discuss whether you would recommend any of the study activities for anxiety reduction to other people?
   - Can you explain why?

   ***Only ask this question if the participant selects one of the activities, and not both***
   - Can you explain why you would not recommend the other activity?

   ***Only ask this question if the participant selects NONE of the activities, and not both***
   - If you would not recommend either activity, can you explain why?

5. Let's think back to the six days where you received eight texts a day and were instructed to either voluntarily imagine music or complete the verbal fluency task.

(Individualised questions are formulated based on the participants' responses to questions in the ESM section).

**Use of voluntary musical imagery in general**

6. Before participating in this study, can you describe any instances where you voluntarily imagined music for a specific reason?
7. How do you think this study might have affected your decision to voluntarily imagine music in the future?
   - Can you discuss the reason behind this?

**Extra**

8. Are there any other comments you would like to add?

## G.17 List of participant-selected songs

Below is a list of the songs the participants chose to use for the VMI intervention study.

Amy Macdonald - This Time's Everything
Angèle - Balance Ton Quoi
Aries - CAROUSEL
B Witched - C'est La Vie
Beach Boys - Wouldn't It Be Nice
Bebe Rexha feat. Florida Georgia Line - Meant To Be
Ben E. King - Stand By Me Stand
Bethany Wohrle - Worthy of It All
Billie Eilish - ilomilo
Blossoms - Charlemagne
Boards of Canada - Roygbiv
Bobby - Runaway
Busted - Year 3000
Christina Aguilera - Show Me How You Burlesque
DAY6 - Shoot Me
DJ Jayhood - Hands On Ya Hips (feat. Adolf Joker)
Dj "S" - 3 Minutes of Smooth Jazz
Dominic Fike - 3 Nights
Drake - Energy
Ed Sheeran - Bibia Be Ye Ye
Elvis Presley - Can't help falling in love with you
Faithless - Baseball Cap
Faze Miyake - Boom Instrumental
Fleet Foxes - Tiger Mountain Peasant Song
Gil Scott-Heron - On Coming From A Broken Home Pt 1.
Good Riddance - Time Of Your Life
Greyson Chance - Shut Up
J Dilla - Don't Cry
James Hype feat. Craig David - No Drama
Jersey Boys Soundtrack - Who Loves You
Josh Dillan, Lily James & Hugh Skinner - Why Did It Have To Be Me?
Kate Bush - Violin
Kaytranada - At all
Khalid feat. SAFE - Don't Pretend
Kittens feat. Flipp Dinero & Kollision - To Light
Lindisfarne - Meet Me On The Corner
Little Birdie - Roscoe Holcomb
Lonely - Innocent Man Nice Guy
Louis Armstrong - What A Wonderful World
Loyle Corner - Damselfly (x2)
Madison McFerrin - No Time To Lose
Meduza feat. Goodboys - Piece Of Your Heart
My Little Airport - 介乎法國與旺角的詩意
Panic! At The Disco - High Hopes (Short Version)

Paolo Nutini - Pencil Full Of Lead
Para One - Girlhood
Pedro Capo - Calma
Sfire - Sfire 7
Skepta feat. Nafe Smallz - Greaze Mode
Sophie Grips - OOPS! Takyon
Spice Girls - Wannabe
Sting - Shape Of My Heart
Stormzy - Cold
Teyana Taylor - Gonna Love Me (K.T.S.E.)
The Beatles - Penny Lane
The Moldy Peaches - Anyone Else But You
The Supremes  - You Can't Hurry Love
Thurston Harris - Little Bitty Pretty One
Victoria Acosta - Could this be Love
Yellow Claw & Yung Felix - Dancefloor Champion
好像掉进爱情海里 - It Seems to Fall Into The Sea of Love
茉莉花 - Mo Li Hua (Jasmine Flower)

## G.18 Email instructions at the end of stage one

Email instructions given to the participants at the end of stage one in the VMI intervention study.

Dear Participant X,

Tomorrow is the last day where you will be contacted at 8 random points between 8am and 8pm via text message, therefore it is necessary for you to keep your phone and a pair of headphones by your side at all times during this specified time frame. Each time you receive a text message, there will be a link for you to follow. Click on this link and read the instructions.

If you have any questions, let me know.

Kind Regards,
Michelle Ulor

## G.19 Experience Sampling Method text message content

Example of the text message content received on one of the ESM days in the VMI intervention study. All of the text messages followed the same layout, except the website link was changed accordingly.

Text message ONE: https://leeds.onlinesurveys.ac.uk/well-being-start-5_
Text message TWO: https://leeds.onlinesurveys.ac.uk/day5_contact1
Text message THREE: https://leeds.onlinesurveys.ac.uk/day5_contact2
Text message FOUR: https://leeds.onlinesurveys.ac.uk/day5_contact3
Text message FIVE: https://leeds.onlinesurveys.ac.uk/day5_contact4
Text message SIX: https://leeds.onlinesurveys.ac.uk/day5_contact5
Text message SEVEN: https://leeds.onlinesurveys.ac.uk/day5_contact6
Text message EIGHT: https://leeds.onlinesurveys.ac.uk/well-being-end-5_