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Stress and Performance Anxiety Intervention for Musicians:A Biofeedback and Compassion Focused Therapy Intervention

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ABSTRACT

Stress and Performance Anxiety Intervention for Musicians: A Biofeedback and Compassion Focused Therapy Intervention

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Performance anxiety and stress are forefront problems for performers in the music industry. Within music training programs, these problems are particularly debilitating. These students are concerned both about performance situations and also their personal lives. The following study compared two treatments, heart rate variability (HRV) biofeedback and Compassion Focused Therapy (CFT) on the effects of cortisol and self-reported stress and mood before and after a required end of semester performance. Thirty students enrolled in a college music program participated in the five-visit intervention (14 in the HRV biofeedback group and 16 in the CFT group). Stress levels, measured by self-report, salivary cortisol, and salivary alpha amylase, showed no group differences between the CFT and HRV groups. Both groups had statistically significant improvement following the intervention on pre-performance DASS scores and alpha-amylase scores, showing lower sympathetic activation and lower report of mood symptoms despite the stress of the required performance. Cortisol and negative affect did not appear to be impacted by the intervention, however, cortisol returned to baseline levels 15 minutes after the intervention, showing relatively quick recovery for both groups. Further research with a larger, more diverse sample and control group is warranted.

Keywords: musicians, stress, anxiety, performance anxiety, HRV biofeedback, Compassion Focused Therapy

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Classical musicians report high levels of stress and anxiety related to both their personal and professional lives (Goren, 2014). While these high levels of stress and anxiety have been an area of concern and discussion, rates of anxiety, stress, and depression in musicians have continued to increase over the last fifty years. Depression and anxiety prevalence rates were around 30% in the 1950s-1960s and 33-50% at the end of the century. More recently, an informal survey found more than 65% of musicians endorsed clinically significant symptoms of depression or an anxiety disorder (Help Musicians UK Survey, 2016, personal correspondence; Kenny, et al., 2014).

These high levels of stress, anxiety, and depression affect musicians at all ages and training levels, from elementary school to the highest paid music “stars” (Kenny et al., 2014). While all training ranges are affected, college and conservatory music teachers and professors are specifically concerned with the mental health concerns of their students. They report there has been an increase in students requiring accommodations or alterations in either their academic or performing schedule to manage stress and mental health concerns (Brigham Young University, personal correspondence). At another music conservatory, professors have found that while the students are able to maintain their rigorous performance schedules, they are struggling in their daily lives (Royal College of Music, personal correspondence). These professors are proactively looking for ways to help their students’ mental health, including increased seminars and classes on both performance anxiety and stress management.

Despite interest in providing interventions for their students, there is little information beyond correlational and preliminary intervention research. More than 17 studies have looked at performance anxiety, most with students (Austin, 2018). However, these interventions had small sample sizes, and few were randomized. Additionally, the interventions were not matched to the population, instead reflecting popular interventions at the time. Even with these shortcomings, the majority of the studies were efficacious, and resulted in small to large effect sizes of Hedges g between -0.455 and -0.813 (Austin, 2018). Results varied by type of intervention and length, with longer intervention and those involving more than one modality having larger effects. These studies were low powered and intended to serve as pilot studies and to be followed up with randomized control studies that built upon their findings.

Based on both the increasing need for these interventions, the institutional support across colleges and professional organizations to both support and implement the research, and the preliminary data from the pilot studies and correlational research, further research with additional treatments and outcomes is the next step to determine the effectiveness of interventions in this area. As more research is done in both performance science and in anxiety and depression treatment, it is possible to identify specific needs of the population and treatments that have addressed those needs in other populations. The purpose of the study is to evaluate the effectiveness of two targeted treatments on performance anxiety, general anxiety, and stress in college age musicians.

Psychopathology in Musicians

Professional musicians exhibit significantly higher levels of physiological and psychological distress than the average person, including elevated cortisol levels pre and post-performance and high levels of self-reported depression and anxiety (Felger, 2014; Kenny et al., 2014). Musicians experience high levels of stress at least partly because of negative personality traits, particularly neuroticism and perfectionism (Stoeber & Eismann, 2007). Negative personality traits contribute to performance anxiety, which is counterproductive to working in competitive and high stress environments (Sadler & Miller, 2010). Additionally, those who report high levels of performance related anxiety, regardless of performance outcomes, report higher levels of occupational strain and lower abilities to control impulsive behavior including alcohol and drug use (Thompson et al., 2017). In addition to being prone to stress and mood disorders, musicians have elevated rates of psychopathology. In a study with a respected professional orchestra in Vienna, members reported elevated rates of social phobias, generalized anxiety, and depression (Kenny et al., 2014). The orchestral members were highly educated and trained, with most having a master's degree and several years of professional training. They also had greater job security than the majority of musicians, who work on a freelance basis (Pilger et al., 2014).

The professional musicians were more educated than the general public, with most professional opera companies or orchestras requiring a master's level degree, which has been shown to be a protective factor (Manturzewska, 1990; McLaren et al., 2015). Even with these favorable and protective conditions, thirty-two percent of the orchestra endorsed clinically significant symptoms of social phobia, compared to between 4.5-9.5% in a German sample (Wittchen et al., 1999). Thirty-two also met criteria for generalized anxiety according to an anxiety screener (Nicholson et al., 2015). The numbers in these studies are greater than the 9% lifetime prevalence reported in the *Diagnostic and Statistical Manual of Mental Disorders, 5th Ed.* (DSM-5; American Psychiatric Association, 2013). Elevated rates of depression are also reported, with 33% meeting criteria for a depressive disorder (Kenny et al., 2014), compared to 7% prevalence rate reported by the DSM-5 (American Psychiatric Association, 2013). In addition to experiencing these psychological disorders, 50% of one correlational study reported experiencing anxiety related to performance (Marchant-Haycox & Wilson, 1992). For some, performance related anxiety can occur at a self-described impairing level weeks to months before performances (van Kemenade et al., 1995). While personality traits and psychopathology can be resistant to change, several preliminary studies with musicians have found statistically and clinically significant symptom reduction (Austin, 2018; Goren, 2014). These studies did not match their interventions to the population specific problems, which could have resulted in more symptom reduction.

Musicians also experience high levels of chronic stress. Professional musicians have been found to have elevated cortisol levels during performances (Felger, 2014). While elevated cortisol levels are adaptive in time limited circumstances, chronic activation of the hypothalamic–pituitary–adrenal (HPA) axis leads to physiologic dysregulation and negative health outcomes (McEwen, 2004; Yehuda, 2014). Chronic HPA axis elevation is problematic considering how many musicians have weekly performances, if not more. In addition to having elevated stress responses in performances, musicians report feeling that they do not have the resources to successfully meet their personal and professional challenges (Parasuraman & Purohit, 2000). These anxiety and stress levels are correlated with both social and physical symptoms. The correlation between anxiety and inflammation was particularly notable for the women surveyed. In addition, chronic elevated cortisol levels have been shown to have negative effects on immune functioning, which could lead to the development of various physical and mental illnesses, as well as potentially change brain function and structure (McEwen, 2004). In addition, these high cortisol levels are associated with lower ratings of social functioning (Pilger et al., 2014).

The recommended treatment for social phobia, generalized anxiety, specific and chronic anxiety, and depression involve treatment with qualified mental health practitioners and doctors (Barlow et al., 2015). The treatments often include therapy and pharmacological interventions. However, Dews and Williams (1989) discovered, that while 90% of musicians sought help, the most widely used sources were friends and social networks. Another often used coping mechanism found in Kenny et al. (2014), was excessive use of alcohol. These coping styles continue to be used, even when unsuccessful at resolving problems.

Stress and anxiety both activate the HPA Axis and produce similar physical reactions. They also both result in similar brain activity, including heightened amygdala activation (Shin & Liberzon, 2010). Because of the overlap between performance anxiety and a stress response to a performance, both terms will be used in the paper. Anxiety, including performance anxiety, involves negative cognitions and physical symptoms (i.e., shaking hands, sweating, biting nails) around performance and stress will refer to the effect of both the negative cognitions that activate the sympathetic nervous system as well as the situations that elicit these responses (Tsigos & Chrousos, 2002).

Effects of Stress on Sympathetic Nervous System Activity

Musicians report elevated levels of perceived stress, both in regards to their performances as well as their personal lives (Felger, 2014). Short lived stressors promote adaptation; however, long term stress leads to wear and tear, called allostatic load (Johnson, 1991). Allostatic load leads to impaired immunity, atherosclerosis, obesity, bone demineralization, and atrophy of nerve cells in the brain (Juster et al., 2010). Negative effects are seen in the brain as neurons in the hippocampus and prefrontal cortex atrophy and neurons in the amygdala show a growth response (McEwen, 2004), resulting in potentially worse memory and more intense emotional experience.

Cortisol as a key hormone in the stress response. The human body uses neurotransmitters and hormones to maintain homeostasis. One such hormone produced by the adrenal cortex is cortisol, a metabolic hormone involved in the stress response (Juster et al., 2010; Watson & Breedlove, 2012). Cortisol is activated by stress as well as circadian rhythms. These hormones and neurotransmitters help the body respond to the stressor by boosting heart rate, breathing, and physiological processes necessary to react to the stressor (Juster et al., 2010; Watson & Breedlove, 2012). Cortisol stimulates glucogenesis, or creation of glucose, in the liver, and also inhibits insulin bringing glucose to the cells. Increases in glucogenesis results in more available glucose in the bloodstream to use in responding to the stressor. Nonessential functions are also lowered, such as immune functioning and reproduction.

Negative effects of chronic stress on cortisol. The short-term effect of cortisol is adaptive when stressors are short lived, as one must survive a physical stressor to live to fight off disease and reproduce (Juster et al., 2010). Following successful resolution of the stressor, the body is able to adapt, or return to balance. However, if the stressors are prolonged or unable to be solved, the body can also face exhaustion, or the inability to return to a place of homeostasis. Chronic elevated cortisol levels can lead to lowered immune functioning, impaired thyroid system functioning, and problems with the gastrointestinal tract (Juster et al., 2010).

Chronic elevated cortisol levels have been shown to be associated with brain changes, particularly in the hippocampus (Tessner et al., 2007). Diffusion Tensor Imaging in individuals with chronic stress has found changes in the white matter connections, with lower areas of conductivity (Liu et al., 2016). The association between psychosocial stressors has strong correlational support, however, the exact mechanisms are unknown. The association between stressors might be one path by which chronic stress is involved in the development and continuance of psychological disorders (Calcia et al., 2016; Liu et al., 2016).

Cortisol measures during performance. Cortisol is used to measure optimal attitudes and states within a person (Armbrecht, 2012). One particularly area of interest for stress biomarkers is in sports and the performing arts as stress levels must be carefully managed to optimally perform. If there is too little stress, there are not enough physical capacities to meet the demands of the activity and on the other hand, too much can equally negatively affect performance. While studies have shown equivalence between cortisol levels in musicians and athletes (Armbrecht, 2012), there are fewer studies with musicians than with athletes. In a naturalistic study with the Vienna Radio Orchestra, cortisol levels were elevated in 40% of musicians during the performance compared to their baseline levels the day before the performance (Pilger et al., 2014). Excessive cortisol has been found to interfere with memory and is correlated with higher rates of overtraining and burnout (Pilger et al., 2014). Forgetting large amounts of memorized music during a performance is a cause of stress and anxiety in young musicians (Stoeber & Eismann, 2007). However, excessive worry and stress are potentially causing the memory difficulties they fear. Interventions that address worries and stress, such as physiological and psychological treatments, will likely improve memory in performance.

