Imagery and Music Performance Anxiety in Elite Musicians

by

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Statement of Contributions

Katherine Finch was the sole author of the General Introduction and the General Discussion, which were written under the supervision of Dr. Jonathan Oakman and were not written for publication. However, parts of the General Introduction were included with our submission of Study 3.

This thesis consists in part of three manuscripts written for publication. Each manuscript was based on originally collected data. Katherine Finch was responsible for conceptualizing study designs, carrying out data analyses, and drafting and submitting manuscripts. Data was collected by Katherine Finch. As co-author and supervisor, Dr. Jonathan Oakman contributed intellectual input on study design and analyses, providing feedback and editing each manuscript.

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Abstract

Many musicians experience music performance anxiety (MPA) regardless of their level of expertise (Fernholz et al., 2019) and based on the level of distress and impairment it causes, MPA can be diagnosed as performance-only social anxiety disorder (SAD) (American Psychiatric Association, 2022). However, important phenomena theorized to fuel social anxiety, such as negative spontaneous self-imagery (NSI), have not been studied in musicians or integrated into existing MPA theory which might limit our conceptualization and treatment of this concern. Due to the distress and impairment associated with MPA, different treatments have been developed, many of which integrate intentional mental imagery manipulation to ameliorate anxiety (e.g., relaxation imagery). However, it is difficult to draw a clear picture regarding whether certain approaches (e.g., relaxation imagery) are more helpful than others due to methodological limitations of existing imagery-based MPA intervention research. Importantly, little is known about how musicians engage in mental imagery to manage MPA independent of existing intervention research, which could guide future imagery-based MPA research (e.g., examination of commonly used approaches). Thus, we conducted a series of studies to extend our understanding of musicians' experiences along the imagery continuum (i.e., spontaneously experienced to intentionally generated) as they relate to MPA to inform future MPA theory, research, and treatment.

In Study 1, we followed elite musicians ($N = 40$) for 7 days leading up to an important anxiety-provoking performance of their choice. After completing an initial battery of questionnaires including a measure of trait MPA, musicians completed nightly measures of NSI and state MPA. We theorized that similar to those with SAD, musicians would experience NSI related to musical performances, and that this phenomenon would be positively associated with

the intensity with which musicians experience trait and state MPA. Consistent with our predictions, we found that NSI was highly prevalent amongst elite musicians. At the between-person level, musicians who experienced more frequent NSI also had higher trait MPA and state MPA intensity. Multi-level analyses further allowed us to explore the association between NSI and state MPA intensity at the within-person level amongst those who experienced NSI, and we found that state MPA intensity was significantly higher on days where musicians experienced NSI compared to days when they did not.

Building on these findings and using the same methodology and participant data, Study 2 investigated the association between NSI and additional variables important to the conceptualization of MPA, including state MPA interpretation (i.e., whether musicians interpret anxiety as helpful or harmful to performances) and self-confidence. Contrary to our hypotheses, we did not find an association between NSI and these variables at the between-person level. However, on average within-person, we found that self-confidence was significantly lower on days where musicians experienced NSI than on days when they did not, although a similar association did not emerge between NSI and state MPA interpretation. Taken together, Studies 1 and 2 indicate that cognitive theoretical models of SAD may be more applicable to MPA than previously thought (Osborne & Franklin, 2002), as an important phenomenon theorized to fuel social anxiety is associated with increased state MPA intensity and decreased self-confidence in anticipation of important anxiety-provoking performances. Further, similar to those with other forms of social anxiety, musicians experiencing MPA may benefit from imagery-enhanced cognitive behavioural therapy for SAD which specifically targets NSI to ameliorate anxiety.

In Study 3, we turned our attention to the use of intentionally generated imagery to manage MPA. To lay important groundwork for future research, Study 3 investigated how elite

musicians ($N = 25$) employ mental imagery to manage MPA, and whether they experience difficulty controlling such imagery through a semi-structured interview and Likert-style rating scales. Thematic analysis revealed that musicians engage in a variety of imagery approaches (e.g., mental rehearsal, relaxation) to manage MPA, several of which are similar to approaches in existing intervention research. Although musicians reported a high degree of overall control of intentionally generated imagery to manage MPA, themes emerged regarding difficulties which musicians experience controlling such imagery. Thus, our findings have implications for future MPA research, as well as clinical implications regarding the use of mental imagery to manage MPA.

We conclude with a summary of our results, provide an overview of clinical implications of our novel findings, outline limitations of our program of research, and suggest directions for future research in this important area.

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General Introduction

Music Performance Anxiety

Music performance anxiety (MPA) can make it difficult for musicians to perform at their best (Papageorgi et al., 2013; Passarotto et al., 2023; Wan & Huon, 2005; Wesner et al., 1990). Prevalence estimates vary widely, yet research suggests that MPA is a common concern impacting between 16.5% to upwards of 60% of professional musicians (Fernholz et al., 2019). MPA is commonly defined as, "The experience of marked and persistent anxious apprehension related to musical performance […] manifested through combinations of affective, cognitive, somatic, and behavioural symptoms" (Kenny, 2010, p.433). Indeed, MPA impacts musicians in a variety of ways, including worried thoughts about performances (Kenny & Osborne, 2006), elevated heart rate, muscle tension (Guyon et al., 2020), and avoidance of performing (van Kemenade et al., 1995), causing some to leave the profession (Kenny, 2010). Studies investigating MPA at different timepoints (e.g., immediately before, during, and after performances) indicate that it peaks in anticipation of performing (Abel & Larkin, 1990; Papageorgi et al., 2013), although some musicians continue to experience high levels of MPA while performing (Spahn et al., 2021).

Music Performance Anxiety Models

Numerous models of MPA have been developed to delineate factors related to its etiology and maintenance (Kenny, 2010; Osborne & Franklin, 2002; Osborne & Kirsner, 2022; Papageorgi et al., 2007; Wilson, 2002). Anxiety-performance theory (i.e., how anxiety impacts motor performance) has been incorporated into many MPA models due to the complexity of fine and gross motor skills required to perform a musical instrument under performance stress. For example, Wilson (2002) applied and extended the well-known Yerkes-Dodson law (1908) and

developed a three-dimensional model of MPA, which theorizes that MPA has a facilitative or debilitative impact on musical performance based on an interaction between trait anxiety, situational stress, and task mastery (i.e., of a piece of music). Building on this work, Papageorgi and colleagues (2007) developed a conceptual model of MPA in which three components are theorized to interact to form a musician's cognitive appraisal of the performance situation, including factors related to a person's susceptibility to MPA (e.g., trait anxiety), task efficacy, and the performance environment (e.g., solo or group). A musician's cognitive appraisal of the performance situation then interacts with their level of physiological arousal immediately preceding a performance, with perceptions regarding control over physiological arousal resulting in adaptive or maladaptive MPA, further impacting performance outcomes.

Most recently, Osborne and Kirsner (2022) outlined a developmental model of MPA which focuses on the anxiety-performance relation. In this model, memories of early traumatic performance experiences are theorized to interact with maladaptive schemas (e.g., negative core beliefs) and low self-efficacy (i.e., for specific performances), influencing cognitions about the likelihood and outcome of negative evaluation when musicians encounter highly evaluative performance situations. Further, during such performances, changes to musicians' physiology and attention result in degraded performance, which can further fuel MPA depending on their responses (i.e., use of coping strategies or disengagement from and avoidance of performing).

Although not an MPA model per se, multidimensional anxiety theory (MAT) has been investigated in musicians and further delineates the anxiety-performance relation (Martens et al., 1990). MAT suggests that cognitive anxiety has a negative linear relation with performance, while somatic anxiety has a curvilinear relation with performance (Martens et al., 1990), and these facets of anxiety are thus measured separately in much of the performance literature (e.g.,

Yoshie et al., 2009). Jones and Swain (1992) further argued that performers' interpretations of cognitive and somatic anxiety as either hindering or helping performance should be measured, to allow for the fact that not all performers perceive anxiety as debilitative to performance (e.g., Jones et al., 1994; Mellalieu et al., 2009).

Indeed, empirical findings suggest that many of the components outlined in these models are associated with MPA. For instance, trait anxiety is strongly associated with MPA (Cox & Kennardy, 1993; Osborne & Kenny, 2005), MPA increases with the presence of an audience (Studer et al., 2014), and solo performance situations elicit the highest levels of MPA (Cox & Kenardy, 1993; Fehm & Schmidt, 2006; Nicholson et al., 2015; Papageorgi et al., 2013). Further, MPA and self-efficacy are negatively associated (Zelenak, 2024). Due to the fine motor control required to perform a musical instrument in socially stressful performance situations, musicians can also become sensitized towards heightened physiological responses, further fueling MPA (Osborne & Kirsner, 2022). Indeed, cognitive and physiological manifestations of MPA are at least partially independent (Craske & Craig, 1984; Studer et al., 2014), emphasizing the important role of musicians' interpretations of their physiological symptoms in the maintenance of this concern. However, anxiety can facilitate performance in those with high task mastery (Hamann & Sobaje, 1983), and not all musicians who experience MPA interpret it as debilitative to performing (see Herman & Clark, 2023 for a review). Thus, MPA-specific and related models highlight the complexity of MPA as factors including different facets of anxiety (i.e., cognitive and somatic anxiety intensity as well as their interpretation), trait MPA, task mastery, self-efficacy, and the performance environment, as well as their interactions are theorized to contribute to and maintain this concern.

Distressing and impairing MPA can also be diagnosed as performance-only social anxiety disorder (SAD) (American Psychiatric Association, 2022) and factors important to the conceptualization of SAD may also enrich our understanding of MPA. For instance, SAD is characterized by a fear of negative evaluation (FNE) in social situations, and fear concerning the consequences and likelihood of negative evaluation for solo performances (Osborne & Franklin, 2002) as well as FNE in a variety of settings (e.g., practice, group, and solo performances) significantly predict MPA (Nicholson et al., 2015). Indeed, several studies have found that musicians experience clinical levels of social anxiety (Barbar et al., 2014; Cox & Kenardy, 1993; Osborne & Franklin, 2002).

It is important to note that there are elements which differentiate MPA from other forms of social anxiety (e.g., social interaction or speech anxiety), such as the complexity of performing a fine motor task under performance stress. Further, not all musicians identify fears related to MPA (e.g., being judged negatively by an audience) as irrational, due in part to the high performance standards in many domains of music (e.g., classical music) (McGinnis & Milling, 2005). Despite these differences, several important factors implicated in the maintenance of SAD (e.g., negative self-imagery) have not been studied to date in musicians or integrated into existing models of MPA and addressing these gaps in the literature could have important implications for our conceptualization and treatment of MPA.

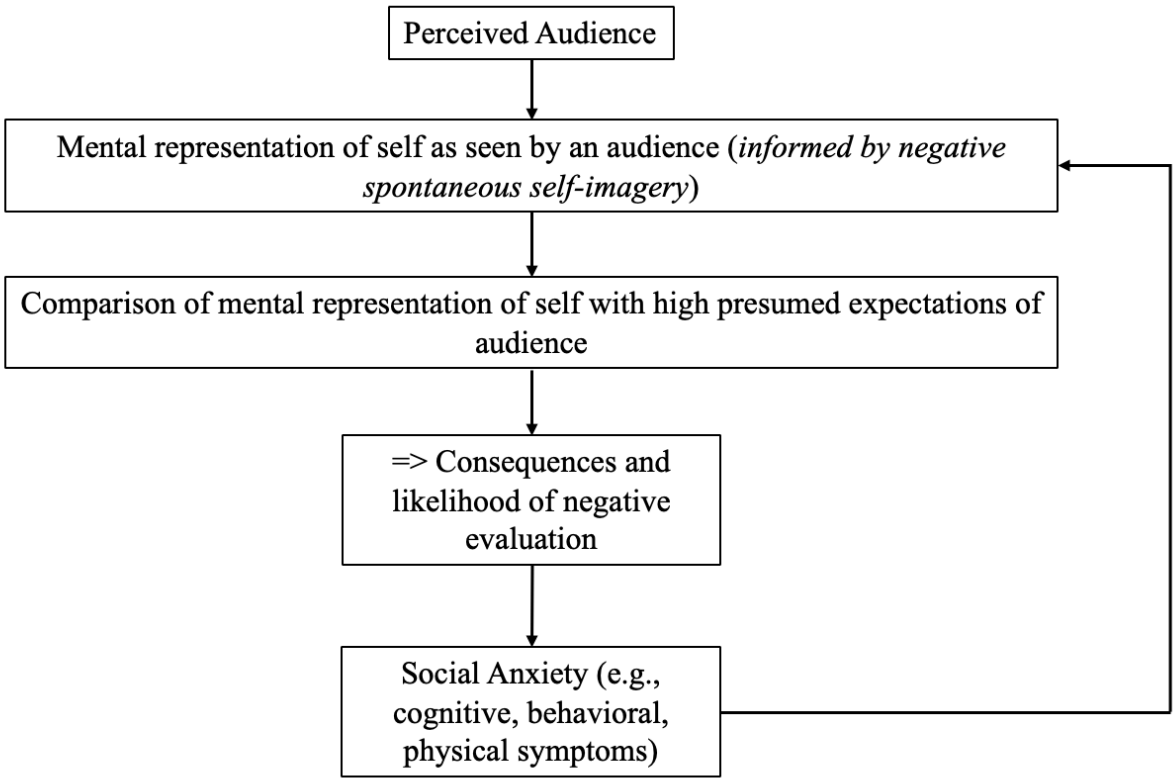
Cognitive Theoretical Models of Social Anxiety Disorder

Numerous cognitive theoretical models of SAD suggest that negative spontaneous self-imagery (NSI) is one factor which maintains the disorder (e.g., Clark & Wells, 1995; Heimberg et al., 2010, 2014; Hofmann, 2007; Rapee & Heimberg, 1997). Such images reflect individuals' social fears (e.g., embarrassing oneself; Ng et al., 2014), are often recurrent, experienced from an

observer's perspective (Dobinson et al., 2020), and relate to early socially traumatic or aversive memories (Dobinson et al., 2020; Hackmann et al., 2000). Rapee and Heimberg's original (1997) and updated (Heimberg et al., 2010, 2014) models suggest that when individuals anticipate, experience, or retrospectively think about social threat, their fear of negative evaluation leads them to turn their attention to sources of external (e.g., others' facial expressions) and internal (e.g., heart racing) threat in their environment. Additionally, when faced with social threat, socially anxious individuals experience exaggerated NSI which reflects how they believe others view them, combining information from external cues (e.g., others' facial expressions), long term memory (e.g., past negative experiences), as well as interoceptive experiences (e.g., racing heart) (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997). Such exaggerated negative self-imagery is discrepant from the high standards that socially anxious individuals believe others hold for their behaviour (e.g., in a performance or social encounter), contributing to fears about the likelihood and consequences of negative evaluation, manifestations of social anxiety (e.g., cognitive, behavioural), and post-event processing of social situations (i.e., ruminating about social performance or interactions), all of which reinforce social anxiety. Thus, NSI is an important factor theorized to contribute to the central discrepancy outlined in the model (i.e., between how socially anxious individuals think others view them, and the high standards which they believe others hold for their behaviour), thereby fueling anxiety. See Figure 1 for a simplified cognitive model of SAD which outlines the role of NSI in the discrepancy theorized to fuel social anxiety.

Figure 1

Simplified Cognitive Theoretical Model of Social Anxiety Disorder



Note. This simplified model is intended to outline the role of NSI in fueling the discrepancy central to cognitive theoretical models of SAD (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997).

Negative Spontaneous Imagery in Social Anxiety Disorder

Consistent with cognitive theoretical models of SAD, many individuals with clinical social anxiety experience NSI. For instance, Hackmann and colleagues (2000) found that all of the socially phobic participants in their study ($N = 22$) experienced NSI. Further, research in clinical samples suggests that those with SAD experience more negative observer perspective self-images of socially stressful situations than healthy controls (Coles et al., 2001; Hackmann et al., 1998; Wells et al., 1998) and those with non-social clinical disorders such as blood or injury phobias (Wells & Papageorgiou, 1999). Analogue research has found that even those with low

social anxiety experience NSI, with some research indicating that this phenomenon is more prevalent in those with high as compared to low social anxiety (Chiupka et al., 2012)[1], while other research has found similar prevalence rates (Moscovitch et al., 2011). Although some differences have been reported regarding the prevalence of NSI in those with varying levels of social anxiety, it is clear that individuals experience NSI in relation to social stress. As such, future research should examine the prevalence and frequency with which musicians with varying levels of MPA experience NSI in relation to performing in order to increase our understanding of this phenomenon in musicians.

Current cognitive theoretical models also suggest that NSI will be more deleterious for those with higher levels of social anxiety (Ng et al., 2014). Indeed, some research suggests that NSI has a greater impact on negative schema concerning self (Chiupka et al., 2012), others, and the world (Moscovitch et al., 2011) for those with high as compared to low social anxiety. As such, NSI is one factor which appears to contribute to and reinforce negative schema fueling anxiety. However, holding a negative self-image in mind during a speech task increases anxiety and the perception that it is visible to a similar degree for those with low *and* high social anxiety compared to control (Makkar & Grisham, 2011) and positive images (Vassilopoulos, 2005). Further, for those with low public speaking anxiety, holding a negative self-image in mind before a speech task increases anxiety and the perception that it is visible significantly more than holding a positive image in mind (Hirsch, Mathews, et al., 2006). Although theory-driven predictions suggesting that NSI may be more deleterious for those with higher social anxiety are not uniformly substantiated by the empirical research reviewed above, NSI clearly impacts

[1] This effect was marginally significant.

anxiety and schema.[2] Thus, future MPA research should investigate the association between NSI and trait MPA and the intensity with which musicians experience state MPA to inform future MPA research and theory. Further, as we have reviewed, MPA specific and related models outline the importance of musicians' interpretations of state MPA (i.e., as helping or hindering performance) in the conceptualization of this concern. It is possible that musicians experiencing NSI (e.g., of themselves performing poorly, making mistakes, etc.) might interpret their state MPA as more debilitative to performing given the immersive nature of mental imagery (i.e., "hearing" and "seeing" themselves performing poorly). Thus, future research should also examine the association between NSI and musician's interpretations of state MPA (i.e., as helping or hindering performances).

Because of the central role of NSI in cognitive theoretical models of SAD and the important findings of empirical research reviewed above, it is curious that as noted, NSI has not been integrated into existing MPA models or examined in empirical research in musicians. This gap in the literature is particularly striking as the cognitive theoretical model of MPA (Osborne & Franklin, 2002) was informed by a study which examined the validity of conceptualizing MPA as a variant of social anxiety.

Cognitive Theoretical Model of Music Performance Anxiety

In a sample of musicians with varying levels of MPA and expertise, Osborne and Franklin (2002) assessed whether central components of Rapee and Heimberg's (1997) model of social anxiety predicted MPA.[3] Generalized fear of negative evaluation was measured (Leary,

[2] See Moscovitch et al. (2023) for a review of ways in which NSI differs between those with low and high social anxiety.

[3] Since this model was developed, Osborne and Kirsner (2022) have outlined a developmental model of MPA which delineates the anxiety-performance relation as previously reviewed. Aspects of this model are identical to the cognitive theoretical model of MPA, yet the visual figure which outlines the model is

1983), and a four-item measure, the Performance Perception Scales (PPS), was created to assess key components of the cognitive model of social anxiety. Participants read a brief performance vignette and were asked to rate perceived audience standards, perceived audience view of performance competence, as well as the likelihood and consequences of negative evaluation related to a specific solo performance. Although participants completed the PPS in response to an imagined performance, they were not specifically asked about experiences of NSI despite its crucial role in Rapee and Heimberg's (1997) model. The discrepancy central to the cognitive model of SAD theorized to fuel anxiety (i.e., between perceived audience standards and audience view of performance competence) was operationalized through a difference score between these items in their analyses, and the authors hypothesized that this discrepancy, as well as generalized fear of negative evaluation and each of the individual items on the PPS would predict MPA.

Contrary to their hypotheses, only the likelihood and consequences of negative evaluation related to a specific formal solo performance predicted MPA. Based on their findings, the authors argued that the discrepancy which fuels social anxiety may not be central to MPA, differentiating MPA from social anxiety. Instead, Osborne and Franklin (2002) propose that MPA is fueled by low self-efficacy which drives a discrepancy between how musicians think audiences perceive them and the high standards which musicians believe audiences hold for their performances. However, the authors did not comment as to whether NSI is implicated in any manner in the development and maintenance of MPA (e.g., such as self-imagery reflecting musicians' view of their own performance competence, or self-imagery reflecting failure to live

not elaborated by accompanying text in their paper and is thus less detailed than the cognitive theoretical model of MPA (Osborne & Franklin, 2002). As such, although Osborne and Kirsner's (2022) model is more recent and in part resembles the cognitive model of MPA, we chose to focus our research questions and situate our findings in reference to Osborne and Franklin's (2002) model.

up to audience standards). Although this study is an important contribution to the literature in terms of investigating MPA as a variant of social anxiety, it is important to consider several limitations associated with the study that informed the cognitive model of MPA. First, the authors did not include NSI in their operationalization of central elements of the Rapee and Heimberg (1997) model. Second, entering a single discrepancy score into analyses as a predictor of MPA is not recommended as it ignores the component measures which may bias findings (Edwards & Parry, 1993). Thus, important questions remain concerning whether key components of theoretical models of social anxiety may inform our conceptualization of MPA, and whether and how processes which maintain SAD are associated with MPA.

Due to the central role of self-efficacy in the cognitive theoretical model of MPA (Osborne & Franklin, 2002), future work should also examine whether and how NSI is associated with self-efficacy. Similar to processes outlined in existing cognitive theoretical models of SAD, NSI may contribute to the discrepancy outlined in the cognitive model of MPA. For instance, NSI (e.g., of mistakes or performing poorly) may lower self-efficacy, fueling a discrepancy between how musicians believe they come across to audiences, and the high standards that they believe audiences hold for their performances. Indeed, recent test anxiety research found that the relationship between self-efficacy and test anxiety was mediated by negative intrusive imagery (Maier et al., 2021). Further, meta-analytic findings indicate that there is a moderately negative association between MPA and self-efficacy, and a moderately positive association between self-efficacy and performance achievement (Zelenak, 2024), which is of utmost importance for musicians. Thus, understanding factors which may be associated with self-efficacy is an important direction for future research.

Last, theoretically informed imagery-enhanced CBT for SAD – which targets NSI – is an effective treatment for social anxiety (McEvoy et al., 2022; McEvoy & Saulsman, 2014) and musicians may similarly benefit from integrating CBT skills which target NSI related to performing (e.g., challenging negative cognitions *and* images about performing). Additionally, evidence-based strategies used to help rescript NSI might also help musicians. To this end, imagery re-scripting involves exposing individuals to negative socially traumatic memories or images and has been successfully incorporated in treatment protocols for CBT for social anxiety (McEvoy et al., 2022; McEvoy & Saulsman, 2014; Norton et al., 2021), and some research suggests that imagery re-scripting has a similar effect on social anxiety compared to cognitive restructuring (e.g., Norton & Abbott, 2016). Imagery re-scripting allows for new meaning to be developed in relation to socially traumatic memories and images (Arntz & Weertman, 1999; Romano et al., 2020, 2021) and is associated with decreased distress related to recurrent images (Nilsson et al., 2012) and decreased imagery vividness (i.e., related to NSI) (Lloyd & Marczak, 2022). Thus, in addition to laying groundwork for future MPA theory and research, our findings could have important treatment implications for musicians.

In sum, the first aim of our program of research was to investigate NSI in musicians, to inform future theory, research, and treatment. Specifically, our primary research questions included:

1. What is the prevalence and frequency with which elite musicians with varying levels of MPA experience NSI in anticipation of performing?
2. What is the association between NSI and trait MPA, as well as state MPA intensity and interpretation (i.e., as helping or hindering performance), and self-confidence in anticipation of performing in elite musicians?

Music Performance Anxiety Treatments

Given the negative impact that MPA can have on musicians as reviewed above, a number of treatment interventions have been developed to help musicians cope with MPA, ranging from cognitive-behavioural interventions (e.g., Braden et al., 2015), music therapy (Kim, 2008), mental skills training interventions adapted from sport psychology (e.g., Cohen & Bodner, 2019), and mindfulness and acceptance-based approaches (Juncos et al., 2017) to name a few (see Herman and Clark (2023) for a review). Further, approximately 30% of orchestral musicians take beta-blockers to manage MPA (Kenny et al., 2014). A detailed review of each is beyond the scope of the current research, yet it is difficult to reach consensus about the most effective treatments for MPA due to the methodological limitations of existing research (Fernholz et al., 2019; Herman & Clark, 2023).

However, intentionally generated mental imagery is one approach which is often integrated into existing MPA treatment interventions, and positive effects have been reported (Finch & Oakman, 2023). Indeed, musicians have long recognized the importance of mental imagery related to performance. For instance, eminent Canadian pianist Glenn Gould spoke about the importance of the "inner ear of imagination" for musicians (Gould, 1984 p. 7). Further, forming a mental representation of a musical score is an essential skill for classically trained musicians (Covington, 2005) and musicians are thus familiar with employing intentional imagery.

Intentional Mental Imagery

Mental imagery can be experienced through different senses and occurs when perceptual information is recalled from memory or combined in novel ways, giving rise to experiences such as "seeing with the mind's eye" or "hearing with the mind's ear" (Kosslyn et al., 2001). Mental

imagery is an immersive experience which shares properties with the stimuli being imagined. For instance, the early visual cortex is activated during visual imagery (Kosslyn et al., 1995), and auditory imagery and perception activate similar brain areas (Halpern & Zatorre, 1999; Zatorre et al., 1996). Kosslyn and colleagues (Kosslyn, 1980, 1994; Kosslyn et al., 2006) developed a computational model of visual imagery supported by cognitive neuroscience research which suggests that imagery is not a singular experience or ability but instead involves sub-processes of image generation, maintenance, inspection, and transformation. A dual-control model of auditory imagery has also been proposed (Cotter, 2019), which outlines the role of mental control in the experience of auditory imagery. For instance, auditory imagery can be initiated either voluntarily or involuntarily, and once auditory imagery is initiated, it must be maintained similar to processes outlined in the visual model detailed above.

