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Testing the effects of mindfulness meditation in reducing music performance anxiety as measured by cortisol and self-report

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TESTING THE EFFECTS OF MINDFULNESS MEDITATION IN REDUCING MUSIC PERFORMANCE ANXIETY AS MEASURED BY CORTISOL AND SELF-REPORT

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Testing the Effects of Mindfulness Meditation in Reducing Music Performance Anxiety as Measured by Cortisol and Self-Report

Abstract

Music performance anxiety (MPA) is a debilitating and career-threatening phenomenon that occurs for many musicians in a public performance setting. As a hormonal measure of stress, cortisol has been shown to increase in musicians who are about to perform in front of an audience. It is important to study ways to keep stress within an optimal range before public performance to help musicians keep their cognitions, behaviors, and autonomic arousal at levels that help rather than hinder their performance. Mindfulness in the form of a brief guided meditation and as yoga has been shown to reduce self-reported anxiety in musicians. This study investigates if a single guided meditation can help reduce music performance anxiety (as measured by cortisol reactivity and self-reported state and trait MPA) in musicians prior to a public performance compared to those listening to a control monologue. The meditation group was not significantly different from the control group on cortisol reactivity or state MPA. However, cortisol reactivity and trait MPA moderated the relationship between meditation and state MPA in this sample. The implications of a potential moderating effect of trait MPA and cortisol reactivity are discussed.

Literature Review

Introduction

Getting ready for a public music performance is often a stressful experience - college musicians typically dread their performance final (commonly referred to as a jury) and professional musicians will be nervous for an upcoming audition. While some degree of stress about performing in front of others is common, in the extreme, it can be debilitating to a musician's career. Music performance anxiety (MPA) is the fear of performing in front of an audience due to exaggerated concerns about how they will be judged, even if not in a formally evaluative situation (Goren, 2014). However, it is also important to realize that the concept of MPA is rather an amalgamation of terms: it may be thought of as a "dimensional construct, as occupational stress, as a focal anxiety disorder, as social anxiety or social anxiety disorder (social phobia), and as a panic disorder" (Kenny, 2011, p. 82). Despite this variety in approaches to defining MPA, there are common physiological changes (e.g., increase in heart rate) and psychological changes (e.g., self-reported high levels of stress) in most musicians prior to a public performance (Aufegger, 2016). Drawing from research in performance psychology, some degree of mental and physical arousal is needed for optimal performance, but extreme arousal will hinder performance such as in a task mastery situation like a musical performance (Yerkes & Dodson, 1908; Matei & Ginsborg, 2017). Therefore, it is important to continue to investigate treatments for high levels of MPA to help musicians perform at their best.

Music Performance Anxiety

For the purposes of this paper, MPA is "the experience of persisting, distressful apprehension about and/or actual impairment of, performance skills in a public context, to a degree unwarranted given the individual's musical aptitude, training, and level of preparation"

(Salmon, 1990, p. 3). A musician suffering from MPA is negatively affected by a trifecta of influences prior to and while performing in front of others: their cognitions, behaviors, and autonomic arousal (Kenny, 2005). MPA can be detrimental to a performance, especially at its highest levels when weakened cognitive abilities affect the musician's ability to recall a memorized piece of music or when autonomic arousal is so high that they lose control of their dexterity or have dry mouth that prevents them from producing vibrations needed for playing their instrument (Yoshie, Shigemasu, Kudo, & Ohtsuki, 2008).

Anxiety may be broken up into two components: state and trait anxiety. Trait anxiety is an enduring personality characteristic while state anxiety is a reaction to insecurity in a particular situation (Meijer, 2001). This concept may be applied to musicians where getting nervous before playing a solo performance would be considered state anxiety and being nervous about performing in general would be considered trait anxiety (Kageyama, n.d.).