Alpha-amylase as a key hormone in the stress response. Along with interest in cortisol samples, there has been an interest in measuring sympathoadrenal medullary system activity using saliva (Rohleder et al., 2004). Chatterton et al. (1996) found that salivary alpha amylase measures were associated with norepinephrine changes following exercise and psychosocial stressors. Research studies comparing both salivary alpha amylase and sympathetic nervous system activity found a significant association between stress induced salivary alpha amylase activity and norepinephrine response (Thoma et al., 2012). Following the initiation of the stress response system, catecholamines, epinephrine, and norepinephrine are released from the adrenal medulla, resulting in decreased blood flow to the gastrointestinal tract, skin, kidneys, and increased blood flow to the brain, heart, and skeletal muscles (Piazza et al., 2010), providing a quick physiological response system to stressors. While measuring epinephrine and norepinephrine previously required urine, plasma, or cerebrospinal fluid samples, circulating catecholamines can now be measured via salivary alpha amylase activity. Salivary alpha amylase activity serves as a marker of sympathetic nervous system activity with at least moderate correlation to norepinephrine and lower correlation to epinephrine (Thoma et al., 2012). Frequency and length of sympathoadrenal medullary (SAM) pathway activity can increase when individuals have prolonged stressors or when stressors increase in chronicity, resulting in higher blood pressure, higher salivary alpha-amylase reactivity, and blunted norepinephrine diurnal response (Piazza et al., 2010).

Alpha amylase during stressor tasks and performance. While there are limited studies of alpha-amylase in musicians, there are several studies looking at the alpha-amylase changes in performance or performance-like situations. Alpha-amylase was found to be higher in sports coaches, drone pilots, and army pilots when engaged in performance-like situations (e.g. game days, flight simulations, and post-flight) compared to non-stressful baseline days (Hudson et al., 2013; Iizuka et al., 2012). Kang et al. (2010) and Ng et al. (2008) in an experimental and then within-subjects design, respectively, found alpha amylase was elevated pre- and post-simulated academic exams. The one study with musicians found that alpha amylase was elevated minutes before and after a simulated performance, but at baseline levels 15 minutes post simulated performance (Aufegger et al., 2013). With the exception of Hudson et al. (2013), all studies used simulated performance situations, which while they produced statistically significant elevated changes in alpha amylase either compared to a control condition or matched non-stressful day, might underestimate or abbreviate the stress response.

HRV Biofeedback and Biofeedback Group

One physiological treatment for chronic stress and anxiety is HRV biofeedback. Biofeedback effectively reduces stress and is often used as an adjunct to other stress management approaches (Lehrer et al., 2013). Biofeedback allows individuals to learn more about their physiology and the control they have over their body's responses. The Association of Applied Psychophysiology and Biofeedback defines biofeedback as the "process that enables individuals to learn how to change physiological activity for improving health and performance… The instruments then provide real time feedback to the user" (Schwartz, 2010, p. 88). With more awareness and practice using the feedback from their physiological reactions and ability to make changes, these changes and improvements can continue even without use of the equipment (Lehrer et al., 2013).

HRV biofeedback is a form of cardiovascular biofeedback aimed at measuring the change in variability of time between heart beats (Lehrer et al., 2013). The variation in time intervals between heart beats is called heart rate variability and shows the body's ability to self-regulate (Lehrer et al., 2013). As blood pressure increases, receptors in the aorta, called baroreceptors, signal the heart rate to slow down, which results in blood pressure lowering. When blood pressure decreases, these same mechanisms send a signal to increase rate heart and blood pressure rises. Heart rate variability (HRV) shows that the body is able to efficiently self-regulate and that interactions between the sympathetic and parasympathetic nervous systems are in balance (Lehrer et al., 2013). HRV, including strong vagal tone, can be increased by breathing at a specific rate, known as resonance frequency (Gevirtz, 2007). When breathing at resonance frequency, heart rate and breathing will oscillate with greater amplitude, strengthening the mechanisms of the baroreflex and increasing vagal tone (Gevirtz, 2007). Increasing HRV has been related to improvements in the treatment of asthma, heart disease, irritable bowel syndrome, major depressive disorder, headaches, generalized anxiety, panic disorder, and performance anxiety (Gevirtz, 2013).

Compassion Focused Therapy

The Buddhist faith and psychological techniques have used compassion for the last 2,600 years. Recent trends in Cognitive Behavior Therapy (CBT) and other forms of psychotherapy have started to include more mindfulness and acceptance techniques (Tirch, 2016). Paul Gilbert (2005) defines compassion as "a basic kindness and deep awareness of the suffering of oneself and of other living things, coupled with the wish and effort to relieve it."

Stress Interventions with Performers

Musicians are not the only performers to report anxiety related to both high stakes performance and evaluation of performance. While this study will focus on musicians, Armbrecht (2012) found no significant difference in performance anxiety between athletes, represented in the study by mixed marital artists, and classical musicians, represented by opera singers. In all groups, the self-confidence subscales had the strongest correlation to quality of performance. Both groups experienced similar levels of psychological disturbances and doubts about professional competence. Based on the study, findings in sports psychology could generalize to music. While the study did not state that interventions for one should be applied to the other, successful interventions with one population could be a reasonable starting point to study with the other population. Interventions used with athletes included treatments such as cognitive restructuring and skills, imagery, and mindfulness (Neil et al., 2012; Pineau, 2015). There have been several efficacious studies for sports using biofeedback. Three studies found that biofeedback significantly reduced performance anxiety in basketball players, golfers, and cyclists (Lagos et al., 2008; Paul & Garg, 2012).

Stress Interventions with Musicians

Searching PsychInfo, ProQuest dissertation databases, and similar sites yielded twenty experimental or quasi-experimental studies with performance anxiety and classical musicians, across a variety of modalities. Interventions included yoga, mindfulness, exposure paired with relaxation, cognitive strategies, and biofeedback (Austin, 2018). While the effects of many studies were promising, many were intended as pilot studies, and the authors encourage replication with larger sample sizes.

A meta-analysis in 2017 calculated the overall effect of 17 studies looking at performance anxiety (Hedge's g -0.627, 95% CI [-0.926, -0.384], $p<.000$) in a random-effects model (Austin, 2018). The samples involved in all interventions were heterogeneous (involving performers playing many types of instruments), with the effects more likely to be accounted for by chance than by the intervention (I_2=35.650). I_2 measures the ratio of true heterogeneity to the total variance across effect sizes found in these interventions, which merits a rating between low and moderate as determined by Higgins et al. (2003). The largest effect sizes were found in combination interventions (Hedges g = -0.81, 95% CI [-1.171, -0.46], $p >0.00$), with purely cognitive interventions having the smallest effect size (Hedges g = -0.46, 95% CI [-0.76, -.15], $p = 0.003$). The physiological interventions had a moderate effect size, with (Hedges g = -0.64, [-

1.11, -0.16], p = 0.01). However, the differences between these effect sizes were not statistically significant (Q (2) = 2.27, p =0.32, i2 = 11.93), which shows a more homogenous distribution of effect sizes between the three types of studies.

Significantly larger effects sizes were seen in the longest four studies (ranging between 8-14 weeks) with an overall effect of Hedges' *g* -0.78 than the five shortest studies (ranging between 2-3 weeks) with an effect size of Hedges' *g* -0.53. A meta regression was then conducted to see the relationship between the length of the intervention (dose) and the effect of the intervention. The results of the meta regression showed that each intervention reduced anxiety by -.33, and that each additional week of intervention resulted in a small but continued reduction in anxiety of -0.04, though the finding is nonsignificant in the 95% confidence intervals contain zero (95% CI [-0.09, 0.01]).

Proposed Study

The proposed study aimed to look at differences in anxiety symptoms following a primarily cognitive or physiological intervention. The study intended to take place at two different locations, an elite music conservatory, as well as a well-established music program in housed within a large university, in order to recruit more participants and better generalize findings to a variety of music programs. The study author trained research assistants and provided equipment to both sites. Due to logistical difficulties, no participants were recruited at the elite music conservatory; this is likely due to the primary study author being onsite at the university but not at the conservatory due to geographical constraints. All other aspects of study design were retained and described below.

Current Study

The following study compared physiological and cognitive interventions at a well-established music program within a large university. The physiological intervention was HRV biofeedback and the cognitive intervention used Compassion Focused Therapy. Biofeedback is promising in both lowering stress levels and helping individuals feel a greater locus of control over their physiology (Gevirtz, 2013). Lack of control over their physiological responses during performances has been found to be distressing in college musicians (Thomas & Nettleback, 2014). Based on the presented evidence, HRV biofeedback may be an effective stress and performance anxiety management tool for musicians. Previous biofeedback studies have found promising results, without using the minimal protocol for research (5 sessions instead of only one; Wells, 2012; Niemann, 1993; Thurber, 2006). Compassion focused therapy will help address the high levels of maladaptive perfectionism and neuroticism, which have been shown to be treatment resistant to many forms of interventions (such as standard CBT) in musicians (Tirch, 2016). The present study will investigate the effect of biofeedback and compassion on a group of second- and third-year collegiate music students.

Method

Participants

Thirty students from a large mountain west university were recruited for the study over 3 consecutive semesters. No participants were recruited from the elite music conservatory. In order to be eligible for the study, they needed to be in their second or third year of the music program, a declared music major, and taking private music lessons. Participants were randomly assigned to the biofeedback treatment condition or Compassion Focused Therapy condition using a computer algorithm. Exclusion criteria included having high blood pressure, heart disease, or taking medications for either of those conditions; no participants met exclusion criteria.

Measures

Cortisol samples. Cortisol is a biomarker for both psychological and physical stress used in research (Hellhammer et al., 2009). It is used in research as an objective measure of stress in types of disease, coping, perception of stress, or to measure effectiveness of interventions. Cortisol is therefore the current gold standard biomarker of psychological stress and related mental or physical diseases. Cortisol samples were measured from saliva, with one sample taken at the initial meeting (baseline sample), and then on the day of the end of semester music performance, 15 minutes prior and 15 minutes after the required performance. Saliva samples were sent to the Technische Universität in Dresden for analysis. Cortisol is considered the major indicator of altered physiological states in response to a stressor (Kirschbaum & Hellhammer, 1989). After ACTH binds to the membranes in the adrenal cortex, cortisol is released into the blood stream. Most of the secreted cortisol will bind to large proteins and carried with these proteins throughout the body through the bloodstream. Cortisol not bound to large proteins can travel freely through the body and centers cells by diffusion and can be measured in body fluids, including sweat, tears, and saliva (Kirschbaum & Hellhammer, 1989).

Alpha amylase. Alpha amylase samples were taken from the same saliva samples as described above in relation to cortisol. Alpha amylase is a biomarker for SAM activity, particularly moderately correlating with norephedrine activity and also more weakly correlating with epinephrine activity (Thoma et al., 2012). Saliva samples were sent to the Technische Universität in Dresden for analysis.

Biofeedback program. This experiment used the Nexus-4 and BioTrace Software, both of which are regularly used in research, and have been recommended by experts in the field (Gevirtz, AAPB HRV Biofeedback Training Course, 2016). Electrode placements were made using Shaffer (2016 biofeedback class) instructions and pictures of proper placement. Electrodes were placed on the collarbones and rib cage.

Scale of Positive and Negative Emotions (SPANE). The Scale of Positive and Negative Emotions was used to measure state anxiety (Diener et al., 2009). The SPANE consists of 12 items, 6 positive and 6 negative, to assess positive and negative emotions over the past 4 weeks, rated on a Likert scale from 1 to 5. The SPANE is valid and reliable with college student populations (Deiner et al., 2009). In one study with college students Cronbach's alpha was .81-.89 for the scales and it correlated between .57-.70 with other feelings scales (Diener et al., 2009).