Because of the potent effect that imagery can have on emotions such as anxiety, it has also been used as a technique to *modulate* affective experience. Indeed, mental imagery has long been integrated into anxiety treatments to facilitate fear-extinction and habituation (Ji et al., 2016) and as noted, imagery-enhanced cognitive behavioural therapy treatments for social anxiety have demonstrated positive effects (e.g. McEvoy et al., 2022). It has also been argued that MPA interventions which only aim to reduce anxiety do not reflect the complex motor requirements of performing under stress (Osborne et al., 2014). To this end, mental imagery offers musicians a unique mental preparation tool which can be employed for a variety of purposes. For instance, mental rehearsal of imagined skill execution is positively associated with performance outcomes (Driskell et al., 1994; Simonsmeier et al., 2021).[4] Although mental

[4] However, a meta-analytic review found that the effect of mental rehearsal on motor tasks was negatively associated with the degree of required task coordination (Driskell et al., 1994).

imagery clearly offers musicians an ideal mental preparation tool, important questions remain concerning *how* musicians should most effectively employ imagery to manage MPA.

Applied Models of Motor Imagery

Applied models of motor imagery (e.g., Cumming & Williams, 2013; Holmes & Collins, 2001; Martin et al., 1999) guide performers and practitioners in its use and several models have been adapted for musicians (Gregg & Clark, 2007; Wright et al., 2014). Early models advised that "what you see is really what you get" (Martin et al., 1999; p. 260). For instance, to down-regulate anxiety, performers should engage in relaxation imagery (Martin et al., 1999). However, contemporary models suggest that performers should integrate emotions and levels of physiological arousal typically experienced during successful performances (e.g., anxiety, excitement, confidence, "butterflies") (Connolly & Williamon, 2004; Holmes & Collins, 2001), which in turn may help musicians habituate to negative emotions while imagining performing well (Clark et al., 2011).

Further, a singular imagery approach (e.g., imagined skill execution) can serve multiple functions (Nordin & Cumming, 2005), and contemporary models differentiate *what* a performer imagines from *why* such imagery is employed (Cumming & Williams, 2013). For example, imagery of a specific performance skill (e.g., a shift on a string instrument) may be used to enhance skill execution, manage performance anxiety, or increase confidence. Such models (Cumming & Williams, 2013) also incorporate the theoretically informed notion that imagery has idiosyncratic meaning to individuals (Ahsen, 1984; Lang, 1979). As such, imagery content employed for a specific purpose (i.e., to manage MPA) might differ across performers. Thus, although applied models provide performers with important practical guidelines (see Connolly and Williamon (2004) for an overview of recommendations for musicians), it is difficult to

derive clear recommendations from applied models regarding how imagery should be most effectively used to manage MPA.

Intentional Imagery to Manage Music Performance Anxiety

Complicating practical guidelines for musicians and practitioners, a variety of imagery approaches have been integrated into existing MPA interventions. An in-depth review is beyond the scope of the current research. However, we have previously provided a comprehensive review of how intentional mental imagery has been integrated into existing interventions to manage MPA (Finch & Oakman, 2023). In brief, numerous imagery approaches such as relaxation (Esplen & Hodnett, 1999; Sisterhen, 2005), systematic desensitization (Appel, 1976; Lund, 1972; Nagel et al., 1989; Norton et al.,1978; Rider, 1987; Wardle, 1974), systematic desensitization and music therapy (Kim, 2005, 2008; Reitman, 2001), metaphorical imagery (Stanton, 1994), and mental skills interventions integrating Centering Down based on Greene (2002)[5] (Cohen & Bodner, 2019; Kageyama, 2007; Osborne et al., 2014) and mental rehearsal (Clark & Williamon, 2011; Cohen & Bodner, 2019) have been used. Additionally, intentional mental imagery has been used to help musicians prepare for specific performances (Esplen & Hodnett, 1999; Sisterhen, 2005), and specific performance situations or experiences (Appel, 1976; Kim, 2005, 2008; Lund, 1972; Nagel et al., 1989; Norton et al., 1978; Reitman, 2001; Rider, 1987; Wardle, 1974).

Of these, some of the strongest evidence comes from mental skills training interventions integrating mental rehearsal in terms of reducing MPA (Braden et al., 2015; Cohen & Bodner, 2019; Osborne et al., 2014), and enhancing facilitative views of MPA and increasing self-efficacy (Clark & Williamon, 2011). However, the multi-component nature of these

[5] Centering down involves goal setting and multi-sensory imagery of performing well.

interventions (e.g., mental rehearsal *and* other cognitive skills) and quasi-experimental designs (e.g., Cohen & Bodner, 2019) must be taken into account as these factors preclude a clear understanding of the unique impact of mental rehearsal on MPA. Further, methodological limitations of existing MPA intervention studies integrating imagery, such as one-arm designs (e.g., Esplen & Hodnett, 1999) and small sample sizes (e.g., Nagel et al., 1989), prevent a clear understanding of whether certain approaches (e.g., relaxation) are more beneficial than others.

To guide future research and provide musicians and practitioners with clearer recommendations, it would be helpful to know how musicians use mental imagery to manage MPA in their own practice, and whether such strategies are similar to those in existing literature. However, we know little about how musicians employ imagery for this purpose. Holmes (2005) found that musicians use "emotional imagery" to "tell a story," and imagery has been used to "deal with nerves" and "develop confidence" (Clark et al., 2007) without further detail. DeSantis and colleagues (2022) developed a questionnaire assessing the reasons singers use imagery and "regulate performance anxiety" emerged as a subscale, including items with varying levels of arousal similar to a previous imagery questionnaire which we developed (Finch et al., 2021). Further, DeSantis and colleagues (2021) conducted a seminal interview study in which singers described using imagery for a variety of purposes, including motivational imagery to "channel nerves as excitement" and visualize positive performance outcomes to enhance mastery. Although these studies provide important information regarding why musicians use imagery and DeSantis and colleagues (2021) elaborated on how singers use imagery for a variety of functions, there is much to learn concerning how musicians engage in imagery to manage MPA.

As noted, mental imagery is not a singular experience or ability and in addition to examining how musicians use intentional imagery to manage MPA, future research should also

investigate whether musicians experience difficulty controlling such imagery. For instance, musicians (DeSantis et al., 2021) and dancers (Nordin & Cumming, 2005) experience spontaneous mental imagery, yet it is not clear whether musicians experience spontaneous imagery while employing intentional imagery to manage MPA or what the phenomenology of this experience might be (i.e., neutral, positive, or negatively valanced spontaneous imagery). Further, some research indicates that those with high social anxiety are more likely than those with low social anxiety to cope with NSI by attempting to suppress or ignore NSI (Moscovitch et al., 2013). Thus, should musicians experience NSI while engaged in intentional imagery to manage MPA, future work should also examine how such intrusions are responded to. Indeed, this is particularly pertinent as applied models stress the importance of generating positive performance imagery (Connolly & Williamon, 2004; Wright et al., 2014). In sum, the primary research questions related to the secondary aim of our program of research (i.e., intentional mental imagery and MPA) included:

1. How do elite musicians use intentional imagery to manage MPA (e.g., sensory characteristics and content)?
2. Do elite musicians experience difficulty controlling intentional imagery used to manage MPA (e.g., experience spontaneous intrusions)?

Summary of Research Aims

To our knowledge, our program of research is the first to provide a comprehensive examination of musicians' experiences along the imagery continuum (i.e., spontaneous to intentional) as they relate to MPA, and has important implications for MPA theory, research, and treatment.

In Study 1, we describe a study that followed elite musicians with varying levels of MPA for 7 days leading up to an important anxiety provoking performance and examined the prevalence and frequency with which musicians experience NSI, as well as the association between NSI, trait MPA, and state somatic and cognitive anxiety intensity.

Building on these initial findings and using the same participant data and methodology, Study 2 extends this investigation to an examination of how NSI is associated with additional factors important in the conceptualization of MPA, namely, state somatic and cognitive anxiety interpretation and self-efficacy.

In Study 3, we turned our attention to intentionally generated imagery and present a qualitative examination concerning how musicians use intentional imagery to manage MPA, and capture difficulties that musicians experience controlling such imagery.

Last, we present a comprehensive summary and integration of our findings, while also addressing limitations and outlining clinical implications and areas for future research.

Study 1

As noted, the primary aim of Study 1 was to address important gaps in the MPA literature to guide future MPA theory, research, and treatment. We explored whether musicians experience NSI and the frequency with which NSI is experienced, and its association with trait MPA and state cognitive and somatic anxiety intensity. We examined the occurrence of NSI, as well as its association with trait MPA and state cognitive and somatic anxiety intensity through a daily diary study which elite musicians with varying levels of MPA completed each of seven days leading up to an important self-selected performance.

As previously outlined in our literature review, those with varying levels of social anxiety experience NSI (Chiupka et al., 2012; Hackmann et al., 2000; oscovitch et al., 2011), and we predicted that musicians with varying levels of MPA would experience NSI leading up to important anxiety-provoking performances. Additionally, as reviewed, given the role of NSI in current cognitive theoretical models of SAD (Clark & Wells, 1995; Heimberg et al., 2010, 2014; Hofmann, 2007; Rapee & Heimberg, 1997) and its impact on anxiety (Hirsch et al., 2006; Makkar & Grisham, 2011; Vassilopoulos, 2005), we further hypothesized that NSI and trait MPA and state somatic and cognitive anxiety intensity would be positively associated leading up to such performances at the within and between-person levels.

Our study design precludes causal inferences. However, findings consistent with our predictions would suggest that the conceptualization of social anxiety outlined in Rapee and Heimberg's original (1997) and updated models (Heimberg et al., 2010, 2014) are more applicable for musicians than previously thought (Osborne & Franklin, 2002), as a factor theorized to fuel social anxiety is associated with trait MPA and state MPA intensity (i.e.,

somatic and cognitive) leading up to performances. Thus, our exploratory research lays important groundwork for future MPA research.

Secondary Objectives

Examining the association between state MPA intensity and NSI over time necessitates modeling state MPA intensity over time. Although research suggests that MPA peaks immediately before performing (Papageorgi et al., 2013), little is known about gradients of change in state MPA intensity as performances approach. To our knowledge, only one study has examined gradients of change in state MPA intensity over time (Miller & Chesky, 2004). However, the authors examined differences between adjacent time points rather than utilizing analyses better suited for repeated measures data and examining trend over time (see Kwok et al. (2008) for recommendations regarding analysis of multi-level longitudinal data), making it difficult to interpret their findings. Further, additional research asked musicians open ended questions regarding their experiences with different facets of MPA at various time-points related to performances and through a retrospective semi-structured interview (Irie et al., 2023), limiting the generalizability of their findings.

Thus, we drew on competitive sport theory and research to inform predictions concerning the trajectory of state MPA intensity over time. Consistent with multidimensional anxiety theory (MAT; Martens et al., 1990) and time-to-event research in competitive sports (Hagan et al., 2017; Hanton et al., 2004; Thomas et al., 2004; Wiggins, 1998), we predicted that somatic anxiety intensity would increase leading up to performances. Consistent with MAT, early work further suggested that cognitive anxiety intensity did not vary as a function of time (Wiggins, 1998), however more recent research has found that cognitive anxiety increases as a function of time (Hagan et al., 2017; Hanton et al., 2004; Thomas et al., 2004). In line with more recent

research, we predicted that cognitive anxiety intensity would also increase leading up to performances. However, given inconsistent findings in the literature and the exploratory nature of the current research, we examined both possibilities regarding the trajectory of cognitive anxiety intensity over time.

To our knowledge, MPA research has not examined whether trait MPA impacts the trajectory of state MPA intensity over time. However, MPA models suggest that trait anxiety may impact state MPA (Papageorgi et al., 2007; Wilson, 2002) and state-trait anxiety theory suggests that trait and state anxiety interact (Spielberger, 1972). Thus, we predicted that those with higher trait MPA would also have higher initial levels of state MPA intensity (i.e., somatic and cognitive). We further predicted that trait MPA may impact the trajectory of state anxiety intensity over time, such that those with higher trait MPA may show smaller gradients of change over time, as their initial levels of state MPA intensity would be higher. However, some research indicates that trait anxiety does not predict the trajectory of state test anxiety over time (Lotz et al., 2021), thus we explored both possibilities.

Method

Procedure

This study was approved by the University of Waterloo Office of Research Ethics (ORE# 44193). Participants were recruited through university-level music performance programs, professional community musical ensembles, and musical contacts of the author. To be eligible for the study, participants had to endorse experiencing some degree of anxiety related to performing, be a professional musician or enrolled in a university or college-level music program (e.g., BMus), and have an upcoming in-person or virtual performance. Prior to beginning the study, researchers met with participants to confirm eligibility. Eligible participants were

provided with a definition of imagery based on White and Hardy (1998) and the difference between intentional and spontaneous imagery was outlined.

Participants first completed a battery of online questionnaires through Qualtrics including a background questionnaire (e.g., demographic information, musical skill level, years of training and experience, etc.), as well as a measure of trait MPA (Kenny, 2009). Next, participants completed a daily diary for 7 days leading up to their important self-selected anxiety-provoking performance, which included questions about NSI related to musical performance as well as a measure of state MPA (Cox et al., 2003a). Participants received up to $40 of pro-rated remuneration.

Measures

Trait Music Performance Anxiety

The Kenny Music Performance Anxiety Inventory – Revised (K-MPAI-R; Kenny, 2009) was used to measure trait MPA. This 40-item measure was developed based on Barlow's (2000) emotion-based theory of anxiety and was created to capture experiences of trait anxiety within the context of music performance. Higher scores indicate higher anxiety. Several items (1, 2, 9, 17, 23, 33, 35, and 37) are worded positively and were thus reverse scored. The K-MPAI-R has demonstrated excellent internal reliability, with a Cronbach's alpha of 0.94 (Kenny, 2009). See Appendix A.

Background Questionnaire

Participants completed a background questionnaire concerning demographic information (e.g., age, gender identity) and musical background (e.g., years of training and experience). Participants were also asked questions (*yes* or *no*) to characterize their experiences with MPA including: i) whether the amount of MPA which they experience is bothersome, ii) whether they

would like to reduce or better manage MPA, iii) whether MPA impacts their performance quality, and iv) whether MPA leads to doubt concerning their career aspirations or goals.

Daily Diary

Participants completed a nightly daily diary through Qualtrics for seven days prior to their self-selected performances, which included daily ratings of experiences of NSI, as well as a state MPA measure (CSAI-2R; Cox et al., 2003; Martens et al., 1990).

Negative Spontaneous Imagery

Participants were provided with a brief description of NSI (i.e., NSI is imagery which "pops" into your mind without any effort to consciously or intentionally create it) and were asked (*yes* or *no*) whether they experienced NSI related to musical performances that day.

State Music Performance Anxiety

The Competitive State Anxiety Inventory-2R (CSAI-2R; Cox et al., 2003; Martens et al., 1990) was used to measure state MPA intensity. The original version of the 27-item CSAI-2 (Martens et al., 1990) was developed to assess the intensity of athletes' cognitive and somatic anxiety, as well as their self-confidence in sport performance. Although the CSAI-2 is one of the most widely used measures in sport psychology, the original version was revised due to concerns regarding its factor structure. The revised version includes 17 items from the CSAI-2R (Cox et al., 2003a) and also includes a subscale that captures performers' interpretation of their cognitive and somatic anxiety (e.g., as helping or hindering performance) to allow for the fact that not all performers perceive anxiety as debilitative to performance (Mellalieu et al., 2009). Study 1 focuses on the cognitive and somatic anxiety intensity subscales. This measure has shown acceptable to excellent internal consistency applied to MPA, with cognitive and somatic intensity alpha's of .84 and .85 (Yoshie et al., 2009). Several changes were made to make the CSAI-2R

appropriate for measuring music performance anxiety. The use of "competition" was changed to "performance," and "losing" was changed to "performing poorly" to better capture the scenarios in which musicians perform. Our revised CSAI-2R included 12 items measuring the intensity of cognitive (5 items) and somatic anxiety (7 items), with responses ranging from 1 (*never*) to 7 (*always*). See Appendix B.[6]

Participants

Participants ($N = 40$) primarily performed classical music (87.5%). Mean years of experience was 15.85 ($SD = 7.36$; range 5 to 36). Of note, 21.1% of participants were professional musicians, 65.8% were advanced music students (e.g., completing BMus, MMus, or DMA degrees in music performance), and 13.2% were other (e.g., in music education programs with a performance requirement). Participants played a variety of primary instruments: 34.2% keyboard, 21.1% woodwind, 18.4% voice, 15.8% strings, 7.9% percussion, and 2.6% brass.

Participants were asked to select their primary racial or ethnic group, or select all that represented an important identity to them. Participants were from a variety of ethnic backgrounds: 55.3% White, 26.3% East Asian, 5.3% East Asian/White, 5.3% South Asian, 2.6% Southeast Asian, 2.6% East Asian/Middle Eastern, 2.6% Other. Mean age was 24.16 ($SD = 7.9$; range = 17 to 51), 68.4% of participants identified as women/transwomen, 25% men/transmen, 5.3% genderqueer/gender non-conforming/gender non-binary.

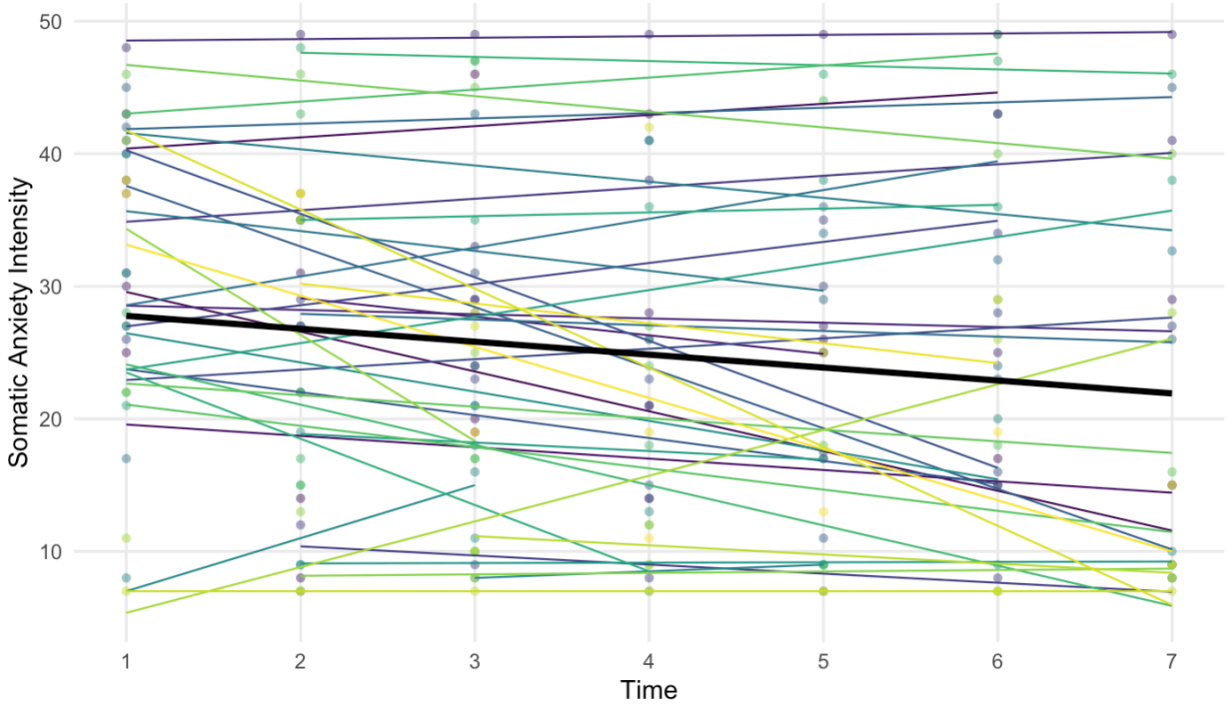
[6] Although the CSAI-2R additionally includes cognitive and somatic anxiety interpretation and self-confidence subscales, results concerning the association between those variables and NSI are presented in Study 2.

Data Analytic Approach

As recommended, we began by plotting and visually inspecting the data (Bolger & Laurenceau, 2013, p. 42). See Figures 2 and 3 for participant plots for somatic and cognitive anxiety intensity over time.

Figure 2

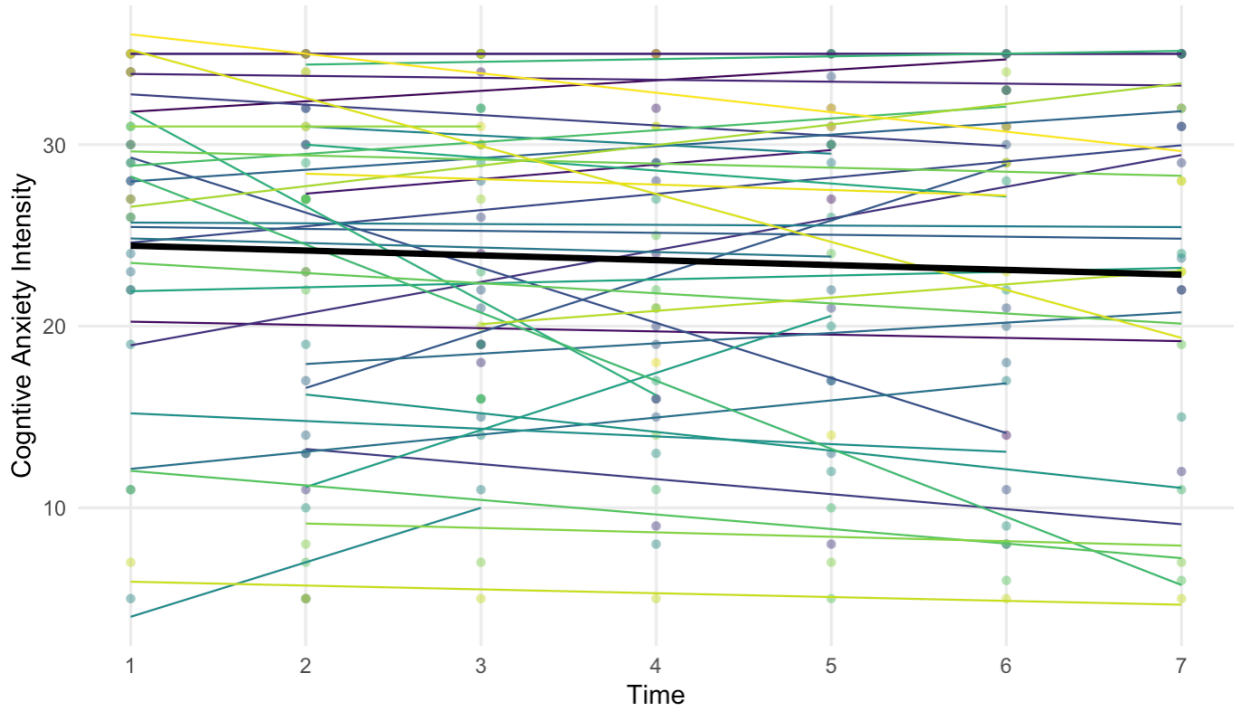
Somatic Anxiety Intensity Scores Over Time



Note. This figure shows each participant's trajectory for somatic anxiety intensity (raw scores) over the 7 days leading up to their performance. The bolded black line represents the average trajectory of somatic anxiety intensity over time. The coloured lines represent each participant's individual trajectory, and are shaded to make the lines more readily descriminable.

Figure 3

Cognitive Anxiety Intensity Scores Over Time



Note. This figure shows each participant's trajectory for cognitive anxiety intensity (raw scores) over the 7 days leading up to their performance. The bolded black line represents the average trajectory of cognitive anxiety intensity over time. The coloured lines represent each participant's individual trajectory, and are shaded to make the lines more readily descriminable.

Data were analyzed using linear mixed models in IBM SPSS version 29. We employed maximum likelihood estimates in our models as this allowed us to compare model fit. Criterion variables were participants' raw scores on all available study days (i.e., daily totals for the different facets of state MPA intensity). Missing item-level data were pro-rated to create daily total scores for the different facets of state MPA intensity, in an effort to retain as much data as possible.[7] We first estimated basic random intercept models for each of our criterion variables in order to determine whether multi-level analyses were appropriate. Next, three main sets of

[7] For somatic anxiety intensity, 1.4% of missing data were pro-rated, while for cognitive anxiety intensity, 2.4% of missing data were pro-rated.

analyses were conducted for each criterion variable (detailed below). Consistent with approaches for repeated measures data, we specified a first order autoregressive covariance structure (AR1) for level 1 (Field, 2009, p. 738). We further specified an unstructured covariance structure for level 2 as we were interested in estimating the covariance between intercepts and slopes.