Prior Research

Some studies have sought to improve physiological or attentional complications resulting from MPA through meditation, yoga, or instructional courses but the results have been conflicting. Chang (2001) assigned participants to either a group that received instruction in meditation or a no instruction control group and measured their pre- and post-intervention levels of MPA and their post-intervention heart rate and blood pressure. This study revealed that there was no significant interaction between the MPA and the group membership (meditation or control), although it was approaching significance with a group of only nineteen music students. Importantly, this study lacked a pre-intervention measure of physiological stress.

Like mindfulness meditation, yoga also focuses on breathing and centering. Stern, Khalsa, and Hofmann (2012) found that music students who were assigned to a nine-week yoga

class had significantly lower levels of self-reported trait anxiety and MPA levels following the class than their baseline levels. There was no control group for this study. Overall, there has been some research into mind-body interactions that suggest that techniques such as meditation or yoga may be effective in reducing MPA; however, there is a need for a study with a true control group that investigates both self-reported MPA and physiological responses to stress before and after the intervention.

Cortisol and Performance

The hormone cortisol is linked to stressful situations and can therefore be used as a physiological indicator of stress (Kemeny, 2003). The stress-response in the body can be turned on even in *anticipation* of a stressful event (Sapolsky, 2004). Cortisol is the hormone released after the hypothalamic-pituitary-adrenocortical (HPA) axis, a system involved in the fight-or-flight response, is activated (Jankord & Herman, 2008). Known as the "stress hormone," cortisol is widely studied in examining the endocrinological response to stress (Blascovich, Vanman, Mendes, & Dickerson, 2013).

Cortisol has been previously studied and linked to performance anxiety in musicians. For example, Fancourt, Aufegger, and Williamon (2015) found that when singers were asked to sing in high-stress (with an audience) and low-stress (no audience) conditions, their cortisol levels decreased in the low-stress condition and increased in the high-stress. This contrasting swing between the conditions suggests that singing (and potentially all music-making) is a stress-reducing activity on its own and the addition of an audience is what increases cortisol and, by extension, stress.

The link between cortisol and performance has been evaluated in other situations, and this relationship may apply to athletes as well. Athletes who perform better in competition

typically have lower levels of cortisol than do those who perform poorly (Raab et al., 2016). It has been proposed that high levels of cortisol may mediate the relationship between stress and loss of motor function through cortisol's effect on the cerebellum which is responsible for voluntary movement and coordination (Gheorghe, Panouillères, & Walsh, 2018). This loss of motor coordination could be problematic for wind, string, and keyboard musicians who must manipulate several body parts such as their hands and fingers successfully play their instrument (Altenmüller et al., 2007).

Guided meditations and mindfulness exercises (as well as yoga and other mind-body exercises), all of which focus on being "mindful" of the present moment have been associated with decreased state anxiety scores and decreases in levels of cortisol, even in non-experienced meditators (Moraes, Miranda, Loures, Mainieri, & Mármora, 2018). Turakitwanakan, Mekseepralard, and Busarakumtragul (2013) assigned thirty medical students to a four-day meditation program and measured their cortisol levels before and after completing the program. The results indicated that cortisol levels were significantly lower for the participants after completing the meditation program, but again, the lack of a control group warrants further study. Overall, guided meditations may be one way of achieving desired reductions in cortisol and stress levels.

Hypotheses

The present study investigates whether a mindfulness technique can lower cortisol levels and state MPA. It is hypothesized that a brief guided meditation prior to a musical performance will result in a significant decrease in cortisol levels and that self-reported state MPA levels will be lower for the meditation group versus the non-meditation group.

Furthermore, it is hypothesized that there will be a significant three-way interaction between group membership, cortisol change, and trait MPA.

Method

Participants

Musicians. Music majors from a midwestern public university volunteered to participate. The university has multiple sections of a performance seminar class in which students formally perform for their peers, but do not receive a grade for their performance. The sections of performance seminar included in the study are woodwind/percussion seminar, brass seminar, keyboard seminar (piano and organ), and string seminar (violin, viola, cello, bass, and guitar). Musicians were randomly assigned to either the meditation (experimental) condition or the neutral monologue (control) condition.