Depression, Anxiety, and Stress Scale (DASS). The DASS is a 42-question self-report measure looking at severity of symptoms of anxiety, depression, and stress. The DASS looks at symptoms over the past week. Cronbach's alpha was acceptable for all scales (a = 0.96, 0.89 and 0.93 for depression, anxiety, and stress, respectively). Two-week test retest showed good temporal stability in untreated groups of patients with depression and anxiety (r = 0.71-0.81). The factor loadings for items on each scale were between 0.54 and 0.83 in the same sample. None of the items were found to load onto more than one scale (Brown et al., 1996).

Kenny Music Performance Anxiety Inventory. The Kenny Music Performance Anxiety Inventory is intended to measure anxiety symptoms related to performance (Kenny & Osborne, 2006). Many of the characteristics measured in the scale are maladaptive anxiety traits related to performance (Seker, 2015). It is a 40-item test, measuring 12 aspects of performance related anxiety. Initial norms were on both orchestral musicians and a professional opera chorus. The initial validation sample reported Cronbach's alpha of .94 for the orchestral musician sample and professional chorus sample. It is also positively correlated with the State Trait Anxiety

Inventory (STAI). Norms have also been created using university music students (Kenny & Osborne, 2006).

Self-Compassion Scale (SCS). Neff's (2003) Self-Compassion Scale measures several components, including self-kindness, self-judgment, common humanity, isolation, mindfulness, and over identification (Neff, 2003). In a study with 391 college undergraduate students, the three-part model fit the responses of the students (NNFI = .88; CFI = .90). The internal validity for the scale was *a* = .92. The model was later cross validated with a different sample and found to have nearly identical psychometric properties. The self-compassion scale was negatively correlated with depressive symptoms (r = .55; Neff, 2003).

Fears of compassion. As compassion for self and others predicts both negative and positive affect, as well as affects response to therapeutic intervention, Gilbert et al. (2011) created a scale measuring Fear of Compassion for Others, Compassion from Others, and Compassion for Self. The scale was validated using a sample of ratings from 222 students as well as from 53 therapists. Findings showed Fears of Compassion for Self and Fears of Compassion from Others were correlated with self-coldness, self-criticism, insecure attachment, depression, anxiety, and stress. Cronbach's alpha was acceptable for all scales (*a* = 0.84-0.95; Gilbert et al., 2011). A recent meta-analysis by Kirby et al. (2019) combined 22 independent samples published in the last seven years with data from more than 4700 participants provides additional data on both clinical and nonclinical reference values.

Procedure

Overview. Participants were randomly assigned to the CFT or HRV group using a computer algorithm.

General procedure. Participants reviewed and signed the consent form, including reading general information about the study**.** Both groups filled out demographic information and baseline measures (SPANE, DASS, SCS, Fears of Compassion, and the Kenny Music Performance Anxiety Inventory) via Qualtrics. Following this, a baseline cortisol sample was taken. They were asked about their cardiac health and informed of disqualifying conditions, including taking medication that affects heart function. Depression and anxiety measures were scored by Qualtrics. If individuals reported anxiety or depression that exceeded the cut off points recommended by the measures, participants received an email recommending they see a mental health or general practitioner and given the contact information for the local counseling center.

Biofeedback condition. Biofeedback training was done using Lehrer's (2013) five visit biofeedback protocol. This specific protocol has been empirically validated in research and clinical practice for disorders such as asthma, anxiety, and depression (Lehrer et al., 2013).

Biofeedback visit 1. Participants reviewed the consent form and exclusion criteria for the study with the research assistant. Participants had a baseline salivary cortisol sample taken. Participants were introduced to the HRV biofeedback and the HRV training program. They had the sensors attached and learned about both the sensors and computer program. Their resonance frequency was determined, and then their smart phone app was set at that frequency. They learned and practiced pursed lips breathing. Homework was assigned from the protocol.

Biofeedback visit 2. Previous visits' homework was recorded. Research assistants reviewed and fine-tuned resonance breathing, and participants practiced pursed lips breathing. Homework from the protocol was assigned.

Biofeedback visit 3. Previous visits' homework was recorded. Participants then practiced resonance frequency breathing with and then without a pacer. They were then assigned homework from the protocol.

Biofeedback visit 4-5. Previous visits' homework was recorded. Participants again practiced resonance frequency breathing with and then without a pacer. They were assigned homework from the protocol. After visit 5, they were given specific instructions on how to continue practicing without the visits.

Compassion group. The compassion group followed a five-visit protocol written by the study author with consultation with individuals involved in creation of the CFT group manual. The protocol for the compassion group combined preliminary aspects of Paul Gilbert's 12 visit Compassion Focused Therapy group protocol (in development), Mindfulness Based Cognitive Therapy group protocol, and Tirch's integration of compassion-based therapy within an Acceptance and Commitment Therapy (ACT) framework (looking at the use of CFT with individual therapy; Tirch, 2016). While there were less visits than the 12-visit group protocol, the individual format allowed for more material to be covered in a single session. All visits consisted of a psychoeducation portion, discussion around the psychoeducation, and ended with both a mindful meditation and homework assignment. The detailed protocols for each visit are attached in Appendix A.

Performance and data collection. Participants received the DASS, SPANE, and Kenny Music Performance Anxiety scale through Qualtrics (taken on the kindle fire) 15 minutes before their required end of semester performances. They then had a salivary sample taken 15 minutes prior to their required end of semester performance (performance consisted of 10-15 minutes playing prepared selections). After their performance, they were asked to sit quietly for 15 minutes, in a quiet room if one was available. After fifteen minutes, they took the SPANE again and provided salivary samples for cortisol and AA. After these measurements were taken, they filled out a debrief form.

Training of research assistants. Researchers were trained by the primary researcher and were able to successfully run the protocol and problem solve prior to seeing participants. They were given the contact information of the primary researcher and supervising professor and instructed to contact if there were safety concerns, including suicidal ideation. The individuals collecting cortisol, self-report forms, and debrief interviews were blinded to the treatment condition as to not influence the performers' perception of the performance.

Data analysis. HRV biofeedback data was recorded using the NEXUS and cleaned using Kubios. The cleaned data provides an objective measure to show that participants have learned the proper breathing strategies. The requirements for successfully learning the protocol are listed in the protocol (Lehrer et al., 2013) and included a minimum number of visits and the ability to breath at approximately resonant frequency using only feedback from the heart rate. All individuals in the HRV group demonstrated proficiency with the intervention.

Effect sizes from the meta-analysis were used to calculate group sizes. As the studies from the meta-analysis were small, preliminary studies, the effect sizes seen in the meta-analysis are likely to have larger effect sizes than would be found in replicated studies, and as such, using these effect size for a power analysis might underestimate the number of participants needed to find an effect. Based off of the lowest effect size from the meta-analysis (cognitive interventions; effect size $g = 0.46$), there would need to be 12 participants per group in a randomized controlled trial in order to find an effect (see Figure 1). However, the study design used in this study does not compare the treatments to a control group, but rather compares the two active treatments.

Using a table to find the sample size needed for an equivalency trial looking to detect a difference between the treatments, the sample size to find a difference between the two treatments would need to be approximately 103 per group.

By nature of the ecologically valid performance measure at the end of the intervention, cortisol samples were taken at different times than baseline value. Groups did not differ significantly in the time differences between the two samples ($p > 0.10$); additionally, the groups did not differ in the time of day for either initial baseline or performance samples. All statistical analyses were performed in Stata using statistical packages and original code (see Appendix D). Researchers checked the data that it did not violate assumptions of the statistical tests used. They tested and corrected for outliers and fenced any outlier values at the mean, plus or minus two standard deviations. Participants were required to answer all questions, so the minimal amount of missing data was due to computer error and considered missing at random. As five percent or less was missing for all self-report measures, the missing value was replaced with the mean value.

Results

Thirty second- and third- year music students enrolled in the School of Music performance and education programs completed either the HRV or CFT intervention and provided baseline and day of performance saliva samples for cortisol and alpha-amylase assays (14 in the HRV biofeedback group and 16 in the CFT group), as well as self-report measures of emotional functioning. On the day of performance, approximately 8-10 weeks after the baseline assessment, salivary samples and self-report measures were taken 15 minutes pre- and post-performance. This end of semester performance is required for advancing to the next year in the music program, is used to determine soloists for special events, and also used to audition for orchestral groups and operatic roles. As such, these performances are very important to future success and opportunities in the program and are viewed as stressful events for students involved.

Due to potential baseline differences between the two intervention groups, we looked at baseline differences in the two intervention groups, which if needed, could be controlled as covariates in future analyses. The CFT and HRV groups were statistically different at baseline on initial cortisol levels ($p = 0.04$; the HRV group had higher initial cortisol levels). The CFT and HRV groups did not differ significantly on any other of the baseline measures, including the DASS overall measure, subscales of the Kenny Music Performance Anxiety Inventory, SPANE scores, or initial alpha-amylase levels (see Table 1 for cortisol and initial alpha-amylase levels; Appendix C).

On the baseline evaluation of performance anxiety, measured using the Kenny Music Performance Anxiety Inventory (KMPAI), the overall score of the both intervention groups combined was 44 (HRV group was 46 and the CFT group was 41; overall sample mean of the measure's initial validation study was 54). The two intervention groups did not differ on overall KMPAI scores ($p > 0.05$) nor on any subscales ($p > 0.05$; see Table 1). An additional study by Kenny et al. (2015) gave KMPAI cut-off scores that corresponded to clinically significant STAI-T scores based on the sum of all items in KMPAI (with a cut point of 105 corresponding to a STAI-T score of ≥ 65; with a cut point of 104 corresponding to a STAI-T score of ≥ 60) allowing the KMPAI to be used to screen for clinically significant difficulties with performance anxiety. The average sum of all items in the measure was 49 for the HRV group and 41 for the CFT group, which was below the recommended cut point for identifying clinically significant performance anxiety in both the CFT and HRV intervention groups. On a measure of positive and negative emotions (SPANE), CFT and HRV intervention groups did not statistically differ on their self-reported feelings of positive emotions, negative emotions, or affective balance ($p > 0.5$; individual subscale scores reported in Table 1). Regarding the Fears of Compassion scores, when compared to the sample from Kirby's 2019 meta-analysis, the HRV and CFT intervention groups scored below the clinical range on the Fears of Compassion from Self and Compassion for Others subscales. They scored above the clinical mean on the Fears of Compassion from Others subscale (see Table 1 for subscale scores). The two intervention groups did not statistically differ on their report of self-compassion (Self-Compassion Scale).

The DASS was given both at baseline as well as 15 minutes prior to the required end of semester performance. At baseline, the two intervention groups did not differ significantly on their reported baseline levels of depression, anxiety, or stress (see Table 1). Both the CFT group and the HRV group scored in the "normal range" as defined by the DASS manual for self-reported levels of depression, anxiety, and stress. Performance based changes on the DASS are discussed later with outcome measures.

Based on meta-analytic data, we hypothesized that the primarily cognitive (CFT) and primarily physiological intervention groups (HRV biofeedback) would differ in their pre- and post-performance physiological responses, with lessened physiological response to a stressor and better recovery in the HRV intervention group compared to the CFT intervention group. That is, we hypothesized there would be time and group interactions between cortisol and alpha-amylase levels, with both lower physiological arousal prior to the stressor and better recovery following the stressor for the HRV group. In order to test this, we fit a repeated measured ANOVA on cortisol, alpha-amylase, with the two intervention methods as the between-subjects factor, and baseline, before performance, and after performance time points as the repeated measures.