First, we modeled the different facets of state MPA over time, with time as a level 1 predictor. Time was centered such that the value of the initial study day was 0 (Peugh & Enders, 2005). We built growth models which allowed participants to have their own initial starting points (i.e., random intercepts) as well as rates of change over time (i.e., random slopes for the linear effect of time). Based on our predictions that state cognitive and somatic MPA intensity would increase over time – and that this effect may accelerate closer to participants' performances – we further included the quadratic effect of time in our growth models. Next, we entered trait MPA as a grand mean centered time-invariant covariate. The cross-level interaction between trait MPA and time was also entered given our hypothesis that trait MPA might influence not only initial levels of state MPA intensity, but trajectories over time. Last, we entered daily experiences of negative spontaneous imagery (NSI) (i.e., yes or no) as a time-varying covariate, given our hypotheses that state MPA intensity would be higher on days wherein participants experienced NSI than on days when they did not. Because this variable has a meaningful 0 point, indicating that a participant did not experience NSI on a given day, this variable was not centered (see Enders & Tofighi, 2007).

Results

Preliminary Analyses

Participants responded to an average of 5.17 out of 7 daily diary surveys (*SD* = 1.48; range 3 to 7).[8] Concerning general experiences of MPA, 65% of the sample reported that the amount of MPA which they currently experience is bothersome, 87% reported that they would like to better manage MPA, 80% reported that MPA negatively impacts their performance quality, and 52% reported that MPA causes doubt regarding their career aspirations or goals. Participants also responded to a series of questions concerning the performance around which they completed the study. Performance type included 70% solo, 12.5% orchestral, 10% chamber, 2.5% choir, 2.5% large ensemble, and 2.5% opera. Concerning the performance, mean importance was 7.71 (*SD* = 1.74; range 3 to 10), mean anxiety was 6.55 (*SD* = 2.33; range 1 to 10), and mean expected level of audience expertise was 6.47 (*SD* = 2.44; range 1 to 10). Performances were primarily in-person (63.6%), with 22.7% virtual, and 13.6% hybrid (i.e., in-person and live-streamed or virtual elements).[9]

Concerning the prevalence of NSI, 82.5% of participants experienced NSI on one or more days throughout the study. However, this was not experienced frequently on average throughout the week leading up to performances, with a mean of 1.95 days (*SD* = 1.58; range 0 to 6).[10] See Table 1 for a summary of the percentage of participants who experienced NSI across study days.

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[8] Of note, 3.8% (8/207) of daily entries for the 7 days leading up to participants' performances were completed at timepoints outside of the pre-determined timepoint to return the daily diary entry due to various factors (e.g., participant illness, links in junk mail folders, etc.).

[9] Due to researcher error, performance mode was only gathered for 22 participants.

[10] Given missing data, we chose to complete primary analyses in a sub-sample of participants who provided the most complete responses with a minimal sacrifice to sample size. Analyses were conducted in a sub-sample of participants (*N* = 27) who completed 5 or more daily surveys. Results were similar

Table 1

Percentage of participants who experienced NSI by study day

Study Day	Percent (Frequency)	*N*
1	69 % (20)	29
2	33.3% (11)	33
3	34.3% (12)	35
4	34.5% (10)	29
5	21.4% (6)	28
6	35.7% (10)	28
7	36% (9)	25

Note. Frequency refers to the number of participants who endorsed experiencing NSI on a given study day, N = total number of participants who responded to the daily item.

Omega values were computed for each subscale of the CSAI-2R as estimates of within-person (ω_w) and between-person (ω_B) reliability (Geldhof et al., 2014). This measure demonstrated adequate reliability for both subscales; somatic anxiety intensity ($\omega_w = .85$, $\omega_B = .95$), cognitive anxiety intensity ($\omega_w = .78$, $\omega_B = .98$).

Within-person Variation

Intra-class correlations reflect the degree of variability due to between-person differences and are presented for the main study variables in Table 2. Between-person correlations reflect the extent to which participants' mean scores on state MPA (i.e., across the 7 days) and trait MPA relate to 1) how frequently (i.e., the number of times) participants experienced NSI over the course of the study, and 2) the general experience of NSI (i.e., yes or no) over the study period.

with 81.5% of participants experiencing NSI on one or more days throughout the study. Similarly, participants experienced NSI on an average of 2.11 days (*SD* = 1.74; range 0 to 6).

Within-person correlations reflect the degree to which a participant's score on different measures are related to one another over time. See Table 2 for means and standard deviations for study variables, as well as a summary of ICCs.

Table 2

Between and within-person correlations for study variables and intraclass correlations

	M	SD	ICC	1	2	3	4	5
CSAI-2R Subscales								
1. *Cognitive Intensity*	23.63	8.33	.74	-	.63**	.38*	.40*	.08
2. *Somatic Intensity*	25.20	11.81	.71	.61***	-	.34*	.50**	.17
3. NSI Daily	1.95	1.58	.23[11]	.28***	.23**	-	.35*	.57**
4. Trait MPA	132.49	38.14					-	.19
5. Any experience of NSI								-

Note: Between-person correlations are above the diagonal and within-person correlations are below the diagonal. NSI = Negative Spontaneous Imagery. Because Trait MPA is a level 2 variable measured once, an ICC and within-person correlations were not computed. Similarly, because 'Any experience of NSI' was captured as a binary variable across the study period, ICC's and within-person correlations were not computed. For between-person analyses, a sum variable was created which reflects the frequency with which participants experienced NSI over the course of the study, and thus the mean and standard deviation also reflect this. *$p < .05$ level (2-tailed). ** $p < .01$ level (2-tailed). *** $p < .001$ level (2-tailed).

[11] The ICC for NSI daily was computed using Fleiss and Cuzick's (1979) approach with the Intracluster Correlation Coefficient for Binary Data (ICCbin) package in R.3.6.1 (R Core Team, 2019) as this method is suited for binary outcomes in multi-level data (McMahon et al., 2006).

At the between-person level, there were significant positive associations between the frequency with which participants experienced NSI over the course of the study and somatic and cognitive anxiety intensity and trait MPA, such that those who experienced more frequent NSI also had higher state somatic and cognitive anxiety intensity and trait MPA. Similarly, within-person, daily experiences of NSI were significantly positively associated with state somatic and cognitive anxiety intensity. Contrary to our hypotheses, at the between-person level, the experience of NSI (yes or no) at any point over the course of the study was associated neither with state MPA intensity nor trait MPA.

Somatic Anxiety Intensity

Unconditional Growth Model

There are differing recommendations concerning building a growth model. Our approach to building our growth model was informed by rationale outlined by Field (2009) and Heck et al. (2014), in which we first investigated the shape of change over time, and next, whether time-related slopes varied between participants.

We began by estimating a simple random intercept model (Heck et al., 2014; Nezlek, 2020; Peugh & Enders, 2005) and 71% of the variability in somatic anxiety intensity was accounted for by between-person differences. Adding the linear effect of time significantly improved model fit, $\chi^2(2) = 28.75$, $p < .01$, as did adding the quadratic effect of time, $\chi^2(1) = 4.3$, $p < .05$. Next, adding a random slope for the linear effect of time also significantly improved model fit, $\chi^2(2) = 9.86$, $p < .01$. Table 3 presents the full unconditional growth model for somatic anxiety intensity.[12]

[12] The overall pattern of results for Model 1 was consistent in the sub-sample with more complete data, though the quadratic effect of time was marginally significant.

Contrary to our predictions, somatic anxiety intensity decreased over time, an effect which flattened. However, consistent with our predictions, participants significantly differed in terms of their initial starting points and rates of change over time. The covariance estimate was not significant and the standard error for this estimate was large and as such, interpretation of this parameter is cautioned. At the within person level, participants' daily somatic anxiety intensity scores significantly varied around their own growth trajectories. Surprisingly, within person, adjacent observations were not significantly correlated. However, within subjects estimates of autocorrelation with small sample sizes (e.g., fewer than 50 observations per participant) are difficult to estimate and strongly negatively biased (Huitema & McKean, 1991). Thus, although this was a surprising finding given the nature of our data, we built additional models with the AR1 covariance structure as this is a common approach for repeated measures longitudinal data (Field, 2009, p. 738). Given the significant Level 1 and 2 variability in somatic anxiety intensity, we next added predictor variables to our model.

Adding Trait MPA as a Time-invariant Covariate

Adding trait MPA and the cross-level interaction between trait MPA and time significantly improved model fit $\chi^2(2) = 107.21$, $p < .01$. Consistent with our hypotheses, trait MPA predicted initial levels of somatic anxiety intensity, such that those with higher trait MPA also had higher initial levels of somatic anxiety intensity. However, contrary to our hypotheses, trait MPA did not predict the degree of change in somatic anxiety intensity over time.[13] Consistent with Model 1, there was significant variability in starting points and rates of change over time for somatic anxiety intensity, and participants' daily somatic anxiety intensity scores significantly varied around their own growth trajectories. See Table 3 for a summary of Model 2.

[13] The pattern of findings in the sub-sample was consistent with these results, with the exception of a negative covariance between intercepts and slopes.

Adding NSI as a Time-variant Covariate

The addition of negative spontaneous imagery (NSI) significantly improved model fit $\chi^2(1) = 5.02$, $p < .05$. Consistent with our predictions, on average within person, somatic anxiety intensity was significantly higher on days when participants experienced NSI.[14] Estimates of random effects were largely consistent with Model 2. See Table 3 for a summary of Model 3.

[14] In the sub-sample, model fit did not improve significantly with the addition of NSI, nor was the effect of NSI significant in Model 3 in the sub-sample. However, the overall pattern of findings was consistent with the full sample.

Table 3

Somatic Anxiety Intensity Model

	Model 1			Model 2			Model 3		
Fixed Effects	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**
Intercept	29.30*** (1.98)	1,47.54	[25.32, 33.27]	29.21*** (1.71)	1,48.86	[25.78, 32.64]	27.51*** (1.84)	1,64.96	[23.85, 31.18]
Time	-2.74* (0.84)	1,98.08	[-4.40, -1.08]	-2.69** (0.89)	1,87.70	[-4.47, -0.91]	-2.18* (0.90)	1,93.02	[-3.97, -0.40]
$Time^2$	0.31* (0.13)	1,79.19	[0.05, 0.57]	0.30* (0.14)	1,69.87	[0.02, 0.58]	0.24 (0.14)	1,72.80	[-0.04, 0.51]
Trait MPA				0.18*** (0.04)	1,37.72	[0.09, 0.26]	0.17*** (0.04)	1,38.17	[0.09, 0.26]
Trait MPA*Time				-0.01 (0.01)	1,39.81	[-0.03, 0.01]	-0.01 (0.01)	1,39.53	[-0.03, 0.01]
NSI							2.76* (1.21)	1,154.08	[0.37, 5.15]
Random Effects	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**
Level 2									
Intercept	115.31*** (32.21)	3.58	[66.70, 199.36]	63.43** (22.46)	2.82	[31.68, 126.98]	63.01** (21.52)	2.93	[32.27, 123.06]
Intercept and Time	-2.23 (4.35)	-0.51	[-10.75, 6.29]	0.58 (3.70)	0.16	[-6.67, 7.83]	-0.04 (3.60)	-0.01	[-7.08, 7.01]
Time	2.71* (1.07)	2.53	[1.25, 5.88]	2.64* (1.16)	2.28	[1.12, 6.23]	2.67* (1.12)	2.38	[1.17, 6.08]
Level 1									
Residual	33.17*** (5.19)	6.39	[24.40, 45.08]	35.68*** (5.96)	5.99	[25.72, 49.50]	33.90*** (5.42)	6.26	[24.78, 46.36]
Autocorrelation	0.09 (0.13)	0.72	[-0.16, 0.33]	0.10 (0.13)	0.77	[-0.16, 0.35]	0.07 (0.13)	0.50	[-0.19, 0.32]
Overall Model Test									
-2 Log Likelihood	1437.14			1329.93			1324.91		
$\Delta\chi^2$				107.21**			5.02*		
Δdf				2			1		

Note: Bs represent unstandardized regression coefficients. Time = linear function of time, $Time^2$ = quadratic function of time. Time is coded day 1 = 0. Intercept = average level of somatic anxiety intensity at Day 0. NSI = negative spontaneous imagery. Model 1 is the Unconditional growth model for somatic anxiety intensity, Model 2 adds Trait MPA as a time-invariant covariate, and Model 3 adds daily experiences of NSI (i.e., yes or no) as a time-varying covariate. $\dagger p < .10$, ** $p < .05$, ** $p < .01$, *** $p < .001$.

Cognitive Anxiety Intensity

Unconditional Growth Model

Seventy-four percent of the variability in cognitive anxiety intensity was accounted for by differences between participants. Building on the random intercept model, adding the linear effect of time significantly improved model fit, $\chi^2(2) = 7.29$, $p < .05$, although adding the quadratic effect of time did not, $\chi^2(1) = 1.72$, $p > .05$. Further, adding a random slope for the linear effect of time did not improve model fit, $\chi^2(2) = 2.61$, $p > .05$. Table 4 presents the full unconditional growth model for cognitive anxiety intensity.

Contrary to our predictions, cognitive anxiety intensity did not increase over time. In fact, the linear and quadratic effects of time were not significant, suggesting that cognitive anxiety intensity did not significantly vary as a function of time. However, there was a marginally significant linear effect of time, suggesting that cognitive anxiety intensity may have decreased over time. However, as this finding was not significant, such trend in the data must be interpreted with caution.

Consistent with our predictions, participants significantly varied in terms of their initial levels of cognitive anxiety intensity. Although variability in slopes was not statistically significant, the confidence interval for this estimate did not cross zero, suggesting trend in the data such that participants' slopes varied. It is possible that the current sample may have been underpowered to detect this effect. The estimate for the covariance between intercepts and slopes was not significant, indicating that initial levels of cognitive anxiety intensity did not provide meaningful information about trajectories over time. At the within person level, participants' daily cognitive anxiety intensity scores significantly varied around their own trajectories. Similar to somatic anxiety intensity, within person, adjacent observations were not significantly

correlated. Given the significant Level 1 and 2 variability in cognitive anxiety intensity, we next added predictor variables to our model.

Adding Trait MPA as a Time-invariant Covariate

Adding trait MPA and the cross-level interaction between trait MPA and time significantly improved model fit $\chi^2(2) = 91.1,\ p < .01$. Consistent with our hypotheses, trait MPA predicted initial levels of cognitive anxiety intensity, such that those with higher trait MPA also had higher initial levels of cognitive anxiety intensity. However, contrary to our hypotheses, trait MPA did not predict degree of change in cognitive anxiety intensity over time, consistent with our previous findings (i.e., regarding trait MPA and somatic anxiety intensity).[15] The estimates for the fixed effects of time were of similar magnitude to Model 1. Further, consistent with Model 1, there was significant variability in initial levels of cognitive anxiety intensity, and participants' daily cognitive anxiety intensity scores significantly varied around their own trajectories. See Table 4 for a summary of Model 2.

Adding NSI as a Time-variant Covariate

The addition of negative spontaneous imagery (NSI) significantly improved model fit $\chi^2(1) = 11.84,\ p < .01$. Consistent with our predictions, on average within person, cognitive anxiety intensity was significantly higher on days where participants experienced NSI than on days when they did not. Estimates of random effects were consistent with Model 2. See Table 4 for a summary of Model 3.

[15] Yet, as noted variability in slopes for cognitive anxiety intensity was not statistically significant, although the confidence interval for this estimate may suggest that there was trend in the data such that participants' slopes varied.

Table 4

Cognitive Anxiety Intensity Model

	Model 1			Model 2			Model 3		
Fixed Effects	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**
Intercept	25.01*** (1.44)	1,50.43	[22.12, 27.91]	25.52*** (1.37)	1,47.94	[22.77, 28.28]	23.51*** (1.45)	1,62.89	[20.61, 26.42]
Time	-1.11† (0.61)	1,87.71	[-2.32, 0.10]	-1.10† (0.65)	1,80.70	[-2.39, 0.19]	-0.53 (0.63)	1,92.35	[-1.78, 0.72]
$Time^2$	0.15 (0.10)	1,71.98	[-0.04, 0.34]	0.14 (0.10)	1,65.81	[-0.06, 0.35]	0.07 (0.10)	1,74.82	[-0.12, 0.27]
Trait MPA				0.08* (0.03)	1,37.86	[0.01, 0.15]	0.07* (0.03)	1,38.33	[0.004, 0.14]
Trait MPA*Time				0.001 (0.01)	1,35.49	[-0.01, 0.01]	.001 (0.01)	1,34.27	[-0.01, 0.01]
NSI							3.21*** (0.89)	1,163.67	[1.45, 4.98]
Random Effects	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**
Level 2									
Intercept	60.60*** (16.65)	3.64	[35.38, 103.83]	45.41** (14.39)	3.16	[24.40, 84.51]	45.85*** (13.52)	3.39	[25.73, 81.71]
Intercept and Time	-0.56 (2.10)	-0.27	[-4.67, 3.56]	-0.71 (2.19)	-0.32	[-5.01, 3.59]	-1.34 (1.20)	-0.67	[-5.26, 2.58]
Time	0.64 (0.47)	1.35	[0.15, 2.73]	0.71 (0.53)	1.35	[.17, 3.05]	0.77 (0.46)	1.66	[0.24, 2.49]
Level 1									
Residual	18.82*** (3.03)	6.21	[13.73, 25.81]	19.80*** (3.25)	6.10	[14.36, 27.30]	17.61*** (2.53)	6.96	[13.28, 23.33]
Autocorrelation	0.06 (0.14)	0.40	[-0.21, 0.32]	0.04 (0.14)	0.31	[-.23, .31]	-0.06 (0.13)	-0.45	[-0.30, 0.19]
Overall Model Test									
-2 Log Likelihood	1305.82			1214.72			1202.86		
$\Delta\chi^2$				91.1**			11.84**		
Δdf				2			1		

Note: Bs represent the unstandardized regression coefficients. Time = linear function of time, $Time^2$ = quadratic function of time. Time is coded day 1 = 0. Intercept = average level of cognitive anxiety intensity at Day 0. NSI = negative spontaneous imagery. Model 1 is the Unconditional growth model for cognitive anxiety intensity, Model 2 adds Trait MPA as a time-invariant covariate, and Model 3 adds daily experiences of NSI (i.e., yes or no) as a time-varying covariate. †$p < .10$, ** $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

MPA Over Time

To our knowledge, our study is one of the first to examine how state MPA intensity (i.e., somatic and cognitive) unfolds over time the week prior to an important anxiety-provoking performance among elite musicians who experience varying levels of MPA. Contrary to our predictions, state somatic anxiety intensity *decreased* over time and state cognitive anxiety intensity demonstrated a similar trend. However, given that the effect of time was not significant for cognitive anxiety intensity, we are most confident in our findings regarding the shape of change for somatic anxiety intensity over time. As noted, it was difficult to advance predictions concerning the shape of change over time for state somatic and cognitive anxiety intensity. Yet, our findings are surprising given that previous research suggests that MPA peaks before performing (Abel & Larkin, 1990; Papageorgi et al., 2013). However, previous studies addressing the temporal association of MPA with performance have measured MPA at intervals leading up to performances such as one hour before a performance, immediately before a performance, during, and after performances (Abel & Larkin, 1990; Papageorgi et al., 2013), whereas we examined the trajectory of state MPA intensity for seven days leading up to performances. Thus, our study design may have precluded measurement of a "ramp up" window found in previous research as our final measure of state MPA intensity was taken the day before performances. However, our finding that cognitive anxiety intensity did not vary significantly over time is consistent with predictions of MAT (Martens et al., 1990) and early work in competitive athletes (Wiggins, 1998).

Although our results were surprising in terms of the average trajectories of state somatic and cognitive anxiety intensity over time, multi-level analyses allowed us to examine differences

between participants (i.e., in terms of initial levels and change over time). Indeed, participants significantly varied in their initial levels of state somatic and cognitive anxiety intensity, and participants' slopes significantly varied around the average slope for state somatic anxiety intensity. Similar to previous test anxiety research (Lotz et al., 2021), we found that trait MPA significantly positively predicted initial levels of state somatic and cognitive anxiety intensity, though the magnitude of these effects were small. However, surprisingly, trait MPA did not predict trajectories of somatic anxiety intensity over time.

Given the significant variability in initial levels of state somatic and cognitive anxiety intensity, and variability in participant slopes for somatic anxiety intensity, there may be important factors apart from trait MPA which predict initial levels of state somatic and cognitive anxiety intensity and the trajectory of state somatic anxiety intensity over time (e.g., fear of negative evaluation, trait self-efficacy). Indeed, our results suggest that the use of multi-level analyses in future MPA research is particularly important, as focusing only on the average trend of change over time may overlook important differences in musicians' experiences of MPA leading up to performances.

Negative Spontaneous Imagery and MPA

The majority of participants in the current study experienced NSI leading up to performing suggesting that similar to those with social anxiety (Hackmann et al., 2000), NSI is a common phenomenon amongst skilled musicians. Although NSI was highly prevalent, it was not experienced frequently throughout the week on average by most participants, though a small subset of participants experienced NSI on most study days. However, in line with our predictions, there were small yet significant associations at the between-person level between state somatic and cognitive anxiety intensity as well as trait MPA and the frequency with which

participants experienced NSI, such that those who experienced NSI more frequently over the course of the study also had higher state somatic and cognitive anxiety intensity and trait MPA. Further, a similar pattern of findings emerged at the within-person level, where state somatic and cognitive anxiety intensity were positively associated with experiences of NSI. Interestingly, there was no association between state MPA intensity or trait MPA and the experience (i.e., yes or no) of NSI over the course of the study. Although correlations were of small magnitude, we must consider that 17.5% of participants in our study did not experience any NSI leading up to performing. Thus, looking at our findings at an average level is only part of the picture, and multi-level analyses allowed for a more fine-grained understanding of the association between NSI and state MPA intensity over time in those who experienced NSI.

Consistent with our predictions, and in-line with previous research in those with social anxiety concerning the association between social anxiety and NSI (Hirsch et al., 2006; Makkar & Grisham, 2011; Vassilopoulos, 2005), on average within person, amongst participants who experienced NSI leading up to performing, state somatic and cognitive anxiety intensity were higher on days where participants also experienced NSI compared to days when they did not. This is particularly striking given that state somatic anxiety decreased over time, with cognitive anxiety intensity similarly trending downward leading up to performances. Thus, our novel results suggest an important coupling of state MPA intensity and NSI, such that on days where musicians experience NSI, state MPA intensity is higher.

As noted, our study design precludes causal interpretations. However, our novel findings suggest that current models of social anxiety may offer more to the conceptualization of MPA than previously thought (Osborne & Franklin, 2002), as a factor theorized to maintain social anxiety is significantly associated with state MPA intensity in anticipation of performing.

However, due to our study design, we cannot rule out the possibility that state MPA intensity leads musicians to experience NSI, or that there are third variables driving both the experience of NSI and state MPA intensity.

Interestingly, we did not see strong associations at the between-person level between trait MPA or state MPA intensity and the frequency with which musicians experienced NSI in the current study. Taken together with the results from our modeling, this may suggest that although NSI is significantly associated with state MPA intensity on days where musicians experience NSI, any effect of this phenomenon does not linger at the trait level, despite the important coupling of NSI and state MPA intensity on average within person. Yet, much of the work in which clinicians engage with musicians occurs over time and our findings have important clinical implications.

Clinical Implications

Given the prevalence of NSI amongst highly skilled musicians, and the significant positive association between state MPA intensity and NSI over time, clinicians working with musicians experiencing MPA would do well to assess for experiences of NSI, which may help to inform idiographic case conceptualizations concerning the association between such experiences and MPA.

Further, common forms of pharmacological treatments for MPA such as beta-blockers (Kenny et al., 2014), which block physiological manifestations of MPA (Herman & Clark, 2023), may not adequately address emotional or cognitive manifestations of MPA (Kenny, 2011), particularly if only used at timepoints more proximal to performing. Additionally, concerns have been raised about the use of beta-blockers in singers and wind musicians, as beta-blockers may increase salivation which may impair performance (Brugués, 2011). Our findings

suggest that clinicians may benefit from incorporating evidence-based treatments which target negative imagery in musicians, particularly as MPA can be diagnosed as performance-only social anxiety disorder. Indeed, both verbally-based and imagery-enhanced CBT for social anxiety are effective treatments for social anxiety (e.g., McEvoy et al., 2022) and as noted in our literature review, musicians might similarly benefit from integrating CBT skills which target NSI related to performing. Relatedly, as we previously outlined, our findings also suggest that musicians may benefit from evidence-based strategies used to help rescript NSI relating to performance. Indeed, imagery re-scripting involves exposing clients to negative memories or images and has been successfully incorporated in treatment protocols for CBT for social anxiety (McEvoy et al., 2022; McEvoy & Saulsman, 2014; Norton et al., 2021). Further, because imagery re-scripting allows for new meaning to be developed in relation to early memories and images (Arntz & Weertman, 1999) and is associated with decreased distress relating to recurrent images (Nilsson et al., 2012), such treatments may be particularly helpful for musicians who experience recurrent NSI related to early socially traumatic memories of performances.

Limitations and Future Directions

A number of limitations must be addressed in the current research. Given our small sample size, we are underpowered and although MLM is well-equipped to handle missing data, missing data was a concern in the present study. However, a similar pattern of findings emerged in a subset of participants who provided the most complete responses, which bolsters our confidence in our findings.

As mentioned, future research should include additional trait-level variables (e.g., self-efficacy), as they may help explain the significant variability observed in musicians' initial state MPA intensity and changes over time in state somatic anxiety intensity. Given the surprising

finding that on average, state somatic anxiety intensity decreased over time, with state cognitive anxiety intensity also trending in this direction, it may be the case that elite musicians' years of experience help them cope with MPA leading up to performing. Further, they may have coping strategies at their disposal which help to ameliorate MPA before a potential "ramp up" window evident in previous research. To this end, future studies investigating MPA over time should explore the strategies musicians may already have at their disposal, and how use over time of such strategies impacts state MPA intensity in anticipation of performing. Further, experience sampling designs with larger samples and numbers of observations within person, coupled with more intensive measurement of MPA on the day of performances (e.g., immediately before and after performing), would provide greater insight into the trajectory of MPA over time. However, our findings provide valuable information concerning experiences of state MPA intensity leading up to performing in highly skilled musicians.