Materials

Self-Report Measures. The music students completed a variety of self-report questionnaires before and after their performance, including the Kenny Music Performance Anxiety Inventory (K-MPAI; Kenny et al., 2004), the Fragebogen Zum Auftritt – Selbst-einschätzung (FZA-S, english translation, Spahn, Nusseck, & Walther, 2013, quoted in 2015), a demographics section, and additional questionnaires not included in this study.

The Kenny Music Performance Anxiety Inventory has a high degree of internal reliability with a Cronbach's alpha of .94, and it is strongly correlated with the State Trait Anxiety Inventory and the Cox and Kenardy Music Performance Anxiety which suggests a strong external validity (Kenny et al., 2004). It may be scored in three subcategories: worries and insecurity ($\alpha = .82$), depression and hopelessness ($\alpha = .77$), and early parental relationship (α

= .57) (Barbar, Souza, & Osório, 2015). Although early parental relationships have poor Cronbach's Alpha, the other two subscores demonstrate acceptable to good levels of reliability.

The Fragebogen Zum Auftritt – Selbst-einschätzung (FZA-S) is a measure by Spahn, Nesseck, and Walther (2013). It was developed to test a person's "state" MPA regarding a specific performance and consists of questions about how the musician felt before, during, and after the performance. This contrasts with other measures, such as the Kenny-Music Performance Anxiety Inventory (K-MPAI; Kenny et al., 2004), which Spahn et al. assert gives an indication of a musician's trait MPA. Spahn et al. administered both the FZA-S and the K-MPAI for their participants who performed before an audition panel. Due to the small sample size of the original sample, a factor analysis was not performed. The present study is similar in nature with the performance situation described in Spahn et al., and so the FZA-S was chosen to have musicians self-report their state MPA levels for the given performance.

Cortisol Samples. Cortisol was collected via two passive drool saliva samples. Peak cortisol levels appear in saliva around twenty to forty minutes following an anxiety-provoking event one is trying to measure (Dickerson & Kemeny, 2004). For both the experimental and the control group, the first sample was collected approximately twenty minutes after the participants arrived at the performance venue (after they completed the first questionnaire) as a baseline measure. The second sample was collected approximately twenty-five minutes after the listening activity to measure participants' stress levels following the meditation or control as a post-intervention measure. All saliva samples were labelled with the participants' ID numbers and immediately frozen. Subsequent immunoassays were conducted in the University of Northern Iowa Psychoneuroendocrinology Lab and using Salimetrics guidelines (Salimetrics, LLC, n.d.).

Listening Activities. The experimental group received a mindfulness meditation to listen to on a computer. A mindfulness exercise is one that focuses on "maintaining a moment-by-moment awareness of [one's] thoughts, feelings, bodily sensations, and surrounding environment" and paying attention to "thoughts and feelings without judging them" (Greater Good Science Center, 2020). Practices such as yoga and meditation often fit this definition of mindfulness by calling awareness to the present moment in a nonjudgmental manner. The experimental condition utilized a ten-minute guided meditation that asked participants to "bring full attention to the present moment" with "openness, patience, and curiosity" as they were guided through a series of breathing exercises and a body-scan. This meditation was delivered via headphones from YouTube.

The control group received a neutral listening activity. For this study, a pre-recorded lecture on the history of music was used. The lecture was also ten minutes in length and delivered via headphones from YouTube to mimic the experimental group in presentation, but not in content.

Procedure

Upon arrival, all participants were asked to read and sign an informed consent sheet prior to participating. Participants were further instructed that they may refuse to participate or stop participating at any time during the study. All participants completed their study activities in an isolated and quiet warm-up room adjacent to the performance hall. In the following table, items in italics represent study activities, while items in regular font represent expected seminar class activities.