Regarding the effect of biofeedback and CFT interventions on changes in cortisol levels, there was an overall main effect between the three time points ($F(2, 84) = 53.70$, $p = 0.00$) but no main effect of group ($F(1, 84) = 6.66$, $p = 0.12$) and no interaction between group and time ($F(2, 84) = 0.53$, $p = 0.29$; see Figure 2). The effect size of time was $\eta_{p2} = 0.56$, indicating a large effect of time on cortisol levels, with the highest cortisol levels for both groups being 15 minutes prior to performance. Cortisol was lowest for all groups at the initial assessment, and highest 15 minutes before the performance, returning to baseline levels 15 minutes post intervention. The impact of performance on cortisol can be interpreted as an informal manipulation check, showing the performance affected participants' physiological responses and was at least somewhat stressful to the participants as cortisol levels were highest 15 minutes prior to performance. The initial hypothesis was incorrect, and groups did not statistically differ on their pattern of cortisol response ($F(2, 84) = 0.53$, $p = 0.28$).

Similarly, for the effect of biofeedback and Compassion Focused Therapy on alpha-amylase levels, there was an overall main effect between the three time points ($F(2, 61) = 11.03$, $p = 0.001$), but not a significant effect for either group ($F(1, 61) = 0.01$, $p = 0.92$) nor an interaction between group and time ($F(2, 61) = 0.07$, $p = 0.94$; see Figure 3); the effect size of time was $\eta_{p2} = 0.27$**,** indicating a large effect of time on alpha amylase response. Alpha-amylase levels were similar during the baseline assessment and 15 minutes following the performance, with a reduction in alpha-amylase 15 minutes prior to assessment. There was not a statistically significant group difference to a performance stressor on alpha-amylase levels between the Compassion Focused Therapy group and HRV biofeedback group; however, alpha-amylase levels would be expected to be higher at the second time point (pre-performance) than at baseline, likely reflecting lower sympathetic arousal despite being in a stressful situation.

We hypothesized that groups would differ in their pre- and post-performance self-report of negative emotions or depression, stress, and anxiety scores, with lower levels of negative affect in the HRV biofeedback group. This would be shown by a time and group interaction in SPANE-negative affect scores. We fit a repeated measures ANOVA on SPANE negative scores with the two intervention methods as the between-subjects factor; baseline, before, and after performance time points were used as the repeated measures. There was a significant main effect for time ($F(2, 84) = 7.24$, $p = 0.01$), but not for either group ($F(1, 84) = 0.31$, $p = 0.59$) nor the interaction between group and time ($F(2, 84) = 0.07$, $p = 0.93$). The effect size for time was $\eta_{p2} = 0.15$ (moderate effect size). Groups had a similar level of low negative affect at baseline and pre-performance, but higher levels of negative affect after performance, showing performance impacted self-reported mood states. Similar to physiological measures of stress and performance anxiety, there were not statistically significant group differences or group/time interactions on self-reported negative affect.

We also fit a repeated measure ANOVA on DASS scores, using the two intervention methods as the between-subjects factor, and baseline and 15 minutes prior to the performance as the repeated measures. There was a significant main effect for time ($F(1, 59) = 68.53$, $p < 0.01$), but not significant main effect for group ($F(1, 59) = 0.50$, $p = 0.83$), nor for the interaction between group and time ($F(1, 59) = 0.01$, $p = 0.92$). Both intervention groups reported lower DASS scores the day of performance than at baseline, showing lower levels of stress, anxiety, and stress later in the semester (see Figure 4). Scores on all subtests (depression, stress, and anxiety) continued to fall in the “normal range” as described in the DASS scoring manual. Overall, there were no group differences for either physiological or self-report measures, and as such, it seems both CFT and HRV biofeedback are equivalent in their impact on pre- and post-performance performance anxiety. Unfortunately, as there was no control group, there is no way to know whether the changes in time seen were related to natural variability prior to and post-performance, or as a result of the interventions.

Recent literature has started to explore the relationship between compassion and psychological disorders, including depression and anxiety. Due to this, we conducted a planned exploratory analysis based on baseline compassion scores. As the Compassion Focused Therapy intervention directly addressed developing compassion, we hypothesized that individuals high on the Fears of Compassion Scale or low on the Self-Compassion Scale will respond less favorably to the interventions, resulting in higher pre- and post-performance anxiety, moderating the relationship between anxiety and the intervention. We ran a repeated measure ANOVAs for each of the three Fears of Compassion subscales and one for the total Self-Compassion Scale score, with the two intervention methods as the between-subjects factor, and baseline, and 15 minutes prior to the performance as the repeated measures in each analysis; corrected and uncorrected levels for statistical significance are provided due to running several exploratory analyses.

The first four analyses focused on evaluating the potential moderating effect of compassion on cortisol levels. For all four ANOVAs, there were neither main effects nor interaction effects for the Self-compassion scale, Fear of Compassion for Self, Fear of Compassion for Others, or Fear of Compassion from Others at either a corrected $p < 0.003$ level or at the uncorrected $p < 0.05$ level. Baseline compassion scores did not moderate the relationship between the two intervention groups and cortisol, or cortisol and time. In regards to the effect of baseline compassion on alpha-amylase, there was an uncorrected main effect for time ($p = 0.02$) for the Compassion for Others subscale, but not any other main effects or interactions ($p > 0.05$ for all other main effects and interactions). When looking at self-report of negative affect, there were neither main effects nor interaction affects for any of the three compassion subscale scores ($p > 0.05$ for all main effects and interaction effects). Compassion did not moderate the relationship between self-reported negative affect and the two intervention groups, nor the relationship between self-report negative affect and time.

As biological vulnerability to anxiety and familial patterns of anxiety/fearfulness are correlated with higher levels of anxiety, we hypothesized that self-reported biological vulnerability scale from the KMPAI could potentially moderate the relationship between the two intervention groups, with lower levels of self-reported biological vulnerability being associated with lower physiological arousal (cortisol and alpha-amylase) and self-report symptoms of anxiety. We fit a repeated measures ANOVA, with the two intervention methods as the between-subjects factor, and the three time points (baseline, 15 minutes prior to performance, and 15 minutes post performance) as the repeated measures, including looking at the interaction between self-reported biological vulnerability scores and group, as well as self-reported biological vulnerability baseline scores and time.

When looking at whether self-reported biological vulnerability moderated the relationship between cortisol response to the intervention for the two groups, there was a significant main effect of time ($F(2, 78) = 3.51$, $p = 0.03$) at the uncorrected $p < 0.05$ level but not at the corrected $p < 0.003$ level, nor main effects for self-reported biological vulnerability ($F(1, 78) = 0.02$, $p = 0.89$), group ($F(1, 78) = 2.70$, $p = 0.10$), nor interactions between biological vulnerability on group ($F(1, 78) = 1.06$, $p = 0.30$), time ($F(2, 78) = 0.03$, $p = 0.97$), or the combination of group and time ($F(2, 78) = 0.07$, $p = 0.94$). With respect to alpha amylase levels, there were neither main effects nor interactions for variables related to self-reported biological vulnerability (p >

0.05 for all main effects and interactions). Similarly, in regard to self-reported biological vulnerability on self-report measures of negative affect, there were neither significant main effects nor interactions ($p > 0.05$ on all main effects and interactions). As such, biological vulnerability did not moderate the relationship between the two intervention methods and the outcome measures.

Discussion

Overall Findings

Previous studies have found both physiological and cognitive performance anxiety interventions to be effective with musicians, though a recent meta-analysis found physiological interventions to be more efficacious than cognitive interventions (Austin, 2018). However, no studies to date have looked at outcome measures following performance using an ecologically valid performance rather than an artificial performance setting. Additionally, while previous research has looked at physiological measures of anxiety using heart rate and skin conductance, they have not yet used cortisol or alpha-amylase levels as outcome measures following a performance anxiety intervention. Due to previous meta-analytic findings, we hypothesized that the physiological intervention (HRV biofeedback) would result in lower self-report of anxiety, lower cortisol, and lower alpha-amylase levels pre- and post-performance compared to the cognitive intervention (Austin, 2018). This hypothesis was not supported in this sample, with no group differences on either physiological or self-reported mood measures. While there appeared to be improvement across both groups, and further study appears merited, the following limitations should be considered in order to not overestimate the findings. The study was intended to be a two-site study to better generalize findings to differing levels of competitiveness in the field, different demographic characteristics, and different protective and risk factors. However, the study was not able to successfully recruit any participants at the second site, limiting the generalization, particularly as the sample at the first site was uncharacteristically low in mood symptoms and high in compassion.

One of the notable findings was that self-reported levels of depression, stress, and anxiety symptoms were lower on the day of performance compared to baseline; as the baseline DASS scores in this sample were below the 23rd percentile of the original norms for both intervention groups, the post-intervention improvement on the DASS seen in this study is unexpected. It is possible there could have been greater improvement following the intervention if the groups were experiencing a clinical level of distress (Coudray et al., 2019). This was shown in a study using data from three internet-based stress interventions in college students, where baseline report of depression, anxiety, and stress was a moderating factor in improvement in DASS scores in internet-based interventions, with minimal to no statistically significant change in intervention samples with baseline DASS scores below the 23rd percentile (Coudray et al., 2019). There is not yet consensus on whether internet-based interventions are equivalent to in-person interventions. however, low baseline report of mood symptoms is likely to also influence the level of improvement seen on self-reported mood measures in non-internet-based stress and anxiety interventions (Andersson et al., 2014).

Another reason improvement on the DASS is unexpected is due to the timing of when the measures were given. Previous research has shown that university students report increasing stress levels throughout the semester, with highest levels during end of semester projects and finals (Garrett et al., 2017; Pitt et al., 2017). Based on these findings, our baseline assessment was taken at a less stressful time compared to the day of performance measures. Additionally, stress was reported to be highest in third to fifth year university students, with one study finding stress was highest in third year students (Bostanci et al., 2005; Mahmoud et al., 2012; Naushad et al., 2014). As our sample consisted of prominently third year university students, in absence of additional coping skills, we would expect self-reported stress, anxiety, and depression to be higher later in the semester. While it is not possible to make the definitive claim that self-reported improvement in mood is a result of the intervention due to the lack of a control group, overall evidence suggests that improvement on the DASS is likely due to the intervention. However, it is unclear whether these findings would generalize to a more depressed or anxious sample.

There was also improvement on physiological measures. Both the CFT and HRV groups had lower alpha-amylase pre-performance compared to baseline and post-performance, showing lower pre-performance sympathetic arousal. Salivary alpha-amylase is correlated with norepinephrine and SAM system activity, often showing a more rapid response to stressors or anticipated stressors than cortisol (Ali & Nater, 2020; Maruyama et al, 2012; Skoluda et al., 2017). This finding has been confirmed in previous psychological research, with salivary alpha amylase increasing more rapidly and at higher levels than cortisol to psychological stressors (Takai et al., 2004). Reduced salivary alpha-amylase response to stressors, similar to the findings in this study, has also been found in previous stress intervention research, particularly in compassion focused interventions (Angerer et al., 2011; Arch et al., 2014; Duchemin et al., 2015). While there were not group differences on salivary alpha-amylase, both intervention groups reported high baseline levels of compassion. Further research with a sample that has wider range of baseline compassion scores will be helpful to see whether this finding could reflect the baseline levels of compassion in this group, or whether a broader range of interventions (e.g. both cognitive and physiological interventions) reduce salivary alpha-amylase response to stressors. However, both groups' alpha-amylase scores were higher after the intervention. As alpha-amylase responds rapidly to stress, this would be expected to be due to task engagement.