Our novel findings also suggest that additional research is needed to understand NSI in musicians, and how this phenomenon is associated with MPA. For instance, future research should operationalize the discrepancies suggested to be central to the cognitive theoretical model of SAD and the cognitive model of MPA, and ascertain whether and how NSI is associated with such discrepancies or contributes to the predictive validity of state MPA above and beyond the central discrepancies outlined in both models. Such research would further increase our understanding of the conceptualization of MPA as a variant of social anxiety.

The present research is the first to investigate an important phenomenon in social anxiety research in musicians with varying levels of MPA and suggests an important coupling of state MPA intensity and NSI. Although important questions remain and there are limitations of the present research, our findings indicate that NSI is an important phenomenon warranting

additional research in musicians to help further inform our conceptualization of MPA and guide future research.

Study 2

To our knowledge, Study 1 was the first to investigate NSI in elite musicians. Yet, as noted in our literature review, not all musicians who experience MPA interpret it as debilitative to performance (Herman & Clark, 2023). Indeed, contemporary measures adapted from competitive anxiety research in athletes (Cox et al., 2003; Martens et al., 1990) capture the intensity of musicians' experiences of state MPA and interpretations of state MPA (i.e., as helping or hindering performances) (e.g., Yoshie et al., 2009). Thus, building on Study 1, Study 2 examined whether and how NSI is associated with musicians' interpretations of state MPA (i.e., as helping or hindering performances) in anticipation of important anxiety-provoking performances in elite musicians. Further, as we previously reviewed, the cognitive theoretical model of MPA (Osborne & Franklin, 2002) purports that self-efficacy plays an important role in MPA, and an additional aim of Study 2 was to investigate the association between NSI and self-confidence[16] in elite musicians in anticipation of important anxiety-provoking performances. The analyses reported here extend those first reported in Study 1. Although Study 2 uses the same methodology and participant data as Study 1, we chose to present Study 2 separately due to the complexity of the data analyses and for ease of interpretation.

We hypothesized that leading up to this performance, state MPA interpretation would be positively associated with NSI (Heimberg et al., 2010; Hirsch, Mathews, et al., 2006; Makkar &

[16] Differences between self-efficacy and self-confidence in performance have been previously articulated (e.g., Lochbaum et al., 2022), with self-efficacy capturing views of performance competence for a specific performance. However, given that our measure of self-confidence was administered in reference to the performance around which participants completed the study, we consider our findings relevant in consideration of the cognitive theoretical model of MPA which outlines the role of self-efficacy in maintaining MPA.

Grisham, 2011; Rapee & Heimberg, 1997; Vassilopoulos, 2005)[17], while NSI and self-confidence would be negatively associated (Zelenak, 2024).

Secondary Objectives

Examining the association between NSI and state MPA interpretation and self-confidence requires modeling state MPA interpretation and self-confidence over time. However, it is difficult to advance predictions regarding the shape of change (e.g., increases or decreases) over time in these variables. Multidimensional Anxiety Theory (MAT; Martens et al., 1990) predicts that self-confidence will remain constant leading up to a performance event[18], yet does not advance hypotheses concerning the shape of change (i.e., increases or decreases) of cognitive and somatic anxiety interpretation over time. Further, conflicting results have been reported in time-to-event research in athletes regarding the shape of change in self-confidence (Hagan et al., 2017; Hanton et al., 2004; Wiggins, 1998) and state anxiety interpretation over time (Hanton et al., 2004; Thomas et al., 2004; Wiggins, 1998). Additionally, a study which investigated gradients of change in state MPA interpretation and self-confidence over time (Miller & Chesky, 2004) compared differences between adjacent time points, rather than utilizing analyses better suited for repeated measures data and examining trend over time (see Kwok et al., 2008), making it difficult to interpret their findings. Thus, the present study includes exploratory analyses concerning the shape of self-confidence and state MPA interpretation over time. However, we advanced tentative predictions based on previous literature. Given that MPA peaks prior to performing (Papageorgi et al., 2013) and the negative association between state cognitive and somatic anxiety intensity and interpretation (e.g., Fernandes et al., 2013), we predicted that state

[17] Interpretation is typically measured on a scale ranging from -3 (very debilitative) to +3 (very facilitative) (e.g., Yoshie et al., 2009). However, for ease of interpretation, we assigned higher values to more debilitative interpretations in the current study as detailed below.
[18] As long as expectations of performance success remain stable over time.

cognitive and somatic anxiety interpretation would become more debilitative over time. Further, given that MPA peaks prior to performing (Papageorgi et al., 2013) and the negative association between state cognitive and somatic anxiety intensity and self-confidence (Silva-Rocha et al., 2019), we predicted that self-confidence would decrease over time.

We also predicted that those with higher trait MPA would have higher initial levels of state MPA interpretation (i.e., more debilitative interpretations) (Fernandes et al., 2013), and lower levels of self-confidence (Yoshie et al., 2009). We predicted that trait MPA may impact the trajectory of state anxiety interpretation and self-confidence over time, such that those with higher trait MPA may show smaller gradients of change over time, as their initial levels of state MPA interpretation would be higher, and their initial levels of self-confidence would be lower.

Method

As noted, the present study involved analyzing data previously reported in Study 1. Please refer to this study for detailed information regarding the Procedure, Methods, Participants, and Data Analytic Plan. Information relevant to the current study and that which differs from Study 1 is outlined below.

Procedure

Participants first completed a battery of online questionnaires through Qualtrics including a background questionnaire (e.g., demographic information, musical skill level, years of training and experience, etc.), as well as a measure of trait MPA (Kenny, 2009), followed by a daily diary for 7 days leading up to their important self-selected performances.

Participants were provided with a brief description of NSI (i.e., NSI is imagery which "pops" into your mind without any effort to consciously or intentionally create it) and were asked (*yes* or *no*) whether they experienced NSI related to musical performances that day.

Participants also completed the 17-item revised version of the Competitive State Anxiety Inventory-2R (CSAI-2R; Cox et al., 2003a; Martens et al., 1990) measuring the interpretation of cognitive (5 items) and somatic anxiety (7 items) ranging from 1(*hinders*) to 7 (*helps)*, and self-confidence (5 items), with responses ranging from 1 (*never*) to 7 (*always*). This measure has shown acceptable to excellent internal consistency applied to music performance anxiety, with cognitive and somatic interpretation alpha's of .78 and .86, and a self-confidence alpha of .90 (Yoshie et al., 2009). For ease of interpretation, we reverse scored the interpretation subscale in our analyses such that higher values indicated more debilitative interpretations of state MPA. See Appendix B.

Participants

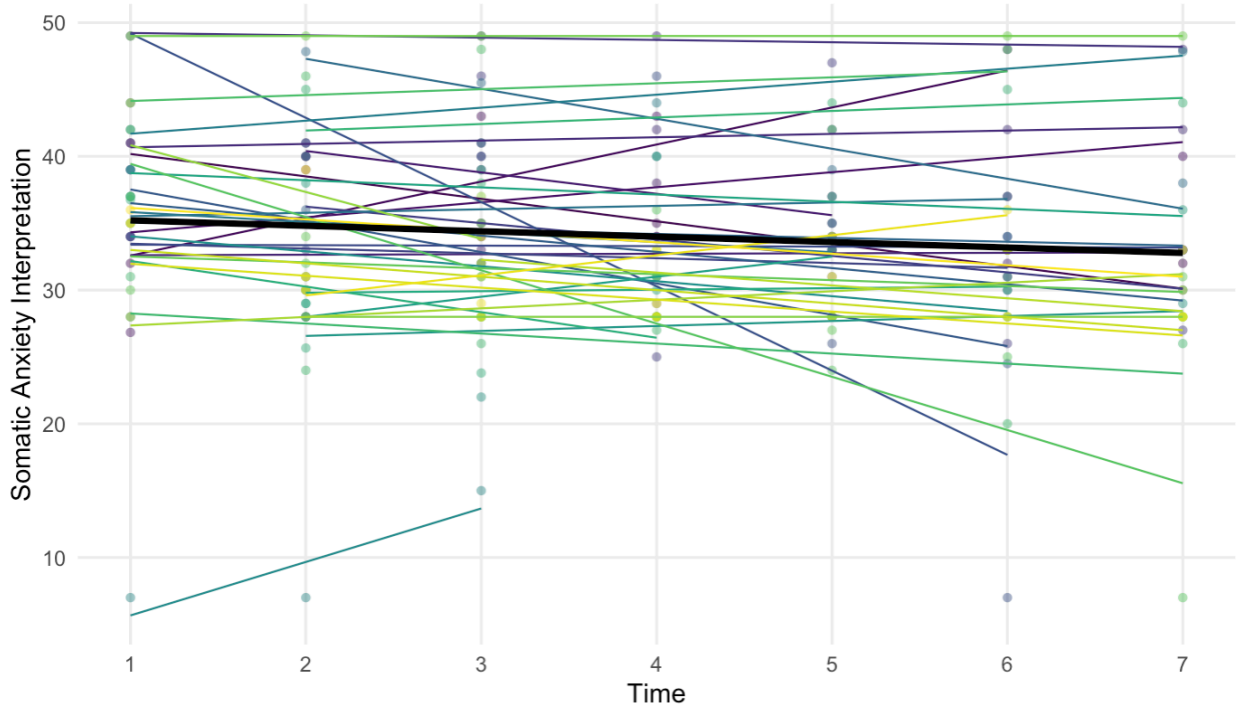
Participants ($N = 40$) primarily performed classical music (87.5%). See Study 1 for further details about the research participants.

Data Analytic Approach

Data were analyzed using linear mixed models in IBM SPSS version 29. See Figures 4, 5, and 6 for participant plots for somatic and cognitive anxiety interpretation as well as self-confidence over time.

Figure 4

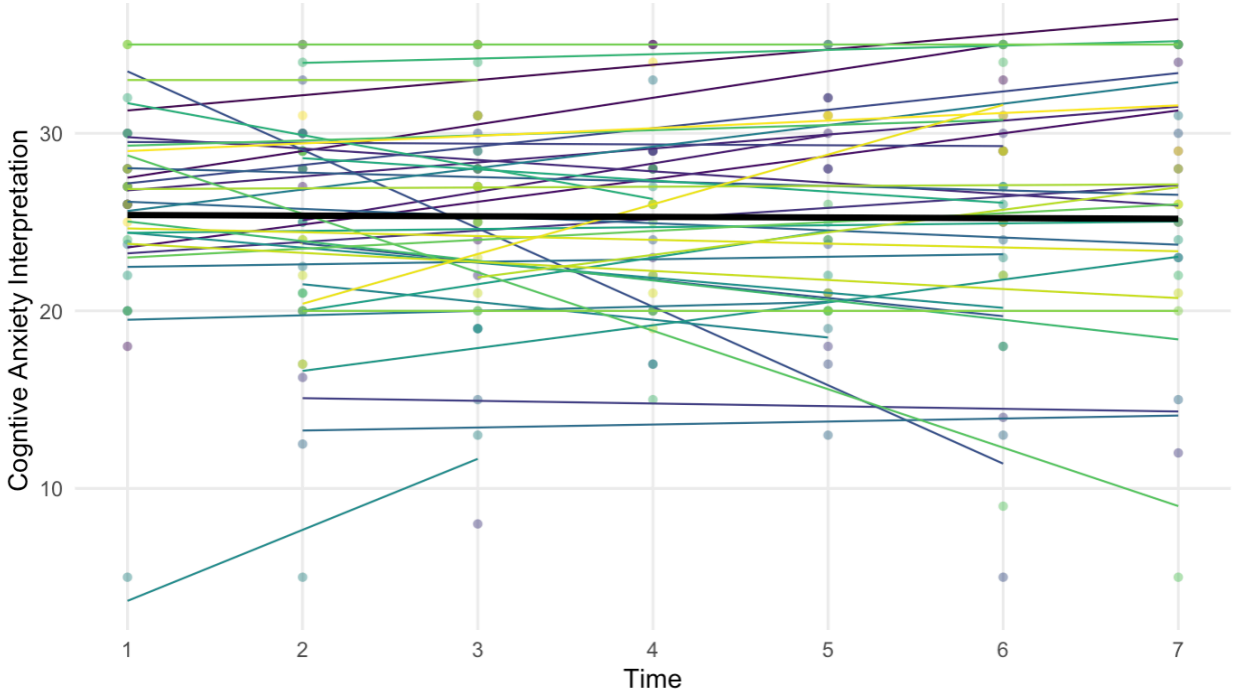
Somatic Anxiety Interpretation Scores Over Time



Note. This figure shows each participant's trajectory for somatic anxiety interpretation (raw scores) over the 7 days leading up to their performance. The bolded black line represents the average trajectory of somatic anxiety interpretation over time. The coloured lines represent each participant's individual trajectory, and are shaded to make the lines more readily discriminable.

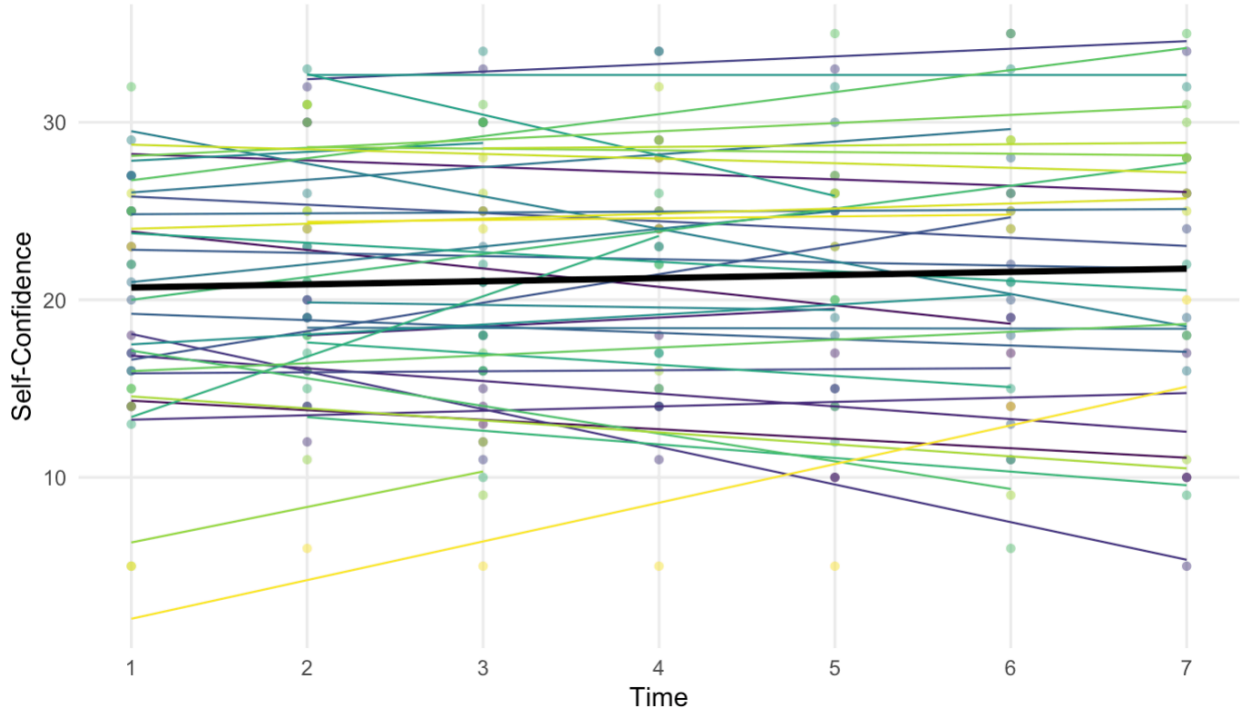
Figure 5

Cognitive Anxiety Interpretation Scores Over Time



Note. This figure shows each participant's trajectory for cognitive anxiety interpretation (raw scores) over the 7 days leading up to their performance. The bolded black line represents the average trajectory of cognitive anxiety interpretation over time. The coloured lines represent each participant's individual trajectory, and are shaded to make the lines more readily discriminable.

Figure 6
Self-confidence Scores Over Time



Note. This figure shows each participant's trajectory for self-confidence (raw scores) over the 7 days leading up to their performance. The bolded black line represents the average trajectory of self-confidence over time. The coloured lines represent each participant's individual trajectory, and are shaded to make the lines more readily discriminable.

After estimating basic random intercept models for each of our criterion variables, we conducted three main analyses for each criterion variable. First, state MPA interpretation and self-confidence were modeled with time as a level 1 predictor, with linear as well as quadratic terms to capture any acceleration in these variables (e.g., increase in debilitative interpretations of anxiety or decreases in self-confidence) over time. Next, trait MPA was added as a grand-mean centred time-invariant predictor as well as the cross-level interaction between time and trait MPA. Last, NSI was entered as a time-variant covariate. Random effects were included for slopes and intercepts as we allowed for the fact that participants might differ in terms of starting points (e.g., initial self-confidence levels) and rates of change over time.

Missing item-level data were pro-rated to create daily total scores for the different facets of state MPA interpretation and self-confidence, to retain as much data as possible.[19]

Results

Preliminary Analyses

Please refer to Study 1 for detailed information regarding the average number of study responses over time as well as characteristics of the performances around which participants completed the study. As reported in Study 1, the majority of study participants (82.5%) experienced NSI on one or more days throughout the study, although mean frequency was low on average, with a mean of 1.95 days (*SD* = 1.58; range 0 to 6).

Omega values were computed for each subscale of the CSAI-2R as estimates of within-person (ω_w) and between-person (ω_B) reliability (Geldhof et al., 2014). This measure demonstrated adequate reliability for all subscales; somatic anxiety interpretation (ω_w = .84, ω_B = .96), cognitive anxiety interpretation (ω_w = .75, ω_B = .99), and self-confidence (ω_w = .76, ω_B = .97).

Contrary to our hypotheses, daily experiences of NSI and cognitive and somatic anxiety interpretation or self-confidence were not significantly associated at the between or within-person levels. However, the frequency with which participants experienced NSI over the study was significantly positively associated with trait MPA, as reported in Study 1. Further, contrary to our hypotheses, at the between-person level, the experience of NSI (*yes* or *no*) at any point over the course of the study was not associated with state MPA interpretation, trait MPA, or self-

[19] For somatic anxiety interpretation, 4.8% of missing data were pro-rated, while for cognitive anxiety interpretation, 2.9% of missing data were pro-rated. There were no missing data for the self-confidence subscale.

confidence. See Table 5 for means and standard deviations for study variables, as well as a summary of ICCs.

Table 5

Between and within-person correlations for state MPA interpretation and self-confidence and intraclass correlations

	M	SD	ICC	1	2	3	4	5	6
CSAI-2R Subscales									
1. *Cognitive Interpretation*	25.05	5.77	.67	-	.59**	-.54**	.20	.38*	.02
2. *Somatic Interpretation*	34.05	7.07	.62	.54***	-	-.35*	.17	.38*	.11
3. *Self-confidence*	21.25	6.75	.79	-.34***	-.28***	-	-.25	-.46**	-.06
4. NSI Daily	1.95	1.58	.23[20]	.02	.10	-.13	-	.35*	.57**
5. Trait MPA	132.49	38.14						-	.19
6. Any experience of NSI									-

Note: Between-person correlations are above the diagonal and within-person correlations are below the diagonal. NSI = Negative Spontaneous Imagery. Because Trait MPA is a level 2 variable measured once, an ICC and within-person correlations were not computed. Similarly, because 'Any experience of NSI' was captured as a binary variable across the study period, ICC's and within-person correlations were not computed. For between-person analyses, a sum variable was created which reflects the frequency with which participants experienced NSI over the course of the study, and thus the mean and standard deviation also reflect this. Within-person correlations reflect the degree to which a participant's score on different measures are related to one another over time.
*$p < .05$ level (2-tailed). ** $p < .01$ level (2-tailed). *** $p < .001$ level (2-tailed).

[20] The ICC for NSI daily was computed using Fleiss and Cuzick's (1979) approach with the Intracluster Correlation Coefficient for Binary Data (ICCbin) package in R.3.6.1 (R Core Team, 2019) as this method is suited for binary outcomes in multi-level data (McMahon et al., 2006).

Somatic Anxiety Interpretation

Unconditional growth model

Sixty-two percent of the variability in somatic anxiety interpretation was accounted for by differences between participants. Building on the random intercept model, adding the linear effect of time significantly improved model fit, $\chi^2(2) = 14.42$, $p < .01$, though adding the quadratic effect of time did not, $\chi^2(1) = .02$, $p > .05$. Adding a random slope for the linear effect of time significantly improved model fit, $\chi^2(2) = 9.66$, $p < .01$. Contrary to our predictions, somatic anxiety interpretation did not become more debilitative over time leading up to performances. Indeed, neither the linear nor quadratic effect of time were significant, indicating that the average overall slope for somatic anxiety interpretation was flat and did not demonstrate trend over time. However, consistent with our predictions, participants significantly differed in terms of their initial levels of somatic anxiety interpretation and rates of change over time. At the within person level, participants' daily somatic anxiety interpretation scores significantly varied around their growth trajectories. See Table 6 for a summary of Model 1.

Adding trait MPA as a time-invariant covariate

Adding trait music performance anxiety (MPA) and the cross-level interaction between trait MPA and time significantly improved model fit, $\chi^2(2) = 87.84$, $p < .01$. Consistent with our hypotheses, trait MPA predicted initial levels of somatic anxiety interpretation, such that those with higher trait MPA also had higher initial levels of somatic anxiety interpretation (i.e., viewed somatic anxiety as more debilitative to performance). Contrary to our hypotheses, trait MPA did not predict the degree of change in somatic anxiety interpretation over time. Consistent with Model 1, there was significant variability in initial levels of somatic anxiety interpretation and

change over time, and participants' daily somatic anxiety interpretation scores significantly varied around their growth trajectories. See Table 6 for a summary of Model 2.

Adding NSI as a time-variant covariate

Contrary to our predictions, the addition of negative spontaneous imagery (NSI) did not improve model fit, $\chi^2(1) = 2.48$, $p > .05$, and the large confidence interval around the NSI estimate suggests that on average within person, somatic anxiety interpretation was not associated with the occurrence of NSI. See Table 6 for a summary of Model 3.

Table 6

Somatic Anxiety Interpretation Model

	Model 1			Model 2			Model 3		
Fixed Effects	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**
Intercept	35.33*** (1.32)	1,48.34	[32.68, 37.97]	34.73*** (1.28)	1,48.14	[32.15, 37.31]	33.81*** (1.42)	1,62.54	[30.97, 36.66]
Time	-0.27 (0.60)	1,85.09	[-1.47, 0.92]	-0.05 (0.64)	1,76.81	[-1.32, 1.22]	0.23 (0.66)	1,82.15	[-1.09, 1.54]
$Time^2$	-0.04 (0.09)	1,68.95	[-0.23, 0.14]	-0.07 (0.10)	1,62.09	[-0.26, 0.13]	-0.10 (0.10)	1,64.50	[-0.30, 0.10]
Trait MPA				0.08* (0.03)	1,37.61	[0.02, 0.15]	0.08 *(0.03)	1,37.77	[0.01, 0.15]
Trait MPA*Time				-0.01 (0.01)	1,31.05	[-0.02, 0.01]	-0.01 (0.01)	1,30.94	[-0.02, 0.01]
NSI							1.50 (0.92)	1,147.16	[-0.32, 3.32]
Random Effects	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**
Level 2									
Intercept	47.96*** (13.85)	3.46	[27.24, 84.45]	38.63** (12.19)	3.17	[20.81, 71.70]	40.48** (12.71)	3.19	[21.88, 74.89]
Intercept and Time	-3.02 (2.57)	-1.18	[-8.06, 2.02]	-2.38 (2.45)	-0.97	[-7.18, 2.43]	-3.05 (2.58)	-1.18	[-8.10, 2.01]
Time	1.48* (0.63)	2.36	[0.65, 3.40]	1.58* (0.67)	2.34	[0.68, 3.64]	1.67* (0.70)	2.37	[0.73, 3.81]
Level 1									
Residual	17.26*** (2.56)	6.75	[12.91, 23.07]	18.07*** (2.74)	6.60	[13.43, 24.31]	17.87*** (2.80)	6.39	[13.15, 24.29]
Autocorrelation	-0.02 (0.14)	-0.14	[-0.29, 0.26]	-0.03 (0.15)	-0.18	[-0.31, 0.26]	0.004 (0.15)	0.03	[-0.29, 0.29]
Overall Model Test									
-2 Log Likelihood	1279.87			1192.03			1189.55		
$\Delta\chi^2$				87.84**			2.48		
Δdf				2			1		

Note: Bs represent the unstandardized regression coefficients. Time = linear function of time, $Time^2$ = quadratic function of time. Time is coded day 1 = 0. Intercept = average level of somatic anxiety interpretation at Day 0. NSI = negative spontaneous imagery. Model 1 is the Unconditional growth model for somatic anxiety interpretation, Model 2 adds Trait MPA as a time-invariant covariate, and Model 3 adds daily experiences of NSI (i.e., yes or no) as a time-varying covariate. †$p < .10$, ** $p < .05$, ** $p < .01$, *** $p < .001$.

Cognitive Anxiety Interpretation

Unconditional growth model

Sixty-seven percent of the variability in cognitive anxiety interpretation was accounted for by differences between participants. Building on the random intercept model, adding the linear effect of time significantly improved model fit, $\chi^2(2) = 28.86$, $p < .01$. Adding the quadratic effect of time did not, $\chi^2(1) = .32$, $p > .05$, nor did adding a random slope for the linear effect of time, $\chi^2(2) = 3.61$, $p > .05$.