Timeline Event	**Notes**
Pre-Performance Questionnaire	*40 minutes prior to performance*

Saliva Sample #1	*20 minutes prior to performance*
10-minute guided meditation or a 10-minute neutral monologue	*~17 minutes prior to performance*
Final preparations for performance as self-directed by student	~7 minutes prior to performance
Student performs as normal	Performance (10 minutes)
Post-performance Questionnaire	*Immediately after performance*
Saliva Sample #2	*~8 minutes after performance (25 minutes after listening activity)*

Design

Participants were randomly assigned to either the meditation group or the control group. For the first two hypotheses, group membership is the independent variable and cortisol change or state MPA, respectively, are the dependent variables. For the third hypothesis, group membership is the predictor variable and state MPA is the outcome variable, with cortisol change and trait MPA as moderators.

Results

Prior to analysis, the data was screened for normality, outliers, and missing cases. The key variables were normally distributed except for cortisol, with the second sample severely positively skewed (skewness = 2.19) and the first sample trending toward a positive skew as well (1.28). A logarithmic transformation was performed on both the cortisol time one and cortisol time two distributions to make them more normal. This improved the normality test statistic for time two (0.55) indicating the distribution was now normal and for time one (0.10). There were no outliers for any of the key variables based on the a priori definition of an outlier consisting of a *z*-score greater than 3.29. One case was not included in any analyses that included cortisol change due to the participant accidentally leaving before the second saliva sample.

To test the first hypothesis, a one-tailed t-test was conducted to determine if the cortisol was significantly lower following the listening activity between the meditation group versus the control group. The meditation group did not have significantly less cortisol reactivity than the control group, $t(14) = 0.46$, $p = .33$. A second one-tailed test was run to test the second hypothesis to determine if the meditation group was lower than the control group for state MPA, using the total FZA-S score. This too yielded a result where the meditation group was not significantly lower than the control group, $t(15) = -0.59$, $p = .28$.

A regression model was run for the third hypothesis to test the significance of a three-way interaction between group membership, trait MPA, and cortisol change on state MPA. Using PROCESS Model 3, the following variables were entered: condition (meditation or control) as the predictor, state MPA as outcome, and cortisol change and trait MPA as moderators. This model was significant, $F(7, 8) = 4.42$, $p < .05$, and predicted 79.44% of the variance in state MPA. The three-way interaction of condition, state MPA, and cortisol change contributed to the model at near-significance, R^2 change = .11, $p = .08$. Thus, the third hypothesis was supported in that the relationship between group membership and state MPA is moderated by trait MPA and cortisol change. For participants who had high state anxiety and did not meditate, their cortisol negatively predicted their trait anxiety. For participants who had low state anxiety and did not meditate, their cortisol positively predicted their trait anxiety.

Discussion

This study investigated the effects of a single guided meditation on music performance anxiety in musicians. The meditation group did not have less cortisol reactivity than the control group. Similarly, the meditation group was not lower for their self-reported state MPA. This null result might initially suggest that meditation does not reduce MPA. However, this result also

may be due to different effects based on individuals' trait level anxiety or cortisol reactivity as discussed below.

More complex analysis from the third hypothesis demonstrates the moderating role of cortisol and trait MPA on the relationship between meditation and state MPA. The greatest difference appeared in the control group when comparing participants with high versus low state anxiety. For those who had high state anxiety and did not meditate, cortisol change was negatively associated with their state anxiety. This means that for participants in this group, as their cortisol reactivity increased, their state anxiety decreased, or vice versa. For those that had low state anxiety and did not meditate, cortisol change was positively associated with their state anxiety. Participants in this group that experienced an increase in cortisol reactivity also had an increase in state anxiety or, similarly, decreases in both. Although the sample size is small, the potential relationships indicate interesting findings that warrant future research.

Limitations

Sample size. The nature of recruiting music students to participate in a psychology study rendered recruitment more difficult than anticipated. Additionally, data collection was interrupted due to campus closures with the spread of COVID-19. A total of seventeen university music students completed the study, with one of the seventeen not providing a second saliva due to leaving early. The small sample size means that these results may not be representative of the population and unique to this sample.

Lack of generalizability. The sample of seventeen was also only from musicians studying at a university who had been playing their instrument between six to seventeen years. They had all had at least one performance in seminar class before, meaning that they had at least some prior experience performing in front of others. For musicians who are just beginning to

play their instruments or professionals, the nature of MPA may differ due to confidence and experience. The results may be limited to the sample tested here and may not be generalizable to all adult musicians.

Multiple class sections. This study relinquished some of the traditional amount of experimental control by conducting research in a naturalistic setting of an existing class. Even more, the class studied had multiple sections in three different performance halls run by professors with different styles. For example, the brass seminar was more relaxed in performance and students volunteered to play each week whereas in the woodwind seminar, professors assigned their students to play in class and made a formal program for each week. Even more, brass seminar specifically may have distorted the results as the class did not adhere to the ten-minute performance slots which made the second saliva collection time more variable from the outlined schedule in the method section. The peak levels for cortisol response following the onset of an event is twenty to forty minutes (Blascovich et al., 2013). Some of the brass seminar performers fell outside this window with their second saliva sample collected forty to fifty minutes after the listening activity. Because this study aimed to be practical in nature, some of the experimental control was given up to be more realistic, but it may have confounded the results.

State versus trait MPA. State MPA was only designated as separate from trait MPA in two sources (Spahn, Nusseck, & Walther, 2015; Kageyama, n.d.) and may not be a viable distinction in measuring MPA. State and trait separations are accepted as different instances of anxiety and are commonly measured through the State-Trait Anxiety Inventory (Spielberger et al., 1983). State MPA was measured in this study following a translation of a German-language inventory created by Spahn et al. (2015). This inventory has not been widely replicated,

particularly in the English language. The particular measure for MPA may not have worked well for English-speaking musicians or perhaps state MPA is not a distinction at all.

Future Directions

More work should be done to replicate these findings in larger and more diverse samples, perhaps looking at beginning students through professional musicians late in their career. The small sample size here has interesting patterns that should be further researched in bigger samples to see if the relationships are supported. Another approach may be to look at different types of meditation settings. How would the results change for meditations that are longer or shorter than the ten-minute meditation used in the present study? How would having multiple sessions of meditation over multiple days/weeks/months affect cortisol and MPA versus the single meditation presented here?

Emerging trends in cortisol research suggest that sex differences may play an important role in cortisol reactivity patterns (Hidalgo, Pulopulos, & Salvador, 2019). Some exploratory findings within this data suggest that gender differences could potentially also affect how musicians experience MPA. Females had higher levels of performance anxiety than males prior to the performance as measured by the “before” subscale of the FZA-S. Gender could be considered in future research as a moderating factor of MPA. Additionally, studies looking at estrogen and testosterone as other hormones potentially involved in MPA could help to elucidate this relationship.

Applications and Conclusion

Although the meditation group was not significantly different from the control group on mean cortisol change or state MPA, many people still individually reported that the meditation helped their performance. Even if the meditation did not collectively reduce MPA, any benefit to

an individual's performance can be a welcome improvement to a musician who feels prepared but needs some centering before playing in front of an audience. Pre-performance rituals have been studied in sports psychology for several decades (Jackson, 2003; Mesango, Marchant, & Morris, 2008; Hazell, Cotterill, & Hill, 2014). Meditation could be a form of a ritual before every performance to ground the musician. These pre-performance rituals reinforce the skills already established in practice by reminding the performer that they are in fact, prepared. Regular use of a brief meditation could serve this function.

It is also important to recognize the complexity of performing music. MPA affects cognitions, behaviors, and autonomic arousal (Kenny, 2011) because all of those areas are involved in performing music, even without the heightened anxiety attached. Therefore, future research should continue to seek to look at the interactions of these variables in exploring the etiology and treatment for MPA. No variable, be it cortisol or self-reported feelings of anxiety, works in isolation in a real-world performance. Such naturalistic investigations should expand upon the interactions that are necessarily a part of this complex phenomenon.

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