Unlike alpha-amylase levels, cortisol levels were higher during the pre-performance period compared to baseline, returning to near baseline levels 15 minutes post-performance; there was no statistically significant difference in baseline and post-performance cortisol scores ($p > 0.05$). While at first this does not seem to be a promising finding, there are several important considerations, particularly in musicians. First, a recent literature review looking at stress-reduction interventions found it was common for interventions to reduce salivary alpha-amylase levels and not cortisol (Ali & Nater, 2020). Due to this, they recommended measuring both salivary alpha-amylase as well as cortisol, as salivary alpha-amylase appeared to be more sensitive to group changes. As such, the discrepancy between improvements on salivary alpha-amylase and cortisol seen in this study is consistent with some previous research on non-musician interventions; cortisol might not have been sensitive to pick up on changes in the stress response if this performance was perceived as less stressful, or due to the low levels of depression, anxiety, and stress in this sample. Additionally, as discussed in the section on the DASS, the baseline measure was taken at a less stressful timepoint compared to the end of semester. Similar cortisol levels at both time points might reflect managing higher levels of perceived stressors without increased physiological arousal.

As stated above, both intervention groups appeared to recover to nearly baseline levels shortly after the performance. This recovery is important, as correlational studies with classical musicians have identified elevated cortisol levels both during performance as well as post-performance. They found cortisol levels in musicians are elevated on performance days compared to rehearsal days, and this elevation continues post-performance (Fancourt et al., 2015). While lower post-performance cortisol levels could be due to the performance being less subjectively stressful than previous research, chronic cortisol elevations have been shown to be associated with negative physical and mental health outcomes in both musicians, and so it is important to look at both response and recovery to performance (Pilger et al., 2014); post-performance cortisol findings will merit further study in larger samples and a control group.

However, cortisol and alpha-amylase did not appear to respond similarly at the sampling time points, with cortisol increased relative to baseline pre-performance and alpha-amylase decreased compared to baseline, with the opposite pattern noted post-performance. While alpha-amylase might have been more sensitive to the changes resulting from the interventions, it is also likely that the biological outcome measures were not taken at the most stressful timepoint pre-performance. Both the HPA activity (measured by cortisol) and SAM system (as measured by alpha-amylase) respond to stressors, with SAM system activity being a nearly instantaneous response and cortisol being trigger following more prolonged exposure to the stressor (Ali & Nater, 2020). As such, if the participants found the morning of the performance more stressful than immediately pre-performance, alpha-amylase may have been reduced pre-performance as it had already peaked and been replaced by the more prolonged stress response, resulting in elevated cortisol levels. Additionally, there is limited to no qualitative or quantitative data on the most stressful pre-performance time point, which from some musicians report is a week or two prior to the performance (personal correspondence). More information is needed to know when is the most stressful pre-performance time point to take outcome measures.

In addition to the primary analyses, two exploratory questions were also examined. First, recent literature proposes there are connections between mood disorders and compassion levels. We hypothesized that individuals high on the Fears of Compassion Scale or low on the Self-

Compassion Scale, both of which would reflect low compassion or difficulties with compassion, would have differing responses to the interventions, with individuals that were relatively higher on the Fears of Compassion Scale responding less well to the CFT intervention. When the p value was corrected for multiple comparisons, there were no interactions between any of the outcome measures and compassion scores, or the interaction between compassion scores, intervention group, and outcome measures. This is not unexpected due to the low levels of mood symptoms and high levels of compassion reported at baseline. The ability to give and receive compassion is correlated significantly with depression, stress, and anxiety, with the strongest inverse correlation seen between mood and the Fears for Compassion for Self subscale (Beaumont et al., 2016); this sample was lowest in the Fears for Compassion for Self. While the compassion measures were not given on the day of performance, DASS scores were significantly lower on the day of performance. As the DASS and compassion measures are correlated, there might have also been some improvement in compassion across groups, despite already average levels of compassion at baseline.

Similarly, the second exploratory analysis looked at whether a scale measuring self-reported biological vulnerability/generational transmission of anxiety moderated the relationship between outcomes. These scales asked about parental and familial behaviors that might indicate parental anxiety or avoidance. In this sample, self-reported biological vulnerability did not moderate the relationship between treatment outcomes or treatment groups. One interesting consideration is that despite endorsing high levels of generational transmission of anxiety and biological vulnerability, both of which having been associated with increased prevalence of depression and anxiety, the sample reported average levels of both anxiety and depression. There is some data that individuals who endorse high levels of biological vulnerability respond differently to stressors based on positive or negative feedback, particularly social stressors such as a performance (Akinola & Mendes, 2008). As such, future research looking at the connection of biological vulnerabilities to performance anxiety might benefit from asking both questions about overall affect as well as perception of response/feedback from performance.

Clinical and Future Research Implications

There are several implications from this study for future clinical work and research in this area. A promising finding is the equivalence of both treatments on symptoms of performance anxiety. As some universities and conservatories have limited mental health and performance anxiety resources, it may be helpful to have preliminary evidence that having treatment is more important than the type of treatment. Another important clinical takeaway is that even in musicians that are not experiencing clinically significant difficulties at baseline, further improvement is possible. Due to the competitive nature of classical music, programs that emphasis emotional coping skill building and stress management skills will likely see benefits in all students, even those who are not struggling.

This study also worked as a proof of concept that it is possible to use an ecologically valid performance for outcome measures. Despite end of semester required performances being stressful, 100% of the sample agreed to take self-report measures and provide salivary samples pre- and post-performance. This study was the first intervention study to date using cortisol or salivary alpha-amylase to look at pre- and post-performance stress responses. There were difficulties with off-site recruitment, and future replication with multisite trials will likely benefit from having locations in a closer geographical area. Future research will likely benefit from looking at both cortisol and alpha-amylase, as alpha-amylase might be more sensitive to physiological changes following stress and anxiety interventions; due to unique characteristics of this sample, such as low pre-performance stress response and low levels of both baseline and pre-performance stress, anxiety, and depression, future replication research will from continuing to use cortisol to see patterns in samples with higher levels of reported distress.

Another area for future research is looking more into post-performance beliefs and behaviors. While both the CFT and HRV interventions taught skills that are appropriate for both pre-and post-performance anxiety, in-session discussion and emphasis was on managing pre-performance anxiety. Post-performance thoughts and beliefs are not traditionally addressed in performance interventions. While not at a clinically elevated level, the highest levels of negative affect occurred post-performance. Further research can look at post-performance thoughts and beliefs, as well as the impact of teaching post-performance recovery and coping skills.

Limitations and Alternative Explanations

There are several limitations to the current study that will benefit from further study and replication. The biggest limitation is the lack of a control group. While the equivalency study design used in this study allowed the greatest number of individuals to be helped while also examining the efficacy of an ecologically valid performance and additional physiological measures, the findings in this study will need to be replicated with a control group to know whether they were due to natural improvement through the semester, a placebo type response, or due to the interventions.

A second limitation to the study is small sample size and that the sample comes from one specific university program. The intended study was to take place at two demographically different programs, which in addition to increasing sample size, also provided more diversity in protective and risk factors for mood disorders and performance anxiety. There were no participants run at the second site, limiting generalizability of the study, particularly with the low base rates of mood disorders seen in the sample from the first site. University and conservatory music programs are very competitive, and the intensive training means programs are typically very small. These students also have very demanding schedules and limited time for out of school commitments. Both of these factors lead to a small number of available participants for the study. An additional constraint, which is likely to affect future research with musicians, is due to space constraints in the music department buildings. This required students to not only devote time to the intervention, but also need to spend time going to a different building for the intervention. Further, while difficulties with recruitment seen at the second site are likely due to primary study personnel being offsite, it is also possible that musicians endorse difficulties with performance anxiety but feel they are unable to commit to the time needed for an intervention, or for other reasons (stigma, lack of knowledge about interventions, normalization of performance anxiety if peers are also experiencing it), are not interested in pursuing treatment. Due to all of these factors, sample size for both groups was limited and well below the recommended cut-points for screening general and performance related anxiety. This impacted our ability to adequately examine group differences and both the primary and secondary analyses were underpowered due to low sample size; this sample might also not generalize to the field due to low levels of mood symptoms in this sample.

This sample likely differs from previous research samples for several reasons. One, this sample was lower in report of stress, anxiety, and depression. Anxiety, depression, and social anxiety are common difficulties seen in musicians, with between 30-65% endorsing symptoms of depression, anxiety, or social anxiety; higher rates are seen in more recent studies or surveys (Help Musicians UK Survey, 2016, personal correspondence; Kenny et al., 2014). Similarly, psychological disorders are also prevalence in university settings. A recent study with self-report data from 140,000 university students found 35% of respondents endorsed symptoms consistent with one or more psychological disorder (Auerbach et al., 2018); with anxiety and depression as the primary presenting difficulties in those seeking treatment (Mistler et al., 2012). The sample in this study endorsed lower symptoms than estimated prevalence of psychological disorders in either university students or musicians. On the DASS, in this sample only 13% reported levels of depression outside the normal range, and only 26% reported levels of anxiety outside of the normal range; only one participant out of the sample of 30 endorsed severe symptoms on any scale (DASS anxiety scale only). Similarly, this sample reported higher than expected compassion scores. This finding is in line with previous empirical studies suggesting that compassion is a predictor of stress, anxiety, and depression (Birnie et al., 2010; Cash & Whittingham, 2010).

There are several possible reasons why this sample might be reporting lower mood and stress symptoms. One possible reason is that the sample underreported mood symptoms. Meyer et al. (2016) found 39% of undergraduate students did not disclose mood symptoms to their medical team. However, more likely, this sample had protective factors against depression and anxiety; this theory is also supported by physiological findings and recovery. One protective factor is that this sample came from a highly religious university. Jennings et al. (2018) found athletes and nonathletes from a religious university, even without stress or mood interventions, reported engaging often in positive coping and rarely in negative coping often reported by students at non-religious universities. MacKenzie et al. (2011) found that negative coping skills, such as alcohol and cigarette use, were correlated with increased depression in university students. The university from which this sample is taken reports much lower than average alcohol or nicotine use, with the majority of students denying use of alcohol, nicotine, or illegal drugs (Princeton Review, 2019).

Another possible reason for lower mood and stress symptoms is increased awareness of mental health and stress in musicians. Due to increased awareness of mental health difficulties, many music programs have begun to incorporate stress management seminars and guest lectures on performance specific anxiety reduction skills. Group and individual music teachers are also monitoring their students' emotional functioning and providing examples of coping skills and normalizing stress responses (RCM and BYU personal correspondence). Due to this, the musicians in this sample might have already been using coping skills similar to those taught during the intervention, resulting in improved emotional functioning prior to the intervention. As the majority of published research looking at emotional functioning in musicians is more than 10 years old, and more recent surveys have not used validated measures, updated studies on prevalence rates of depression and anxiety in musicians can identify if increased focus on mental health has resulted in decreased rates of mood disorders in musicians.

The end of semester performance used in this study appeared to be less stressful than previous research. While sample characteristics, such as lack of reported stress or mood symptoms on the day of performance, likely contributed, it is also possible this performance was less stressful compared to other performances. One reason is individuals with certain characteristics, such as higher self-reported biological vulnerability endorsed in both intervention groups, respond differently to social stressors based on perceived positive or negative feedback (Akinola & Mendes, 2008). These students are familiar with the professors evaluating these performances; if they anticipated positive feedback, the performance might have been viewed as subjectively less stressful. Additionally, previous research had been done with novel performances created for the study. While the performance used in this study had implications for the participants' future opportunities and standing in the program, it also required every semester; some participants in this intervention had participated in four of these required semester performances previously. There is not yet literature on whether musicians respond differently to novel or repeated performances. As musicians regularly perform in both types of performances, this is an important consideration for future research and possibly more targeted interventions.

Additionally, a limitation from this study and previous music performance anxiety interventions, is that individuals who volunteer might not represent music students as a whole. Those who are experiencing the highest level of stress, anxiety, or depression might feel overwhelmed and not volunteer for the study; this might also explain why the study sample was lower in mood disorders and stress symptoms than estimated from correlational and observational research. Future research can build on the promising findings from this study by using a control group, more diverse sample, and larger sample size.

While not necessarily a limitation for this study, future research might choose different study designs in order to have cortisol and alpha-amylase samples taken at the same time of day at both time points. Due to the ecologically valid nature of the outcome measures, cortisol and alpha-amylase samples were taken at different times of day for the baseline and day of performance samples; this is different than much of the cortisol research, where samples are taken at an identical time of day. While this was unlikely to impact our group as the two intervention groups did not statistically differ in the time differences between the two times of day for each group, and samples were taken in the middle of the day for both time points, further research looking to have identical time points and not to statistically control for time of day can use performances with set times (such as an operatic or orchestral concert where the times are planned months in advance). This will limit the type of musicians but provide similar conditions for both cortisol and alpha-amylase measures.

Conclusion

In summary, this study shows that it is possible to take physiological and self-report outcome measures following an ecologically valid performance. Cortisol and alpha-amylase are also feasible outcome measures and using these outcome measures will allow comparison with other interventions using musicians, and also be used to compare treatments with performance anxiety treatments (e.g. those with athletes) and more general stress and anxiety reduction interventions. While these findings will need to be replicated with a larger sample and a control group, as well as with individuals reporting clinically significant performance anxiety, the brief HRV and CFT interventions in this sample resulted in lower pre-performance physiological arousal and self-reported mood symptoms.

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APPENDIX A
CFT Protocol

Visit 1 (45 minutes): Assembling the Conditions that Give Rise to Compassion

- Review limits of confidentiality, talk about course of treatment, ect

Psycho-ed portion:

Introduce CFT as a whole

CFT and emotional regulation

- Old brain/new brain (zebra analogy)
- Emotional regulation
    - Incentive/resource focused system
    - The threat focuses system
    - The nonwanting/affiliative system

Tug of war exercise

Importance of mediation/mindfulness, instruction on meditation mindfulness:

- Posture: cross-legged on the floor with a straight back or in a chair with feet flat on the floor; hips higher than the knees (help support participants as needed); back straight without being tense, shoulders and face relaxed; chin tucked gently so the neck is long; eyes gazing straight ahead or slightly downward (or closed – discuss); hands resting on the thighs or in the lap
- Discuss how settling the body settles the mind; posture will become easier with time; show simple stretches if appropriate; emphasize the practice and not perfecting the posture

Stopping the war meditation (ACT book 157)

Take a few moments to allow yourself to become comfortable where you're sitting, adopting a posture that's secure and grounded. Make any small adjustments to your position and posture that you may need so you can be at ease. Now allow your eyes to close… Without deliberately changing the pace of your breathing, begin to gently bring your attention to the flow of the breath in and out of your body… Now bring part of your attention to the soles of your feet…. Next, bring part of the attention to the top of your head… And now bring attention to everything in between… Now return your breathing and simply follow the breath. As you're breathing in, know that you are breathing in, and as you're breathing out, know that you are breathing out.

Begin to notice the sensations that are present in your body. If there are feelings of tension, pressure, or discomfort, bring your attention to these as well. As much as you can, bring an attitude of willingness to these experiences. As you breathe in, breathe attention especially into those areas of the body that present discomfort, tension, or resistance. Can you make space for *these experiences? Bring part of your attention to any feelings of resistance, to any struggle that you're experiencing around these sensations. Notice the tension that's involved in fighting these experiences, moment by moment. When meeting these sensations, wherever is may arise in the body, open yourself to the experience. Let go of the fight. Bring gentle attention to your breathe. Let yourself be exactly as you are in the moment.*

As you exhale, completely let go of attention to physical sensations. Then, with your next natural inhalation, bring your attention to your thoughts and emotions. What thoughts are flowing through your mind? What feelings are moving in your heart? Bring an open, receiving attention especially to those thoughts and emotions that you would typically struggle against. As much as you can, allow yourself to soften around these thoughts and feelings in this moment. Can you make space for these events in your mind and heart? Can you let go of this war within yourself, if even just for this very moment?

Now return your attention to the flow of your breath, to your feet on the ground, to your seat in the chair, and to your back feeling upright and supported. As you breathe in, bring attention to the struggles in your life. What struggles are you continuing to fight? See if you can feel the presence of these battles. If you struggle with your body, brig awareness to that. If you struggle against your emotions, notice that in this moment. If there are thoughts that intrude, thoughts that you wage war against, bring a gentle awareness to those struggles. For a moment, allow yourself to feel the weight of all of these struggles and battles. How long have these armies within you been fighting?

Softening around even this experience, allow yourself to bring open, compassionate attention to the struggles. Let go of these battles. As you exhale, allow yourself to feel a complete willingness to be exactly who you are, right here and right now. In this moment, allow yourself to accept the totality of everything that life has brought to you and all that you have brought to life. Isn't it time to stop the war you've been waging within yourself? Allow yourself to fully accept who you are, right here and right now. Now bring part of your attention to the soles of your feet… Next, bring part of your attention to the top of your head… And now bring attention to everything in between… Returning attention to breathing, simply follow your breath. As you're breathing in, know that you are breathing in, and as you're breathing out, know that you are breathing out. When you're ready, open your eyes and allow yourself to let go of the exercise and resume your day.

Homework/handouts:

- ABCs of compassion worksheet
- Meditation/mindfulness options worksheet (maybe CD with scripts?)

Visit 2: Cultivating Self-Compassion

Psycho-ed portion: ideal compassionate other (not religious figure)

Soothing, attachment, and affilative emotions (CFT, pg. 117-122)
- Skilled affection and kindness
- Social referencing
- Living in the mind of others

Experience compassion flowing in

Sit with your back upright and supported, either in a comfortable chair or on a meditation cushion. Begin by brining attention to your breathing, observing its flow and rhythm and allowing it to fins its pace. Now bring part of your attention into your body and feel the strength and your sit bones connected to your cushion or chair, and your spine upright and supported. Your posture is grounded and dignified and reflects your sense of calm and self compassion. Allow your face to form a gentle smile.

Now, with part of your attention staying with the flow of your breath begin to remember a pleasant day in your past when someone was compassionate and supportive toward you. This person wasn't judgmental and didn't condemn you; rather, this person was empathic and cared about you and your happiness. As much as you can, remember the sensory details of the experience: Can you remember what you were wearing? Where were you? Was it hot or cold? Was it raining or was the wind blowing through the trees? Was the radio on in the background?

Now, bringing part of your attention bac to the flow of your breath, inhale and exhale and, for a few moments, stay with this imagery of an experience of receiving compassion. By remembering receiving such help and kindness, you can focus your attention on and increase your desire to be kind and helpful, including toward yourself.

Whenever your mind is inevitably distracted and wanders away from this memory, gather your attention with your next natural inhalation and make space for whatever is arising; then, with your next natural inhalation and make space for whatever is arising; then, with your next natural exhalation, simply return your attention to your breath and to the image of this compassionate person. AS you breathe in again, with your next natural inhalation, bring your attention to the facial expression of this person from your past. Allow yourself to remember, as much as you can, this person's body language and movements. What did this person say to you? How did this person say it? Pay particular attention to tone of voice. Stay with this experience for a little while, breathing in and out.

Next, bring your attention to the quality of the emotions this person seemed to display toward you. How did the person feel toward you? And how does this make you feel? Do you have any physical sensations as a result of your emotion? Take a few minutes to remain in the presence of that emotion. You may feel safe and protected as if your body is grounded and stronger. However, this emotion shows up, see if you can welcome it, identify it as mindful compassion, and invite yourself to make space for it. This is a time to bring attention to the experience of *compassionate flowing into you. Now bring your attention back to the flow of your breath, inhaling and exhaling smoothly, and take a few moments to stay with the way this experience feels. As much as you can, connect with the emotions of appreciation, gratitude, and happiness that arrived with this person's are. For as long as if feels right to you, perhaps a few minutes more, remain in the presence of this memory and this feeling.*

When it feels right, let this experience go with your next natural exhalation, allowing the memory and images to fade away. After a few more slow and even breaths, exhale and completely let go of this exercise. Before you open our eyes, take a moment to give yourself credit for engaging with your practice of self compassion, recognizing that you have made a conscious decision to take care of yourself and move toward alleviation of your suffering.

Homework/handouts:

- Compassion practice log pg. 183 ACT

Visit 3: Developing Equanimity, developing Appreciation and Gratitude for Others

Psycho-ed: self compassion as a condition of compassion

Talk about how self compassion can help give rise to compassion for others. How appreciation and gratitude for others results from self compassion, and vice versa

Experiencing compassion flowing out (174)

Adopt a dignified, meditative posture, with the soles of your feet connected to the floor, your sit bones on your chair or cushion, and your back upright and supported. Start by following the breath in and out of your body, and become aware of your physical presence, just as it is, in this very moment. Allow your breath to find its own rhythm and pace. Whatever your attention wanders, gently and consistently draw your attention back to this moment by focusing on the breath once again.

After a few minutes, once you've gathered and collected your awareness in a mindful and compassionate way, bring your attention to a time when you felt compassionate toward toward another person – someone who was in need of a helping hand. Alternatively, you can bring your attention toward compassion you felt for an animal, perhaps a pet. Fully remember that time of relatively peace and happiness. Although we often direct compassion toward loved ones during times of distress, this exercise involves using imagery to evoke a feeling that's separate from difficult emotions.

As you imagine feeling kindness and compassion toward this other person or being, see if you can imagine yourself expanding as the warmth and care of your intention grows. Imagine that you're becoming wiser, emotionally stronger, and warmer with each inhalation and exhalation. As you become more attuned and resilient with every breath, recognize this means that, with each breath you have more to give, and with each moment you are becoming more helpful, open, wise. How does this feel? What physical sensations are you experiencing?

Now bring your attention back to the flow of your breath and, for a moment longer, focus on these feelings and the images associated with your experience of extending compassion to another. All the while, observe your desire for this person or being to be happy, filled with compassionate, peaceful, at ease, and well. What is your tone of voice like? What is the expression on your face? How is your body moving and reacting to your feelings and to the feelings of the other person? Take some time to enjoy the sense of pleasure you may feel as a result of being helpful and caring.

Smile gently, and as you breathe in and out, allow yourself to notice the sense of compassion flowing out of you so that it reaches this person or being whom you care so deeply about. Imagine your compassion touching the other's heart. Imagine that the burden of the other's suffering is lifted, little by little, with every breath. With your next exhalation, once again sense the compassion flowing out of your and joy and peace flowing into the person or being to whom you're extending kindness.

With your next exhalation, let go of this representation of the other person or being and draw your attention to the experience of compassion in yourself. Recognize where in your body your open and heartfelt desire to share kindness and helpfulness presents itself. Allow yourself to rest in this feeling of loving- kindness for others, feeling the presence of compassion for others as it flows through you. Stay with this sensation for a few moments. If your attention wanders at any point, simply notice where it has gone and then refocus by bringing part of your attention to your next natural inhalation and the exercise at hand. Remain in the presence of this warmth and kindness.

As you're ready to end this visualization, return your awareness to your feet on the floor… then to your position in the chair…. Then to your back, upright and supported. And ultimately, to the top of your head. When you feel you're ready, exhale and completely let go of this exercise. Before you open your eyes, take a moment to give yourself some credit for having engaged in this practice, recognizing that you have made a conscious decision to take care of yourself and move toward alleviation of your suffering.