Contrary to our predictions, cognitive anxiety interpretation did not become more debilitative over time leading up to performances. Indeed, neither the linear nor quadratic effect of time were significant, indicating that the average overall slope for cognitive anxiety interpretation was flat and did not demonstrate trend over time. However, consistent with our predictions, participants differed in terms of their initial levels of cognitive anxiety interpretation[21] though there was not significant variability in terms of participants' rates of change over time. At the within person level, participants' daily cognitive anxiety interpretation scores significantly varied over time. See Table 7 for a summary of Model 1.

Adding trait MPA as a time-invariant covariate

Adding trait music performance anxiety (MPA) and the cross-level interaction between trait MPA and time significantly improved model fit, $\chi^2(2) = 87.84$, $p < .01$. Consistent with our hypotheses, trait MPA predicted initial levels of cognitive anxiety interpretation, such that those with higher trait MPA also had higher initial levels of cognitive anxiety interpretation (i.e., viewed cognitive anxiety as more debilitative to performance). However, contrary to our hypotheses, trait MPA did not predict the degree of change in cognitive anxiety interpretation

[21] This finding trended towards significance.

over time and participants' slopes did not significantly vary. Consistent with Model 1, there was significant variability in initial levels of cognitive anxiety interpretation and change over time, and at the within-person level, participants' daily cognitive anxiety interpretation scores significantly varied over time. See Table 7 for a summary of Model 2.

Adding NSI as a time-variant covariate

Contrary to our predictions, the addition of negative spontaneous imagery (NSI) did not improve model fit, $\chi^2(1) = 2.48$, $p > .05$ and the large confidence interval around the NSI estimate suggests that on average within person, cognitive anxiety interpretation was not associated with the occurrence of NSI. See Table 7 for a summary of Model 3.

Table 7

Cognitive Anxiety Interpretation Model

	Model 1			Model 2			Model 3		
Fixed Effects	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**
Intercept	24.72*** (.10)	1,46.08	[22.71, 26.73]	24.76*** (.97)	1,48.80	[22.81, 26.71]	24.66*** (1.06)	1,63.48	[22.56, 26.77]
Time	0.36 (0.53)	1,81.64	[-.70, 1.42]	0.58 (0.56)	1,76.49	[-0.53, 1.69]	0.61 (0.57)	1,80.37	[-0.52, 1.75]
$Time^2$	-0.05 (0.08)	1,65.84	[-0.22, 0.12]	-0.08 (0.09)	1,60.49	[-0.25, 0.10]	-0.08 (0.09)	1,62.13	[-0.26, 0.09]
Trait MPA				0.07** (0.02)	1,39.73	[0.02, 0.12]	0.07* (0.03)	1,39.90	[0.02, 0.12]
Trait MPA*Time				-0.004 (0.01)	1,33.46	[-0.02, 0.01]	-0.004 (0.01)	1,33.45	[-0.02, 0.01]
NSI							0.15 (0.63)	1,117.67	[-1.09, 1.40]
Random Effects	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**
Level 2									
Intercept	19.18† (11.12)	1.73	[6.16, 59.75]	15.24† (8.81)	1.73	[4.91, 47.34]	15.51† (8.86)	1.75	[5.06, 47.52]
Intercept and Time	-0.06 (1.95)	-0.03	[-3.89, 3.77]	-0.60 (1.82)	-0.33	[-4.17, 2.96]	-0.66 (1.84)	-0.36	[-4.26, 2.94]
Time	0.61 (0.54)	1.12	[0.11, 3.77]	0.87 (0.57)	1.52	[0.24, 3.16]	0.88 (0.57)	1.54	[0.24, 3.14]
Level 1									
Residual	16.30** (6.23)	2.62	[7.71, 34.46]	15.05** (5.004)	3.01	[7.85, 28.88]	14.94** (4.95)	3.02	[7.81, 28.60]
Autocorrelation	0.50** (0.19)	2.71	[0.07, 0.78]	0.44* (0.19)	2.36	[0.02, 0.73]	0.43* (0.19)	2.32	[0.01, 0.72]
Overall Model Test									
-2 Log Likelihood	1183.25			1099.91			1099.86		
$\Delta\chi^2$				83.34**			0.05		
Δdf				2			1		

Note: Bs represent the unstandardized regression coefficients. Time = linear function of time, $Time^2$ = quadratic function of time. Time is coded day 1 = 0. Intercept = average level of cognitive anxiety interpretation at Day 0. NSI = negative spontaneous imagery. Model 1 is the Unconditional growth model for cognitive anxiety interpretation, Model 2 adds Trait MPA as a time-invariant covariate, and Model 3 adds daily experiences of NSI (i.e., yes or no) as a time-varying covariate. †$p < .10$, ** $p < .05$, ** $p < .01$, *** $p < .001$.

Self-confidence

Unconditional growth model

Seventy-nine percent of the variability in self-confidence was accounted for by differences between participants. Building on the random intercept model, adding the linear effect of time did not significantly improve model fit, $\chi^2(2) = .24$, $p > .05$, nor did adding the quadratic effect of time, $\chi^2(1) = .09$, $p > .05$. However, adding a random slope for the linear effect of time significantly improved model fit, $\chi^2(2) = 9.6$, $p < .05$.

Contrary to our predictions, self-confidence did not decrease over time. Indeed, neither the linear nor quadratic effect of time were significant, indicating that the average overall slope for self-confidence was flat and did not demonstrate trend over time. Consistent with our predictions, participants significantly differed in terms of their initial levels of self-confidence and rates of change over time. At the within person level, participants' daily self-confidence scores significantly varied around their growth trajectories. See Table 8 for a summary of Model 1.

Adding trait MPA as a time-invariant covariate

Adding trait music performance anxiety (MPA) and the cross-level interaction between trait MPA and time significantly improved model fit $\chi^2(2) = 81.83$, $p < .01$. Consistent with our hypotheses, trait MPA predicted initial levels of self-confidence, such that those with higher trait MPA also had lower initial levels of self-confidence. However, contrary to our hypotheses, although there was significant variability in participants' slopes, trait MPA did not predict the degree of change in self-confidence over time. Consistent with Model 1, there was significant variability in initial levels of self-confidence and change over time, and participants' daily self-

confidence scores significantly varied around their growth trajectories. See Table 8 for a summary of Model 2.

Adding NSI as a time-variant covariate

The addition of negative spontaneous imagery (NSI) significantly improved model fit $\chi^2(1) = 5.81$, $p < .05$. Consistent with our predictions, on average within person, self-confidence was significantly lower on days where participants experienced NSI compared to days where they did not. See Table 8 for a summary of Model 3.

Table 8

Self-confidence Model

	Model 1			Model 2			Model 3		
Fixed Effects	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**	***B* (*SE*)**	***df***	**95% CI**
Intercept	21.28*** (1.14)	1,46.66	[18.99, 23.56]	21.10*** (1.11)	1,45.32	[18.87, 23.33]	22.11*** (1.18)	1,54.32	[19.75, 24.47]
Time	0.03 (0.39)	1,90.54	[-0.74, 0.79]	-.01 (.41)	1,84.36	[-.82, .80]	-.29 (.40)	1,86.41	[-1.09, .51]
$Time^2$	-0.003 (0.06)	1,71.94	[-.012, 0.12]	.01 (.06)	1,66.34	[-.12, .13]	.04 (.06)	1,65.62	[-.08, .16]
Trait MPA				-.08* (.03)	1,38.56	[-.13, -.02]	-.07* (.03)	1,38.45	[-.13, -.02]
Trait MPA*Time				-.003 (.01)	1,31.59	[-.01, .01]	-.003 (.004)	1,31.48	[-.01, .01]
NSI							-1.59* (.64)	1,152.28	[-2.85, -.34]
Random Effects	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**	***Estimate (SE)***	***z***	**95% CI**
Level 2									
Intercept	43.30*** (10.71)	4.04	[26.66, 70.31]	36.56*** (9.54)	3.83	[21.92, 60.96]	37.77*** (9.70)	3.89	[22.83, 62.48]
Intercept and Time	-0.85 (1.16)	-.73	[-3.12, 1.42]	-1.18 (1.18)	-1.00	[-3.49, 1.13]	-1.44 (1.18)	-1.22	[-3.76, .88]
Time	0.52* (0.23)	2.31	[0.22, 1.23]	0.59* (0.26)	2.26	[0.25, 1.39]	0.61* (0.25)	2.42	[0.27, 1.38]
Level 1									
Residual	8.42*** (1.07)	7.84	[6.55, 10.80]	8.76*** (1.15)	7.63	[6.78, 11.33]	8.33*** (1.08)	7.74	[6.47, 10.73]
Autocorrelation	-0.23† (0.13)	-1.81	[-0.45, 0.03]	-0.24† (0.13)	-1.84	[-0.47, 0.03]	-0.31* (0.12)	-2.48	[-0.53, -0.05]
Overall Model Test									
-2 Log Likelihood	1190.69			1108.86			1103.05		
$\Delta\chi^2$				81.83**			5.81*		
Δdf				2			1		

Note: Bs represent the unstandardized regression coefficients. Time = linear function of time, $Time^2$ = quadratic function of time. Time is coded day 1 = 0. Intercept = average level of self-confidence at Day 0. NSI = negative spontaneous imagery. Model 1 is the Unconditional growth model for self-confidence, Model 2 adds Trait MPA as a time-invariant covariate, and Model 3 adds daily experiences of NSI (i.e., yes or no) as a time-varying covariate. †$p < .10$, ** $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

State MPA Interpretation and Self-Confidence Over Time

Our research provides valuable insight into elite musicians' experiences of state MPA interpretation and self-confidence leading up to important anxiety-provoking performances. Contrary to our predictions, state somatic and cognitive anxiety interpretation did not vary as a function of time at the group level (i.e., demonstrating no trend over time) and this result is similar to previous findings in athletes in which interpretation did not vary over time (Hanton et al., 2004; Wiggins, 1998). Additionally, contrary to our hypotheses, self-confidence did not vary as a function of time at the group level, findings consistent with MAT (Martens et al., 1990) and research in athletes (Hanton et al., 2004; Wiggins, 1998). Yet, it is possible that our study design precluded measurement of a "ramp-up" period which has been found in previous research measuring MPA more proximal to performances (Papageorgi et al., 2013) in which self-confidence may decrease and state MPA interpretation might become increasingly debilitative. Thus, future research should examine the trajectory of state MPA interpretation and self-confidence the day of and immediately before performances, in addition to timepoints more distal to performing.

However, in line with our predictions, participants significantly differed in terms of their initial levels of somatic and cognitive[22] anxiety interpretation and self-confidence, and in their rates of change over time for somatic anxiety interpretation and self-confidence. Further, at the within-person level, participants significantly varied around their own growth trajectories for somatic anxiety interpretation and self-confidence, and around the estimated growth trajectory for cognitive anxiety interpretation.

[22] This effect was marginally significant.

Consistent with our predictions, those with higher trait MPA initially interpreted state somatic and cognitive anxiety as more debilitative to performance and those with higher trait MPA also had lower initial levels of self-confidence. Further, the majority of the variability in somatic and cognitive anxiety interpretation and self-confidence was accounted for by differences between rather than within participants, yet the associations between these variables and trait MPA were small. Thus, as we have suggested in Study 1, future research should capture other variables which might better account for differences between participants (e.g., fear of negative evaluation for specific performances). Although there was significant variability in participants' slopes for somatic anxiety interpretation and self-confidence, contrary to our predictions, trait MPA did not influence variability over time and there may be other factors (e.g., trait self-efficacy) which predict such variability over time.

Although several of the above findings were unexpected, multi-level analyses allowed us to explore the association between NSI and state MPA interpretation and self-confidence among participants who experienced NSI leading up to performances. In line with our predictions, on average within person, self-confidence was significantly lower on days where participants experienced NSI compared to days where they did not. However, contrary to our predictions, NSI was not significantly associated with musicians' interpretations of state cognitive or somatic anxiety (e.g., as helping or hindering performances) leading up to performances.

Clinical Implications

Taken together with our previous findings, our results concerning the association between NSI and self-confidence bolster our previous suggestion that clinicians working with musicians should assess for experiences of NSI which may enrich case formulations, and consider integrating imagery-based Cognitive Behavioural Therapy techniques designed to target negative

imagery (see Study 1 for additional details). While more research is needed to understand the potential causal relationship between NSI and self-confidence, NSI may be especially impactful for musicians, considering the link between self-confidence and performance outcomes (Lochbaum et al., 2022; Woodman & Hardy, 2003).

Limitations, Conclusions, and Future Directions

Several limitations of the current research must be addressed. Our study included a small sample size and we may have been underpowered to detect small but important effects. Future well-powered research should investigate the association between NSI and state MPA interpretation and self-confidence in larger samples of elite musicians leading up to anxiety-provoking performances. Further, such research should include timepoints more proximal to performing as our study design may have impacted our findings. Although multi-level analyses are well-equipped to handle missing data, missing data was also a concern in the present research.

In Study 1, we found that state cognitive and somatic anxiety intensity were higher on average within person on days where musicians experienced NSI compared to days when they did not. However, our current findings indicate that the association between NSI and state MPA intensity is not mediated by musicians' interpretations of their MPA (i.e., as helping or hindering performance), as NSI and state MPA interpretation were not associated in the current study.

Yet, our novel findings suggest an important coupling between NSI and self-confidence such that on average within person, self-confidence was significantly lower on days where musicians experienced NSI compared to days where they did not. Thus, although NSI does not appear to impact whether musicians perceive state MPA intensity as helping or hindering performances, it may be one factor which contributes to musicians' self-efficacy (i.e., whether

they feel up to the performance task) for specific feared performances. Although such experiences were not associated at the trait level in the current study – indicating that any effect of NSI on self-confidence may be transient – self-confidence and performance outcomes are positively associated (Lochbaum et al., 2022; Woodman & Hardy, 2003). As such, factors associated with *decreased* self-confidence on average within person leading up to important anxiety provoking performances warrant additional research.

Indeed, taken together, our previous and current findings suggest that NSI is not only highly prevalent, but impactful for musicians. Specifically, those with higher trait MPA as well as somatic and cognitive anxiety intensity experience NSI more frequently, and leading up to important anxiety-provoking performances, state MPA intensity is higher and self-confidence is lower on days where musicians experience NSI compared to days where they do not. Thus, our findings may have important implications for theoretical models of MPA.

As reviewed, the cognitive theoretical model of MPA suggests that anxiety is fueled by low self-efficacy which drives a discrepancy between how musicians believe audiences perceive them and the high standards which musicians believe audiences hold for their performances (Osborne & Franklin, 2002). However, the study which informed the cognitive model of MPA did not measure NSI and given our findings, it is possible that this phenomenon fuels MPA similar to its role in social anxiety (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997). For instance, our results indicate that musicians anticipating anxiety-provoking performance situations experience NSI related to performances. Such imagery may reflect how musicians believe audiences perceive them (e.g., performing poorly, making mistakes). Although we measured self-confidence and not self-efficacy per se, it is possible that NSI lowers musicians' self-efficacy for such performances, reinforcing and contributing to negative self-schema

concerning performance competence. Further, similar to processes outlined in cognitive models of social anxiety (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997), musicians may compare such mental representations of themselves (e.g., performing poorly) to the high standards they presume audiences hold for their performances, fueling the discrepancy central to the cognitive model of MPA. Indeed, the proposed interaction between NSI and schema concerning self-efficacy for feared performances situations is consistent with the combined cognitive biases hypothesis (Hirsch, Clark, et al., 2006), in which multiple cognitive biases interact.

However, we must acknowledge that our suggestions are speculative at this point and need to be examined empirically. Indeed, as previously outlined, we cannot rule out the possibility that NSI is not implicated in the maintenance of MPA due to our study design. For instance, decreases in self-confidence may leave musicians more vulnerable to experiences of intrusive imagery, and third variables which we did not measure might also drive both experiences.

Thus, in order to inform future MPA theory and understand more about the potential role of NSI in the maintenance of MPA, cross-lagged designs should investigate the relationship between NSI and self-confidence leading up to important anxiety-provoking performances in elite musicians who experience MPA. Further, as outlined in Study 1, research in elite musicians should also operationalize the discrepancies central to the cognitive models of MPA (Osborne & Franklin, 2002) and social anxiety (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997) to investigate whether and how each predicts MPA. Such research should also examine whether NSI adds incremental validity to the prediction of MPA and would further clarify our

conceptualization of MPA as a variant of social anxiety disorder and may suggest that the exclusion of NSI in the cognitive model of MPA should be reconsidered.

To our knowledge, our study is one of the first to examine elite musicians' experiences of state MPA interpretation and self-confidence leading up to anxiety-provoking performances, providing a unique window into the experiences of elite musicians. Further, to the best of our knowledge, our study is the first to examine the association between NSI, an important factor theorized to maintain social anxiety, and state MPA interpretation and self-confidence in anticipation of performing. Although some findings were inconsistent with our hypotheses, our research provides important clinical implications and lays groundwork for future MPA theory and research.

Study 3

As we outlined in our literature review, MPA can have a negative impact on even the most seasoned musicians (Fernholz et al., 2019) and numerous treatments have been developed to help musicians manage this distressing concern. Intentional mental imagery is often used in such intervention research (Finch & Oakman, 2023), and musicians have long understood the importance of intentional imagery (Covington, 2005) related to musical performances. Indeed, as we previously outlined, intentional mental imagery represents an ideal mental preparation tool for musicians, as it can be used to regulate anxiety (Ji et al., 2016; McEvoy et al., 2022) and enhance performance (Driskell et al., 1994; Simonsmeier et al., 2021). Yet, key questions remain regarding how musicians should most effectively employ mental imagery to manage MPA. Thus, as an important first step, the primary aim of Study 3 was to investigate how elite musicians employ intentional imagery (e.g., its content and characteristics) to manage MPA to inform future imagery-based MPA intervention research. To explore the phenomenology of intentional imagery in-depth, we conducted a semi-structured interview with elite musicians.

Because imagery can serve multiple functions (Cumming & Williams, 2013), we were also interested in what musicians find most helpful about imagery used to manage MPA, and whether contextual factors influence the type of imagery musicians use to manage MPA, such as the proximity and subjective importance of a performance, performance type (e.g., solo or group), character/s of the piece being performed, or how anxious musicians are for a given performance. Similarly, given that imagery can serve multiple purposes (Cumming & Williams, 2013), we also examined whether musicians use imagery for other functions (e.g., to prepare for performances).

Previous research suggests that musicians use intentional imagery for a variety of purposes including affect regulation (Clark et al., 2007; DeSantis et al., 2021, 2022; Holmes, 2005), and we thus predicted that musicians would use imagery to manage MPA and for other functions (e.g., to prepare for performances).

Secondary Objectives

As noted in our literature review, mental imagery is not a singular experience or ability. As such, a secondary objective of Study 3 was to investigate whether musicians experience difficulty controlling intentional imagery used to manage MPA. For instance, as previously reviewed, musicians (DeSantis et al., 2021) and dancers (Nordin & Cumming, 2005) experience spontaneous mental imagery, and we were interested in whether musicians experience spontaneous content in their intentional imagery used to manage MPA, and the valence of such experiences (e.g., neutral, positive, or negatively valanced imagery). Last, as we outlined above, some research indicates that those with high social anxiety are more likely than those with low social anxiety to cope with NSI by attempting to suppress or ignore NSI (Moscovitch et al., 2013). Thus, we were also interested in how musicians respond to NSI which they might experience while using intentional imagery to manage MPA given the importance of positive

Method

Procedure

This study was approved by the University of Waterloo Office of Research Ethics (ORE# 31521). In order to participate, participants had to endorse using intentional imagery or experiencing spontaneous imagery related to musical performance. Additionally, participants had to be professional musicians, music students enrolled in university or college-level music performance programs (e.g., BMus, MMus), or students enrolled in university or college-level

programs with a significant performance requirement (e.g., Bachelor of Arts in Music). Participants were recruited through the University of Waterloo and other university and college-level music performance programs, professional musical ensembles, and musical contacts of the first author.

Participants first completed a battery of online questionnaires to characterize our sample, including demographic (e.g., age) and musical background information (e.g., primary instrument, years of experience). Next, participants were contacted for a semi-structured interview which took approximately 45 minutes and was held virtually (Skype) or in-person at the University of Waterloo depending on participants' location and preference. All interviews were conducted by the first author prior to the Covid-19 pandemic. Participants received $40 remuneration for completing the study and all interviews were audio recorded for transcription.

Measures

Background Questionnaire

Participants completed a background questionnaire concerning demographic (e.g., age, gender) and musical background information (e.g., years of experience).

Imagery Interview

The imagery interview protocol was developed for the current research (See Appendix C). Similar to other interview studies investigating imagery in musicians (DeSantis et al., 2021) and dancers (Nordin & Cumming, 2005), it began by providing participants with a definition of imagery based on White and Hardy (1998, p. 389). The researcher also outlined the difference between intentionally created and spontaneously experienced imagery, and participants were given the opportunity to ask questions about this distinction. Throughout interviews, the

researcher also probed to ensure that participants were describing images as opposed to purely verbally-based cognitions.

Our primary interest was in imagery used to manage MPA or heightened physiological arousal.[23] Yet as noted, applied models suggest that the same imagery approach can serve multiple functions (e.g., anxiety management and performance optimization) (Cumming & Williams, 2013). As such, the protocol began by asking participants about their general use of imagery related to music performance, their goals concerning reported strategies, and whether and how such imagery was difficult to control.

Next, participants were asked open-ended questions concerning how they specifically use imagery to manage MPA or heightened physiological arousal.[24] Likert-style scales were also included to capture how frequently participants used such imagery on a scale from 1 (*Never*) to 7 (*Always*), and how helpful such imagery was on a scale from 1 (*Not at all*) to 7 (*Extremely*). Participants were asked whether they incorporated specific sensory content into imagery (e.g., auditory, visual, kinesthetic, etc.). Participants were also asked whether imagery used to manage MPA or heightened physiological arousal varied based on how close and subjectively important an upcoming performance was, the type of performance (e.g., solo or group), character/s of the piece being performed, and how anxious they were about a given performance.

Participants were also asked to rate how difficult it was to control intentional imagery used to manage MPA or heightened physiological arousal, on a scale from 1 (*Not at all*) to 7 (*Extremely*) and were asked open-ended questions concerning what was difficult to control about intentional imagery used to manage MPA or heightened physiological arousal. Next, participants

[23] Because not all musicians identify MPA as debilitative to performance (see Herman and Clark (2023) for a review), we asked participants about imagery used to manage MPA and heightened physiological arousal.
[24] For participants who endorsed experiencing MPA, questions were phrased in regards to MPA specifically, and not heightened physiological arousal.

were asked whether they experienced spontaneous intrusions that "popped" into mind while engaged in intentional imagery to manage MPA or heightened physiological arousal and were asked open-ended questions concerning the content of such intrusions and how they responded to these. Likert-style ratings captured how frequently this occurred on a scale from 1 (*Never*) to 7 (*Always*) while engaged in intentional imagery to manage MPA or heightened physiological arousal.

Although interview questions asked participants about specific experiences as outlined above, participants often shared experiences which were relevant to our study aims, but included content which differed from the original questions which prompted these reflections. However, the researcher probed these responses due to the richness of the data.

Participants

Participants included professional musicians (70%) and music students (30%) in university-level music programs ($N = 24$).[25] Participants' mean years of experience on their primary instruments was 24.22 ($SD = 14.4$; range 2 to 54) and participants primarily performed classical music (68%). Participants played instruments from a variety of musical families including: strings (54.2%), woodwind (20.8%), voice (12.5%), brass (8.3%), and keyboard (4.2%).

Participants were 35 years of age on average ($SD = 14.9$, range 18-66). Sixty-seven percent of participants identified as women, 33% as men. Seventy-six percent of participants were White, 4% East Asian, 4% South Asian, 4% Middle Eastern, 4% West Indian/Caribbean, and 4% other.

[25] One participant noted throughout the interview that they were unsure whether they were describing imagery or thoughts, and their data was thus excluded.

Data Analytic Approach

Audio files of the interviews were transcribed and qualitative coding software (NVivo 12) was used to conduct a thematic analysis informed by Braun and Clark (2006) to allow for inductive and deductive coding. We also assessed inter-coder reliability, as we were interested in how reliably the coding scheme could be applied by multiple coders. Coding took place across several phases and the corpus of interviews was coded by the first author and a research assistant with university-level musical training.

Phase 1. Coders independently reviewed the corpus of interviews and generated an initial list of codes which they later organized into superordinate and subordinate themes. Next, a coding manual was created which provided definitions for superordinate and subordinate themes.

Phase 2. Qualitative researchers assessing inter-coder reliability must determine how much of the data to double code (e.g., segments of the interview). An approach from Campbell et al. (2013) was adapted in which segments of the interviews were selected as codable material. This approach was chosen as coding longer interviews is cognitively demanding and associated with poorer reliability (Hruschka et al., 2004).

Phase 3. Coders were each assigned half of the corpus of interviews to code using NVivo, which were then double coded by the second coder. Following suggestions by Campbell et al. (2013), coders were able to code text which had been selected by the first coder. However, the specific codes selected by the first coder did not appear for the second coder. Because imagery can serve numerous functions, multiple codes could be applied to the same text segment. This approach allowed us to explore passages of text to which coders applied various codes.

The coding process was recursive and instances of disagreement were discussed between coders. For instance, for disagreements between coders which were not consistent across multiple interviews as coding progressed, text was not recoded and discussions resolved disagreements for future coding. However, in instances where there was patterned disagreement (e.g., between two codes across multiple interviews as coding progressed), interview text was recoded.

Phase 4. In order to assess inter-coder reliability, a binary present or absent assessment was made for each code in the coding scheme across each interview for each coder, with Kappa values computed across the corpus of interviews. Guidelines for interpreting Kappa coefficients across the entire corpus were taken from Landis and Koch (1977), with coefficients above .41 indicating moderate agreement, above .61 indicating substantial agreement, and above .81 suggestive of near perfect agreement.[26]

Results

Twenty-three participants reported experiencing MPA (95.8%), while one participant endorsed experiencing heightened physiological arousal[27] related to musical performance. Regarding general experiences of perceived distress and impairment associated with MPA, 41.7% of participants found MPA distressing, 45.8% found that MPA impaired performance quality, and 47.6% reported that MPA impaired their career or career aspirations.

[26] O'Connor and Joffe (2020) note that different guidelines exist for interpreting ICR. However, the purpose of the research and its implications should be considered when interpreting ICR in qualitative research (e.g., with higher thresholds for results which are intended to inform policy decisions) (Hruschka et al., 2004). Given the exploratory nature of the present study, we chose the above interpretative guidelines (i.e., Landis & Koch, 1977) prior to conducting our analyses. However, others have suggested that Kappa estimates above .60 indicate moderate agreement (McHugh, 2012).

[27] This participant denied use of intentional imagery to manage heightened physiological arousal. As such, results reported below concern intentional imagery used to manage MPA.

Function of Intentional Imagery

Several themes emerged concerning why (i.e., for what function) participants used intentional imagery, including managing MPA, improving performance quality, preparing for a performance, and supplementing physical practice. Because the primary focus of the current study was to investigate intentional imagery used to manage MPA, we begin by exploring this function and additional related sub-themes which emerged. Inter-coder reliability fell above the moderate agreement range for the majority of codes.

Intentional imagery to manage MPA

The majority of study participants, 91.7% (N = 22), reported using intentional imagery to manage MPA, which participants endorsed using often (M = 5.95, SD = 1.32) and rated as helpful (M = 6.05, SD = .10). Concerning what participants imagined when utilizing imagery for this purpose, several subordinate themes emerged and participants reported that such imagery contained different sensory modalities. See Table 9 for the percentage and number of participants who endorsed various sensory content in their intentional imagery used to manage MPA. Table 10 presents Kappa values as well as the number and percentage of interviews to which the subordinate themes were applied across the corpus of interviews.

Table 9
Sensory content of intentional imagery used to manage MPA

Sensory Content	Percentage endorsed	Number of participants
Auditory	95.5	21
Visual	100	22
Kinesthetic	81.8	18
Tactile	72.7	16

Note: Although we included questions concerning all sensory modalities, participants did not endorse integrating olfactory or gustatory sensory content in their intentional imagery.

Dress Rehearsal

Dress Rehearsal was the sub-theme with the highest frequency across participants. Participants outlined creating detailed imagery of performances, ranging from the physical environment, to the acoustics and how a performance would ideally sound, to elements such as concert attire.

> I'll use mental imagery as a way to kind of rehearse before the actual performance. So one of my teachers in my masters told me to really specifically imagine what the performance was going to be like. So what outfit you were going to be wearing, what the stage is going to feel like. As much information as you could possibly conjure as basically a precursor, a dress rehearsal, as a mental image to practice what it's going to feel like when you get on stage (Participant 23).

> So an awareness of the environment, and that's a multi-faceted sort of thing. It could be a visual thing, are there a lot of lights on stage, can you see the actual audience or not, are the walls different. But also it could be an aural sort of thing, how does the concert hall sound, is it very reverberant, is it very dead, is there a lot of carpeting (Participant 13).

Reduce Anxiety

This approach often contained elements of physiological relaxation. For instance, Participant 9, a string player, detailed using imagery to envision "how you want things to feel on the fingerboard or with your bow, you imagine yourself in kind of like a relaxed state." Participant 14 further detailed a combination of physiological relaxation with more abstract

images to reduce anxiety, “For me, I almost always imagine a physical release of muscles. And it’s usually an image with like melting chocolate or spreading peanut butter, or something ooey and gooey that helps me just kind of melt into the sound.”

Exposure

Participants also described using imagery to pre-experience aspects of anxiety prior to performing to habituate to MPA. For instance, Participant 11 noted “another reason why I use imagery is to kind of imagine the worst case scenario, and stuff to kind of help me feel less nervous and to get all those nerves out of my system before I have to perform.” Participant 20 described a similar approach which is integrated into imagery at later stages of learning a piece of music, and additionally reported recommending this to their music students, “but I have my students and myself also, once everything is learned properly and you just know what you’re doing then imagery is like a performance in the venue as something you can imagine. And that involves actually enhancing nervousness so there’s not a shock when you walk out on stage.”

Harness/Channel Anxiety

Participants also detailed ways in which imagery was used to harness or channel aspects of their experience of MPA into feeling energized or excited. Participant 17 described:

> Well it’s an energy – you know that anxiety – it’s just like being excited about something, or what I mean there’s a certain – so it’s trying to get that anxiety channeled into a way that is helpful rather than harmful. It’s not like you don’t want any anxiety, because having anxiety – I mean maybe that’s not the right word to use – but it actually helps you focus, and kind of gives you that little bit of an edge.

Participant 7 similarly described:

> I think I try to feel it, and then try and change it from feeling nervous to energized. Because that’s generally how I am in real life is that I’ll get on stage and I’ll feel those sensations, I’ll feel really nervous, so in my visualization I’ll do that. I’ll be started by feeling nervous, and then I’ll try and channel it to just energy, and like feeling really good about the performance.

Mental Rehearsal

Participants also used Mental Rehearsal, in which detailed technical components of compositions were imagined in order to cope with MPA. Participant 13 described using Mental Rehearsal to shift focus away from or prevent MPA:

> For me the visualization is the music. Imagining the connection there and in terms of, you know there's a crescendo here, there's a decrescendo there, there's a rit [ritardando], I'm going to accent this particular note, this chord I'm going to roll, and hopefully by merging yourself in that - or myself – but emerging myself in that, I don't – or try not to allow the intrusion of negative thoughts that might cause performance anxiety.

Similarly, Participant 16 described:

> Like my approach so far has been to sort of follow this method of preparation and playing which you know at the ideal of it, you don't have to think about managing performance anxiety because you're sort of like stepping out of the one area of like – I don't know – nervousness or like feelings outside playing, and then into like this is my sphere of what happens when I play, and it doesn't include like I don't know, performance anxiety.

Metaphorical Imagery

Similar to Mental Rehearsal, Metaphorical Imagery emerged as a sub-theme wherein participants detailed focusing their attention on immersing themselves in the music in order to manage MPA. For instance, Participant 18 described using imagery to "try and get myself in the mood of the piece if that makes any sense. Or the character of the piece I guess… I'd say more like just a block and so I can focus on the piece. So really kind of pushing away all – any sort of thought that would come into my head. And focusing all my energy on the piece of music that I'm performing." Similarly, Participant 26, a vocalist, outlined, "…then I'm thinking about like the meaning behind the text and the story, and visualizing the character stuff as well, the acting side of things. So that I can more immerse myself in that and take myself and my performance anxiety out of the picture. Like it's not about you being nervous, it's about you telling the story."

Table 10
Subordinate themes of intentional imagery used to manage MPA

Sub-themes	Kappa value	Number of Participants (Percentage)
Dress Rehearsal	.73	17 (77)
Reduce Anxiety	.74	16 (73)
Exposure	.49	13 (59)
Harness/Channel Anxiety	.91	9 (41)
Mental Rehearsal	.33	15 (68)
Metaphorical Imagery	.50	13 (59)

Note: Percentage refers to the percentage of interviews to which codes were applied among participants who endorsed using imagery to manage MPA ($N = 22$).

Further, participants endorsed that the type of intentional imagery they used to manage MPA depended on factors such as how close they were to performing (81.8%), how anxious they were for an upcoming performance (81.8%), how important an upcoming performance was (81.8%), the performance situation (e.g., solo as compared to group) (95.5%), and the character of the piece or passage being performed (68.2%). Consistent with applied imagery models suggesting that imagery can be used for different purposes (Cumming & Williams, 2013), many participants responded that yes, they had other goals in mind while using imagery to manage MPA (90.9%).

What is helpful about imagery used to manage MPA?

Given that imagery functions (e.g., to manage MPA) can serve multiple purposes, participants were asked what was helpful about intentional imagery used to manage MPA, and several subordinate themes emerged. See Table 11 for a summary of Kappa values as well as the number and percentage of interviews to which these subordinate themes were applied. Anxiety reduction emerged as a theme. For instance, participant 10 described, “And so by using these

other forms of learning and memory [e.g., mental rehearsal], then it just ensures that if one of the types of memory that we use if it's not working for that split second, we still have a backup. And that's really – and that knowledge and use then reduces performance anxiety even further." Some participants found that although imagery used to manage MPA may not have resulted in reduced anxiety, such imagery improved performance quality, another subordinate theme which emerged. Participant 24 detailed, "It didn't make me less nervous, but it made it go well." Interestingly, the most common subordinate theme noted by participants was that intentional imagery used to manage MPA helped participants prepare for performances, by increasing confidence, motivation, or focus for performing. Participants often identified ways in which this was closely related to managing MPA:

> And for me I find like the only way that I'm ever a hundred percent confident is if I have prepared extremely effectively and that kind of like really visualizing the concert experience I found to be super effective for me… So if I can attack performance anxiety from you know being prepared, from every different angle, all the ways I can think of, then I'll be more successful (Participant 12).

> I've always found preparation is one of the largest sort of solutions for overcoming performance anxiety, the more prepared and the more you perceive that you are prepared, the less anxiety has an effect on the actual performance… It's more about preparation and hopefully that effects or decreases the chances of sort of performance anxiety where it gets to the point where it disrupts the performance (Participant 13).

Table 11

Sub-themes concerning what is helpful about imagery used to manage MPA

Sub-themes	**Kappa value**	**Number of Participants (Percentage)**
Anxiety Reduction	.67	13 (59)
Performance Quality	.52	15 (68)
Performance Preparation	.70	21 (95)

Note: Percentage refers to the percentage of interviews to which the code was applied across coders among participants who endorsed using imagery to manage MPA ($N = 22$).

Additional Functions of Intentional Imagery

Several other themes emerged concerning why participants used intentional imagery.

Improve Performance Quality

Intentional imagery used to improve performance quality emerged as a theme, which included using imagery to aid in musical interpretation, connect with the mood or character of a piece or passage, and to imagine how participants sounded while performing with other musicians. For instance, Participant 21 described ways in which imagery improved performance quality through enhancing connection to the music, "And that's helped me to – in the performance – feel more connected to the music instead of a disconnect."

Prepare for a Performance

Another theme which was identified was imagery used to prepare for a performance, which included imagery used to increase confidence and focus, or engage in mental dress rehearsals of a performance. Participant 18 described:

> I usually try and imagine myself on the stage that I will be performing at, and with people in the audience. So try and put myself I guess in the exact situation that I will be in… I will try to just sit down and hear the whole piece in my head before I go on stage to play it. And I think I do this just to remind myself that I have put the time in, and that if I'm able to imagine the piece then I know I'm able to perform it I guess. I know I'm prepared.

Supplement Physical Practice

Supplementing physical practice, wherein participants engaged in mental practice, and imagery to prevent injury and manage their practice time also emerged as a theme. Participant 7 described, "Once in a while I will do – if I'm having trouble with a passage or something I will sit down and I'll just try and visualize it, like I'll either do it with my eyes closed or looking at the music but not playing." Participant 6 also noted:

> So I'll just run through the piece in my head. I'll imagine you know my breathing before I start. I'll imagine just kind of the motions of both my arms and my hands. I would

> imagine all of the individual – what the different fingers are doing, what gestures I'm making with the bow arm, as well as just also my physical relationship with the instrument itself and how that kind of feels.

Inter-coder reliability was difficult to assess or poor for several of these codes. For instance, although Prepare for a Performance was applied to all 24 interviews, a Kappa estimate could not be computed as there was no variability in one coder's responses (i.e., one coder selected "present" for this code across 24 interviews). However, percentage agreement was high (83%) between coders. Further, Improve Performance Quality was coded across 92% of the interviews ($N = 22$), yet had a poor Kappa coefficient, $\kappa = -.07$, $p > .05$. Percentage agreement was near chance for this code (54%), and there was poor agreement between coders regarding instances in which this code was absent. However, Supplement Physical Practice was coded across 71% ($N = 17$) of the interviews and demonstrated adequate inter-coder reliability, $\kappa = .73$, $p < .01$.

Difficulty Controlling Intentional Imagery

Several sub-themes emerged concerning difficulty controlling intentional imagery. These included difficulty generating and maintaining imagery, imagery being overlearned or over-practiced (i.e., hard to change or manipulate), and experiences of spontaneous intrusions while engaged in intentional mental imagery.

Although questions concerning difficulty controlling intentional imagery in the interview protocol primarily concerned imagery used to manage MPA, these themes emerged and were coded across the corpus of interviews and captured difficulties participants noted while describing intentional imagery used for different functions (e.g., to manage MPA, supplement physical practice). However, given the primary focus of the current study, these themes were primarily coded in response to participants' difficulties with intentional imagery used to manage

MPA. Further, mean difficulty controlling intentional imagery specifically used to manage MPA was low (i.e., not rated as highly difficult to control on average), 3.14 (*SD* = 1.39, range 1 – 6). See Table 12 for a summary of Kappa values as well as the number and percentage of interviews to which these subordinate themes were applied across interviews.

Generating Imagery

Participants described ways in which it was difficult to create imagery that was as clear or vivid as they would like. For instance, Participant 7 detailed, "I don't know if that's just me or if I haven't done it enough, so sometimes in the visualization it feels like it's fuzzy kind of and I want it to be clear. Not necessarily even in terms of just visual, but in terms of all the senses."

Maintaining Imagery

Participants also detailed ways in which it was difficult to maintain intentional imagery. Participant 12 noted, "I just like get distracted sometimes. Like I think you need like for a lot of visualization I think you need to be super focused. You kind of have to like get in the zone, and if I'm like really not ready to be there, then I won't get much done." Participant 18 similarly remarked, "So all of a sudden if I lose that focus – let's say I'm using imagery to imagine a piece – then I'm unable to remember where I am in that piece and kind of remember where to go next from there."

Overlearned

One participant also noted that imagery used in a particular manner can become difficult to control or change once it is overlearned, which can also impact performance:

> However, I find for example if I practice something a certain way, let's just do a hypothetical – practicing this phrase a certain way in an ensemble with a conductor. And then the conductor tells us, "This is going to be stretched out now" or, "we're going to change how it is performed". I find that can be a challenge to get out of that kind of rehearsed or kind of ingrained thing. So I don't know if that works as like – that's like the

smaller level of trying to change that imagery that is pre-established or something like that (Participant 5).

Table 12

Sub-themes concerning what is difficult about controlling intentional imagery

Sub-themes	Kappa value	Number of Participants (Percentage)
Generating imagery	.55	11 (46)
Maintaining Imagery	.91	16 (67)
Overlearned	1	1 (4)

Note: Percentage refers to the percentage of interviews to which the codes were applied across the corpus of interviews ($N = 24$).

Spontaneous Imagery

Participants also described experiencing spontaneous elements while using intentional imagery. For instance, the sub-theme mistakes emerged, wherein participants detailed experiencing memory slips, wrong notes, coming in incorrectly after rests, etc., while engaged in intentional imagery. Participant 18 described, "Usually I think memory slips. Like let's say things that I haven't prepared for, things that I'm afraid will happen, those usually pop into mind." Participant 4 similarly described, "Often something strange would happen to the image, like I would go to a wrong note or something wasn't really really clear, something different would happen or I wouldn't have kind of a clear idea, and it's actually really challenging to kind of image certain passages." Participant 7 also described their experience while using imagery to manage MPA:

> Usually it's like something negative happening because I know I'm doing this for you know – manage the nerves. So it normally would be like, "I'll mess up". Or if I'm trying to run through a piece and I'm trying to put a positive spin on it, something will happen and I'll squawk or I won't finish, or some sort of negative blip in the performance.

Participant 8 also detailed, "Just falling on stage, or my voice cracking. Or any array of, "oh this has gone horribly wrong"." In addition to mistakes, the sub-theme random also emerged,

in which participants experienced spontaneous content in their intentional imagery that was not related to performances:

> It does. Let's say if I've like had a dream two days ago, sometimes it would just kind of come back, or weird images would come back. Or let's say you're thinking about someone or something that will pop into your mind as well (Participant 2).

Further, two sub-themes emerged regarding ways in which participants responded to such imagery. For instance, some participants detailed ignoring spontaneous content, such as Participant 8, "I just kind of ignore it, like, "okay we don't have time for that now." However, the sub-theme replay also emerged in which participants described replaying their originally intended imagery:

> I'll go over that as if I'm in a practice room and do it a few times to kind of undo the mistake that I did (Participant 23).

> I would say I would replay it the correct way as many times as I could (Participant 24).

> I usually just like go back a little bit and then restart it (Participant 7).

Of note, 72% of participants (N = 18) endorsed experiencing spontaneous content while specifically using intentional imagery to manage MPA. Mean frequency of spontaneous intrusions during intentional imagery used to manage MPA was 3.47 (SD = 1.13, range 2 to 6). See Table 13 for a summary of Kappa values and the number and percentage of interviews to which the codes were applied amongst participants who endorsed spontaneous content in their intentional imagery.

Table 13

Sub-themes concerning spontaneous imagery while engaged in intentional mental imagery

Sub-themes	Kappa value	Number of Participants (Percentage)
Mistakes	.83	13 (72)
Random	.86	5 (28)
Ignore	1	3 (38)
Replay	.91	9 (50)

Note: Percentage refers to the percentage of interviews to which the codes were applied among participants who experienced spontaneous imagery while engaged in intentional imagery ($N = 18$).

Discussion

The primary aim of the current study was to investigate how musicians use intentional imagery to manage MPA. Our novel findings suggest that consistent with our predictions, most participants ($N = 22$) endorsed using intentional imagery to manage MPA which they identified as helpful and noted using often. Further, a variety of approaches were used for this purpose.

Dress rehearsal was the theme most frequently applied across interviews, in which musicians imagined "run throughs" of how performances would look, feel, and sound, as well as details such as the performance context and concert attire. This approach appears consistent with guidelines outlined by the motor imagery model PETTLEP (Holmes & Collins, 2001; Wright et al., 2014), which suggests that imagery should mimic actual performance conditions as closely as possible to optimize performance.

Musicians also employed imagery with varying levels for arousal. For instance, *reduce anxiety* involved physiological relaxation and images intended to induce relaxation, and similar strategies have been utilized in MPA interventions with positive effects (Esplen & Hodnett, 1999). However, several themes emerged in which musicians integrated heightened levels of physiological arousal and anxiety. *Exposure* captured imagery used to anticipate and habituate to

MPA prior to performances. Further, *harness/channel* involved harnessing experiences of MPA into feeling energized or excited to perform. Similar findings have been reported regarding singers' use of imagery for motivational purposes (DeSantis et al., 2021), and such approaches have helped athletes view competitive anxiety in a more facilitative (i.e., positive or helpful) manner (Cumming et al., 2007).

Themes also emerged in which musicians described employing imagery to manage MPA that did not incorporate explicit affect regulation. For instance, *mental rehearsal* included imagining technical components of compositions, consistent with execution imagery (i.e., of particular skills) used by singers for different purposes (DeSantis et al., 2021), and imagery employed in mental skills interventions with positive results (Braden et al., 2015; Clark & Williamon, 2011; Cohen & Bodner, 2019; Osborne et al., 2014). However, the poor inter-coder reliability of this code must be taken into account. *Metaphorical* also emerged as a theme in which musicians created detailed images related to the character of a piece of music or passage, similar to previous findings regarding ways that musicians (DeSantis et al., 2021) and dancers (Nordin & Cumming, 2005) use intentional imagery for different functions.

Concerning *how* musicians employed imagery to manage MPA, various sensory content was integrated consistent with recommendations of applied imagery models (Holmes & Collins, 2001; Wright et al., 2014) and previous findings in dancers (Nordin & Cumming, 2005). Specifically, all musicians endorsed using visual imagery, while most endorsed integrating auditory content, and many incorporated kinesthetic and tactile imagery. Further, musicians often used more than one imagery approach to manage MPA. Indeed, participants reported that various factors including the proximity of a performance, their anticipated anxiety level, characteristics

of the piece(s) being performed, and the performance situation (e.g., solo or group) influenced the type of intentional imagery that was used.

In terms of what was helpful about imagery used to manage MPA, *anxiety reduction* emerged as a theme, as did *improving performance quality* and *performance preparation*. These findings indicate that musicians may use similar strategies to manage MPA and improve performance quality.

Several other themes emerged concerning *why* (i.e., for what purpose or function) musicians use intentional imagery including *improving performance quality*, *preparing for a performance*, and *supplementing physical practice*. Yet, as noted we could not assess ICR for *preparing for a performance*, and ICR was poor for *improving performance quality*. This difficulty may reflect conceptual overlap between these functions of imagery, and such themes may be more parsimoniously captured as imagery aimed to enhance performance.

Similar to previous interview studies with singers (DeSantis et al., 2021) and dancers (Nordin & Cumming, 2005), musicians were able to introspect about the difficulties they experienced controlling intentional imagery. Themes included difficulty *generating* and *maintaining* imagery, changing the content of imagery once it has become practiced (i.e., *over-learned*), as well as experiencing *spontaneous* content. We also found that although some spontaneous content was not negatively valanced or related to music performance, many musicians experienced negatively valanced spontaneous content in their intentional imagery representing *mistakes*. Thus, not only do musicians experience negative spontaneous imagery in anticipation of performing as reported in Studies 1 and 2, they also experience this phenomenon while engaged in mental imagery. Additionally, themes emerged regarding how musicians

responded to such imagery, including *replaying* their originally intended imagery, or *ignoring* such experiences.

Limitations

Although our study provides valuable insight into how musicians use mental imagery to manage MPA, several limitations of the current research must be addressed. First, our study investigated imagery used to manage MPA in a retrospective manner, and future work should capture imagery in anticipation of performing.

There are different views within qualitative research regarding whether and how to assess inter-coder reliability (ICR). Although a detailed review of arguments for and against its use is beyond the scope of the current research, it has been suggested that the inclusion of ICR is antithetical to the epistemological foundations of qualitative research (see O'Connor & Joffe, 2020 for a review) and many argue against its use (Braun & Clarke, 2013). Further, the recursive coding process may have resulted in an underestimation of reliability estimates for some codes and an over-estimate for others. However, ICR is one way of communicating to readers how reliably coders working within the same framework achieved consensus in their interpretation of data (O'Connor & Joffe, 2020), and conversations between coders can increase precision in a coding scheme and its application as the recursive coding process unfolds (Joffe & Yardley, 2004). Thus, we chose to assess ICR, which was moderate or above for the majority of codes in the present study. However, interpretation is cautioned for several codes which demonstrated poorer reliability (i.e., *mental rehearsal* and *improve performance quality*).

Importantly, the nature of intentional imagery – in which a singular approach can be used for different functions – may be cognitively demanding for coders when such imagery appears to serve multiple functions (e.g., manage MPA *and* improve performance quality). Indeed, in their

investigation of dancers' use of intentional imagery, Nordin and Cumming (2005) commented on the "complex web of relationships" (p. 412) between *what* dancers imagined and *why* they engaged in such imagery. Similarly, DeSantis and colleagues (2021) found that singers used the same imagery approach for different functions. To this end, we developed a detailed coding scheme to reflect perceived nuance in our data. However, coding schemes with a greater number of codes are associated with poorer reliability (Hruschka et al., 2004). Thus, although our efforts were intended to capture the complexity of musicians' use of intentional imagery, future research in this area assessing ICR might consider limiting the number of codes or investigating one function of imagery (e.g., to manage MPA) at a time, as highly detailed coding schemes such as ours may be cognitively taxing for coders, impacting reliability.

Despite these limitations, our novel findings provide insight into musicians' use of intentional imagery and have clinical implications and offer suggestions for future MPA research.

Clinical Implications

As the primary aim of Study 3 was to lay groundwork for future MPA intervention work, drawing clear clinical implications from this study is challenging. We found that in addition to reducing anxiety, musicians found imagery used to manage MPA helpful in terms of improving their performance quality and aiding performance preparation. As previously noted, this may suggest – consistent with the implications of applied models (Cumming & Williams, 2013) – that the imagery approaches musicians use to manage MPA and enhance their performances are closely linked (i.e., similar approaches are employed related to both objectives). Thus, given that we found musicians use mental rehearsal to manage MPA, clinicians working with musicians might benefit from drawing on findings from meta-analytic reviews regarding the effective use

of mental rehearsal to optimize performance. Although not a clinical implication of our research, musicians might benefit from using mental rehearsal in 20 minute increments and from using this leading up to and proximal to performing as the effect of mental rehearsal on performance significantly degrades approximately 2 weeks after employing this approach (Driskell et al., 1994). Further, for optimal results, research suggests that mental rehearsal should be integrated with physical practice (Driskell et al., 1994), and include a variety of sensory content (Connolly & Williamon, 2004; Holmes & Collins, 2001; Wright et al., 2014), particularly auditory imagery which may be particularly important for performance quality in musicians (Brown & Palmer, 2013; Highben & Palmer, 2004). However, suggestions for integrating implications from the broader literature in terms of the effective use of mental rehearsal to manage MPA are currently speculative, as we have limited understanding of the unique impact of mental rehearsal on MPA.