Homework/handouts:

- Gratitude journal for the week

Visit 4: Developing Affection and Empathy

Psycho-ed:

- Many selves
- Discussion about many parts of us: compassionate self, angry self, anxious self, our joyful self, and so on.
- Contacting the many selves meditation (ACT book pg. 179)

Discussion of hypothetical situation: (bad job interview, someone putting on weight) pg 130-131 of CFT book. Then use same skills for a challenge this week

Cultivating compassion for the anxious self and angry self meditation pg 180

After taking a comfortable and supportive posture, close your eyes. Begin by grounding yourself in your body and breath. After settling your awareness and focusing your attention on the breath, slow your breathing and even out your inhalations and exhalations. When you're ready, bring to mind an image of your compassionate self. Focus on the qualities of this self, perhaps contacting compassionate warmth, wisdom, and strength. You many want to adopt a friendly facial expression of a half smile as you imagine the characteristics of your compassionate self. If you're willing, place one or both hands over your heart and remain in this position throughout the visualizations that follow, bringing mindful attention to the warmth and physical sensations of this gesture while imagining your compassionate self.

When you feel connected to your compassionate self, and as you're ready, bring to mind your anxious self in the context of the argument you imagined in the previous exercise. See if you can look upon this part of yourself from the perspective of your compassionate self, making room for the tension and fear in the anxious self and connecting with the anxious experience while remaining rooted in the qualities of your compassionate self. Allow your compassionate strength to support the aggravated, scared, or uncertain anxious self. Let your wisdom witness the impermanence of anxiety and how it's impacted by thoughts and memories.

Next, bring warmth to the scared and anxious part of yourself, showing it kindness and caring. As you bring to mind your desire to be there for your anxious self in a way that's helpful and caring, consider what this part of you that is struggling with fear and anxiety needs most. How does your compassionate self want to be with your anxious self? How might you validate and support this anxious part of you? What does your compassionate self want to offer this part of yourself?

After spending some time experiencing these compassionate intentions of your anxious self, allow yourself to let go of these images. Expand your awareness to your breathing and the feeling of your hand over your heart. Now bring your attention back to the flow of your breath. With your next natural exhalation, and while remaining connected to your compassionate self, bring to mind your angry self in the context of the argument you imagined in the previous exercise. Allow yourself to step back and look at this frustrated or angry part of yourself. Observe what your angry self is doing. What facial expressions does it have? What tone of voice does it use? Who is the angry self mad at? What is the angry self most irritated with?

What does this angry self need most right now? What would help it find peace? How does your compassionate self want to be with your angry self? How might you validate and support this part of you? What does your compassionate self want to offer to your angry self?

After spending some time experiencing these intentions for your angry self, allow yourself to let go of these images. Let your awareness settle on your breathing and the feeling of your hands over your heart. Resting in this way, allow yourself to notice other feelings or experiences that may have arisen during this visualization. Bring attention to how you feel physically and emotionally, or to anything particularly important or meaningful that has shown up.

Now bring your attention back to the flow of your breath once again. With your next exhalation, allow your hands to rest comfortably in your lap. Then exhale and completely let go of this practice. Return your attention to the room around you, and adjust your posture or gently stretch as needed.

Homework/handout:

Compassionate letter writing (CFT, pg 196)

Visiting 5:

Psycho-ed: review of compassionate attributes and skills

Discussion on skills learned, skills still to develop, resources, relapse plan.

Loving kindness meditation – calm.com 5 or 10 minutes depending on time of session

Homework/handouts:

Loving kindness mediation every day

APPENDIX B

Debrief Interview

Participant ID:

Thank you for your participation in our study. We have a few questions about other resources you might have used during the study. We have included commonly used stress management techniques, but feel free to add anything else you have found helpful or tried to use to manage stress. This information will be kept anonymous.

Examples of activities: Therapy, Biofeeback at the Counseling Center, Yoga, Mindfulness, Mediation, Talking with a religious leader, Relaxation Exercises, Pharmaceutical Interventions

How long: Typical amount of time you spent on the activity. E.g. 15 minutes, or you can give a range, such as 10-30 minutes

How often: could be once daily, once a week, or however often you practiced or used this intervention.

Type of Activity	How long?	How Often?

APPENDIX C: FIGURES AND TABLES

Table 1

Baseline physiological and self-report measures by group

	HRV		CFT			
	M	*SD*	*M*	*SD*	*T*	*p-value*
Initial Cortisol*	1.33	0.73	0.89	0.61	2.16	0.04
Initial AMA	2.47	0.70	2.40	0.60	0.21	0.84
KMPAI - Proximal Anxiety	51.00	10.50	46.50	9.00	-1.12	0.27
KMPAI - Worry/Dread	54.75	15.00	51.75	12.75	-0.75	0.46
KMPAI - Depression	36.00	9.00	37.50	11.25	0.47	0.64
KMPAI - Parental Empathy	32.25	9.75	24.00	11.25	-1.58	0.13
KMPAI - Memory Difficulties	33.00	21.75	28.50	12.00	-0.62	0.54
KMPAI - Generational Anxiety	54.75	27.00	48.00	24.00	-1.20	0.24
KMPAI - Anxious Apprehension	44.25	7.50	41.25	8.25	-0.74	0.47
KMPAI - Biological Vulnerability	61.31	15.00	54.00	20.25	-1.16	0.26
SPANE - Positive	2.98	0.68	3.14	0.81	0.58	0.57
SPANE - Negative	1.88	0.40	1.85	0.69	-0.17	0.87
SPANE -Affective Balance	1.20	1.01	1.39	1.23	0.45	0.66
DASS - Depression	5.93	4.85	5.86	3.61	-0.05	0.96
DASS - Anxiety	7.02	3.18	5.71	4.14	-0.98	0.34
DASS - Stress	9.42	5.95	10.14	4.05	0.38	0.71
Self-compassion Scale	54.08	15.06	56.79	13.64	0.51	0.61

* = p <0.05 ** = p<0.005

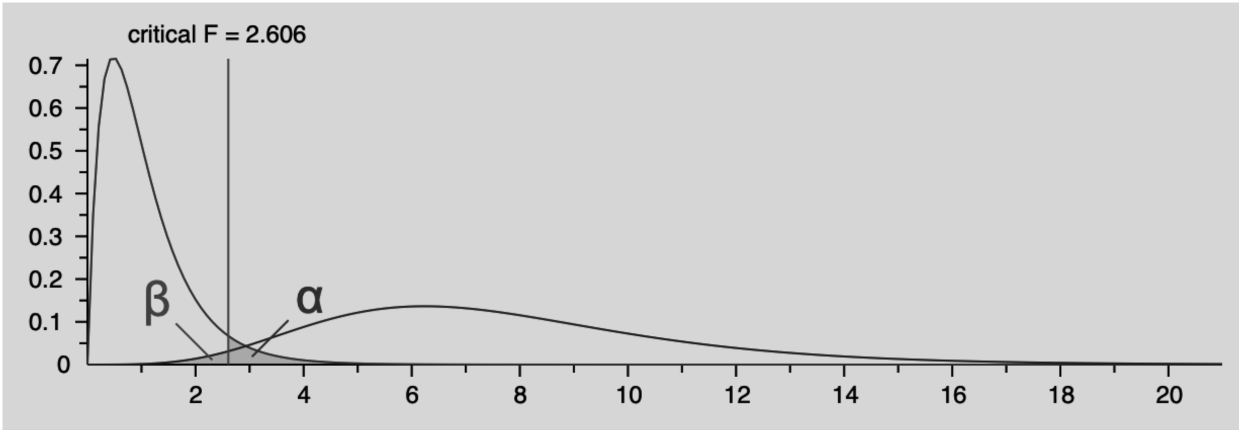

Figure 1. Power analysis using the cognitive intervention from previous meta-analytic data.

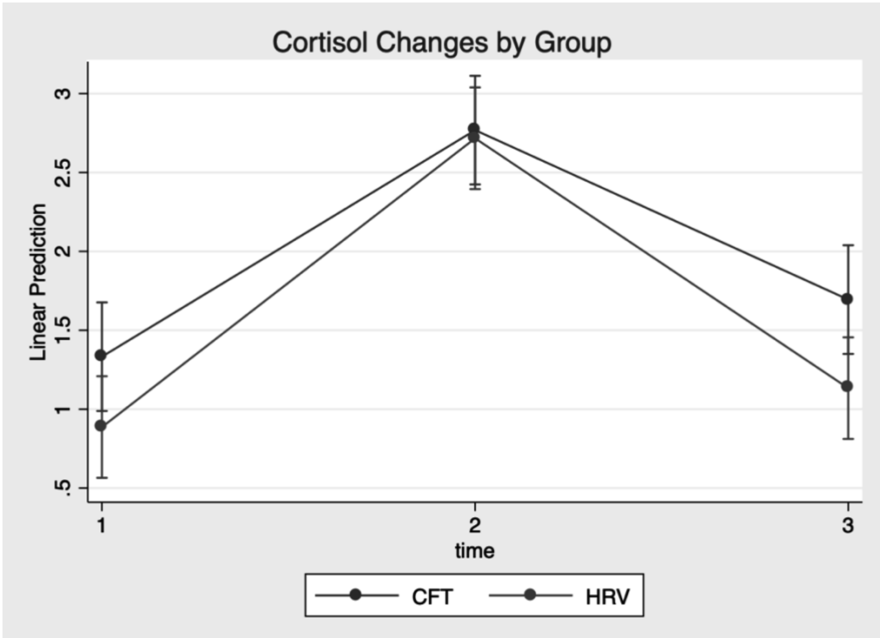

Figure 2. Cortisol Changes by Intervention Group, with the three time points at baseline (1), 15 minutes prior to performance (2) and 15 minutes post performance (3). Cortisol change is represented on the Y axis, with higher numbers reflective of higher cortisol levels.

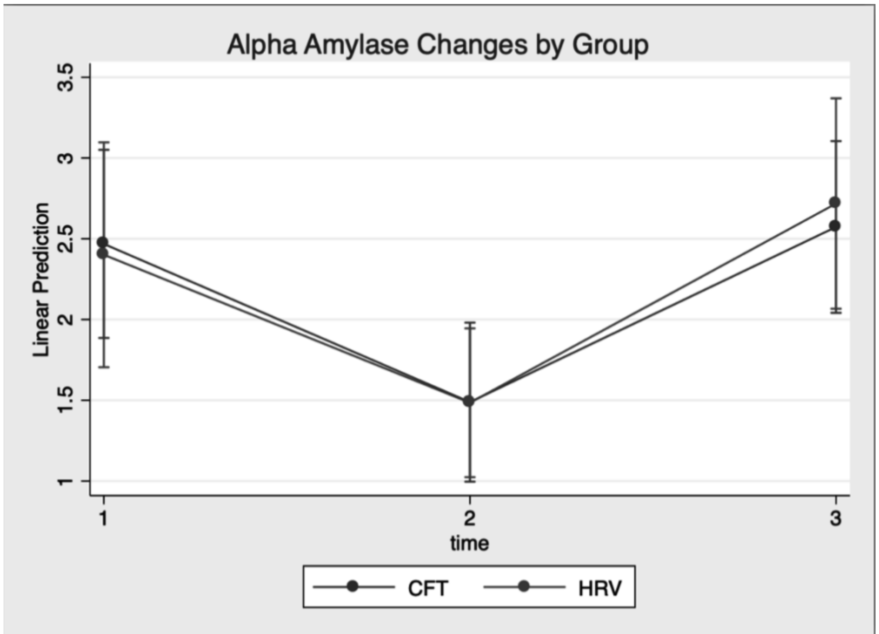

Figure 3. Alpha Amylase Changes by Group with the three time points at baseline (1), 15 minutes prior to performance (2) and 15 minutes post performance (3). Alpha-amylase is represented on the Y axis, with higher numbers reflective of higher alpha-amylase levels.

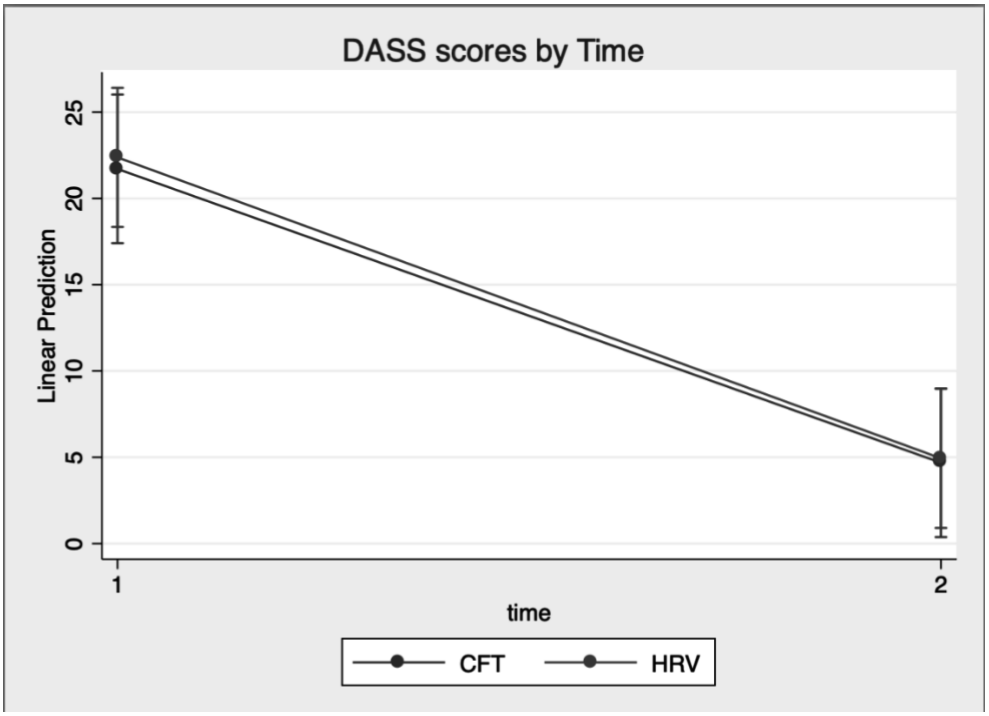

Figure 4. DASS scores by Group with the two time points measured at baseline (1) and 15 minutes prior to performance (2). The two groups had significantly lower self-report of depression, anxiety, and stress pre-performance compared to baseline levels.

APPENDIX D

STATA CODE

```
****Stata Final Dissertation

****Data cleaning

gen sex = "f"
replace sex = "m" in 6
replace sex = "m" in 10
replace sex = "m" in 16
replace sex = "m" in 29

encode sex, gen(sex_encoded)

**** transform string to numeric (intervention group)
encode group, gen(group_encoded)
encode partid, gen(id)

**** make dass one measure
egen dass1 = rowtotal(dasss dassa dassd)
egen dass2 = rowtotal (dasss2 dassa2 dassd2)

**** compassion scale
egen cfs = rowmean(cfse cfsa)
egen cfoo = rowmean(cfooe cfooa)
egen cfro = rowmean(cfroe cfroa)

**** drop unused variables
drop dasss
drop dassa dassd
drop cfse cfsa cfroe cfroa

**** look at missing data
ssc install mdesc
net install dm91, from("http://www.stata.com/stb/stb61")

mdesc
mdesc kmpaipr-spanep3
mvpatterns

**** Replace missing values with mean
foreach var of varlist kmpaipr-spanep3{
egen `var'_mean = mean(`var')
replace `var' = `var'_mean if `var' == .
drop `var'_mean
}
```

```
**** Fence outliers at +/- 2 SD
foreach var of varlist kmpaipr-spanep3{
egen `var'_sd = sd(`var')
gen `var'_lf = `var' - (2*`var'_sd)
gen `var'_uf = `var' + (2*`var'_sd)
drop `var'_sd
order `var'_lf `var'_uf, last
gen outlier_`var' = 0
replace outlier_`var' = 1 if `var' > `var'_uf | `var' < `var'_lf
}

**** Normality check examples:
foreach var of varlist kmpaipr-spanep3{
swilk `var'
}

**** Check and correct for normality
quietly foreach var of varlist kmpaipr-spanep3{
gen `var'_transformed = .
gen `var'_trans_type = "identity"

ladder `var'
gen `var'_cubic_chi2 = r(cube)
gen `var'_square_chi2 = r(square)
gen `var'_identity_chi2 = r(ident)
gen `var'_sqrt_chi2 = r(sqrt)
gen `var'_log_chi2 = r(log)
gen `var'_1_sqrt_chi2 = r(invsqrt)
gen `var'_inverse_chi2 = r(inv)
gen `var'_1_square_chi2 = r(invsq)
gen `var'_1_cubic_chi2 = r(invcub)

egen min_transfrom`var' = rowmin(`var'_cubic_chi2 `var'_square_chi2 `var'_identity_chi2
`var'_sqrt_chi2 `var'_log_chi2 `var'_1_sqrt_chi2 `var'_inverse_chi2 `var'_1_square_chi2
`var'_1_cubic_chi2)

replace `var'_transformed = `var'^3 if `var'_cubic_chi2 == min_transfrom`var'
replace `var'_transformed = `var'^2 if `var'_square_chi2 == min_transfrom`var'
replace `var'_transformed = sqrt(`var') if `var'_sqrt_chi2 == min_transfrom`var'
replace `var'_transformed = log(`var') if `var'_log_chi2 == min_transfrom`var'
replace `var'_transformed = 1/sqrt(`var') if `var'_1_sqrt_chi2 == min_transfrom`var'
replace `var'_transformed = 1/`var' if `var'_inverse_chi2 == min_transfrom`var'
replace `var'_transformed = 1/(`var'^2) if `var'_1_square_chi2 == min_transfrom`var'
replace `var'_transformed = 1/(`var'^3) if `var'_1_cubic_chi2 == min_transfrom`var'
```

```
replace `var'_trans_type = "cubic" if `var'_cubic_chi2 == min_transfrom`var'
replace `var'_trans_type = "square" if `var'_square_chi2 == min_transfrom`var'
replace `var'_trans_type = "square root" if `var'_sqrt_chi2 == min_transfrom`var'
replace `var'_trans_type = "log" if `var'_log_chi2 == min_transfrom`var'
replace `var'_trans_type = "1/(square root)" if `var'_1_sqrt_chi2 == min_transfrom`var'
replace `var'_trans_type = "inverse" if `var'_inverse_chi2 == min_transfrom`var'
replace `var'_trans_type = "1/square" if `var'_1_square_chi2 == min_transfrom`var'
replace `var'_trans_type = "1/cube" if `var'_1_cubic_chi2 == min_transfrom`var'

replace `var'_transformed = 0 if `var'_transformed == . & `var' == 0 & `var'_trans_type !=
"identity"

drop min_transfrom`var' `var'_cubic_chi2 `var'_square_chi2 `var'_identity_chi2 `var'_sqrt_chi2
`var'_log_chi2 `var'_1_sqrt_chi2 `var'_inverse_chi2 `var'_1_square_chi2 `var'_1_cubic_chi2
}

**** Log transform cortisol
gen logcort1 = log(cortisol1)
gen logcort2 = log(cortisol2)
gen logcort3 = log(cortisol3)

gen logama1 = log(ama1)
gen logama2 = log(ama2)
gen logama3 = log(ama3)

gen spanet1 = spane1n
gen spanet2 = spanen2
gen spanet3 = spanen3

**** Group baseline differences?
foreach var of varlist scs dass1 dass2 kmpaipr_transformed kmpaiw_transformed
kmpaid_transformed kmpaipa_transformed kmpaim kmpaig_transformed kmpaia_transformed
kmpaib_transformed psi6 spane1p spane1n_transformed spane1b spanep2 spanen2_transformed
spaneb2 dasss2_transformed dassa2 dassd2_transformed spanep3_transformed spanen3 spaneb3
logcort1 logcort2 logcort3 logama1 logama2 logama3{
ttest `var',by(group)
}

foreach var of varlist coglog1 amalog1 kmpaipr_transformed kmpaiw_transformed
kmpaid_transformed kmpaipa_transformed kmpaim kmpaig_transformed kmpaia_transformed
kmpaib_transformed spane1p spane1n_transformed spane1b spanep3_transformed spanen3
spaneb3{
ttest `var',by(group)
}
```

```
foreach var of varlist kmpaib spane1p spane1n spane1b{
ttest `var',by(group)
}



tabstat cfs cfoo cfro dass1 dass2 kmpaipr_transformed kmpaiw_transformed
kmpaid_transformed kmpaipa_transformed kmpaim kmpaig_transformed kmpaia_transformed
kmpaib_transformed psi1_transformed psi2_transformed psi3 psi4 psi5_transformed psi6
psi7_transformed psigbl_transformed spane1p spane1n_transformed spane1b spanep2
spanen2_transformed spaneb2 dasss2_transformed dassa2 dassd2_transformed
spanep3_transformed spanen3 spaneb3 logcort1 logcort2 logcort3 logama1 logama2 logama3,
by(group) statistics(mean sd) columns(statistics) save
mat G2t = r(Stat2)'
mat G1t = r(Stat1)'
mat Tt = r(StatTotal)'

putexcel set "descriptive_stats_transformed.xlsx", replace
putexcel A1 = "CFT"
putexcel D1 = "HRV"
putexcel G1 = "Overall"

putexcel A2 = matrix(G1t), names
putexcel D2 = matrix(G2t), names
putexcel G2 = matrix(Tt), names

**** For DASS, stop here and go to line 196

****reshape long form for cortisol, ama, and spanen anova (seperate for DASS)

gen coglog1 = logcort1
gen coglog2 = logcort2
gen coglog3 = logcort3

gen amalog1 = logama1
gen amalog2 = logama2
gen amalog3 = logama3

reshape long coglog amalog spanet, i(partid) j(time)

*Do the groups differ in pre-performance cortisol controlling for baseline cortisol?
*Do the groups differ in post-performance recovery cortisol controlling for baseline cortisol?
*(no difference between time of day differences between groups, so no need to control for this)

**** ANOVA with interaction
```

```
anova coglog time group_encoded time#group_encoded
margins time#group_encoded
marginsplot
estat esize
contrast time@group_encoded, effects mcompare(scheffe)

anova amalog time group_encoded time#group_encoded
margins time#group_encoded
marginsplot
estat esize

anova spanet time group_encoded time#group_encoded
margins time#group_encoded
marginsplot
estat esize

**** Exploratory Analyses

anova coglog time##group_encoded##c.cfs
anova coglog time##group_encoded##c.cfoo
anova coglog time##group_encoded##c.cfro

anova amalog time##group_encoded##c.cfs
anova amalog time##group_encoded##c.cfoo
anova amalog time##group_encoded##c.cfro

anova spanet time##group_encoded##c.cfs
anova spanet time##group_encoded##c.cfoo
anova spanet time##group_encoded##c.cfro

anova coglog time##group_encoded##c.kmpaib
anova amalog time##group_encoded##c.kmpaib
anova spanet time##group_encoded##c.kmpaib

**** Go back to beginning, finish at line 145 and continue below:

gen dasstwo = dass2
drop dass2

gen dassone = dass1
drop dass1

gen dass1 = dassone
gen dass2 = dasstwo

reshape long dass, i(partid) j(time)
```

```
anova dass time group_encoded time#group_encoded
margins time#group_encoded
marginsplot
estat esize
contrast time@group_encoded, effects mcompare(scheffe)
```