We found that mean difficulty controlling imagery to manage MPA was low (i.e., not difficult to control on average), yet musicians experienced difficulty generating and maintaining imagery. Thus, practitioners working with musicians might consider assessing imagery ability and investigating whether musicians experience difficulty with particular sub-processes of mental imagery (e.g., image transformation) which could impact the helpfulness of mental imagery. Interestingly, we found that intentional imagery can be difficult to transform or manipulate once it is overlearned or ingrained in a particular manner, indicating that even if intentional imagery is highly vivid, it may be difficult to alter once rehearsed. As such, musicians may benefit from rehearsing a range of positive performance outcomes as opposed to solely focusing on specific facets of a performance (e.g., tone) as they may need to change aspects of their performances as rehearsals progress.

Further, we found that many musicians experienced negatively valanced spontaneous imagery (e.g., of mistakes) while using imagery to manage MPA. Applied models and guidelines for musicians engaging in intentional imagery (Connolly & Williamon, 2004; Wright et al., 2014) stress the importance of generating positive content (e.g., of performing well), in part to "avoid ruminating on possible mistakes or errors" (Clark et al., 2011, p. 361). Thus, our findings further suggest that musicians may benefit from imagery re-scripting to target NSI. Although such suggestions are speculative, negatively valanced spontaneous intrusions may reduce the effectiveness of intentional mental imagery techniques given current recommendations that emphasize positive performance imagery (Connolly & Williamon, 2004; Wright et al., 2014). Further, such intrusions may also undermine musicians' confidence in the effectiveness of intentional imagery for managing MPA.

Future Directions

Given the variety of approaches used in existing research and our novel finding that musicians employ numerous imagery approaches to manage MPA, what approaches are most effective, for whom, and under what conditions? As noted, some of the strongest evidence from existing MPA literature comes from mental skills training interventions utilizing mental rehearsal (Braden et al., 2015; Clark & Williamon, 2011; Cohen & Bodner, 2019; Osborne et al., 2014). Despite the methodological limitations previously reviewed, mental rehearsal is positively associated with performance outcomes (Driskell et al., 1994; Simonsmeier et al., 2020), and strategies used to manage MPA should also consider performance optimization due to the complex motor demands of performing under stress (Osborne et al., 2014). However, to provide musicians and practitioners with clearer guidelines regarding the optimal use of mental rehearsal

to specifically manage MPA, the impact of mental rehearsal on MPA and performance quality must be investigated in stand-alone interventions.

In terms of strategies integrating explicit affect regulation, as previously reviewed, PETTLEP suggests that performers integrate emotions and levels of physiological arousal which they typically experience during successful performances (e.g., anxiety, confidence, excitement, "butterflies") (Wright et al., 2014), which may also help musicians habituate to negative emotions while imagining performing well (Clark et al., 2011). Importantly, the use of relaxation strategies prior to engaging in imagery is not recommended, as this may be contrary to the heightened arousal musicians experience during performing (Wright et al., 2014). Such recommendations also appear consistent with contemporary anxiety-performance theory (i.e., how anxiety impacts motor performance), including the individualized zones of optimal functioning (IZOF) model (Hanin, 2000). IZOF suggests that performers have individualized zones of optimal arousal in which they achieve peak performance, which are partly informed by affective experiences during previous successful performances (see Ruiz et al., 2017 for a review of IZOF). This model has been investigated in musicians (Yao & Li, 2022), yet more research is required to better understand the affective experiences and levels of physiological arousal musicians with MPA experience during successful performances (e.g., anxiety, confidence, relaxed, "butterflies," etc.), which will better inform suggestions regarding the effective use of imagery to manage MPA. Further, musicians and practitioners working with musicians should consider monitoring their zones of optimal arousal during successful performances to inform idiosyncratic imagery content (e.g., specific emotions and levels of arousal).

Additionally, *exposure* and *harness/channel* can be conceptualized as imaginal exposure to feared performances situations. Many exposure treatment protocols recommend against the

use of anxiety control strategies (e.g., Barlow, 2008). Indeed, theory suggests that engaging in anxiety control strategies during exposures may interfere with exposure in a number of ways (see Blakey and Abramowitz (2016) for a review), yet anxiety control strategies may allow individuals to better tolerate exposures and approach feared stimuli (Blakey & Abramowitz, 2016) particularly during earlier phases of treatment. Strategies integrating heightened arousal or anxiety (i.e., systematic desensitization) in existing MPA intervention research have used concurrent relaxation strategies (e.g., Nagel et al., 1989), which may be conceptualized as an anxiety control strategy and is not recommended by applied models (Wright et al., 2014). However, our results suggest that musicians engage in high arousal imagery strategies without concurrent relaxation. Thus, the literature would benefit from investigating the helpfulness of high arousal strategies in which musicians imagine performing well (e.g., *exposure* and *harness/channel*) without concurrent relaxation strategies.

Importantly, our novel findings suggest that musicians do not simply employ one imagery approach to manage MPA, and instead use numerous approaches which depend on factors such as the importance of an upcoming performance, anticipated anxiety level, etc. Future research should examine how factors such as those identified through our study (e.g., anticipated anxiety level) impact the type of imagery which musicians use to manage MPA to guide additional research.

Our results indicate that musicians are able to introspect regarding difficulties experienced controlling intentional imagery. Applied models suggest that imagery ability is a factor which moderates the effectiveness of motor imagery (Cumming & Williams, 2013; Martin et al., 1999), and musicians experiencing difficulty controlling imagery might benefit from strategies to improve imagery ability. Although a review is beyond the scope of the current

paper, the layered stimulus response training approach (Cumming et al., 2017) improves aspects of imagery ability (Williams et al., 2013) and future work should examine this training approach in musicians.

Our novel findings provide invaluable insight into musicians' use of mental imagery to manage MPA. Despite several limitations, our work contributes to a growing literature examining how musicians employ an important mental preparation strategy used in the broader performance psychology literature. Our results provide clinical implications and suggest fruitful avenues for future research to better inform which imagery approaches are most helpful, to whom, and under what conditions for this important function.

General Discussion

MPA is a common concern (Kenny et al., 2014) making it difficult for many musicians to perform at their best (Papageorgi et al., 2013; Wesner et al., 1990). Distressing and impairing MPA can be diagnosed as performance-only social anxiety disorder (SAD) (American Psychiatric Association, 2022), with negative spontaneous self-imagery (NSI) theorized to play an important role in the maintenance of this concern (Clark & Wells, 1995; Heimberg et al., 2010, 2014; Hofmann, 2007; Rapee & Heimberg, 1997). Given that MPA can be diagnosed as performance-only SAD, we found it striking that models of MPA had not considered the potential role of NSI in MPA (e.g., Osborne & Franklin, 2002) and to our knowledge, NSI had not been examined in existing MPA research. We sought to address this critical gap in the literature in Study 1, which examined the prevalence and frequency with which musicians experience NSI, as well as the association between NSI and trait MPA and state MPA intensity leading up to important anxiety-provoking performances. We hypothesized that NSI and state and trait MPA would be positively associated at the between and within-person levels leading up to performances.

Building on Study 1 and utilizing the same participant data, Study 2 investigated the association between NSI and additional factors important to the conceptualization of MPA. For instance, not all musicians who experience MPA interpret it as debilitative to performing (Herman & Clark, 2023) and we speculated that NSI may be one factor which contributes to debilitative interpretations of MPA. Thus, we predicted that NSI and state MPA interpretation (i.e., wherein higher scores indicate more debilitative interpretations) would be positively associated at the between and within-person levels leading up to performances. Additionally, the cognitive theoretical model of MPA (Osborne & Franklin, 2002) suggests that low self-efficacy

for performances is an important factor which contributes to MPA, and we reasoned that NSI (e.g., of mistakes) may negatively impact musician's self-confidence[28] in anticipation of anxiety-provoking performances. Thus, we predicted that self-confidence and NSI would be negatively associated at the between and within-person levels leading up to performances.

Although much of the social anxiety literature has focused on NSI and theory-driven treatments to ameliorate it (e.g., McEvoy et al., 2022), musicians have long recognized the importance of intentionally generated imagery related to musical performance (Covington, 2005). Intentional mental imagery has also received considerable attention in the closely related field of sport psychology due to its positive impact on performance outcomes (Driskell et al., 1994; Simonsmeier et al., 2021) and because it provides performers with a mental preparation strategy which can be flexibly deployed for different purposes (e.g., affect regulation, performance enhancement). Although intentional mental imagery clearly represents a potent affect regulation strategy for musicians, there was a paucity of research concerning how musicians engage in mental imagery to manage MPA independent of existing intervention research, and addressing this gap has important implications for future research (e.g., identification of commonly used approaches which should be studied further). Thus, as a crucial first step, we conducted a qualitative examination of musicians' use of intentional imagery to manage MPA in Study 3, and predicted that musicians would engage in intentional imagery for this function.

Importantly, mental imagery is not a singular experience or ability, but includes sub-processes of image generation, maintenance, inspection, and transformation (Kosslyn, 1980,

[28] As we have noted, differences between self-efficacy and self-confidence in performance have been previously articulated (e.g., Lochbaum et al., 2022). Yet, we consider our findings regarding self-confidence to be relevant to the cognitive model of MPA as our measure of self-confidence captured views of performance competence for a specific performance in Study 2.

1994; Kosslyn et al., 2006). Thus, we were also interested in whether musicians experience difficulty controlling intentional imagery used to manage MPA, such as difficulty maintaining imagery or experiencing spontaneous intrusions while engaged in intentional imagery. Further, some research indicates that those with high social anxiety cope with negative spontaneous self-imagery by suppressing or ignoring it (Moscovitch et al., 2013), and we were also interested in how musicians might respond to such intrusions. Thus, Study 3 also included an exploratory investigation of difficulties musicians experience while engaged in intentional imagery to manage MPA.

Music Performance Anxiety Over Time

As outlined above, the centerpiece of this dissertation examined musicians' experiences of NSI and how this phenomenon is associated with MPA. Thus, we begin by turning our attention to the major findings from Studies 1 and 2. As noted, we first modelled state MPA intensity, interpretation, and self-confidence over time so that we could examine the association between these variables and NSI. We hypothesized that state MPA intensity (i.e., somatic and cognitive) would increase leading up to important anxiety-provoking performances, while state MPA interpretation (i.e., somatic and cognitive) would become more debilitative and self-confidence would decrease. However, none of these hypotheses were substantiated and there was no evidence of trend over time at the group level for state MPA interpretation or self-confidence. Contrary to our predictions, we found that on average, somatic anxiety intensity significantly decreased – with cognitive anxiety intensity trending in a similar direction – leading up to performances. What might account for these unexpected findings? As reviewed in Studies 1 and 2, it was difficult to advance specific predictions due to conflicting results which have been reported in previous research, and our study design may have precluded measurement of a

proximal "ramp-up" window found in previous research (Papageorgi et al., 2013). However, Study 3 also indicates that musicians do not passively prepare for performances but engage in intentional mental imagery to manage MPA which might help them cope with such experiences in anticipation of performing. Although our findings regarding the average trajectories of state MPA intensity, interpretation, and self-confidence over time were surprising, our results also suggest that there is important variability in initial levels and change over time between participants.

As predicted, we found that there was significant variability in musicians' initial levels of state MPA intensity, interpretation[29], and self-confidence in Studies 1 and 2. Further, consistent with our hypotheses, those with higher trait MPA also had higher initial levels of state MPA intensity and interpretation, and lower levels of self-confidence. Yet, trait MPA appears to account for only a small proportion of the variability in initial levels of these variables. Although we did not find significant variability in slopes over time for cognitive anxiety intensity or interpretation, as predicted, there was significant variability in rates of change over time for somatic anxiety intensity and interpretation, and self-confidence. Yet, contrary to our predictions, trait MPA did not predict such variability over time. There was also significant variability over time at the within-person level for state MPA intensity, interpretation, and self-confidence. However, our findings indicate that most of the variability in state MPA and self-confidence was accounted for by differences between, rather than within participants. Our results suggest that including additional trait variables we did not measure (e.g., trait self-efficacy for performances, fear of negative evaluation) may be particularly important in future research. These variables may help to better explain variability in state MPA and self-confidence over time

[29] There were marginally significant differences for state cognitive interpretation.

at the between-person level (i.e., beyond trait MPA), as we did not find strong central tendencies for state somatic anxiety intensity and interpretation, or self-confidence (i.e., average trajectories over time). After modeling state MPA and self-confidence over time, we were able to examine the association between these variables and NSI, and now turn our attention to these findings.

Negative Spontaneous Imagery

Our findings suggest that as predicted and similar to those with social anxiety (Hackmann et al., 2000), NSI is highly prevalent amongst elite musicians leading up to important anxiety provoking performances. Indeed, nearly 83% of participants experienced NSI on one or more study days in Study 1. Although NSI was highly prevalent, we found that most musicians did not experience NSI frequently during the 7 days prior to their performances. Further, although we did not statistically examine NSI over time, the frequency of this phenomenon at the between-person level did not appear to increase as musicians got closer to performing. However, those who experienced NSI more frequently also had higher trait MPA and state somatic and cognitive anxiety intensity. Although these associations were of small magnitude, our results might indicate that those with higher trait MPA and somatic and cognitive anxiety intensity are more vulnerable to experiencing NSI. However, contrary to our predictions, we did not find associations between the frequency with which musicians experienced NSI and state MPA interpretation at the between or within person levels.

As hypothesized, on average within person, state somatic and cognitive anxiety intensity were higher and self-confidence was lower, on days where musicians experienced NSI compared to days where they did not. However, we did not find a similar pattern between state MPA interpretation and NSI on average within person, suggesting that NSI does not appear to impact how musicians interpret MPA (i.e., as helping or hindering performances). Although our design

precludes causal interpretations, similar to suggestions outlined in cognitive theoretical models of SAD (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997) and previous work regarding the impact of NSI on social anxiety (Hirsch et al., 2006; Makkar & Grisham, 2011; Vassilopoulos, 2005), it is possible that NSI may fuel MPA as self-confidence was lower and state MPA intensity was higher on days where musicians experienced NSI compared to days when they did not.

Study 3 also allowed us to examine the phenomenology of spontaneous intrusions musicians experience while engaged in intentional imagery (e.g., to manage MPA), and we found that in addition to random images (i.e., not related to musical performance), musicians experienced negatively valanced spontaneous imagery related to performing (e.g., of mistakes, falling onstage, etc.). Additionally, some participants in Study 3 attempted to replay their originally intended imagery in response to these intrusions, indicating that such imagery may be distressing to musicians or impact the perceived helpfulness of intentional imagery used to manage MPA when intrusions occur. Indeed, applied models of motor imagery stress that performers should imagine positive performance outcomes (Connolly & Williamon, 2004; Wright et al., 2014). These findings further bolster our previous suggestion that musicians might benefit from strategies that target negative imagery, such as imagery re-scripting, particularly when such images relate to memories of socially traumatic performance experiences and intrude on mental preparation imagery.

Taken together, our findings indicate that NSI is not only highly prevalent but impactful for elite musicians. Although we did not find strong associations between NSI and state MPA intensity and self-confidence at the trait level – indicating that any effect of NSI on state MPA intensity and self-confidence may be transient – factors associated with increased MPA and

decreased self-confidence in anticipation of important anxiety-provoking performances could have important implications for the conceptualization of MPA.

Conceptualization of Music Performance Anxiety

The cognitive theoretical model of MPA suggests that anxiety is fueled by low self-efficacy which drives a discrepancy between how musicians believe audiences perceive them and the high standards which musicians believe audiences hold for their performances (Osborne & Franklin, 2002).[30] Yet, the study which informed their model did not investigate NSI and as we have suggested, it is possible that NSI fuels MPA akin to its role in social anxiety (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997). As previously reviewed, Heimberg and colleagues (2010; 2014) theorized that when socially anxious individuals anticipate or face a perceived audience, they experience exaggerated, negatively valanced self-imagery from an observer's perspective. Such imagery may be particularly impactful for musicians, whose mistakes (e.g., a memory slip during a solo performance) are readily observable to an actual as compared to perceived audience (e.g., in a social interaction), which may enhance fears of negative evaluation. Further, the model purports that NSI are informed in part by heightened attention to external indications of evaluation, self-monitoring of socially anxious individuals' behaviour in social situations, and interoceptive experiences (e.g., sweating). Socially anxious individuals then compare their negative self-images to the high standards they believe others hold for their behaviour in feared social situations, fueling cognitions concerning the likelihood and

[30] In their paper, Osborne and Franklin (2002) note that the discrepancy which fuels MPA is "between the individual's schema of their ability to competently perform the task and their expectation of audience performance standards" (p. 90). Yet, in the figure outlining their model, it appears as though low self-efficacy informs a discrepancy between how musicians believe they appear to others, and the high standards which they presume others hold for their behavior. Thus, we have attempted to reconcile these slightly incompatible conceptualizations in our description of the central discrepancy in the model.

consequences of negative evaluation, other manifestations of social anxiety (e.g., behavioural) and post-event processing of social situations, all of which reinforce social anxiety.

In Studies 1 and 2, we found an important coupling between NSI related to performing and state MPA intensity and self-confidence, and those with higher MPA may be more vulnerable to experiencing NSI. Regrettably, we did not examine the phenomenology of NSI in these studies. However, in Study 3, we found that many musicians experience spontaneous imagery of themselves making mistakes (e.g., memory slips) while engaged in intentional imagery (e.g., to manage MPA). Indeed, our novel findings suggest that the exclusion of NSI from models of MPA should be reconsidered.

Building on Osborne and Franklin's (2002) earlier work, we have outlined several areas in which NSI may be implicated in the maintenance of MPA (See Figure 7).[31] Similar to those with social anxiety (Ng et al., 2014), musicians may experience memories of early negative performance experiences. Indeed, musicians who have experienced a socially traumatic performance experience endorse more negative thoughts about performing compared to musicians who have not (Osborne & Kenny, 2008). Second, given our findings regarding the association between NSI and self-confidence, such images may lower self-efficacy when musicians anticipate anxiety-provoking performances.[32] Third, NSI may inform a musician's mental representation of themselves as seen by an audience (e.g., making mistakes) as suggested in current cognitive theoretical models of SAD (Heimberg et al., 2010, 2014; Rapee &

[31]In this revised model, bolded numbers indicate areas where NSI may be implicated in MPA. Further, we have integrated aspects from existing cognitive models of SAD (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997), including the importance of a mental representation of self (i.e., NSI), and comparison of this representation with presumed audience standards which were not included in the cognitive model of MPA (Osborne & Franklin, 2002).

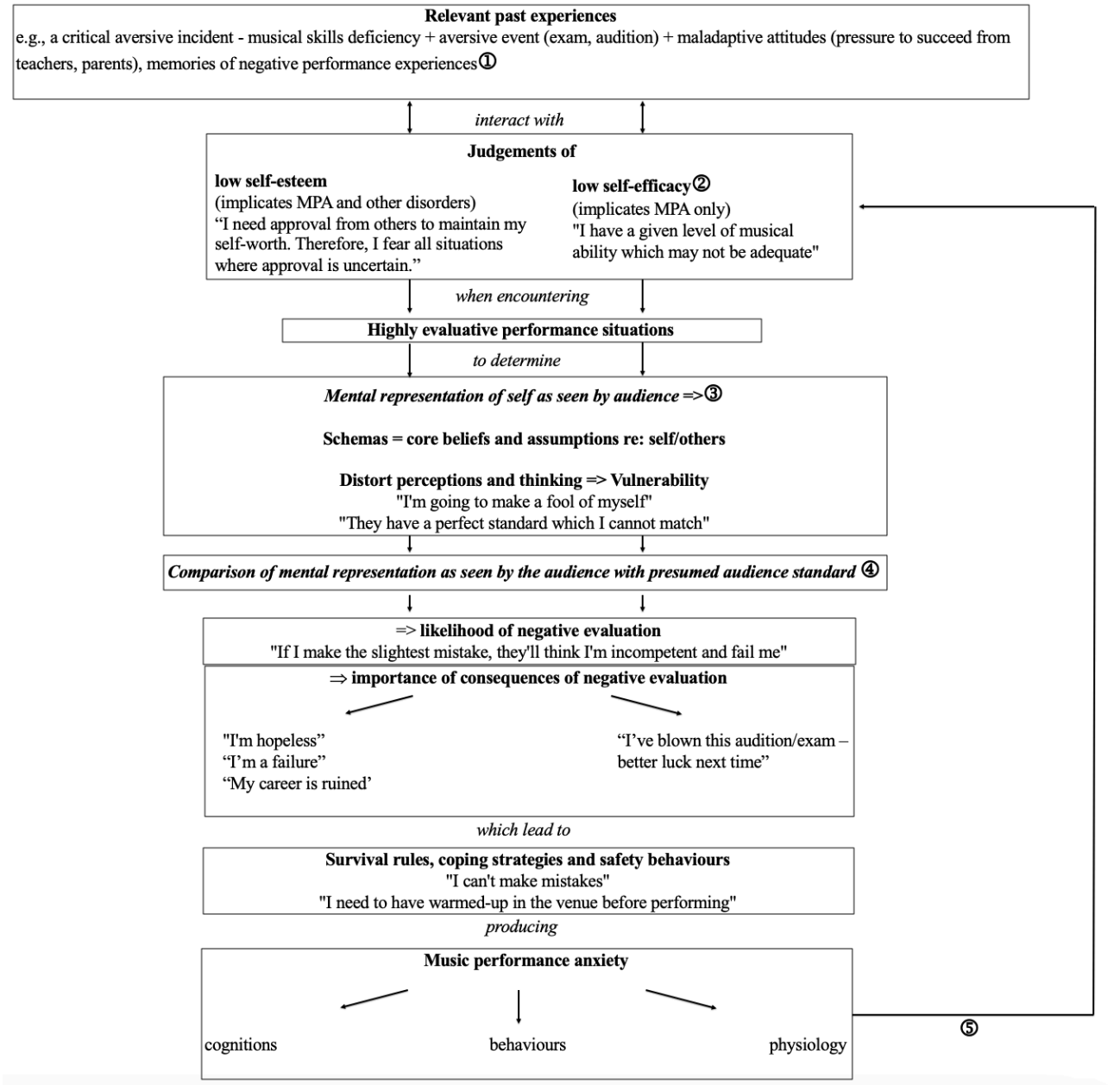
[32]Although, as noted, we cannot rule out the possibility that such imagery is an output or consequence of low self-efficacy.

Heimberg, 1997). Fourth, as outlined in such models, NSI may drive a discrepancy between how musicians believe they appear to audiences (e.g., making mistakes, performing poorly, etc.) and the high standards they perceive audiences hold for their performances. These processes may in turn lead to cognitions concerning the likelihood and consequences of negative evaluation, resulting in maladaptive coping responses (e.g., safety behaviours) and manifestations of MPA (e.g., behavioural) which are further reflected in NSI, contributing to the vicious cycle of MPA.

However as noted, such suppositions are merely speculative and must be examined empirically. Indeed, we cannot rule out the possibility that NSI is merely epiphenomenal in musicians.

Figure 7

Updated Cognitive Theoretical Model of MPA[33]



[33] Corresponding with the numbered circles in the above figure, NSI may be implicated in the cognitive model of MPA in a number of ways. First, musicians might experience memories of negative performances. Second, NSI may lower self-efficacy. Third, NSI might inform how musicians believe audiences view them. Fourth, NSI may drive a discrepancy between how musicians believe they appear to audiences and the high standards they assume audiences hold for their performances. Fifth, manifestations of MPA (e.g., sweating) may be further integrated into NSI, contributing to the vicious cycle of MPA.

Intentional Imagery to Manage Music Performance Anxiety

In addition to seeking to understand more about the potential role of NSI in the maintenance of MPA, we also sought to examine how musicians intentionally employ mental imagery to manage MPA, and next turn our attention to these findings.

In line with our predictions, most musicians in Study 3 used intentional mental imagery to manage MPA and identified this as a helpful strategy which they use often, consistent with previous work indicating that musicians use intentional imagery to manage MPA (Clark et al., 2007; DeSantis et al., 2021). However, prior to the current research, we knew little about *how* musicians used imagery to manage MPA. Our findings indicate that musicians use a variety of approaches to such imagery, including dress rehearsals of performances, and that similar to existing MPA interventions (Esplen & Hodnett, 1999; Sisterhen, 2005), musicians use strategies which appear to include explicit affect management such as imagery to reduce anxiety. We also found that musicians use intentional imagery approaches which integrate heightened arousal, such as imagery to expose oneself to heightened anxiety which has not been investigated in existing MPA research, and imagery to harness anxiety into excitement, similar to confident coping imagery which helps athletes interpret anxiety in a more facilitative manner (Cumming et al., 2007). Additional codes which emerged (i.e., mental rehearsal and metaphorical) suggest that musicians also engage in imagery to manage MPA which orients their attention away from explicit affect regulation. To this end, musicians appear to use imagery to immerse themselves in the character of a piece of music, and similar to existing MPA interventions integrating mental rehearsal (Clark & Williamon, 2011; Cohen & Bodner, 2019), musicians imagine technical components of pieces or passages being performed. Further, our findings indicate that musicians use multiple imagery approaches to manage MPA, and that the type of imagery used depends on

different factors (e.g., performance type). Taken together, these results suggest that imagery used to manage MPA amongst elite musicians is highly idiosyncratic, and that consistent with applied models of motor imagery (Cumming & Williams, 2013), the meaning of specific imagery content may differ depending on the context in which it is employed.

Musicians also noted that they had other goals in mind while using imagery to manage MPA. Indeed, additional codes which emerged included imagery used to improve performance quality, prepare for a performance, and supplement physical practice. As reviewed, ICR was difficult to assess or poor for several of these codes, and these approaches may more parsimoniously reflect imagery utilized to enhance performance. Interestingly, the most frequently applied code concerning what musicians found helpful about imagery used to manage MPA was that it aided performance preparation by increasing confidence, motivation, or focus for performing. As noted, these findings suggest anxiety regulation and performance enhancement strategies appear closely linked in elite musicians.

Notably, all musicians incorporated visual imagery, while most musicians also used auditory imagery, and many used kinesthetic and tactile imagery to manage MPA. It was surprising that most but not all musicians employed auditory imagery given the importance of auditory artistic output for musicians, and as we have previously noted, auditory imagery may be particularly important for performance outcomes for musicians (Brown & Palmer, 2013; Highben & Palmer, 2004). Thus, musicians employing strategies such as mental rehearsal or dress rehearsals of performances integrating visual, tactile, or kinesthetic imagery might benefit from integrating auditory imagery, particularly as our findings suggest that affect management and performance enhancement strategies are closely linked.

Musicians in Study 3 were also readily able to reflect on difficulties which they experienced controlling intentional imagery, and although related codes were applied to imagery used for different functions, we focus our discussion on imagery used to manage MPA. Interestingly, mean difficulty controlling intentional imagery used to manage MPA was low (i.e., not difficult to control on average). In contrast to this overall sense of control, 72% of participants experienced spontaneous content while engaged in intentional imagery to manage MPA, and of those participants, an additional 72% experienced negatively valanced spontaneous imagery related to performances (e.g., mistakes). Although previous work indicated that musicians (DeSantis et al., 2021) and dancers (Nordin & Cumming, 2005) experience spontaneous imagery, we knew little about the content or valence of such experiences in musicians. Further, some participants attempted to replay their originally intended imagery. Thus, our findings may suggest that coping with negative imagery related to performing (e.g., of mistakes related to past performance experiences) might be important to allow musicians to maximally benefit from intentional imagery to manage MPA, particularly as applied imagery models stress the importance of positive performance imagery (Connolly & Williamon, 2004; Wright et al., 2014). Indeed, considered with the findings of Studies 1 and 2 (i.e., regarding the association between NSI and state MPA intensity and self-confidence), these findings further suggest that musicians may benefit from imagery re-scripting to target NSI.

Limitations

There were several limitations associated with our series of studies which could be improved upon in future research. Our sample size in Studies 1 and 2 was small, and we may have been underpowered to detect small but important effects. Further, our design for these studies may have precluded measurement of a "ramp up" window in the hours preceding and

during a performance which should be included in future research. Additionally, missing data was a concern in Studies 1 and 2. Furthermore, we examined musicians' experiences leading up to one performance. Although we found that much of the variability in state MPA and self-confidence was accounted for by differences between rather than within participants, it is unclear whether such differences are stable across performances (i.e., from one performance to the next).

Although the qualitative design of Study 3 allowed us to explore musicians' experiences with intentional mental imagery in-depth retrospectively, future work should examine intentional imagery used to manage MPA in anticipation of performances, as this may impact reported strategies. Further, researcher familiarity with the imagery-based MPA literature and other closely related areas (e.g., sport psychology and social anxiety research) may have influenced our findings. For instance, researcher bias might have unintentionally led to examination of certain areas of focus in greater detail at the expense of others. Yet, the semi-structured format of the interview allowed the researcher to probe specific questions, while also allowing the interviews to unfold based on participant responses. Although we were interested in examining the reliability with which our coding scheme could be applied in Study 3, we were unable to asses ICR for some codes, and ICR was poor for several codes, suggesting we should be cautious in our interpretation of some of our findings. Reassuringly, ICR for most of the codes which emerged in Study 3 was moderate or above. As we have noted, future qualitative research in this area may benefit from limiting the coding scheme to fewer codes, or from focusing on imagery used for a single function (i.e., MPA management alone).

Future Directions and Conclusions

As noted, we found that most of the variability in state MPA intensity, interpretation, and self-confidence was accounted for by variability between rather than within participants.

Although trait MPA significantly predicted initial levels of these variables, the magnitude of these correlations was small. Further, trait MPA did not account for variability in slopes over time (i.e., for somatic anxiety intensity and interpretation, and self-confidence). Thus, additional trait variables which we did not measure (e.g., trait self-efficacy for performances) may be particularly important to include in future research to better account for variability in initial levels of state MPA and self-confidence (i.e., in addition to trait MPA) as well as change over time. Further, given that most of the variability in state MPA and self-confidence was accounted for by differences between participants, future research should examine the stability of individual differences in MPA over time. For instance, initial levels of state MPA and self-confidence may be impacted by factors such as a musician's familiarity with the acoustics of a concert venue, comfort with a guest conductor (e.g., for an orchestral performance), or difficulty of the composition being performed.

Importantly, our findings suggest that NSI is highly prevalent amongst elite musicians similar to those with social anxiety (Hackmann et al., 2000). Yet interestingly, NSI was experienced infrequently on average by most musicians during the 7 days leading up to important anxiety-provoking performances. To our knowledge, research in other social anxiety domains (e.g., social interaction, speech anxiety, etc.) has not examined the frequency of NSI over time and its association with social anxiety. In line with existing cognitive theoretical models of SAD (e.g., Clark & Wells, 1995; Heimberg et al., 2010, 2014; Hofmann, 2007; Rapee & Heimberg, 1997) one would presume that NSI – implicated in the maintenance of SAD – would ramp up concurrently with anxiety in anticipation of such performance events. Thus, the literature would benefit from examining the association between NSI and social anxiety in anticipation of performance events utilizing experience sampling designs (e.g., in those

experiencing speech anxiety) to enhance our understanding of the frequency with which individuals with social anxiety experience NSI over time.

Although we were not able to directly test this suggestion empirically due to our study design, NSI may be implicated in the maintenance of MPA in a manner similar to its role in social anxiety. We have outlined such areas in our revised cognitive model of MPA and have suggested future directions to test these ideas in Studies 1 and 2 which could further inform our conceptualization of MPA as a variant of social anxiety. Yet, even if NSI is implicated in *processes* which maintain MPA as we have tentatively outlined, there may be important differences in the phenomenology and impact of NSI in MPA compared with other forms of social anxiety (e.g., speech or social interaction anxiety). For instance, cognitive models of social anxiety (Heimberg et al., 2010, 2014; Rapee & Heimberg, 1997) outline the importance of observer-perspective visual imagery in the maintenance of SAD. However, given the importance of auditory artistic output for musicians, its role in performance outcomes (Brown & Palmer, 2013; Highben & Palmer, 2004), and our finding that musicians intentionally engage in auditory imagery to manage MPA and are thus well-practiced in employing this modality, auditory NSI may be particularly detrimental for musicians. Further, research suggests that auditory and motor imagery processes interact (Baumann et al., 2007; Lotze et al., 2003), and musicians who experience negative spontaneous auditory imagery related to performances (e.g., "hearing" oneself hit the wrong note) may experience concurrent motor imagery of such mistakes (e.g., "feeling" oneself miss a shift on a string instrument), thereby lowering self-efficacy for performances and fueling MPA. Indeed, previous research has demonstrated that compared to non-pianists, pianists show greater motor representation for piano-specific sounds (Jäncke et al. 2000). Thus, future research should examine the phenomenology of NSI experienced in

anticipation of performing as this may further inform our conceptualization of MPA and increase our understanding of unique considerations which might differentiate MPA from other forms of social anxiety.

As noted, our preliminary findings suggest that imagery re-scripting may be a helpful treatment for MPA, yet such suggestions must be examined empirically in elite musicians. For instance, as a starting point, case series with elite musicians experiencing MPA could examine the impact of imagery re-scripting as a stand-alone treatment for MPA. Given that there may be important differences in the phenomenology of NSI in musicians compared to those with other forms of social anxiety (e.g., speech anxiety), clinicians considering integrating imagery re-scripting should also assess whether NSI experienced by musicians relates to early socially traumatic memories (e.g., of key negative performance experiences) which are often the focus of imagery re-scripting (Ng et al., 2014), for which this approach may be particularly suited.

In terms of intentional imagery strategies which musicians use to manage MPA, we found that musicians engage in mental rehearsal in Study 3, although the poor ICR for this code must be taken into consideration. We have previously outlined the need for future well-controlled studies to examine the specific impact of mental rehearsal on MPA and performance outcomes. Although mental skills training interventions adapted from sport psychology utilizing mental rehearsal are gaining traction in the MPA literature and have demonstrated promising results (Clark & Williamon, 2011; Cohen & Bodner, 2019; Osborne et al., 2014), an important distinction between many types of athletic performance (e.g., running) and musical performance is the degree of cognitive complexity and task coordination required to perform a musical instrument. For instance, many musicians read complex musical scores while performing (e.g., classical music) which include information about pitch, rhythm, tempo, dynamics, etc. Further,

while performing this complex cognitive task, musicians must translate musical scores into coordinated fine and gross motor movements on their instruments, all the while collaborating with other musicians. Although mental rehearsal and performance outcomes are positively associated, meta-analytic findings indicate that this effect is negatively associated with the degree of task coordination required to perform a motor task (Driskell et al., 1994). Thus, although a promising area for future research – particularly as our findings suggest that affect management and performance enhancement strategies are closely intertwined – more work is required to understand the unique impact of mental rehearsal on MPA. Indeed, the degree of task coordination required to perform a musical instrument differentiates musical performance from many forms of skilled motor performance (e.g., running).

Further, we found that many musicians experience spontaneous intrusions while engaged in different forms of intentional imagery to manage MPA. As such, future research should also examine whether such intrusions impact the perceived and actual helpfulness of intentional imagery used to manage MPA in anticipation of performing. Further, given our findings regarding the association between NSI and MPA in Studies 1 and 2, future research should examine whether those with higher MPA are more vulnerable to experiencing negatively valanced spontaneous imagery while engaged in intentional mental imagery to manage MPA. As reviewed, applied models suggest that imagery ability is one factor which moderates the effectiveness of intentional imagery (Cumming & Williams, 2013; Martin et al., 1999) and some research indicates that auditory imagery ability decreases musicians sensitivity to specific forms of interference during performance on a musical task (Brown & Palmer, 2013). Thus, future research should also study whether imagery ability (e.g., auditory imagery ability), protects

musicians from negative spontaneous intrusions while engaged in intentional mental imagery to manage MPA.

Building on previous MPA research and drawing from closely related literatures (i.e., sport psychology and social anxiety), our series of studies is the first to provide a comprehensive examination of musicians' experiences along the imagery continuum (i.e., spontaneous to intentional) as they relate to MPA. Despite limitations, our novel findings provide important theoretical and clinical implications while also suggesting fruitful avenues for future research.

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Appendix A:

K-MPAI Revised

Below are some statements about how you feel generally, and how you feel before or during a performance. Please select the response to each statement that best describes your experience.

The items below are part of a questionnaire of music performance anxiety that is often used in research. Although some of the questions might appear unusual and not connected to the study aims regarding imagery and performance anxiety (e.g.,1. I generally feel in control of my life), using this questionnaire allows us to connect our work to other music performance anxiety research and we appreciate your responses.

1. I generally feel in control of my life
2. I find it easy to trust others
3. Sometimes I feel depressed without knowing why
4. I often find it difficult to work up the energy to do things
5. Excessive worrying is a characteristic of my family
6. I often feel that life has not much to offer me
7. Even if I work hard in preparation for a performance, I am likely to make mistakes
8. I find it difficult to depend on others
9. My parents were mostly responsive to my needs
10. Prior to, or during a performance, I get feelings akin to panic
11. I never know before a concert whether I will perform well
12. Prior to, or during a performance, I experience dry mouth
13. I often feel that I am not worth much as a person
14. During a performance I find myself thinking about whether I'll even get through it
15. Thinking about the evaluation I may get interferes with my performance
16. Prior to, or during a performance, I feel sick or faint or have a churning in my stomach
17. Even in the most stressful performance situations, I am confident that I will perform well
18. I am often concerned about a negative reaction from the audience
19. Sometimes I feel anxious for no particular reason
20. From early in my music studies, I remember being anxious about performing
21. I worry that one bad performance may ruin my career
22. Prior to, or during a performance, I experience increased heart rate like pounding in my chest
23. My parents almost always listened to me
24. I give up worthwhile performance opportunities
25. After a performance, I worry about whether I played well enough
26. My worry and nervousness about my performance interferes with my focus and concentration
27. As I child I often felt sad
28. I often prepare for a concert with a sense of dread and impending disaster
29. One or both of my parents were overly anxious
30. Prior to, or during a performance, I have increased muscle tension
31. I often feel that I have nothing to look forward to
32. After a performance, I replay it in my mind over and over

33. My parents encouraged me to try new things
34. I worry so much before a performance, I cannot sleep
35. When performing without music, my memory is reliable
36. Prior to, or during a performance, I experience shaking or trembling or tremor
37. I am confident playing from memory
38. I am concerned about being scrutinized by others
39. I am concerned about my own judgment of how I will perform
40. I remain committed to performing even though it causes me great anxiety

Appendix B:

CSAI-2-R

The following are several statements that musicians use to describe their feelings just prior to performing before an audience. Please take a moment to imagine yourself getting ready to perform in your upcoming important performance and answer the following questions based on how you feel at this moment as you imagine your upcoming performance.

For the **intensity** scale, please select the response that best describes how intense the feeling is right now as you imagine this performance, and for the **interpretation** scale, please select whether having that feeling will help or hinder (i.e., get in the way) of your upcoming performance.

For example, you might feel very jittery thinking about your upcoming performance and think that this will either get in the way of your performance, or help you to feel engaged during a performance.

Alternatively, you might not feel jittery thinking of your upcoming performance and think that this will get in the way of your performance (e.g., you won't feel engaged), or that it will help you feel calm.

Intensity Scale

Never						***Always***
1	***2***	***3***	***4***	***5***	***6***	***7***

Interpretation Scale

Hinders						***Helps***
1	***2***	***3***	***4***	***5***	***6***	***7***

1. I am concerned that I may not play as well as I could in this performance
   Intensity___
   Interpretation___
2. I feel jittery
   Intensity___
   Interpretation___
3. I am concerned about choking under pressure
   Intensity___

Interpretation___

4. My body feels tense
   Intensity___
   Interpretation___
5. I feel tense in my stomach
   Intensity___
   Interpretation___
6. I am concerned about failing
   Intensity___
   Interpretation___
7. I am concerned about performing poorly
   Intensity___
   Interpretation___
8. My heart is racing
   Intensity___
   Interpretation___
9. I feel my stomach sinking
   Intensity___
   Interpretation___
10. I am concerned that others will be disappointed with my performance
    Intensity___
    Interpretation___
11. My hands are clammy
    Intensity___
    Interpretation___
12. My body feels tight
    Intensity___
    Interpretation___

The following are additional statements that musicians use to describe their feelings just prior to performing before an audience. Please take a moment to imagine yourself getting ready for your upcoming performance and answer the following questions based on how you feel at this moment.

Please rate the intensity of each feeling below.

Never						***Always***
1	***2***	***3***	***4***	***5***	***6***	***7***

1. I feel confident___
2. I'm confident of performing well___
3. I mentally picture myself reaching my goal for this performance___

4. I’m confident about performing well under pressure___
5. I am confident that I can meet the audience’s expectations___

Appendix C: Imagery Interview Protocol

Part 1: Intentional Imagery Section

Today's interview will be based on musical performance and mental imagery. Although many people think of imagery in terms of visualizing something through the mind's eye, imagery can include different kinds of sensory information. Imagery is an experience that mimics real experience. We can be aware of "seeing" an image, feeling movements as an image, or experiencing an image of smell, taste, or sound without experiencing the real thing (White & Hardy, 1998, p.389). Some people use other words to describe mental imagery, like mental rehearsal or mental practice, but essentially mental imagery can be used to create an internal sensory experience.

Images can be deliberately/**intentionally created** or **experienced spontaneously** (e.g., an image that "pops" into your head) without any effort to envision them. The following section involves questions about images you **intentionally** imagine. Does this distinction make sense?

I'm going to ask you some specific questions about ways that you might use imagery (e.g., to manage music performance anxiety), but first, I'd like to learn about why you use mental imagery related to musical performances (e.g., to "get into" the character of a piece, to imagine a technical section of a piece)?

Based on participant responses, ask participants:

- ***What** they imagine (e.g., sensory content)*
- ***When** they use imagery (e.g., during practicing)*
- ***Why** they use imagery (e.g., to improve playing)*
- *How **confident** musicians are that the imagery strategy they use is an intentional strategy (i.e., doesn't also include spontaneous elements)?*
- *How **long** have they been using imagery?*
    - *Has this **changed** over time?*
- *How did they **learn** to use imagery?*

_____
_____
_____
_____

Based on participant responses, ask participants how helpful and how often they use imagery for different purposes related to musical performances using the below scales*

How helpful:

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

How often:

Never						***Always***
1	***2***	***3***	***4***	***5***	***6***	***7***

How confident are you that "X" is an intentional imagery strategy?

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

Intentional Imagery and Performance Anxiety

Next, I'm going to ask some questions about whether and how you might use imagery to manage performance anxiety.

For all questions in the Intentional Imagery section, ask participants how confident they are that the imagery they are describing is an intentional/deliberate strategy.*

How confident are you that "X" is an intentional imagery strategy?

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

- Do you experience music performance anxiety?
  Yes / No
- If **no**: Do you experience heightened physiological arousal during performances that impacts your playing (e.g., tense muscles, heart racing, sweating, etc.)?
  Yes / No

1) Do you use imagery to manage performance anxiety or heightened physiological arousal that impacts your playing?
   - **Yes / No**

- If **yes**: On a scale from 1 (*Never*) to 7 (*Always*), how often do you use imagery to manage performance anxiety or heightened physiological arousal?

Never						***Always***
1	***2***	***3***	***4***	***5***	***6***	***7***

2) When you use imagery to manage MPA or heightened physiological arousal, how do you try to manage it (e.g., reduce it, harness it to facilitate performance)?

3) When you use imagery to manage MPA or heightened physiological arousal, what kinds of things do you imagine?

4) Through which sense/senses do you use imagery to manage performance anxiety? *Note: more than one response can be selected. If visual imagery is endorsed, through what perspective (e.g., first or third person).*

   a) Auditory (sound)
   b) Visual (sight)
   c) Kinesthetic (perception of motion)
   d) Tactile (touch)
   e) Olfactory (smell)
   f) Gustatory (taste)
   g) Other (please explain):

5) When you use imagery to manage MPA or heightened physiological arousal, do you also have other goals in mind (e.g., to improve performance quality, to increase self-confidence, supplement physical practice)?
   Yes / No
   If yes, please explain:

6) People can imagine different emotional states (e.g., being calm, excited, nervous). Do you imagine specific emotional states – like being calm, excited, nervous, etc. – when you use imagery to manage MPA or heightened physiological arousal?
Yes / No
If **yes**, please specify:

7) How helpful is imagery used to manage MPA or heightened physiological arousal?

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

- **If > 1**: What is helpful about it?

8) When do you use imagery to manage performance anxiety or heightened physiological arousal (e.g., before, during, after performances)?

9) Does the type of imagery you use depend on how close you are to performing (e.g., three weeks before, the night before a performance, or right before going onstage)?
   - **Yes / No**
   - If **yes**, please explain:

10) Does the type of imagery that you use to manage performance anxiety depend on how nervous you are for an upcoming performance?
    - **Yes / No**
    - If **yes**, please explain:

11) Does the type of imagery that you use to manage performance anxiety depend on how important an upcoming performance is?
    - **Yes / No**
    - If **yes**, please explain:

12) Does the type of imagery that you use to manage performance anxiety depend on the performance situation (e.g., solo vs. group)?
    - **Yes / No**
    - If **yes**, please explain:

13) Does the type of imagery that you use to manage performance anxiety depend on the character of the piece/passage you imagine performing?
    - **Yes / No**
    - If **yes**, please explain:

14) When you use intentional imagery to manage MPA or heightened physiological arousal, do you find that things you don't try to imagine "pop" into your mind?
Yes / No
If **yes**: What kinds of things "pop" into your mind?

15) Do you use intentional imagery to try and make changes to the negative spontaneous images that you experience (e.g., to make them less negative or change the features of these images)?
Yes / No
If **yes**, please specify:

16) If yes: How often do things "pop" into mind while you are using intentional imagery?

Never						***Always***
1	***2***	***3***	***4***	***5***	***6***	***7***

17) How difficult is it to control the imagery that you use to manage MPA or heightened physiological arousal?

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

18) If > 1, What is difficult to control?

Is there anything else you would like to share with us about your use of intentional mental imagery to manage MPA or heightened physiological arousal? Or are there any important questions you felt were missing?

Intentional Imagery and Performance Quality

******The following section is not part of the results reported in the current dissertation, but was included in a larger part of the project******

1. Do you use imagery to improve your playing?
   - **Yes / No**
   - Does the imagery that you use to improve your playing differ at all from the imagery that you have already described?
   - **Yes / No**
   - If **yes**, please describe ***and continue with Intentional section***:

- If **no**, skip to Negative Imagery section

  - If **yes**: On a scale from 1 (*Never*) to 7 (*Always*), how often do you use imagery to improve your playing?

Never						***Always***
1	***2***	***3***	***4***	***5***	***6***	***7***

2. When you use imagery to improve your playing, what kinds of things do you imagine?

3. Through which sense/senses do you use imagery to improve your performance quality?
Note: more than one response can be selected.

a) Auditory (sound)
b) Visual (sight)
c) Kinesthetic (perception of motion)
d) Tactile (touch)
e) Olfactory (smell)
f) Gustatory (taste)
g) Other (please explain):

4. When do you use imagery to improve your playing (e.g., during practicing or right before going onstage?

5. Do you focus on specific aspects of performance quality during imagery such as intonation, breathing, sound quality, pedaling, memorization, etc.?

- **Yes / No**
- If **yes**, please explain:

6. On a scale from 1 (*Not helpful*) to 7 (*Extremely helpful*), how helpful is imagery used to improve performance quality?

Not Helpful						***Extremely Helpful***
1	***2***	***3***	***4***	***5***	***6***	***7***

19) **If > 1**: What is helpful about it?:

Is there anything else you would like to share with us about your use of intentional mental imagery to improve your playing? Or are there any important questions you felt were missing?

Spontaneous Imagery Section
Anxiety Provoking Performance

******The following section is not part of the results reported in the current dissertation, but was included in a larger part of the project******

Although musicians experience varying levels of performance anxiety, most musicians can think of a performance situation in which they were nervous to some extent. Is this true for you?

Please bring to mind a recent performance (that took place within the last 6 months) in which you felt anxious. Does a performance come to mind?

If no performance comes to mind, ask participants if they can recall a performance where they felt even slightly nervous.

1) On a scale from 1 (*Not anxious*) to 10 (*Extremely anxious*), how anxious were you immediately before this performance:

Not anxious									***Extremely anxious***
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***

2) On a scale from 1 (*Not important*) to 10 (*Extremely important*), how important was this performance to you:

Not important									***Extremely important***
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***

3) What type of performance was this (e.g., solo, choir, band, orchestra, etc.)?:

4) Approximately how long ago was this performance?:

At the beginning of our interview we talked about intentionally created imagery, but images can also be **spontaneously experienced**, without any effort to envision them. The following section involves questions about images you might experience that spontaneously enter your mind (e.g., images that seem to "pop" into your mind).

As well, sometimes sensory impressions or representations are clearly images that **aren't** based on actual experiences (e.g., an image of floating on a cloud).

However, sometimes spontaneous images **are** closely related to actual events or memories. For example, it is possible to experience a spontaneous image of eating dinner with a friend at a restaurant that you have visited many times.

Please take another moment to bring your recent anxiety provoking performance to mind and tell me when you have it in mind again.

5) Immediately before or during the performance you just described, did you experience any **spontaneous image/s or sensory impression/s** that "popped" into your mind?

Yes / No

- 5a) If "**No**"
- What comes to mind when you recall this performance?

- 5b) If **no**: Have you *ever* experienced **spontaneous imagery or sensory impressions** that "pop" into your mind immediately before or during anxiety provoking performance situations?
- **Yes / No**
- 5c) If **yes**, please bring the image to mind and tell me when you've got it. Please describe the image/s or sensory impression/s that "popped" into your mind in as much detail as possible:

- If **"yes"** to 5: please bring the image to mind and tell me when you've got it. Please describe the image/s or sensory impression/s that "popped" into your mind in as much detail as possible:

Please hold your spontaneous image/s or sensory impression/s in mind while answering the following questions.

As mentioned earlier, spontaneous images can vary in the extent to which they resemble memories of actual events. For example, some are **clearly images** of things you have never actually experienced (e.g., floating on a cloud), while others **clearly resemble memories** of actual events (e.g., eating dinner with a friend at a restaurant that you have visited many times).

6) On a scale from 1 (*Pure memory*), 4 (*Blend of a memory and image*), to 7 (*Pure image*), how closely did the spontaneous image/s or sensory impression/s you just described resemble a memory or an image?

1	***2***	***3***	***4***	***5***	***6***	***7***
Pure memory			***Blend of a memory and image***			***Pure image***

*6a) *Depending on participant response, ask what parts of the image resemble a memory, or what parts of the image represent things that have not been experienced (e.g., feared performance outcomes).**

7) Using the following scale, (*point to relevant scale*), please rate the vividness of the spontaneous image/s or sensory impression/s you just described using the rating scale below:

1	2	3	4	5
Perfectly clear and as vivid as an actual performance	*Clear and reasonably vivid*	*Moderately clear and vivid*	*Vague and dim*	*No image at all (only "knowing" that you are thinking of the performance)*

8) On a scale from 1 (*Not at all*) to 7 (*Extremely*), how distressing are the image/s or sensory impression/s that you just described?

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

8a) **<u>If response > 1</u>**: What is distressing about the image/s or sensory impression/s that you just described?

8) Does having images like the one you just described impact your performance quality?

- **Yes / No**
- If **yes**, please explain:

9) Does having images like the one you just described impact how anxious you are for performances?

- **Yes / No**
- If **yes**, please explain: