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Access To Music Among Air Traffic Controllers: Perceptions, Performance, Stress, And Ethics

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ACCESS TO MUSIC AMONG AIR TRAFFIC CONTROLLERS: PERCEPTIONS, PERFORMANCE, STRESS, AND ETHICS

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To my wife Lisette,

My parents John and Nia,

My brother Stanley and sister Ramona,

And my dearest friends,

Whose love and support made this possible!

ABSTRACT

The purpose of this study was to examine the interactions between music listening, stress, and performance among 268 air traffic controllers. The research questions included: (1) What is the relationship between air traffic controller perceived performance and music listening?; (2) What is the relationship between air traffic controller stress level and music listening?; (3) Should music listening be considered an ethical and/or effective solution to improve emotional and physiological outcomes among air traffic controllers? The results showed that as ratings increased for (1) agreement that participants listened to music while working, (2) time spent listening to music; (3) beliefs that music improved work performance, (4) beliefs that music should be allowed at work, (5) beliefs that the FAA and DOT have a responsibility to reduce stress; (6) preferred music listening frequency, and (7) experiencing stress during air traffic control increased, Music-Related Performance also significantly increased. While some participants felt that music should not be permissible while working live air traffic and in certain work environments, others felt that music reduced stress, improved morale, and enhanced coordination and focus in an air traffic control setting. Through these reported increases of performance as a direct result of music listening, these findings suggest that music may increase awareness to neurobiological processes. The results of this study show that oversight organizations for air traffic control may have an ethical responsibility to reduce stress-induced emotional and physical symptoms among employees.

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CHAPTER 1

Introduction and Literature Review

The argument that music should be available in workplace settings has brought about broad research positions, ranging from person-based ethics, to organizational-based performance. From an organizational perspective, Meyer (2019) posits that music not only affects public behavior, but also supports the public's contemporary positions that organizations should ensure ethical environments for its employees. Harari (2016) notes that music is a "miracle" of mathematics, which transforms air vibrations and frequencies into emotions, while embodying physical laws. Employees who play music at work are more likely to be more productive and have better performance outcomes in both small tasks (Oldham et al., 1995) and overall job performances that require a high degree of complexity and creativity (Lesiuk, 2005).

This stream of research was first pioneered by Fox and Embrey (1972), who found that music increases efficiency when employees perform quality control tasks. Oldham (1995) found that employees who have access to their favorite music are less likely to reconsider their job positions, while increasing their performance. Beyond the performance measures, it is possible to consider that organizations' giving their employees access to music is simply ethical, as well as effective (Meyer, 2019).

Today's organizations should not only do things that make sense economically, but also things that do good for their employees; this can be in psychological, mental, and health capacities. As such, researchers argue that organizations should be effective as well as ethical (Meyer, 2019). Music improves individuals' moods and emotions, while allowing them to cope with challenges that come along with nerves, stress, and exhaustion (Lesiuk, 2005; Oldham et

al., 1995). Summek (2016) states that music can actively intensify, promote, or balance specific feelings to put oneself into a particular mood, which contradicts the widely held belief that music is simply a passive emotional driver. As such, Meyer (2019) argues that promoting positive emotions such as joy, compassion, and optimism reflects ethical behavior from the standpoint of organizational leaders that can in turn lead to helping behaviors, altruism, and honesty among workers.

Music can compel employees to act with beneficial behavior that leads to a positive organizational culture, promoting positive actions that reflect organizational policies and structures (Cameron & Caza, 2002; Meyer, 2019). Meyer (2019) states that:

> Music is an effective way to gain key competencies such as extroversion, responsibility, and emotional stability. The development of such social competencies impacts our personality traits, and this signifies building character. In addition, findings regarding music therapy suggests that music helps people to overcome communication barriers, depression, and hyperactivity among other social, emotional, and mental conditions…In sum, there are at least three ways in which music can help develop our personality: (a) through its collective dimension; (b) its healing effects; and (c) as a stimulus for (novel) behavior (p. 97).

Music may be particularly effective for workers in highly stressful environments. Air traffic controllers experience excessive levels of high demand workload, which includes responsibility and work overload. According to the U.S. Department of Labor, air traffic control has been classified as the fourth most stressful occupation (U.S. Bureau of Labor Statistics, 2010). Air traffic controllers have been shown to exhibit psychophysiological responses to changes in workload during simulated air traffic control (Hollnagel & Woods, 2005).

Additionally, there are many human factors to be considered in relation to the air traffic control domain (Duca & Attaianese, 2012). For example, air traffic controllers must maintain a high level of situational awareness (Durso & Sethumadhaven, 2008; Lee, 2012), which interacts with workload history and task performance (Cox-Fuenzalida, 2016).

Unsurprisingly given their stressful work environments, air traffic controllers have been found to experience depression, substance use, hypertension, upper respiratory infections, and reduced impulse control (Mohler, 1983). Therefore, there is great importance in examining factors that may detract from productivity, along with understanding strategies to increase efficacy and performance. However, providing music to air traffic controllers may also be attached to an ethical decision that may help increase emotional and physiological outcomes.

Music listening has been shown to increase positive affect in a way that decreases stress and improves performance in air traffic controllers (Lesiuk, 2008; 2010). However, since 2006, air traffic controllers have been prohibited from listening to music while working live air traffic on the operational control floor (Federal Aviation Administration, 2006). Only in 2016, slight amelioration occurred when the FAA partially conceded, permitting music listening on the control floor during the Mid Shift, between the hours of 10 PM to 6 AM (Federal Aviation Administration, 2016) at select facilities.

However, through the informed observations of the present research, music listening occurs on the operational control floor during the prohibited hours of 6 AM to 10 PM through creative “work arounds”; this is because many practitioners state that music plays a significant role in job performance, contributing to their functioning at optimal levels. Despite the fact that music listening is restricted by aviation protocol, it still makes its way into aviation workspaces, specifically, the air traffic control operational floor. This raises a concern as access to music

during prohibited hours is not universally available to all air traffic controllers, as “work arounds” are highly subjective in nature; for example, music may be played loudly from a location adjacent to, but not on the operational work floor itself, allowing practitioners to hear and benefit from the music. Certain management at air traffic facilities view this as acceptable, while others at a comparable facility, even in the same region, define it as unacceptable. As such, it is important to investigate potential avenues to increase beneficial music listening effects, such as improved emotional and physiological outcomes, within the parameters of prohibitive governmental policies in this population.

In the context of a loss of situational awareness, this presents a concern for safety, especially for this sector (Dekker, 2015; Li et al., 2018). Daytime sleepiness is associated with stress in air traffic controllers (Freitas, 2017). Therefore, it is vital to understand strategies that may be adopted to increase control, coordination, and adaptive performance in air traffic control, especially as it relates to events that involve a loss of control (Kontogiannis & Malakis, 2013). This chapter will review papers that identify the gaps in the literature pertaining to air traffic controller behavior, emotional and physiological outcomes, and music listening, specifically to elucidate the following questions:

1. What is the relationship between air traffic controller perceived performance and music listening?
2. What is the relationship between air traffic controller stress level and music listening?
3. Should music listening be considered an ethical and/or effective solution to improve emotional and physiological outcomes among air traffic controllers?

This chapter will examine the demands of air traffic controllers such as mental workload, cognitive demand, and the need for situational awareness in its relation to stress, burnout, and performance. Furthermore, this chapter will examine whether music is an appropriate coping strategy for reducing stress in air traffic controllers, and investigate its ability to mitigate these demands with relation to increased performance. A search of key terms included “Stress”, “Burnout”, “Human Factors”, “Wellbeing”, “Cognitive Demand”, “Situational Awareness”, “Workload”, “Music”, “Resilience”, and “Performance” on the Ebscohost, ERIC, JSTOR, and PubMed databases. Articles were selected if they contributed to understanding gaps and associations of stress, air traffic controllers, and music listening as an intervention. Specifically, the gaps in the literature involving the effects of music on stress and productivity in air traffic controllers are described and synthesized.

Effects of Music on Stress and Health

Levitin and colleagues (2018) posit that music and movement are universal among humans, which are facilitated by temporal qualities such as tempo, rhythmic patterns, and pulse to derive a heightened cognitive state. Music not only engages the auditory domain, but the visual domain as well. Visual cues can alter musical experiences, which affect cross modal perception, multisensory integration, and synesthesia. Having accuracy with tempo, rhythmic patterns, and pulse indicates a healthy cognitive and neurophysiological state.

Brain lesions and disorders are associated with dysfunctional perception of music, which can produce issues with rhythm and timing linked to motor dysfunction. For example, Parkinson’s patients are not able to accurately perceive changes in rhythmic patterns compared to healthy controls (Levitin et al., 2018). Additionally, patients with basal ganglia disorders such as Huntington’s disease show impairment in rhythm and timing tasks (Levitin et al., 2018). As

such, internal timekeeping processes in these patients reduce their ability to accurately predict tempo.

Music listening can have positive effects in relation to emotion (Levitin & Tirovolas, 2009). For example, listening to classical music can increase strong emotions such as pleasure, which is accompanied by a physical response such as changes in heart rate. These pleasurable experiences are linked to activation of the orbitofrontal, subcallosal cingulate, and frontal polar cortices (Levitin & Tirovolas, 2009). Chills derived from music listening are associated with the left ventral striatum, which is associated with the reward system, and deactivation of the amygdala. Dopamine is released through the facilitation of the ventral tegmental area (Levitin & Tirovolas, 2009). In concert, these processes are involved in controlling the brain's response to rewards. Dopaminergic pathways are further stimulated through music by the hypothalamus, insula, and orbitofrontal cortex, which underpin pleasurable music (Menon & Levitin, 2005).

Another important brain area affected by music is the limbic system in which the hippocampus is activated during pleasurable music, while the parahappocampal gyrus, involved in emotional processing, is also activated. As such, these networks that control the memory and stress responses, such as the hippocampus and amygdala respectively, form the basis of music and emotional processing (Levitin & Tirovolas, 2009). The listener may experience chills, as the individual becomes an active participant in creating an emotional experience through captive attention (Levitin & Tirovolas, 2009).

Sad music can also offer comfort and mood regulation, due to the hormone prolactin. This hormone is released by the anterior pituitary gland during a sad event and produces a tranquilizing effect. Prolactin is not always present in tears; it is only found when tears are associated with a sad event, not when the eye is irritated or with tears of joy (Levitin &

Tirovolas, 2009). When a person experiences a depressed mood, happy music can inflame negative emotions because the individual does not feel understood. On the other hand, sad music produces the tranquilizing effects of prolactin, which opens a sense of connection and feeling understood with an analogous affective state (Levitin & Tirovolas, 2009).

As such, it may be productive to investigate the use of sad music in the context of stressful situations, such as those associated with the work of air traffic controllers; this would help researchers understand the response of anterior pituitary gland in producing prolactin, which may help mitigate the negative effects of work demands. However, there is no study that examines sad music in response to stress among air traffic controllers. Studying the variations of music genres to include classical music to sad ballads may produce diverging emotional effects (Levitin & Tirovolas, 2009), wherein the researcher may be able to find types of music that are most therapeutic in the midst of stress and negative emotional affect.

The Case for Music in High-Stress Work Environments

The work attributes of operating room staff and air traffic controllers can be comparable, as they both require a high level of situational awareness, vigilance, and sustained attention. Occupational stress occurs in operating room settings when there is, “an imbalance between perceived environmental and occupational requirements; and individual adaptive capacities” (Kacem et al., 2020, p. 4). Music therapy significantly improves the levels of stress among operating theater staff (Kacem et al., 2020). Muhammad and colleagues (2019) found that meditation music improved the quality of suturing among neurosurgeons of different surgical experience during an experimental bypass procedure. Lies and Zhang (2015) found that plastic surgery residents completed surgical closures in less time when they listened to preferred music. In a systematic review, Rastipisheh et al. (2019) concluded that most studies on the effects

listening to controlled music on surgical teams were positive as reported by staff. As such, the researchers find that music is an economical, non-pharmacological, simple, and non-invasive intervention to prevent medical occupational stress and burnout. On the other hand, Srivastava and colleagues (2021) found that noise in the operating theater might have negative effects on surgeons in some settings, while having a calming, soothing effect that decreases anxiety and stress in others.

Although music can interfere with the ability of operating room staff to communicate with one another due to acoustic interference, several studies have found that music increases spatial task performance, which is known as the Mozart effect (Guilbaud & Birnbaum, 2020). One of the most difficult surgeries to perform is laparoscopic surgery, which is time-consuming, costly, and at times inefficient in training settings. However, many studies have found that junior and novice surgeons benefit from music in terms of instrument handling, task performance quality, and time to task completion (Oomens et al., 2019).

The first randomized study that examined the effects of music on surgical performance was completed in 2008. This study sample consisted of 45 junior surgeons who did not have prior laparoscopic experience. The participants conducted virtual surgical procedures while listening to music pieces that varied in intensity and emotional quality. The study found that the group that listened to music had worse performance in the first trial. However, this group improved in surgical performance when they listened to music they considered pleasant (Miskovic et al., 2008).

Oomens and colleagues (2019) used a randomized control trial design to examine the effect of laparoscopic performance in a virtual setting. In addition to measuring performance, the authors also examined music's effect of mental workload among 16 medical students.

Participants who listened to their preferred music performed significantly faster and used the instruments more effectively. In regard to mental workload and situational stress, these factors were significantly lower while listening to music. In support of Oomens et al. (2019), a study by Conrad et al. (2010) demonstrated that relaxing auditory input benefits the accuracy of experts in laparoscopic motor skill performance. Since high levels of anxiety and stress impair surgical performance and increase adverse events, music may be an economical and simple method of improving surgical outcomes.

Problems with Music Listening and Performance

Although the majority of research suggests that music is beneficial to workers, there are also some inconsistencies in these findings. For example, while many studies have shown that music listening reduces errors and improves overall employee productivity (Fox & Embry, 1972; Gatewood, 1921; Kirkpatrick, 1943), some research has shown that music has harmed work performance or produced no effect (Gladstones, 1969; Henderson et al., 1945; Jensen, 1931; Newman et al., 1966). Much of the research is quite outdated; therefore, more information about music listening among workers is necessary.

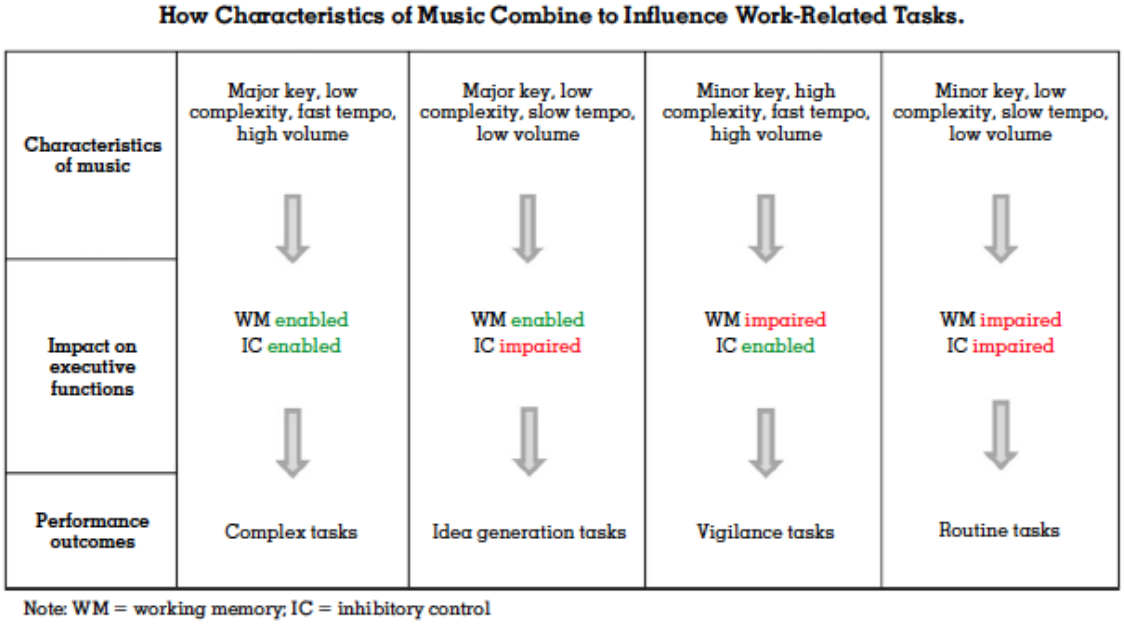
In a recent paper, Keeler and Cortina (2020) argue that, "characteristics of music influence self-regulatory processes- specifically, working memory and inhibitory control- by influencing attentional breadth. Working memory and inhibitory control then affect cognitive and behavioral problems at work" (p. 448). In the authors' analysis, Keeler and Cortina (2020) found that cognitive task load indicates the attention and breadth needed for successful execution, and that, "listening to music with particular characteristics can optimize attentional breadth for a given task; certain characteristics expand or narrow attention (via affect and arousal) and in turn, facilitate or impeded executive functions" (p. 445). The authors take a more

precautionary view of music listening by stating that four types of tasks (idea generation, complex, vigilance/quality control, and executive control demands) are affected by music in different ways.

Specifically, the authors posit four overarching patterns when comparing the type of music to performance outcomes, as seen in Figure 1. First, music with a *major key, low complexity, fast tempo, and high volume* engaged working memory and inhibitory control when workers completed complex tasks. Second, music with a *major key, low complexity, slow tempo, and low volume* enabled working memory and impaired inhibitory control when workers needed to generate ideas for a task. Third, music in a *minor key, high complexity, fast tempo, and high volume setting* impaired working memory and improved inhibitory control. Finally, music in a *minor key, low complexity, slow tempo, and low volume* impaired both working memory and inhibitory control in the context of performing routine tasks (Keeler & Cortina, 2020).

Figure 1

Music Characteristics and Performance Outcomes of Work-Related Tasks



Source: Keeler and Cortina (2020).

The authors state that preference for music and familiarity matter, although their paper focuses on objective characteristics of music. Researchers have found that music characteristics predict familiarity and liking (Cassidy & MacDonald, 2009; Rickard, 2004). For example, preferred music and familiar music can generate feelings of positivity and increased arousal (Huang & Shih, 2011). Keeler and Cortina (2020) argue that this effect may be present because preferred music increases characteristics that induce positive affect, which is music in a major key with low complexity. On the other hand, music that is in a minor key with high complexity induces negative affect and may increase these musical characteristics in the listeners. However, Perham and Sykora (2012) found that listening to disliked music, or least preferred music, can help cognitive performance, as listening to preferred music can be distracting (Huang & Shih, 2011). As such, more research is needed to determine the types of music that may influence performance outcomes in work settings.

Air Traffic Controllers and Stress

Since the September 11 terrorist attacks, there has been a rise in traumatic and crisis experiences among air traffic controllers, which contributes to stress responses and the interaction with potential conflicts (Vogt & Kastner, 2001). However, in order to ensure flight safety of passengers and crew, air traffic controllers must be vigilant, effective, and respond quickly, in a sustainable manner (Angenendt, 2003). Air traffic controllers are of an occupation with high levels of reported stress, which is reflected in their responsibility, existence of high demand work, and work overload. As a consequence, air traffic controllers have been documented to experience upper respiratory infections, disruptions of impulse control, depression, substance use, and hypertension (Mohler, 1983). As such, it is vital to examine the

ways in which air traffic controllers may benefit from stress coping strategies to maintain work efficacy and performance.

Air traffic management systems are evolving in a major restructuring process involving personnel, management, and process architecture and environments. The level of automation as a support tool is one of the main drivers of change in this sector, and is projected to increase (Borghini et al., 2020). Demands associated with air traffic control include mental workload and level of responsibility, while stress is linked to adherence to procedures, and control of the planning and execution of tasks, available time, and team support (Borghini et al., 2020). Performance drops dramatically when mental workload decreases or increases at high levels. Only at certain levels of stress are air traffic controllers able to maintain a proper level of engagement and thus high-performance levels (Borghini et al., 2020).

Mental Workload

Stress is considered a component of mental workload. Borghini and colleagues (2020) note that productivity can occur not only when mental workload is high, but also when it is low because of effects of isolation and monotony. The authors describe low stress conditions as those leading to processing unfamiliar information or complex procedures without any time constraints as another factor of low productivity. As such, these findings suggest that ensuring that the air traffic controller is not affected by isolation and monotony, perhaps by providing a palliative coping technique such as music listening (Hanser, 1985), is important for optimal productivity.

Music as a Coping Strategy

Music is considered a palliative coping approach wherein the internal psychological strategies are enhanced to reduce tension and distress (Hanser, 1985). Alternative methods to reduce stress in a workplace setting include increasing one’s coping ability, behavioral

responses, and physiological responses, as well as decreasing work demands (Muchinsky, 1990). However, listening to music has been shown to be a moderator of stress and resilience, and has the ability to significantly increase coping and social integration; as such, it can be argued that music is a palliative coping medium that may increase other coping capacities (Robb, 2000).

State anxiety is a psychological manifestation of stress, which is an "unpleasant emotional experience, a transitory emotional condition or feeling state that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity" (Lesiuk, 2008, p. 2). Music treatment techniques include guided imagery, music listening, and progressive muscle relaxation to music (Robb, 2000), wherein music may reduce and prevent anxiety. While it may be tempting to characterize music as having a sedative role in the mitigation of stress and anxiety, neuropsychological research has showed that it allows for better processing of emotional responses (Trainor & Schmidt, 2003).

In terms of music's effectiveness in air traffic controller productivity and performance, this subject warrants further examination of trauma in air traffic controllers; the experience of trauma and crisis has increased since the September 11 terrorist attacks, which contributes to an increase in stress responses and corresponding interactions with potential work-related conflicts (Vogt & Kastner, 2001). However, there is no clear research on trauma on air traffic controller productivity in the literature. As such, it is beneficial to understand the effects of music on trauma that may affect this population through the investigation of music in other populations.

On a neurophysiological level, one of the key drivers of music's success on a therapeutic level is its focus on neuroplasticity, which occurs as the brain begins to reset as a consequence of trauma or brain injury (Herholz & Zatorre, 2012; Kraus & Chandraskeran, 2010; Schlaug, 2001). For example, in the event of a brain injury, when the individual experiences disruptions in

multiple brain regions associated with PTSD, this can lead to a deactivation of the Broca's speech area, and an increased activation in the amygdala that leads to anxiety and fear. As such, these patients may have problems in expressing these symptoms verbally, while experiencing unanticipated reactions to the environment. Music therapy can bring awareness to these neurobiological processes to understand the patient's expression and avoid cyclical traumatization such as that associated with auditory stimuli (Benismon et al., 2008).

Music therapy is usually not capable of providing a global treatment when there is damage to multiple neural circuits; although, music therapy does have a robust effect on the rebuilding of connections between different brain regions and neural networks (Sihvonen, et al., 2017). Through research studies regarding music therapy on the brain, it is widely accepted that music can increase neuroplasticity. For example, the brains of musicians exhibit unique abilities and structural differences in comparison to non-musicians, which align with the functional application of music therapy in the context of neuroplasticity (Herholz & Zatorre, 2012; Kraus & Chandraskeran, 2010; Schlaug, 2001).

Therefore, in the area of neurorehabilitation, the adoption of music can be seen as a forceful agent of change that improves neurologic impairment following trauma by its ability to engage multiple neural networks and capitalize on brain plasticity (Sarkamo et al., 2016). Studies using fMRI have shown that music therapy increases dopamine, which in turns increases motivation, learning, and behaviors that are associated with awards. As such, music can be used to provide an augmented learning environment where individuals can rebuild damaged neural circuits simultaneously with the presence of activated dopaminergic neurons.

Air Traffic Controller Performance

Since automation in civil aviation and air traffic management systems evolve to become increasingly more complex with the rise of automation, air traffic controllers must become adaptable and engage in greater control and coordination. There is often a sense of "loss of control". In order to manage control, Hollnagel and Woods (2005) developed the Extended Control Model, which describes functional air traffic control. In order to maintain control, the air traffic controller must:

1. Maintain control of actions
2. Transfer control
3. Coordinate
4. Choose new models of functioning and recovery when control breaks down

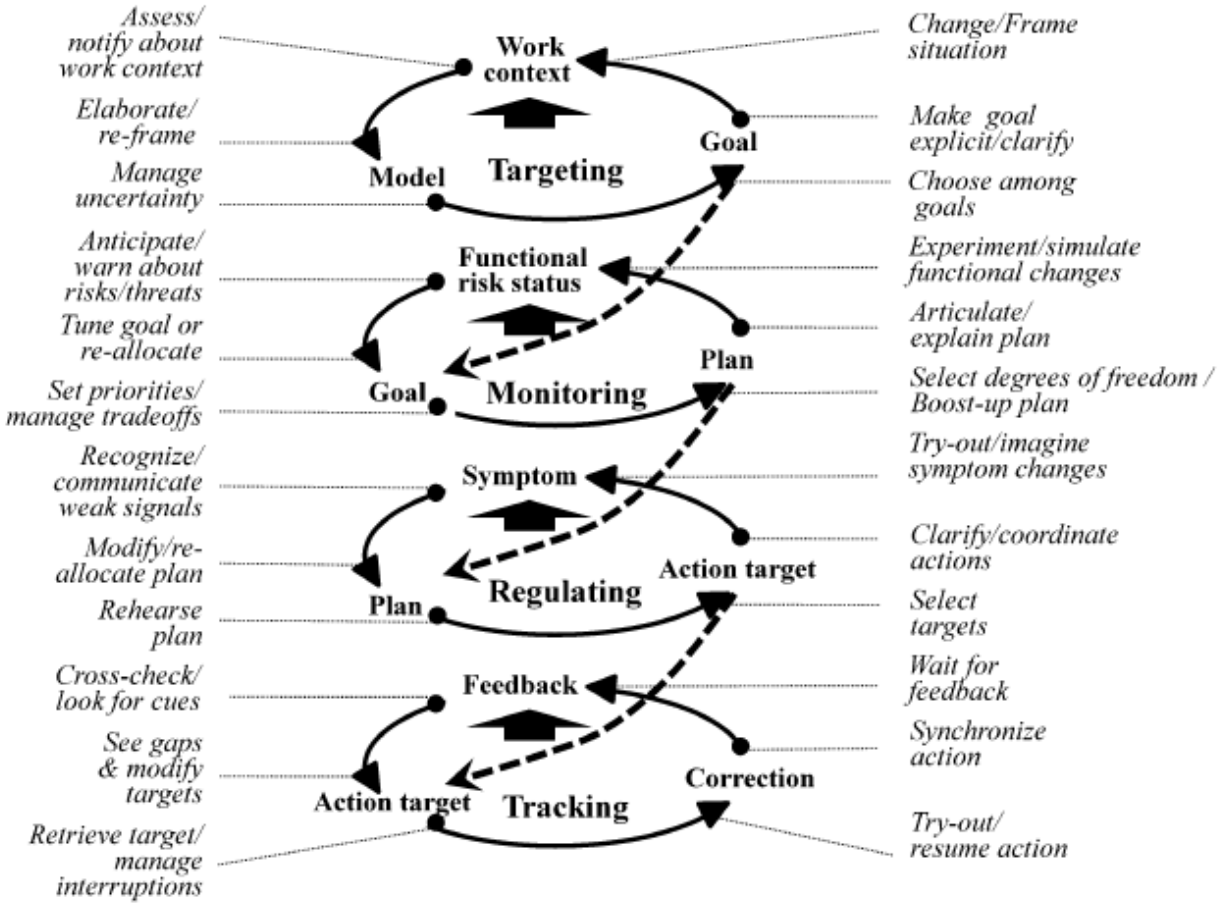
Transfer of control occurs within the same individual for different work demands and between other individuals at shift handover and cross-sector coordination. This includes vertical transfer of control, wherein the air traffic controller must transfer from one loop to another in sync with the changing demands and constraints. In horizontal transfer, this takes the form of transferring between shifts of different controllers and automation, as well as adjacent teams (Parke & Mishkin, 2005).

Another aspect of transfer of control is observability and transparency to others in which the air traffic controller must ensure that the responsibility for different tasks is transferred in an unambiguous way, such as setting fixed coordination points. The final aspect of transfer of control is the stages and duration of handover, which include not only verbal updates but also the use of paperwork such as records of handwritten logs, and the tracking of events and flight plans throughout the day. As such, incoming individuals may have to arrive earlier to get the most

updated information prior to transfer of control (D'Arcy & Della Rocco, 2001). Control strategies are shown in Figure 2.

Figure 2

Control and Coordination



Source: Kontogiannis and Malakis (2013).

Loop failures occur within a pattern of loss of control in which the air traffic controller exhibits difficulties in performing the control strategies to support each loop. One example is when air traffic controllers do not have the capacity to act fast enough to prevent unexpected events in the early phases of the disruption (Kontogiannis & Malakis, 2013). This may be

associated with weak signals that go undetected, which leads to increasing threats without anticipation for controlling them.

Another example is how air traffic controllers may have difficulty assessing how a complex plan may be carried out in the future, and corresponding challenges. The authors note that some processes meant to simplify control actually increases disruption, as oversimplification can lead practitioners to generalize the conditions in contexts of variability and critical dissimilarities.

> According to Kontogiannis and Malakis (2013), adaptation failures occur when:
>
> …the difficulties in adapting modes of functioning and recovery when control breaks down…Adaptability can be seen as the ability of practitioners to match their modes of functioning to different contexts of work. Modes of functioning can be seen as a space of fundamental trade-offs such as efficiency-thoroughness, feedforward-feedback control, centralization-local control improvisation, [and] implicit-explicit coordination (p. 165).

These adaptation failures may not be able to couple between upcoming tasks. Tightly coupled tasks align well with efficiency, but allow for little adaptation for absorbing dysfunction or disturbances and revision of plans. Kontogiannis and Malakis (2013) describe that in high tempo contexts, air traffic controllers must "switch to more modular or loose plans that afford more opportunities for recovery (e.g., more redundancies, more options, and more time to recover)" (p. 166). This has also been supported by Orasanu (1993), who summarized findings that there was a positive correlation between captains' communication aims and team performance, more than communications in high tempo situations. Therefore, air traffic

controllers must assess how "margins of maneuver" fluctuate in relation to surprises and uncertainties (Kontogiannis & Malakis, 2013).

> According to Kontogiannis and Malakis (2013), maintaining control is broader than: …keeping key parameters within limits to manage cognitive functions such as monitoring progress in the face of situational changes…[Air traffic controllers] have to coordinate in order to build a shared understanding, align their goals across different roles, and see how others progress to maintain control within their cope of authority (p. 163).

The authors conclude that air traffic controllers must maintain control of regulating, tracking, monitoring, and targeting. Furthermore, they must be vigilant about transfer of control to sustain loops and adapt to work demands between different practitioners during handovers. Air traffic controllers must coordinate different relationships between practitioners in which goals and information share boundaries. Finally, practitioners must readily adapt between modes of functioning and recovery when experiencing a loss of control. Strategies to diminish "loss of control events" are needed in order to mitigate these occurrences (Hollnagel, 2003).

Direct Effects of Music on Stress in Air Traffic Controllers

Lesiuk (2008) found that music listening decreased psychological anxiety, but not physiological markers of anxiety such as heart rate and mean arterial pressure. However, Lesiuk also found that sitting in silence also produced this same effect in air traffic controllers, which may be associated with an increase in mindfulness (Lesiuk, 2008). Additionally, the format of the study did not allow the participants to select their preferred music, so it is possible that the type of music in the context of stress reduction would produce alternative effects (Lesiuk 2005; Lesiuk 2008; Lesiuk 2010). In terms of enjoyment, air traffic controllers indicated that listening

to preferred music was as enjoyable as the implementation of an alternative stress reduction technique. As such, it would be valuable for research to further elucidate the role that preferred music plays in reducing stress and anxiety in air traffic controllers.

Borghini et al. (2020) characterize boredom associated with low levels of activity as detrimental to productivity in air traffic controllers. As such, one gap in the literature may include whether music can mitigate these decreases in productivity associated with contexts of low mental workload, in which there are no time constraints to solve complex problems.

Lesiuk (2008) found that air traffic controllers with the combination of high-trait anxiety and introversion only slightly decrease their states of anxiety, with no sustained decrease over time. On the other hand, those with high-trait anxiety and extraversion, low-trait anxiety with introversion, and low-trait anxiety with extraversion experience significantly lower stress after music listening and sitting in silence conditions. As such, the researcher concludes that introverts are more productive and suited for relaxed work environments, because their response to stress in the presence of high intensity stress associated with air traffic can create a stress cycle without any amelioration (Lesiuk, 2008).

However, when Lesiuk (2008) measured physiological markers of stress, such as heart rate and mean arterial pressure, no differences between groups were found. As such, it may be possible that introverts are simply more accurate at indicating their stress state in the self-report questionnaires. This may be possible since objective physiological markers were comparable between introverts and extroverts (Lesiuk, 2008), and the presence of stress has been shown to persist right after the stressor is terminated in air traffic controllers, while individuals are simultaneously not consciously aware of the stress (Borghini, 2020). Therefore, the author’s

conclusion that introverted air traffic controllers experience higher levels of stress, which implies lower performance, should be further examined.

Specifically, performance tests should better investigate these two groups in the context of additional neurophysiological markers and a greater breadth of self-report questionnaires to elucidate this paradigm. It may be further warranted to vary the mood of the music to be happy or sad to examine whether there is a difference in low mood mitigation. Since Levitin and Tirovolas (2009) note that sad music is more beneficial for those experiencing depressive emotions, this type of music may be more beneficial to air traffic controllers during stressful events.

Since emotional intelligence has also been shown to positively affect work-related decision-making, emotional affect control strategies of workers in high cognitive demand jobs may focus on honing their positive affect. Furthermore, the use of music therapists can help engage positive affect wherein the employee is more aware and able to identify their mood states to assist in developing and identifying positive mood (Lesiuk, 2010).

Employers of air traffic controllers can implement the use of music therapists to progress this affective process and increase cognitions associated with higher performance. However, air traffic controllers have been barred from listening to music on the operational floor between the hours of 6 AM to 10 PM. As such, it may be beneficial for employers to implement music therapy during periods of time wherein the worker is not in the immediate space of air traffic control. A gap in the literature on music therapy among air traffic controllers persists, and it would be beneficial for future research to focus on the timing of music listening in this population, and whether off-hours music therapy can circumvent the structural policies that prevent potential positive effects of music listening on the job.

Associations between Air Traffic Controller Stress, Performance, and Music

The purpose of this review is to understand the relationship between productivity and performance of air traffic controllers and music listening, how the situational demands of this occupation coincides with stressful experiences, and how music listening may affect stress levels in this population. The physical and mental state derived from stress can affect work performance, wherein there is a disconnect between a practitioner's expectations and the reality of the occupational outcomes and contexts (Shaufeli & Buunk, 1996). Situational awareness is more identifiable in certain individuals who have greater capacity for working memory, divided attention, spatial reasoning, and spatial working memory in an aviation context (Durso & Sethumdhaven, 2008).

However, air traffic control has been classified as the fourth most stressful occupation (U.S. Bureau of Labor Statistics, 2010), which can lead to psychophysiological responses when there are changes in workload in air traffic control environments (Brookings, 1996). Human factors such as situational awareness requires multiple domains that interact with workload history and task performance (Durso & Sethumadhaven, 2008). Since the September 11 attacks, air traffic controllers have experienced an increase of trauma and crises experiences (Vogt & Kastner, 2001), which should be further investigated by researchers.

Specifically, understanding clear connections between trauma therapy and stress may be helpful in this domain, as trauma therapy has been shown to be very effective in trauma patients. Although music therapy does not provide an overall treatment of trauma, music therapy does have a robust effect on the rebuilding of connections between different brain regions and neural networks through neuroplasticity in the brain (Sihvonen, et al., 2017).

Additionally, air traffic controllers often underestimate their levels of stress, due to the sustained effects of cortisol versus the immediate release of electrical activity following the termination of a stressful event (Borghini et al., 2020). Although Lesiuk (2008) stressed that introverted individuals were much more likely to report increased levels of stress in the face of environmental occupational pressure, the author found that levels of physiological activity were constant between extroverts and introverts. As such, although the current literature on air traffic controllers demonstrates that introverts experience higher levels of stress, it is possible that since stress persists after the termination of the stressful event due to lingering cortisol levels. Because physiological-related stress activity was constant in both groups, introverts may simply be more precise at determining their actual levels of stress.

Problem Statement

The literature on music and work performance has produced inconsistent results, which motivates a new study to further examine its utility in air traffic control settings. Whether music is helpful or not in these settings does not contradict the fact that music is being used in aviation settings through my informed observations. Lesiuk (2008) found that music listening among air traffic controllers decreased psychological anxiety, but not the physiological responses to anxiety such as heart rate and mean arterial pressure. Interestingly, there were no significant differences in implementing a music listening intervention versus a sitting in silence intervention to mitigate stress in air traffic controllers. This suggests that multiple forms of auditory treatment may aid stress in this population. Since 2006, air traffic controllers have been prohibited from listening to music while working live air traffic on the operational control floor. Slight amelioration occurred in 2016 when the FAA conceded, permitting music listening on the control floor on the Mid Shift, between the hours of 10 PM to 6 AM (Federal Aviation Administration, 2016). As such

this elucidation may provide more context to the modes of therapeutic interventions that may be effective in this group within these restrictions.

Since structural policies prevent air traffic controllers from listening to music, employers may weigh the benefits of implementing a music therapy intervention or a sitting in silence intervention outside of hours worked. However, further research is needed to demonstrate whether these interventions would improve efficacy and performance among air traffic controllers. Sitting in silence may provide a helpful alternative to the constraints on music listening in air traffic controllers because sitting in silence may be associated with an increase in mindfulness (Lesiuk, 2008). This may allow the practitioner to become more fully aware of one's affective state, which may lead one to turn to coping mechanisms that may increase positive affect.

Purpose

Since the effects of music and air traffic controller performance are still relatively inconclusive, it is beneficial to investigate music listening as a way to increase affective states in air traffic controllers; affective states are associated with greater performance and stress reduction, which increases cognitive resources to maintain hyper-vigilance, and perform effective environmental information processing at a steady, unhurried pace. This research examined three key questions that need to be assessed among air traffic controllers. First, this research attempted to answer, "What is the relationship between air traffic controller performance and music listening?" from the perspectives of air traffic controllers. Second, this paper asked, "What is the relationship between stress levels and music listening among air traffic controllers?" from the perspectives of this population. Last, this research examined whether music listening should be considered an ethical and effective solution to improve emotional and

physiological outcomes. In elucidating these questions, federal policy makers may be better informed in ways to improve emotional and physiological outcomes as well as work performance among air traffic controllers.

Summary

Air traffic control has been shown to be the fourth most stressful occupation in the United States (Federal Bureau of Labor Statistics, 2010). Robust research findings have shown that air traffic control requires a great sense of situational awareness, sustained attention, and vigilance in order to carry out required tasks, such as controlled transfer of communication (Kontogiannis & Malakis, 2013). As such, it is imperative to offer interventions that may increase the ability to manage mental workload and stress in order to mitigate these effects and increase performance capacity (Lesiuk, 2005; 2008; 2010). Music listening may be an appropriate intervention that is provided at no cost, and is non-invasive (Rastipisheh et al., 2019). As such, this research aims to build upon previous findings, and identify how air traffic controllers perceive music to be functional during their work within federally instructed constraints and stress (Federal Aviation Administration, 2016). The next chapter describes the methodological procedures to fulfill this task.

CHAPTER 2

Methodology

This chapter outlines the methodological procedures used in the current study. This study used a mixed methods design (qualitative, quantitative) that examines the functionalities attributed to music from the perspectives of air traffic controllers. Empirical data were gathered about participants' music listening during work, including the amount of time spent listening to music. Using a four-point Likert scale, participants were asked to provide the extent to which they agreed with statements about music listening. This research also used a qualitative methodology by asking participants about their views on whether they consider music listening to be an important ethical concern in regards to their mental and physical health. The study examined music functionality in air traffic controllers based on the study by Haake (2011). Specifically, this research asked:

1. What is the relationship between air traffic controller perceptions and music listening?
2. What is the relationship between air traffic controller stress level and music listening?
3. Should music listening be considered an ethical and/or effective solution to improve emotional and physiological outcomes among air traffic controllers?

Participants

This study consisted of 268 participants who were currently working, have previously worked, or have retired as air traffic controllers. Participants qualified for this study if they were

over the age of 18. The types of air traffic controllers that were studied included: (a) Federal Aviation Administration (FAA) Air Traffic Controllers; (b) Federal Contract Tower (FCT) Air Traffic Controllers; (c) Department of Defense (DOD) Air Traffic Controllers; (d) U.S. Military (all branches). Air Traffic Controllers employed in all 50 states and US territories (such as Guam, Saipan, Puerto Rico) were eligible for participation.

Recruitment

Participants were recruited through digital flyers and a recruitment video posted on social media websites related to air traffic control, including Facebook groups and ATC-related discussion forums. The flyer described the purpose and nature of the study, inclusion criteria, an option to participate located on the survey landing page, study link, and the researcher's contact information. The researcher used a study email address for written communications, along with email and phone contact information of the researcher's thesis committee.

Sampling

The sample was obtained through purposive sampling. Purposive sampling is widely used in qualitative research in order to obtain information that is directly related to the specific phenomena of importance (Palinkas et al., 2015). The current study used a mixed-methods design that included qualitative research about the experiences of air traffic controllers and their music listening habits. In order to ensure that all participants were air traffic controllers, it was beneficial to use purposive sampling.

Survey Questionnaire

Participation

This survey study gathered empirical and qualitative data in late September and early October of 2022. The electronic survey was hosted on Qualtrics. Study participants were notified

of the survey through a flyer posted on social media websites such as Facebook groups for air traffic controllers and discussion board forums for air traffic controllers. The study began data collection after the approval of the University of North Dakota Institutional Review Board (IRB). In order to meet the requirements of the IRB, the researcher ensured that the benefits of the research outweighed the risks of participation in the study. For example, the researcher ensured that any risks associated with asking participants questions related to their stress levels did not cause emotional harm that may outweigh the benefits of the study.

Before the participant began the study, they selected an option on a pop-up that indicated that they consent to participate. The pop-up provided a brief description about the purpose of the study and indicated any potential risks of participation. If the participant clicked on the option, they were forwarded to a survey about the topic of music listening in the workplace. The consent form indicated that the survey would take approximately 10 to 15 minutes to complete, and they had the option to be entered into a raffle in which the researcher would randomly select three participants to receive digital VISA gift cards ($100 each) at random.

Survey Contents

The quantitative survey had multiple responses on Likert-style scales. The participants were asked about demographic information, including their age, gender, years on the job, and level of education. The survey included both quantitative and qualitative questions. Quantitative data were gathered on a survey data that asked for information about:

- Occupations
- Functionality of music
- Performance

- Perceptions about Federal Aviation Administration rules (Air traffic and associated work related)
- Workload
- Levels of perceived stress
- Amount of time listening to music while working per week
- Concurrent activities while listening to music
- Listening technologies
- Choices about music selection
- Hours worked

The qualitative questions asked participants about:

- Music preferences at work
- The functionality of music
- Reasons why one would and would not listen to music
- Whether music should be allowed
- Perceptions about ethical topics
- Any other comments about music listening

The survey is shown in the Appendix.

Protection of Participants

The survey was carried out in accordance with the Institutional Review Board (IRB) of the University of North Dakota to uphold its ethical principles and guidelines for research. Participants were provided with study information online that detailed the purpose of the study, confidentiality policy, and withdrawal policy. The survey did not contain any questions that asked the participants to provide any personally identifiable information (PII), such as name or

contact details. Instead, participants were assigned a pseudonym (P1, P2, etc.) that contained the number, gender, age-group, and occupation details, as shown in the Appendix. Participants were told that they are free to skip any survey questions or withdraw from the study at any time.

The risks of participation were minimal, in that they did not exceed risks associated with normal day-to-day activities. It is possible that participants were hesitant or felt discomfort about answering questions about stress. To mitigate this possible risk, the researcher provided participants with contact information of a mental health organization that specializes in providing support to aviation professionals.

Any information transmitted over the internet is at risk for data breaches. Risks associated with confidentiality and privacy were minimized by taking precautions to ensure confidential data management through Qualtrics. Specifically, the researcher did not collect any personally identifying information, and all study data were to be stored on a password-protected computer over a secure server for three years after the completion of the study.

Analysis

This study used a mixed methods approach, which aligns with previously conducted research on music preferences among employees of specific occupations (Haake, 2011). The quantitative data was exported onto SPSS 28; the empirical analyses consisted of frequency, correlation, descriptive, and regression analyses. Qualitative data were examined through inductive reasoning to identify units of code that were labeled, categorized, and developed into theories.

Data were analyzed using generic qualitative inquiry as outlined by Percy et al. (2015). Generic qualitative inquiry describes and explores perceptions and experiences of real-world phenomena. It was advantageous to use generic qualitative inquiry for the current study because

it allows the researcher to focus on the subjective nature of described opinions, perceptions, and real-world components of experience. This methodology attempts to set aside preconceived biases and assumptions about responses to a particular situation, along with human feelings and experiences (Percy et al., 2015)

The process of inductive analysis is described in 12 steps according to Percy et al. (2015):

1. Reading and highlighting words, sentences and paragraphs that appear to be related to research questions
2. Deciding whether highlighted segments are related to research questions
3. Eliminating highlighted segments that do not appear to be related to research questions
4. Coding data units into discrete labels
5. Organizing coded data units into clusters to identify patterns
6. Identifying quotes from responses that align with patterns
7. Examining found themes or "patterns of patterns"
8. Creating a thematic matrix in which codes, descriptions, patterns, and clusters are categorized into certain themes
9. Formulating an "abstract analysis" among participants
10. Corresponding an "abstract analysis" for each participant
11. Forming cumulative analysis of data among participants
12. Synthesizing themes into a composite synthesis to aid in answering research questions

The researcher also presented the findings with facilitation of triangulation analysis. Using triangulation analysis, both the quantitative and qualitative sources of data may be

converged to provide an overall synthesis of the results and provide validation of both the quantitative and qualitative findings (Carter et al., 2014). Triangulation was used to identify thoughts, opinions, feelings, and attitudes about music listening; an air traffic controller can better inform the ways in which music could possibly be used as a tool to manage stress, and whether air traffic controllers perceive music to be a helpful and ethical intervention for stress reduction and performance capability.

Reliability and Validity

According to Louangrath (2018), empirical evidence shows Likert scales are highly reliable, with the cutoff for high reliability being 80%. The current study used a Likert-like scale. Specifically, the four-point Likert-type scale (1, 2, 3, 4) showed reliabilities of 92% according to this study (Louangrath, 2018). Therefore, the empirical portion of this study was based on evidence that Likert scales are reliable and valid. The questionnaire was also a modified version of a survey that was done on professionals to assess workplace music listening habits (Haake, 2011). However, the current study modified the questions to be relevant to air traffic controllers. The purpose of the prior study was to examine music listening in workplace settings in the United Kingdom (Haake, 2011). As there are very few music listening surveys pertaining to the workplace, the current research uses this previously published study that examined how employees managed their music listening practices and perceived the benefits of listening to music.

Summary

This study used a mixed-methods approach for data collection and analysis. The researcher examined 268 air traffic controllers in the United States, employed in all 50 states and US territories such as Guam, Saipan, and Puerto Rico. Purposeful sampling was used to recruit

participants out of a population of approximately 15,500 air traffic controllers. A survey with both qualitative and quantitative questions examined participants' demographics, and views about stress, music listening perceptions, and ethics topics. The quantitative analysis used statistical methods by analyzing the Likert-like responses, while the qualitative responses were analyzed through generic qualitative inquiry. The next chapter will detail the results of the analyses.

CHAPTER 3

Results

This chapter is organized into six sections. Sections 1 and 2 describe the descriptive statistics of the participants and descriptive analyses of the demographic and outcome variables. Section 3 explains the factor analysis for the Music Listening and Performance scale. In section 4, the parametric assumptions and correlations of the independent and dependent variables are defined. Section 5 reports the regression analyses corresponding with the factor analysis. Finally, section 6 describes the thematic interpretation of qualitative results.

Participant Demographics and Background Characteristics

Participants were 268 air traffic controllers recruited through purposive sampling through an online flyer in the United States. The sample included 218 males (81.3%) and 27 females (10.1%), with two participants who chose not to disclose their gender. The average age of the participants was approximately 35 years. Nineteen percent of participants were aged 25 or younger; one participant was aged 19-20, while 18% of participants were aged 21-25.

The participants were included in the study if they were a current or former air traffic controllers in the United States or United States territories. A small segment of participants were between the ages of 18 and 25 (7.69%); one participant was aged 18-20 (.40%), while 18 participants were aged 21-25 (7.29%). Of the total sample, 77.74% of participants were between the ages of 26 and 45, 51 (20.65%) participants were aged 26-30, 67 (27.13%) participants were aged 31-35, 48 (19.43%) participants were aged 46-40, and 26 (10.53%) participants were aged 41-45. Of the oldest age groups, 13.35% of participants were aged 46 or above; 5 (2.02%) were

between the ages of 46-50, 4 (1.62%) were aged 51-55, 9 (3.64%) were aged 56-60, 8 (3.24%) were aged 61-65, 7 (2.83%) were aged 66-70, and 3 (1.21%) were aged 71 and above.

The participants reported a range of education levels. Forty-six (18.62%) had 12 years of schooling (high school), 182 (73.68%) had 12-16 years of schooling (college), and 19 had 17 or more years of schooling (graduate school). The respondents had a minimum of one year experience as an air traffic controller, out of 250 who reported their years of experience. Sixty-nine (27.60%) had 1 to 5 years of experience. The majority of participants had 6 to 20 years of experience; 66 (26.4%) had 6 to 10 years of experience, 55 (22%) had 11 to 15 years of experience, and 21 (8.40%) had 16 to 20 years of experience. Of the most experienced air traffic controllers, 32.6 % had 21 or more years of experience; 17 (6.80%) had 21 to 25 years of experience; 8 (3.20%) had 26 to 30 years of experience, 8 (3.20%) had 31 to 35 years of experience, and 2 (.80%) had 41 or more years of experience.

The participants were asked to report all the types of air traffic control facilities they have worked in. There were 117 (28.40%) of participants who worked in an Air Traffic Control Tower (ATCT), 70 (19.17%) who worked in an Air Route Traffic Control Center (ARTCC), 89 (21.60%) who worked in Terminal Radar Approach Control (TRACON/RAPCON), 117 (28.40%) who worked in Combined Tower with TRACON (Up/Down) or TRACAB, and 10 (2.43%) who worked in Traffic Management Coordination (TMU/ATCSCC). Finally, respondents indicated that they currently or formerly worked within several different ATC operational categories. Fifty (16.61%) participants indicated that they currently or formerly worked in the U.S. Military (all branches) as an air traffic controller. Thirteen (4.32%) indicated having current or former experience as a Federal Contract Tower (FCT) air traffic controller. The most common type of operational category was Federal Aviation Administration (FAA) air

traffic controller with 228 participants (75.75%), and 10 (3.32%) had worked in the Department of Defense (DOD) as an air traffic controller.

Results of Factor Analysis for Music-Related Performance Scale

An exploratory factor analysis was conducted on items related to work performance and music listening (Table 1). The researcher used Principal Axis Factoring with Direct Oblimin rotation. Participants were asked to rate the extent they agreed to 13 statements on a Likert-like scale. Specifically, the responses indicated the extent they agreed to the statements: (1) Listening to music at work improves my focus; (2) Helps me relax; (3) Improves my mood; (4) Makes me less bored; (5) Distracts me from unwanted thoughts; (6) Blocks out surrounding noise; (7) Makes me less tired; (8) Makes me happier; (9) Helps my creative flow; (10) Inspires/stimulates me; (11) Provides a different perspective; (12) Helps me pace my work; (13) Creates a suitable atmosphere. The iterations that were accepted loaded onto the factor matrix (Table 1). A factor analysis showed that all 13 items had factor loadings over .50. The Eigenvalue was 7.798, which explained 59.981% of the variance in the model. A reliability analysis among the 13 items produced a Cronbach's alpha of .941, which indicates high reliability. As such, it is likely that all the items on this scale measure the same construct.

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to evaluate the factorability of used items. This measure indicates to what extent a correlation matrix contains factors or a simple chance correlation between a small set of variables (Worthington & Whittaker, 2006). The overall Kaiser-Meyer-Olkin (KMO) measure was 0.934 with individual KMO measures all greater than 0.6; these were classifications of acceptable according to Kaiser (1974). Bartlett's test of sphericity was statistically significant ($p < .001$), indicating that the data was suitable for the factor analysis. A scree plot of factors was derived from the 13-item scale,

wherein the elbow appeared to be located at the second factor; this corresponds with the specified one dimension of the outcome variable for Music-Related Performance, so one extracted factor was retained. The survey contained 13 items related to Music-Related Performance and they all loaded appropriately without need for reductions.

Table 1

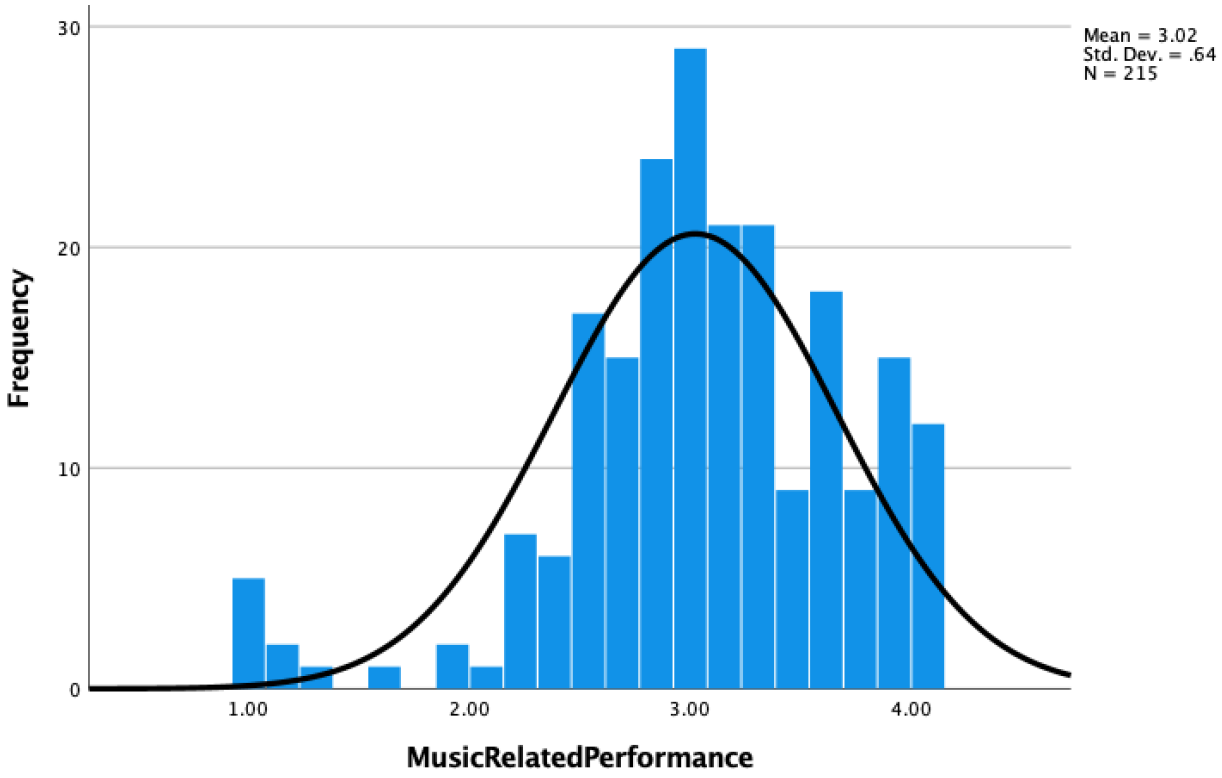
Factor Analysis for Music-Related Performance

Items	Factor 1	Mean	SD
Focus	.753	2.81	.894
Relax	.814	3.29	.749
Mood	.779	3.37	.723
Bored	.785	3.38	.739
Thoughts	.704	2.91	.876
Noise	.508	2.93	.930
Tired	.764	2.89	.886
Happier	.814	3.29	.751
Creative	.814	3.00	.815
Inspires	.832	3.08	.844
Perspective	.662	2.57	.898
Pace	.734	2.63	.923
Atmosphere	.777	3.13	.835
Eigenvalue	7.798		
% Variance	59.981		
Alpha	.941		

The factor analysis produced a scale used as the dependent variable, Music-Related Performance. The mean was 3.01 (*SD* = .64). This scale had a skew of -.874, and a kurtosis of 1.441. This indicates that the scale is moderately skewed (Figure 3).

Figure 3

Histogram of the Distribution of the Frequency Distribution for Music-Related Performance



Preliminary Analyses for Linear Regressions

To analyze normality of predictor and outcome variables, kurtosis and skewness were examined. The independent predictor variables included: (1) Music Listening Status; (2) Time Listening; (3) Reported Performance; (4) Music Permissibility; (5) Oversight Responsibility; (6) Preferred Music Listening Frequency; (7) Oversight Assessment; (8) Stress in ATC. Most independent variables were based on individual items that were measured on a four-point Likert-like scale: (1) Strongly Disagree (2) Disagree; (3) Agree; (4) Strongly Agree. The minimum of the four-point items on the survey was 1, while the maximum was 4. However, the Time Listening item was measured on a nine-point scale: (1) 0-5 hours; (2) 6-10 hours; (3) 11-15 hours; (4) 16-20 hours; (5) 21-25 hours; (6) 26-30 hours; (7) 31-35 hours; (8) 36-40 hours; (9)

41+ hours. The Preferred Music Listening item was measured on a five-point scale, with (1) Never; (2) Sometimes; (3) About half the time; (4) Most of the time; (5) Always.

Histograms were created to offer visualizations that depict the symmetry of each factor (Figures 4-11). For the Music Listening Status predictor, this variable was normally distributed (*M* = 2.04, *SD* = 01.137) (Figure 4). For Time Listening, the distribution was highly skewed and not normally distributed (*M* = 1.64, *SD* = 1.449) (Figure 5). The Reported Performance variable was normally distributed (*M* = 2.75, *SD* = 1.047) (Figure 6). For Music Permissibility, the distribution was moderately skewed (*M* = 3.14, *SD* = .986) (Figure 7). For Oversight Responsibility, the distribution was highly skewed and not normally distributed (*M* = 3.63, *SD* = .701) (Figure 8). Preferred Music Listening Frequency was moderately skewed (*M* = 2.60, *SD* = 1.202) (Figure 9). For Oversight Assessment, the distribution was highly skewed (*M* = 1.60, *SD* = .784) (Figure 10). The outcome variable of Stress in ATC was slightly skewed (*M* = 2.94, *SD* = .649) (Figure 11). The skewness and kurtosis for the predictor variables are shown in Table 2. Means, standard deviations, range, bivariate correlations, and Cronbach's alphas of predictor and dependent variables are shown in Table 3.

Table 2

Skewness and Kurtosis of Predictor Variables

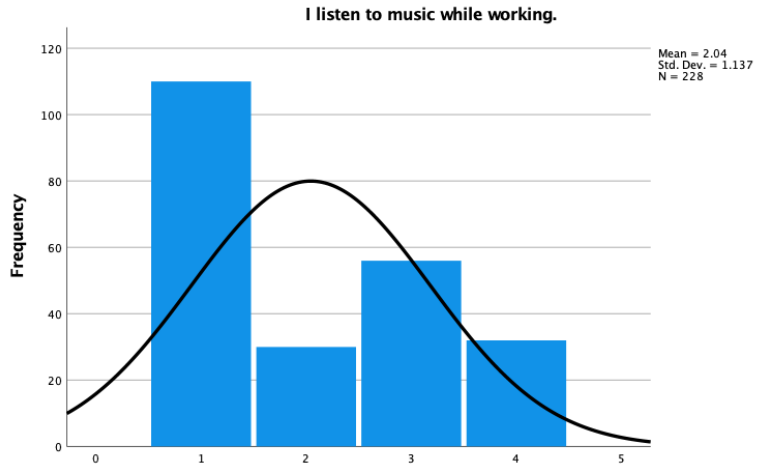
Variable	Mean (SD)	Skewness	Kurtosis
Music Listening Status	2.04 (1.137)	-.494	-1.293
Time Listening	1.64 (1.449)	2.933	9.019
Reported Performance	2.75 (1.047)	-.524	-.891
Music Permissibility	3.14 (.986)	-.881	-.326
Oversight Responsibility	3.63 (.701)	-2.208	4.882
Preferred Listening Freq	2.60 (1.202)	.439	-.943
Oversight Assessment	1.60 (.784)	1.152	.563
Stress in ATC	2.94 (.649)	-.569	-1.109

An absolute skew value that is greater than 1 means the data is highly skewed and not normally distributed. If the absolute skew value is between 1 and 0.5, the data is moderately skewed (Hair et al., 2010). An absolute kurtosis value that is greater than 2 represents non-normal distribution (Hair et al., 2010). Therefore, Time Listening, Music Permissibility, Oversight Assessment, and Stress in ATC were not normally distributed. The key to account for non-normality of this variable was to use bootstrapping in the following regressions. Bootstrapping is a nonparametric technique that is less dependent on symmetrical sampling and normal distributions, and is the best fit compared to standard parametric analyses (Preacher & Hayes, 2008).

Figure 4 depicts the histogram for the Music Listening Status scores. Participants rated the extent to which they agreed that they listened to music while working, and the results were normally distributed.

Figure 4

Histogram of the Frequency Distribution of Music Listening Status Scores



The frequency distribution of Time Listening scores is shown in Figure 5. Participants reported how much time they listened to music, resulting in an abnormal distribution.

Figure 5

Histogram of the Frequency Distribution of Time Listening Scores

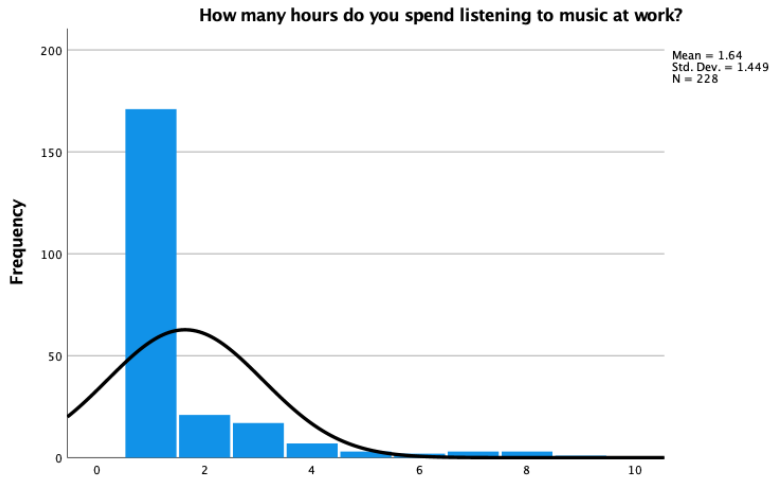
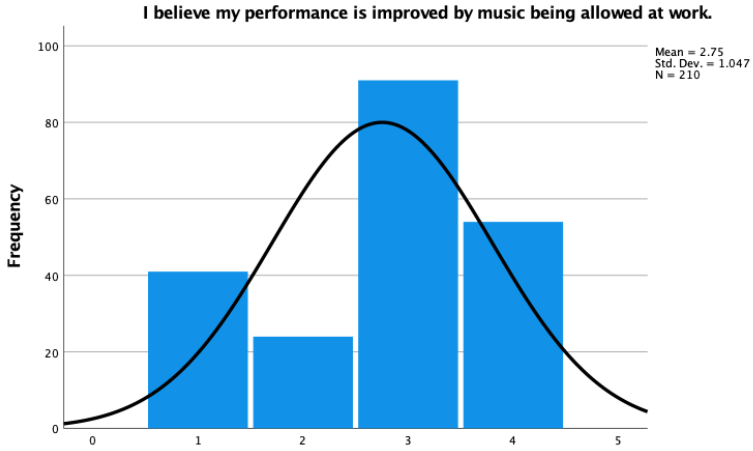


Figure 6 depicts the histogram for Reported Performance; participants rated the extent to which they believe that their performance was improved, resulting in a normal distribution.

Figure 6

Histogram of the Frequency Distribution of Reported Performance Scores



The frequency distribution for Music Permissibility is shown in Figure 7. Air traffic controllers reported the extent to which they agreed that music should be allowed, resulting in a moderately skewed distribution.

Figure 7

Histogram of the Frequency Distribution of Music Permissibility Scores

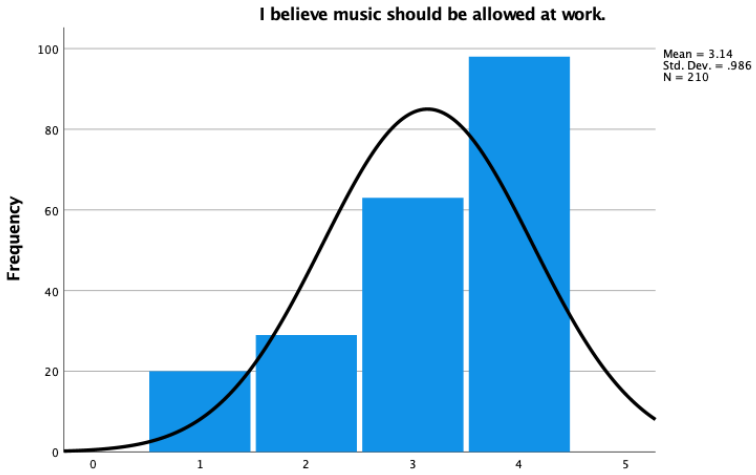
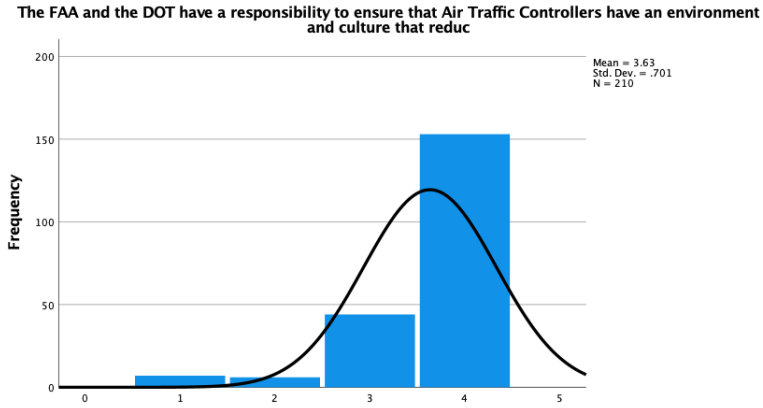


Figure 8 shows the histogram for Oversight Responsibility, where participants were asked to rate their agreement that the FAA and DOT have a responsibility to reduce stress. This resulted in a highly skewed distribution.

Figure 8

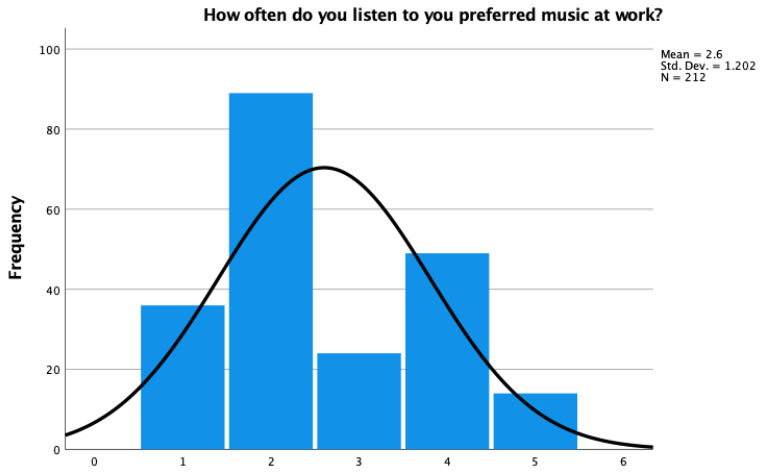
Histogram of the Frequency Distribution of Oversight Responsibility Scores



The frequency distribution for Preferred Music Listening Frequency scores is presented in Figure 9; participants rated the extent to which they listened to their preferred music, resulting in a moderate skew.

Figure 9

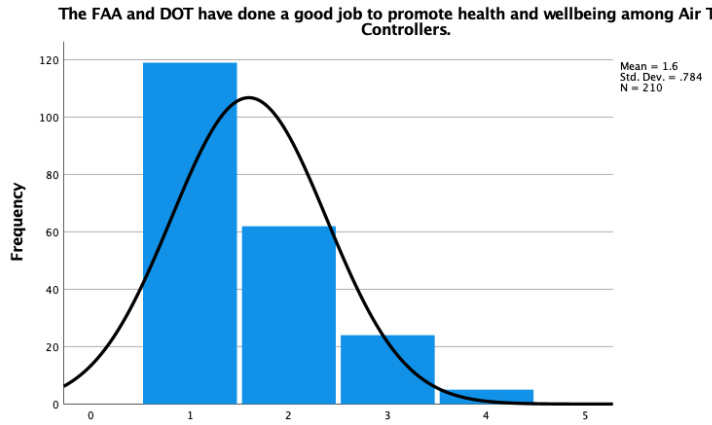
Histogram of the Frequency Distribution of Preferred Music Listening Frequency Scores



For Oversight Assessment, air traffic controllers rated the extent to which they believed that the FAA and DOT have done a good job to promote health and wellbeing; this resulted in a highly skewed distribution (Figure 10).

Figure 10

Histogram of the Frequency Distribution of Oversight Assessment Scores



The final frequency distribution showed a slightly skewed distribution for Stress in ATC, where participants rated the extent to which they agreed that air traffic control is stressful (Figure 11).

Figure 11

Histogram of the Frequency Distribution of Stress in Air Traffic Control Scores

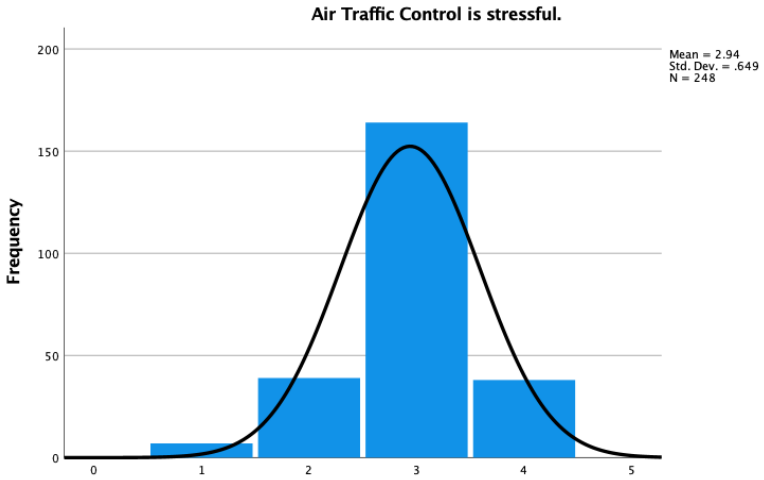


Table 3

Means, Standard Deviations, Range, Bivariate Correlations, and Cronbach's Alphas of Predictor and Dependent Variables

Variable	*N*	*M (SD)*	*Range*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	α
1. Music Listening Status	209	2.07 (1.146)	1-4									
2. Time Listening	214	1.67 (1.48)	1-9	.51**								
3. Reported Performance	209	2.75 (1.05)	1-4	.46**	.31**							
4. Music Permissibility	210	3.14 (0.98)	1-4	.38**	.21**	.74**						
5. Oversight Responsibility	209	3.63 (.701)	1-4	.009	.071	.21**	.22**					
6. Preferred Listening Freq	211	2.60 (1.202)	1-5	.34**	.32**	.27**	.25**	.14**				
7. Oversight Assessment	210	1.60 (.784)	1-4	.129	.064	.064	.023	-.062	-.060			
8. Stress in ATC	214	2.96 (.651)	1-4	.087	.14**	.19**	.20**.	.099	.025	.011		
Music-Related Performance	214	3.022 (.640)	1-4	.46**	.24**	.67**	.55**	.23**	.34**	.664	.22**	.94

*p< .05 **p< .01

Frequencies of Non-Significant Variable Results

Several variables that were tested against the dependent variable of Music-Related Performance did show statistical significance in a regression model. First, participants were asked, “What type of music do you prefer to listen to in your workplace? Check all that apply” (Table 4). Participants were asked, “Who picks the music to listen to at work on the operational control floor while providing air traffic control services or any of its related functions during the Day, Swing, or Mid-Shift?” (Table 5). The survey also included the question, “Who picks the music to listen to at work in places other than the operational control floor (e.g. breakroom, lunchroom, other common areas)?” (Table 5). Finally, participants were asked, “Answer the extent to which you agree with these statements. listen to music:” (1) While working live air traffic on the Day and Swing Shifts (6AM to 10PM); (2) While working live air traffic on the Mid Shift (10PM to 6AM); (3) During Computer-Based Instruction/training (e.g. CBI, eLMS, CEDAR); (4) During breaks or relaxing. The participants answered the extent to which they agreed with the statements on a 4-point scale, with 1 being Strongly Disagree, and 4 being Strongly Agree (Table 6).

Table 4

Frequencies of Music Genre Preference

Variable	*n*	%
Total	*268*	100
Art (Classical)	40	15
AvantGarde/Experimental	11	4
Blues	27	10
Country	52	19
Easy Listening	69	25
Electronic	53	20
Contemporary Folk	15	05
Hip Hop/Rap	60	22
Jazz	44	16
Pop	71	26
Rhythm & Blues	34	13
Rock	136	50
Regional	12	4
Religious	7	2
Traditional Folk	11	4
Other	44	16
Options Selected	686	16

Note. n = Number participants. % = Percentage of participants.

Table 5

Frequencies of Music Selector

Variable	*n*	*%*
Total	*268*	100
On the Operational Control Floor		
Anyone	58	21
First to Arrive	21	8
Most Senior	6	2
Highest Workload	11	4
I'm the Only Person	34	13
Myself	12	4
Owner of Equipment	11	4
No One/ Prohibited	117	4
Other than Operational Control Floor		
Anyone	90	34
First to Arrive	41	16
Most Senior	5	2
I'm the Only Person	17	6
Myself	95	36
Owner of Equipment	16	6

Note. n = Number participants. % = Percentage of participants.

Table 6

Frequencies of Music Listening Shifts

Variable	*Mean*	*SD*
Total	220	100
Shift		
Day/Swing	1.56	.97
Mid	2.29	1.28
CBI/eLMS/CEDAR	2.35	1.13
Breaks or Relaxing	3.05	.91

Regression Model Results

The first round of regression analyses tested the demographic variables against the outcome variable of Music-Related Performance. Eight linear regressions were used to test the relationship between the predictive values of the independent variables and the outcome variable of ATC Music-Related Performance (Table 7). The first independent variable was Music Listening Status. Participants were asked to rate on a four-point scale the degree they agreed with the statement: "I listen to music while working". The second independent variable was Time Listening. Participants rated the question: "Thinking about your working week, approximately how many hours do you spend listening to music at work?" on a nine-point scale. For the independent variable of Reported Performance, participants reported the extent they agreed with the statement: "I believe my performance is improved by music being allowed at work" on a four-point scale. Music Permissibility was measured through the statement: "I believe music should be allowed at work" on a four-point scale. Participants then rated Oversight Responsibility, and reported the extent to which they agreed that: "The Federal Aviation Administration (FAA) and the Department of Transportation (DOT) have a responsibility to ensure that Air Traffic Controllers have an environment and culture that reduces stress" on a four-point scale. Listening Frequency was measured, wherein participants reported, "How often do you listen to preferred music at work?" on a five-point scale. In order to examine Oversight Assessment, participants answered the extent they agreed with: "The FAA and DOT have done a good job to promote health and wellbeing among Air Traffic Controllers" on a four-point scale. The final predictor variable was Stress in ATC. Participants answered the extent they agreed with the statement: "Air Traffic Control is stressful" on a four-point scale.

SPSS 28 was used to estimate confidence intervals and limits with bootstrapping because many of the variables were not normally distributed. The only notable demographic variable was Gender. A regression analysis found that there was an effect of gender that approached significance on Music-Related Performance, $\Delta R^2 = 0.017$, $\Delta F\ (1,213) = 3.636$, $p = 0.058$). Males were less likely to believe that music was helpful for their work, $\beta = -.236$, $F = 3.631$, $p = .058$) than females, but this was not statistically significant. Males scored an average of 3.232 ($SE = .090$), while females scored an average of 3.468 ($SD = .169$). All other demographic variables were non-significant in predicting Music-Related Performance.

Hypothesis 1 stated that participants who agreed to a greater extent that they listen to music while working would have a higher Music-Related Performance score. A regression analysis found that Music Listening significantly predicted Music-Related Performance, $\Delta R^2 = 0.175$, $\Delta F\ (1,213) = 45.162$, $p < .001$. As Music Listening increased, Music-Related Performance also increased, $\beta = .234$, $p<.001$.

Hypothesis 2 stated that participants who listened to music more often would have higher Music-Related Performance. A regression analysis found a significant effect of Time Listening and Music-Related Performance scores, $\Delta R^2 = 0.071$, $\Delta F\ (1,213) = 17.310$, $p < .001$. As Time Listening increased, Music-Related Performance also increased, $\beta = .118$, $p<.001$.

Hypothesis 3 stated that participants who agreed to a greater extent that music improves their performance while working would have a higher Music-Related Performance score. A regression analysis found that Reported Performance significantly predicted Music-Related performance, $\Delta R^2 = 0.449$, $\Delta F\ (1,208) = 169.382$, $p < .001$. As Reported Performance increased, Music-Related Performance also increased, $\beta = .410$, $p<.001$.

Hypothesis 4 stated that participants who agreed to a greater extent that music should be allowed while working would have a higher Music-Related Performance score. A regression analysis found that Music Permissibility significantly predicted Music-Related performance, $\Delta R^2 = 0.311$, $\Delta F\ (1,208) = 93.916$, $p < .001$. As Music Permissibility increased, Music-Related Performance also increased, $\beta = .363$, $p<.001$.

Hypothesis 5 stated that participants who agreed to a greater extent that the FAA and DOD have a responsibility towards workplace stress would have a higher Music-Related Performance score. A regression analysis found that Oversight Responsibility significantly predicted Music-Related performance, $\Delta R^2 = 0.057$, $\Delta F\ (1,208) = 12.577$, $p < .001$. As Oversight Responsibility increased, Music-Related Performance also increased, $\beta = .218$, $p = .006$.

Hypothesis 6 stated that participants who reported listening to their preferred music more often would have a higher Music-Related Performance score. A regression analysis found that Preferred Music Listening Frequency significantly predicted Music-Related Performance, $\Delta R^2 = .124$, $\Delta F\ (1,210) = 29.724$, $p < .001$. As Preferred Music Listening Frequency increased, Music-Related Performance also increased, $\beta = .188$, $p < .001$.

Hypothesis 7 stated that participants did not agree to a greater extent that the FAA and DOD has done a good job to reduce workplace health and wellbeing would have a higher Music-Related Performance score. A regression analysis found that Oversight Assessment did not significantly predict Music-Related performance, $\Delta R^2 = 0.001$, $\Delta F\ (1,208) = .189$, $p = .664$. Oversight Assessment was not related to Music-Related Performance, $\beta = .025$, $p = .703$.

Hypothesis 8 stated that participants who agreed to a greater extent that Air Traffic Control is stressful would have higher Music-Related Performance score. A regression analysis

found that Stress in ATC significantly predicted Music-Related performance, $\Delta R^2 = .043$, $\Delta F (1,213) = 9.513$, $p = .002$. As Stress in ATC increased, Music-Related Performance also increased, $\beta = .203$, $p = .004$.

Table 7

Summary of Regressions for Prediction of Music-Related Performance

				95% CI with BCA				
Step	Predictor	*B*	*p*	*Lower*	*Upper*	ΔR^2	*df*	ΔF
1.	Music Listening Status	.23	<.001	.16	.30	.17	1, 208	45.16
2.	Time Listening	.12	<.001	.07	.17	.07	1,213	17.31
3.	Reported Performance	.41	<.001	.33	.49	.44	1,208	169.3
4.	Music Permissibility	.36	<.001	.27	.45	.31	1,208	93.91
5.	Oversight Responsibility	.21	<.001	.08	.37	.05	1,208	12.57
6.	Preferred Listening Frequency	.18	<.001	.11	.25	.12	1,210	29.72
7.	Oversight Assessment	.02	.664	.11	.15	.01	1,208	.18
8,	Stress in ATC	.20	.002	.07	.33	.04	1,213	9.51

Note: N = 268. CI = Confidence Intervals

*$p < .05$

Qualitative Results

Participants were asked to respond to qualitative questions about stress and music performance related to Air Traffic Control. Participants were asked: (1) Can you describe what stress is for you?; (2) Are there any reasons why you wouldn't listen to music in the workplace?; (3) Please tell us any additional information or comments that you would like to add in relation to music listening in the workplace. The following themes were found through the generic qualitative inquiry, as seen in Tables 8-11:

1. Air traffic controllers are highly stressed in work and environment.
2. Air traffic controllers have mixed feelings about music listening.

3. Air traffic controllers offer support and alternative strategies for productivity and music listening.

Table 8

Clusters with Supporting Meaning Units for Question 1

Abnormal Work Situations/Operations	
Participants noted that stress came up in settings where it was difficult to pay attention in situations in which they lacked control.	• Stress for me is when the normal operation becomes abnormal due to weather or equipment issues. Additionally working with individuals that are not professional in how they work. • Stress is working in conditions other than Standard compliance with procedures and practices. This is usually due to inattentive or distracted team members • Stress is an emotional and physiological response to an abnormal or life-threatening (even remotely) situation. • Equipment failure at critical times during heavy traffic conditions • Personnel conflicts, adverse weather, or abnormal operations. • Stress is a feeling of being overwhelmed or not in control. When an outside force, either one that is strong or a collection of many small forces, start to wear and grind on you and wear you out; that's stress. • Stress is feeling borderline out of control, on the edge of losing effectiveness. When the laser like focus begins to fray around the edges. • Stress is caused by the unknown. Stress could come from not being in control. • Stress is mental strain. Stress is being in a demanding situation where I have little to no influence in easing mental strain. • Stress for me is when you are completely engulfed in the fear of something potentially happening in our field. “What if I cause a crash” “what if I can’t qualify”. This can spread into our social lives as well. • Stress, to me, is rarely caused by working planes. I find that the most stress comes from the work schedule, especially as I get older. Also, it's caused by working

	with a work force which can be considered Type-A overwhelmingly. • Too many planes calling during thunderstorms..Also when radar would fail. Lost pilot with low ceiling near mountainous terrain. • Stress is being ignored when requesting help in an ATC situation, and not receiving it. • Bad schedules with quick turns from nights to mornings, difficult coworkers and management that doesn't follow contracts.
Stress Invokes Emotions and Feelings	
Participants also reported "anxiety" often, which was accompanied by feelings of fear and failure. Other common words mentioned included being "overwhelmed", "exhausted", "emotional", "discomfort", "unease", "weighted", "consequences", and "worried".	• Stress is a feeling of anxiety or anticipation. Worrying about something that has not happened yet. I also believe that fatigue from a compressed schedule is another type of stress. • Lots of anxiety. Feeling of not being good and failing. Mounting tasks that feel unobtainable. • Feeling panicked, heavy weight feeling, anxiousness. • Stress is a feeling of anxiety or anticipation. Worrying about something that has not happened yet. I also believe that fatigue from a compressed schedule is another type of stress. • Lots of anxiety. Feeling of not being good and failing. Mounting tasks that feel unobtainable. • Feeling panicked, heavy weight feeling, anxiousness • Unable to think in a calm manner. Being irrational and may have outburst of emotion. • Having a feeling of tightness. Feeling anxiety. • My body tensing up and my mind racing as a response to a build up of tasks it even a single task that I will have difficulty completing. • Persistent Overwhelmed mental faculty feeling of worry and tension • The feeling of multiple things that need to get done in a very short amount of time. Each decision made must be correct to

	maintain or lower the current stress level. The wrong decision/outcome can lead to additional stress.
Stress Invoked by the Environment	
Participants also reported that there were issues with the environmental culture, such as toxicity, and interference with their jobs.	• In the context of employment, toxic work environments that are not checked by management. • Poor management decisions and interference in operations. Non-operational persons making decisions for operational persons without knowledge of how the operation actually runs. • Work stress: Poor management, toxic work environment, aircraft not following instructions. • Factors that mentally hurt your ability to do your jobs. • Stress many times for me is when I feel I can't make someone happy or someone is mad at me and I don't know why. I really fret over why they are mad or upset and try to figure out what I can do to make it better. If I can't I worry what the reasoning is and try to fix it. • Someone that negatively affects multiple areas of your life. • Dealing with idiots, be it fellow controllers, pilots, but mainly the incompetence of the FAA and the management. • Long term changes in mental health. Constant feel of pressure that comes from the un-winnable situations the FAA constantly puts us in. • Rotating shifts combined with short staffing created most of the stress I encountered during my 27 year career in FAA. • Continuous task overload. Add up the stress of work, family life, children sickness. Keeping it all separated and compartmentalized for years. Dealing with management. • Frustration caused by things outside of my control. Air Traffic itself does not stress me out but the schedule, coworker/management relations, and lack of concern from management as a whole about some issues ie. Staffing levels,

	transferring process, and working conditions.
Physiological Stress	
Physiological stress was described through comments involving constant vigilance, a lack of sleep and rest, elevated body and blood pressure, heart rate, and a rise in body temperature.	• An overwhelming feeling that effects more than just your emotional well-being. (Physical, intellectual, personal life). • Situations where my mental faculties are challenged. When I'm not well rested, much easier to get stressed. Often, it's a situation where you have to draw on past experiences to manage things. • Constant vigilance, worry and double-checking for possible mistakes made, combined with abnormal sleep patterns or outright lack of proper sleep and routine contributes greatly to stress in this job. Stress is mental and physical strain caused by an outside force. • My body's response to stress results in an increased heart rate, rise in body temperature, and a mindset focused on getting out of the situation. Stress is also unpleasant, energy-wasting, and can sometimes lead to poor gut health. • Physical response to perceived stimuli. My blood pressure goes up, my ears feel flush and begin pounding, my heart rate goes up, my foot starts tapping, my breathing becomes quick and shallow, forehead becomes sweaty… • Stress is the feeling of frustration and being overwhelmed. Stress can sometimes lead to physical symptoms for me, like my neck feeling tight. • Stress for me is heightened anxiety, an eye twitch, and elevated body temperature. • Anxiety, or physical reactions like sweating, blurred vision.

Table 9

Clusters with Supporting Meaning Units for Question 2

Annoyance and Irritation with Music	
Participants had mixed feelings about whether music should be allowed in certain work areas, such as the control floor. Music was	• Music has no business on the control floor! It is your responsibility to listen to the radio at all times. If you are distracted by ANYTHING, you will become

viewed as “annoying, “too much”, and “noise pollution”.	complacent. Complacency leads to errors. There is no room for errors on the control floor.. • Can't have people jamming out to a song when issuing traffic is needed. • I view music as nothing more than annoying noise. The last thing I want to deal with while I work traffic is noise pollution. • I listen to enough noise while in on position, I like the quiet breaks so I can relax and hear myself think.
Incompatible Work Areas	
Participants stated that music was a distraction in certain environments, such as a tower environment, operational floor, and certain shifts.	• I don't want to assume that the other people with whom I am working want to listen to the same thing as me. I've been in a tower environment with the radio playing, and it was more distracting than appealing because it wasn't my style of music. • Added distraction (outside of mid-shift operations). Added distraction of what genre of music to listen to between controllers. Operation floor isn’t conducive to having music played (large TRACON), music would have to be too loud for all to hear. • Music in the operational ATC environment is not only a distraction but could lead to unsafe conditions in the workplace. • If there's too much going on (the one super busy push during the day)**,** music could be a distraction. • It’s distracting from listening to radio calls if you listen to it working live traffic.
Choice of Music (Genre)	
Participants also reported that it was difficult when they listened to music that was not of their preference. It can be a distraction when they listen to music that they did not choose themselves.	• Music can be a distraction. You turn your attention to the music and not what you are working. Who picks the music? Now I’m distracted cause it’s not the music I listen to. Oh, never heard this song before. Let me listen more intently to the music and not what’s in my headset. Is it too loud? Too soft? • Being exposed to music that I do not enjoy is a distraction for me. In prior work assignments where music was played in the operational quarters, certain

	types of music were a distraction. I would prefer no music at all versus listening to music I do not enjoy. • It would be a distraction and I would probably be pissed if I had to listen to someone else's. • It can be rude when around other people due to a difference in music choices and lack of social attention to those around me. • Distracting. Don't like what is chosen. • Distracting at times. People would have disagreements over what music.
No Objections to Music	
Many participants indicated that they had no objections to music being allowed. Many participants simply answered with the word "no" to the question.	• No, even if the style of music was not my favorite. • Besides it not being allowed, no. • improves atmosphere. • None that I can think of. • There aren't any. Prior to the White Book, we listened to music all of the time and it was great. It helped get into a rythem with traffic, and created a more relaxed and happy environment

Table 10

Clusters with Supporting Meaning Units for Question 3

Support for Music Among Air Traffic Controllers	
Many participants offered their comments in support of music listening while working. Many offered complete support, while others offered conditional support.	• Before the ban on radios in the operational areas, I trained with and without the use of radios. Under intense instruction it was tried with different trainees with and without the radio. There was a significant difference in positive performance with the radio on vs off. The trainee was under much less visible stress with the radios on. When the tool of using the radio was taken away, training became much more difficult. The trainee seemed to have no outlet, couldn't wait to get out of position. • My experience has been very positive where the music was automatically handled by one of the team members.listening to your peers makes you aware of situational awareness. When

	you hear the voices change from the norm, most controllers will key in to get the picture. • I believe it could help with reducing distractions caused by loud conversations between controllers. Also it could help in improving people's mood which in turn would reduce arguments between controllers and between controllers and pilots. • Listened to music in the tower cab prior to the FAA shoving the white book down our throats and removing privileges like listening to music. They thought that would improve safety, resulted in the opposite. • During more balanced traffic loads or during breaks I believe music is great. And can be a great tool especially with earbuds as long as a controllers music does not disrupt anyone else trying to work. I'm all for it. • It should be allowed at all times. It's ridiculous that it's allowed on the mid but no other time. I worked long ago when it was allowed and it was not an issue for anything operation that I recall. I miss it. • DoD and other facilities around tha NAS have big-screen TVs in the operation for use during the mid and slower periods. For God sake let us have a radio to help us relax. • If allowed I believe music would help people relax in the work place and make it better and lower extra sidebar conversations. • I grew up doing homework, studying, or doing projects with my family having the TV or radio on most all of the time. Have the background noise masks distractions for me. But I realize that's not true for everyone. • Music was my major in college. From my Navy experience at a control tower, a radio has always been located in the cab. It has never occurred to me that music in the workplace is a distraction.

	• Circa 2006, the NATCA Local at my first facility bought an XM satellite radio for use in the tower cab. The Agency prohibited music in the operation the following week. Funny story • I play guitar and have for 70 years. After work as a controller I would play my music for 30 min to 1 hour each day, this habit has followed me into retirement. • In air traffic, sometimes people relate controlling traffic to getting to a 'rhythm'. Having a music beat in the background could help in achieving that rhythem. • When pilots hear music in the background, they often make a comment about it. It makes us seem more human/relatable in the other end of the mic. • Music was allowed in FAA control room, usually a local radio station on low volume. In my opinion improved moral. Strictly forbidden now. • It makes for good background noise while working traffic and sometimes helps provide a good rythym and flow to transmissions. • I have worked in both places with and without music and I was much happier working in an environment that music was allowed. • The radio is on during our super busy times as well as has no impact on our ability to work traffic • If music was allowed during normal hours moral would be increased • Listening to music at work seems to help keep the brain relaxed. • Music in the background makes the day fly by faster • Listening to music, when agreed to by the team working the operation, increases cohesion and improves morale. • I think it could keep us more engaged in lower volume times. • I am at a facility with mandatory 6 day work weeks plus at least one 10 hour shift a week. I do not believe the FAA

	really cares about our well being as much as they say they do. This is absolutely not sustainable. So if there was anything that would help ever the slightest thing such as listening to music I feel like the FAA should listen. There are a lot of controllers who are very burned out and need some type of escape.
Non-Distracting Music	
Many participants noted that non-distracting music may improve mental acuity, be soothing, and reduce stress. Many air traffic controllers reported that non distracting music such as instrumental, ambient, orchestral, symphony, and "robotic" music could be helpful.	• Music can be soothing and just having white noise helps sometimes • Music creates ambient noise in the tower while working alone on the mid shift • I think having a list of curated classical music playing very softly in the background would be beneficial. • I think music should be allowed on the floor, especially orchestral or symphony work that have been proven to increase mental acuity. • Music should be allowed at all hours in the control room. It cuts out the dreaded hum and ambient noise of the equipment. Plus it's just good for the soul! • Standard workflow (when work is slow or easily robotic in nature)music is an EXCELLENT WELCOME addition that adds to moral and perhaps even enhances my awareness due to my upbeat demeanor • I wish I could have some quiet instrumental music playing in the background while I worked. I'd like to see if that would reduce stress. But that's not allowed. • I listen to music constantly when I am not at work or am not on position. Its an enormous part of my life. Being able to listen to music when the traffic isnt at its peak would be great. However when the traffic picks up I would prefer silence, or instrumental only music so I could more easily coordinate with my collegues. • I'd absolutely support it if there were clear guidelines • Different allowances should likely be made for different genres of music. Instrumental for instance could be

	more acceptable, as one would never confuse a lyricist for a pilot transmission. Or even just low key background noise near the entrance to the radar floor would make a world of difference. In an ideal world, I would want music to be allowed with headphones during single-digit traffic instances.
Limits to Volume	
Air Traffic Controllers noted that music played at a low volume would be helpful and not distracting.	• Volume must remain appropriate to background noise, should not interfere with operational duties. • The volume should be set low enough so as not to interfere with communications. • Volume should be at a level that it is not heard over communications. • Loud music should be discouraged. • it has to be at a low volume • It should be allowed in non distracting levels

Table 11

Themes with Supporting Clusters

Air Traffic Controllers Are Highly Stressed in Work and Environment	Abnormal Work Situations/Operations Stress Invokes Emotions and Feelings Stress Invoked by the Environment Physiological Stress
Air Traffic Controllers Have Mixed Feelings About Music Listening	Annoyance and Irritation with Music Incompatible Work Areas Choice of Music (Genre) No Objections to Music
Air Traffic Controllers Offer Support and Alternative Strategies for Productivity and Music Listening	Support for Music Non-Distracting Music Limits to Volume

Theme 1: Air Traffic Controllers Are Highly Stressed in Work and Environment

The qualitative analysis showed that air traffic controllers are highly stressed in their work and work environment (Table 8). Participants noted that stress came up in settings where it was difficult to pay attention in situations, and they lacked a sense of control. One participant emphasized the sentiment, “Stress is a feeling of being overwhelmed or not in control. When an

outside force, either one that is strong or a collection of many small forces, start to wear and grind on you and wear you out; that's stress". Similarly, another participant echoed that air traffic controllers do not have any control over future events, causing a fear from the "unknown", with the statement, "Stress is caused by the unknown. Stress could come from not being in control". The participants noted that in situations ever-present in air traffic control, there is no shortage of profound events that may happen as a consequence of lost control. Fear and uncertainty were common themes among the responses to this question. For example, one participant noted, "Stress for me is when you are completely engulfed in the fear of something potentially happening in our field. "What if I cause a crash" "what if I can't qualify". This can spread into our social lives as well".

Participants also reported "anxiety" often, which was accompanied by feelings of fear and failure. Other common words mentioned included being "overwhelmed", "exhausted", "emotional", "discomfort", "unease", "weighted", "consequences" and "worried". One participant stated that anxiety, failure, and the impossibility of control weighed heavily with the statement, "Lots of anxiety. Feeling of not being good and failing. Mounting tasks that feel unobtainable." Other constructs related to stress in ATC were summed up by another participant: "Feeling panicked, heavy weight feeling, anxiousness".

Participants noted that there were issues with the environmental culture, such as toxicity, and interference with their jobs. Common issues involved negative occupational culture through management and oversight. One participant stated that there were, "constant feel(ings) of pressure that comes from the un-winnable situations the FAA constantly puts us in". In terms of management, one participant felt like decision making was hampered in their work, with, "Poor

management decisions and interference in operations. Non-operational persons making decisions for operational persons without knowledge of how the operation actually runs."

Physiological stress was described through comments involving constant vigilance, a lack of sleep and rest, elevated body and blood pressure, heart rate, and a rise in body temperature. Respondents noted that they had to maintain, "constant vigilence (sp)", as noted by one participant. Another participant stated that, "My blood pressure goes up, my ears feel flush and begin pounding, my heart rate goes up, my foot starts tapping, my breathing becomes quick and shallow, forehead becomes sweaty".

Theme 2: Air Traffic Controllers Have Mixed Feelings About Music Listening

The qualitative analysis also showed that air traffic controllers had mixed feelings about music listening during work (Table 9). In particular, some participants had mixed feelings about whether music should be allowed in certain work areas, such as the control floor. Music was viewed as "annoying, "too much", and "noise pollution". A participant stated, "I view music as nothing more than annoying noise. The last thing I want to deal with while I work traffic is noise pollution", while another stated, "Can't have people jamming out to a song when issuing traffic is needed".

Some respondents stated that music was a distraction in certain environments, such as a tower environment, operational floor, and certain shifts. A common word used to describe reasons not to have music during work was "distraction", which could lead to errors. Another participant noted, "Music in the operational ATC environment is not only a distraction but could lead to unsafe conditions in the workplace". Some noted that having music playing could become dangerous on heavier shifts, as one participant stated, "If there's too much going on (the one super busy push during the day), music could be a distraction".

Participants also reported that it was difficult when they listened to music that was not of their preference. It could be a distraction when they listened to music that they did not choose themselves. For example, a respondent noted, “It can be rude when around other people due to a difference in music choices and lack of social attention to those around me.” Another participant stated that music was, “Distracting at times. People would have disagreements over what music”.

On the other hand, many participants indicated that they had no objections to music being allowed. Instead of answering the question with a statement, many participants (20) simply answered with the word “no” to the question, along with two answering “none” and one answering “nope”. One participant had no objection, further explaining: “There aren't any. Prior to the White Book, we listened to music all of the time and it was great. It helped get into a rythem (sp) with traffic, and created a more relaxed and happy environment”. Another participant answered “no”, along with a willingness to accommodate, “No, even if the style of music was not my favorite”.

Theme 3: Air Traffic Controllers Offer Support and Alternative Strategies for Productivity and Music Listening

The analysis showed that air traffic controllers offered support and alternative strategies for productivity and music listening (Table 10). Many participants offered their comments in support of music listening while working. Many offered complete support, while others offered conditional support. A participant said, “My experience has been very positive where the music was automatically handled by one of the team members. Listening to your peers makes you aware of situational awareness. When you hear the voices change from the norm, most controllers will key in to get the picture.” Some stated that music could help improve the atmospheric mood of the job, while providing distractions from conversations between other

controllers. One participant noted, “I believe it could help with reducing distractions caused by loud conversations between controllers. Also, it could help in improving people’s mood which in turn would reduce arguments between controllers and between controllers and pilots”.

Many participants noted that non-distracting music may improve mental acuity, be soothing, and reduce stress. Many air traffic controllers reported that non distracting music such as instrumental, ambient, orchestral, symphony, and “robotic” music could be helpful. For example, a participant noted, “I think music should be allowed on the floor, especially orchestral or symphony work that have been proven to increase mental acuity.” One respondent noted that the preference for different types of music should be accounted for by all the controllers present: “Different allowances should likely be made for different genres of music. Instrumental for instance could be more acceptable, as one would never confuse a lyricist for a pilot transmission”. Finally, air traffic controllers noted that music played at a low volume would be helpful and not distracting. For example, one respondent said, “I think it could keep us more engaged in lower volume times”, while another added that, “Loud music should be discouraged”.

Summary

The quantitative analyses of this study consisted of frequency, correlation, factor, and regression analyses. An exploratory factor analysis was used to calculate the dependent variable of Music-Listening Performance through the scaled value of 13 variables, which produced a Cronbach’s alpha of .941, and indicates high reliability. As such, it is likely that all the items on this scale measure the same construct. However, many of the independent and dependent variables showed signs of non-normality, which precipitated the use of bootstrapping in the regression analyses. The results showed that, for Hypothesis 1, Music Listening significantly predicted Music-Related performance; as Music Listening increased, Music-Related

Performance also increased. In terms of Hypothesis 2, a regression analysis found a significant effect of Time Listening and Music-Related Performance; as Time Listening increased, Music-Related Performance also increased. The result associated with Hypothesis 3 showed that Reported Performance significantly predicted Music-Related performance; as Reported Performance increased, Music-Related Performance also increased.

For Hypothesis 4, Music Permissibility significantly predicted Music-Related performance; as Music Permissibility increased, Music-Related Performance also increased. Hypothesis 5 showed that Oversight Responsibility significantly predicted Music-Related performance. As Oversight Responsibility increased, Music-Related Performance also increased. Regarding Hypothesis 6, Preferred Music Listening Frequency significantly predicted Music-Related performance; as Preferred Music Listening Frequency increased, Music-Related Performance also increased. For Hypothesis 7, Oversight Assessment did not significantly predict Music-Related performance. Finally, for Hypothesis 8, a regression analysis found that ATC Stress significantly predicted Music-Related performance. As ATC Stress increased, Music-Related Performance also increased.

Qualitative analyses using generic qualitative inquiry on survey data found that: (1) Air traffic controllers are highly stress in work and environment; (2) Air traffic controllers have mixed feelings about music listening; (3) Air traffic controllers offer support and alternative strategies for productivity and music listening (Table 11). The next chapter will provide a discussion of the results of the study.

CHAPTER 4

Discussion

Eight hypotheses were tested in this study. The hypotheses set out to state the predictive value that the independent variables (Music Listening, Time Listening, Reported Performance, Music Permissibility, Oversight Responsibility, Preferred Music Listening Frequency, Oversight Assessment, and Stress in ATC) had on the dependent variable of Music-Related Performance. Additionally, respondents were asked to provide their thoughts about stress in air traffic control, why music should not be allowed at work, and any additional thoughts related to the subject.

This study sought to examine how stress, music, and performance may interact among air traffic controllers. Much of the literature on work performance has shown that music might be particularly effective for workers in highly stressful environments. Air traffic control has been rated as the fourth most stressful occupation (U.S. Bureau of Labor Statistics, 2010). Additionally, air traffic controllers often show psychophysiological responses to changes in workload during simulated air traffic control (Hollnagel & Woods, 2005). When accounting for all the human factors to be considered in relation to the air traffic control domain, these include maintaining a high level of situational awareness (Durso & Sethumadhaven, 2008; Lee, 2012), which affects task performance (Cox-Fuenzalida, 2016). Lesiuk (2008; 2010) showed that air traffic controllers and others in high-stress occupations have responded positively to music, with music directly related to improved performance and decreased stress in a lab-controlled environment.

Air traffic controllers must ensure flight safety of passengers and crew, and must be vigilant, effective, and respond quickly, in a sustainable manner (Angenendt, 2003). Air traffic

controllers are of an occupation with high levels of reported stress, which is aligned with the occupation's responsibility, existence of high demand work, mental workload, and work overload. Prior studies have shown that air traffic controllers have been documented to experience upper respiratory infections, disruptions of impulse control, depression, substance use, and hypertension (Mohler, 1983). Therefore, it is important to bridge the wide gaps in the data, and examine the ways in which air traffic controllers may benefit from stress coping strategies to maintain work efficacy and performance. However, since 2006, air traffic controllers have been prohibited from listening to music while working live air traffic on the operational control floor (Federal Aviation Administration, 2006). Only in 2016, slight amelioration occurred when the FAA partially conceded, permitting music listening on the control floor during the Mid Shift, between the hours of 10 PM to 6 AM (Federal Aviation Administration, 2016) at select facilities. As such, this study sought to examine how music was related to reported performance and stress among air traffic controllers.

Summary of the Study

A survey was issued to 268 current and former air traffic controllers to gather data about factors related to music listening, stress, work performance, and personal beliefs about the subjects. In addition to the study's primary analyses, demographic variables were also measured in relation to Music-Related Performance. The results of the analysis showed that participants were mostly male, with only 10.1% being female. However, participants had a range of years' experience as an air traffic controller, with the majority having worked between 6 and 20 years (56.8%). Additionally, most of the participants had either currently or formerly worked within the FAA (75.75%).

A factor analysis was used to produce the Music-Related Performance scale. The researcher used Principal Axis Factoring with Direct Oblimin rotation. The items indicated the extent they agreed to the statements: (1) Listening to music at work improves my focus; (2) Helps me relax; (3) Improves my mood; (4) Makes me less bored; (5) Distracts me from unwanted thoughts; (6) Blocks out surrounding noise; (7) Makes me less tired; (8) Makes me happier; (9) Helps my creative flow; (10) Inspires/stimulates me; (11) Provides a different perspective; (12) Helps me pace my work; (13) Creates a suitable atmosphere. A factor analysis showed that all 13 items had factor loadings over .50. The Eigenvalue was 7.798, which explained 59.981% of the variance in the model. The Music-Related Performance scale had a Cronbach's alpha of .941, which indicates high reliability. The mean of the Music-Related Performance Scale was 3.022 (*SD* =.640), indicating that most participants agreed that music was helpful in improving work-related performance.

This study included eight independent variables, which were analyzed for their predictive value towards Music-Related Performance. The independent predictor variables included: (1) Music Listening Status; (2) Time Listening; (3) Reported Performance; (4) Music Permissibility; (5) Oversight Responsibility; (6) Preferred Music Listening Frequency; (7) Oversight Assessment; (8) Stress in ATC. However, many of these variables were not normally distributed. Therefore, bootstrapping was employed in the regressions in order to provide a nonparametric method for analysis that is less dependent on normal distributions (Preacher & Hayes, 2008).

A regression analysis found that there was an effect of gender on Music-Related Performance that approached significance. Men were less likely to believe that music was helpful for their work, β = -.236, p= 0.058). Males scored an average of 3.232 (*SD* = .090), while females scored an average of 3.468 (*SD* = .169). All other demographic variables were non-

significant in predicting Music-Related performance. This result aligns with previous findings that women show more positive psychophysiological responses to music compared to males. A pre and post treatment procedure of music listening uncovered that females showed decreased systolic and diastolic blood pressure and heart rate among females more so than males, and reduced negative affect more intensely among females (Gupta & Gupta, 2016). However, this prior study also showed that music reduced stress, anxiety, and depression while increasing optimism and hope among both males and females (Gupta & Gupta, 2016).

Hypothesis 1 predicted that participants who were more likely to listen to music while working would have a higher Music-Related Performance score. A regression analysis found that Music Listening significantly predicted Music-Related performance. Specifically, as Music Listening increased, Music-Related Performance also increased, $\beta = .234$, $p<.001$. As such, Hypothesis 1 was supported.

Hypothesis 2 stated that participants who spent more time listening to music would have a higher Music-Related Performance score. A regression analysis found a significant effect of Time Listening and Music-Related Performance. As Time Listening increased, Music-Related Performance also increased, $\beta = .118$, $p<.001$. Therefore, this hypothesis was supported.

Hypothesis 3 stated that participants who reported they perform better when listening to music while working would have a higher Music-Related Performance score. As Reported Performance increased, Music-Related Performance also increased, $\beta = .410$, $p<.001$. As such, Hypothesis 3 was supported.

Hypothesis 4 stated that participants who believe that music should be permissible while working would have a higher Music-Related Performance score. A regression analysis found that Music Permissibility significantly predicted Music-Related performance. This hypothesis was

supported; as Music Permissibility increased, Music-Related Performance also increased, β = .363, p<.001.

Hypothesis 5 stated that participants who believed that the FAA and DOT have a responsibility to reduce workplace stress would have a higher Music-Related Performance score. A regression analysis found that Oversight Responsibility significantly predicted Music-Related performance. This hypothesis was supported because as Oversight Responsibility increased, Music-Related Performance also increased, β = .218, p =.006.

Hypothesis 6 stated that participants who were able to listen to music they preferred with more frequency would have a higher Music-Related Performance score. A regression analysis found that Preferred Music Listening Frequency significantly predicted Music-Related performance. This hypothesis was supported because as Preferred Music Listening Frequency increased, Music-Related Performance also increased, β = .188, p < .001.

Hypothesis 7 stated that participants who believed to a greater extent that the FAA and DOT have done a good job to reduce workplace health and wellbeing would have a higher Music-Related Performance score. However, a regression analysis found that Oversight Assessment did not significantly predict Music-Related performance.

Hypothesis 8 stated that participants who were more likely to agree that Air Traffic Control is stressful would have higher Music-Related Performance score. A regression analysis found that Stress in ATC significantly predicted Music-Related performance. As Stress in ATC increased, Music-Related Performance also increased, β = .203, p =.004, thus confirming that Hypothesis 8 was supported.

Generic qualitative inquiry was used to analyze three open-ended questions provided on the survey related to Air Traffic Control, stress, and music. These questions were: (1) Can you

describe what stress is for you?; (2) Are there any reasons why you wouldn't listen to music in the workplace?; (3) Please tell us any additional information or comments that you would like to add in relation to music listening in the workplace. The themes were found following the generic qualitative inquiry analysis: (1) Air traffic controllers are highly stressed in work and environment; (2) Air traffic controllers have mixed feelings about music listening; (3) Air traffic controllers offer support and alternative strategies for productivity and music listening.

Findings

Music Listening Status

The mean for Music Listening Status was 2.07 (*SD* = 1.146) on a scale of 1 to 9. The most common answer to this question was "Strongly Disagree", accounting for 48.25% of the responses. However, 38.6% of participants indicated that they either somewhat or strongly agreed that they listen to music while working. Given that most participants replied that they listen to music low levels, this contextualizes the lack of normality seen in this variable. The majority of participants reported that they listened to music 0-5 hours per week while working (75%). When participants agreed to a greater extent that they listened to music at work, Music-Related Performance also increased, $\beta = .234$, $p<.001$. This may point to individual-level differences wherein some air traffic controllers may benefit more from music compared to others, depending on general inclination.

Time Listening

The mean score of Time Listening was 1.67 (*SD* = 1.48) on a scale of 1 to 9. As such, this is a relatively low number in the context of the scaled variable. A study by Haak (2001) found that a sample of workers in a music listening study reported to listen to music for 36% of their working week on average (*M* = 36.26, *SD* = 31.35). Specifically, respondents in this study

reported that they listened to music while driving/traveling, doing routine tasks, talking to others, and doing graphical tasks (Haak, 2001). Therefore, it appears that air traffic controllers listen to music to a much lesser extent compared to other working populations. This is not surprising given that the FAA has disallowed music listening on most shifts since 2006. The results showed that Time Listening increased, Music-Related Performance also increased, $\beta = .118$, $p<.001$. It appears that participants who are exposed to a music listening environment also find that music improves their performance at work. It is possible that this is simply due to the repeated exposure to music as a product of one's environment, or it is also possible that those who respond well to music on an individual level seek out experiences during work that lead to increased perceived music-related performance.

Reported Performance

In terms of Reported Performance, most of the participants believed that their performance was improved by listening to music. Specifically, 69% of participants answered that they somewhat or strongly agreed with this statement. The mean score of Reported Performance was 2.75 ($SD = 1.05$) on a scale of 1 to 4. The results of the study showed that air traffic controllers who perceived that music improved their performance also scored higher on the Music-Related Performance scale, in which factors such as focus, distraction from unwanted thoughts, and pacing were measured, $\beta = .410$, $p<.001$. This aligns with previous findings related to other high-stress occupations, such as that surgeons benefit from listening to music in terms of task performance quality, time to task completion, and instrument handling when performing laparoscopic surgery (Oomens et al., 2019).

Music Permissibility

Most participants believed that music should be allowed at work (76.67%) by stating that they either somewhat or strongly agreed, while only 9.52% strongly disagreed. The mean score was 3.14 (*SD* = .98) on a scale of 1 to 4. The results of a regression analysis showed that as Music Permissibility increased, Music-Related Performance also increased, β = .363, p<.001. It appears that those who believed that music should be allowed at work also reported to benefit from music during air traffic control settings.

Oversight Responsibility

A majority of respondents agreed with the statement that the FAA and DOT have a responsibility to ensure an environment and culture that reduces stress at work. Specifically, 72.86% strongly agreed, while 20.95% somewhat agreed. The participants scored particularly high on this scale, with a mean of 3.63 (*SD* = .70) on a scale of 1 to 4. The participants who believed that the FAA and DOT had a responsibility to reduce a culture of stress had higher Music-Related Performance scores, β = .203, p =.004. As such, the general agreement that the FAA and DOT have this responsibility may imply that air traffic controllers believe oversight organizations have an ability to influence the stress levels of air traffic controllers and implement strategies, which in turn may reduce stress and thus increase performance. According to this result, respondents agreed that air traffic controllers view oversight structures such as the FAA and DOT as having power to reduce stress in a way that aligns with ethical considerations towards employee wellbeing and health. One participant stated that there was a feeling of, "pressure that comes from the un-winnable situations the FAA constantly puts us in". Participants also felt their concerns over stress were not being properly addressed: "Air Traffic itself does not stress me out but the schedule, coworker/management relations, and lack of

concern from management as a whole about some issues ie. Staffing levels, transferring process, and working conditions." Research has shown that a lack of acknowledgement can contribute to ethics-induced stress, which is associated with organizational conflict, job dissatisfaction, and employee turnover (Menzel, 1996).

It appears that participants who believe that oversight organizations have a power to improve stress levels may also believe that stress can be modifiable. A person with a growth mindset views abilities and talents as malleable and capable of improvement, while those with a fixed mindset view them as unchanging and stable over time (Mangels et al., 2006). Participants of a growth mindset may take the action to use music as a tool to decrease their stress levels, in turn showing that music increases their performance. On the other hand, participants who do not believe that oversight organizations have the responsibility to reduce stress may simply believe stress in an inherent factor that cannot be changed, and do not pursue possible interventions such as music listening. Individuals with a fixed mindset are often vulnerable to negative feedback and tend to withdraw from learning opportunities (Mangels et al., 2006). Studies have shown that having a growth mindset corresponds with significant changes in performance among many professions, including computer programming (Cutts et al., 2010). Future research may evaluate the usefulness of understanding fixed versus growth mindsets among air traffic controllers in order to best understand opportunities for occupational improvements.

Preferred Music Listening Frequency

When participants were asked how often they listen to their preferred music at work, the greatest proportion answered "Sometimes" (41.98%). The participants who answered "Never" were 16.98%, those who answered "About half the time" were 11.32%, those that answered "Most of the time" were 23.11%, and those who answered "Always" were 6.60%. The mean of

Preferred Music Listening Frequency was 2.60 (*SD* = 1.20) on a scale of 1 to 5. Lesiuk (2008) showed that air traffic controllers found preferred music listening as being enjoyable as a stress reduction method. Lesiuk also noted that air traffic controllers, "reported music as helpful in refreshing oneself for the next work period" when the music was their preferred choice. A study by Miskovic and colleagues (2008) similarly found that surgical performance was improved among junior surgeons prior to laparoscopic surgery when they listened to music that they perceived as pleasant.

Oversight Assessment

Only 2.38% of participants strongly agreed that the FAA and DOT have done a good job promoting health and wellbeing among air traffic controllers, while 11.43% somewhat agreed. While 29.52% somewhat disagreed with this statement, the majority of participants strongly disagreed (56.67%). The mean score or Oversight Assessment was particularly low compared to the other predictive variables, with a mean of 1.60 (*SD* = .78) on a scale of 1 to 4. However, Oversight Assessment was not related to Music-Related Performance. Although participants believed that the FAA and DOT have not done enough to ensure wellbeing and health in their profession, the data appear to show that this belief among air traffic controllers does not predict Music-Related Performance.

Stress in Air Traffic Control

One pathway towards high stress among air traffic controllers is mental workload. Most of the air traffic controllers somewhat agreed that air traffic control is stressful (66.13%), while 15.32% strongly agreed. Interestingly, 15.73% somewhat disagreed, while 2.82% strongly disagreed. The participants scored a mean of 2.96 (*SD* = .651) on a scale of 1 to 4. In a moderately high-stress occupation sample of computer information systems developers, music

was found to have enhanced mood via positive affect. However, this does not account for individual differences, such as personality types, mood experiences due to personal traits, and trends within music listening (Lesiuk, 2009). Borghini and colleagues (2020) note that decreases in productivity can occur not only when mental workload is high, but also when it is low because of effects of isolation and monotony. Borghini et al. (2020) describe low stress conditions as those leading to processing unfamiliar information or complex procedures without any time constraints as another factor of low productivity. Based on these results, air traffic controllers experience high degrees of mental workload, as they reported that they experience a "loss of control" and stress from an accumulation of insurmountable tasks. Aligned with previous studies, these findings suggest that ensuring that the air traffic controller is not affected by isolation and monotony, perhaps by providing an ameliorative coping technique such as music listening (Hanser, 1985), is important for optimal productivity. Alternative methods to reduce stress in a workplace setting include increasing coping and physiological responses (Muchinsky, 1990). Additionally, listening to music has been shown to be a moderator of stress and resilience, and has the ability to significantly increase coping and social integration; as such, it can be argued that music is a mitigating coping factor that may increase other coping strategies (Robb, 2000). Overall, the reports that air traffic controllers experience high degrees of stress, which warrant an immediate intervention for coping strategies. Additionally, the quantitative data shows that air traffic controllers report that music is an effective strategy to increase occupational performance. As such, if music were to be permissible at a group-level, all air traffic controllers in the immediate environment would have to be in agreement that music enhances their performance, rather than detracts from it.

Qualitative Responses to Air Traffic Control and Stress

For the first open-ended question, the qualitative analysis showed that air traffic controllers are highly stressed in their work and work environment. Participants noted that stress came up in settings where it was difficult to pay attention in situations wherein they lacked a sense of control. Second, participants used words such as being “overwhelmed”, “exhausted”, “emotional”, “discomfort”, “unease”, “weighted”, “consequences”, and “worried”. The reasons why air traffic controllers appeared to be stressed was often due to feelings of anxiety or anticipation, and feeling panicked about the task at hand. Air traffic controllers had to handle multiple tasks at hand which may seem like an unmanageable burden. One participant noted that there was a, “feeling of multiple things that need to get done in a very short amount of time. Each decision made must be correct to maintain or lower the current stress level. The wrong decision/outcome can lead to additional stress”. This is significant because, within an air traffic control environment, a loss of situational awareness, presents a concern for safety, especially for this sector (Dekker, 2015; Li et al., 2018).

Air traffic controllers experience state anxiety, which is a psychological manifestation of stress according to the qualitative results. Stress is an “unpleasant emotional experience, a transitory emotional condition or feeling state that is characterized by subjective, consciously perceived feelings of tension and apprehension, and heightened autonomic nervous system activity” (Lesiuk, 2008, p. 2). The results of the quantitative and qualitative data show possible intervention techniques including guided imagery, music listening, and progressive muscle relaxation to music may help air traffic controllers reduce stress (Robb, 2000); specifically, music may decrease and even prevent anxiety. The results of this study suggest that music does not have a reported sedative role in the mitigation of stress and anxiety. In line with this finding,

neuropsychological research has showed that it allows for better processing of emotional responses (Trainor & Schmidt, 2003).

Physiological stress is also a concern for air traffic controllers, both as a risk to themselves as well as public safety. Air traffic controllers experienced many physiological changes as a consequence of stress while working. Participants reported feeling tightness in their neck, high blood pressure, high heart rate, foot tapping, shallow breathing, and quickened breath. These issues may also be compounded by a lack of rest and sleep among air traffic controllers. One participant stated that there was an experience of, "constant vigilance, worry and double-checking for possible mistakes made, combined with abnormal sleep patterns or outright lack of proper sleep". Lesiuk examined air traffic controllers' physiological factors such as blood pressure, mean arterial pressure, and heart rate when comparing their response to music while working in a music listening group and control group (2009). Although this study did not examine physiological responses to stress, these results correspond with findings that air traffic controllers are highly impacted by stress-induced responses while working live air traffic (Lesiuk, 2009).

Feelings About Music Listening

Question 2 asked air traffic controllers to report reasons why not to allow music at work. The respondents noted that certain work environments, such as heavy air traffic volume and large control rooms may not be conducive to music. For example, one participant stated that the "Operation floor isn't conducive to having music played (large TRACON), music would have to be too loud for all to hear". It is also possible that not all music is conducive to air traffic control, particularly when listening to non-preferred music, and music at a loud volume. Another respondent stated, "I view music as nothing more than annoying noise. The last thing I want to

deal with while I work traffic is noise pollution". As such, the results show that certain types of music, volumes, and environments are not conducive to increased performance and decreased stress among air traffic controllers.

Strategies for Music Listening

The third qualitative asked participants to share any additional thoughts related to air traffic control, stress, music, and performance. The results point to a possible strategy for receiving the benefits of music while avoiding issues with distractions related to music; this may be to ensure that all controllers in an environment agree to a music genre, that the music is non-invasive, and that the music is at a low volume. Music that was in a minor key, high complexity, fast tempo, and high volume setting impaired working memory and inhibitory control (Keeler & Corina, 2020). Participants noted that non distracting music such as instrumental, ambient, orchestral, symphony, and "robotic" music could improve the mood, atmosphere, and focus among air traffic controllers. Many air traffic controllers noted that music played at a low volume would be helpful and not distracting in a working environment. Helpful music was described as being "ambient noise" and "white noise" that could possibly enhance situational awareness. One participant stated, that instrumental music, "adds to moral and perhaps even enhances my awareness due to my upbeat demeanor". In agreement with these findings, prior studies also showed that plastic surgery residents and neurosurgeons also improved the quality of their suturing and surgical closures in less time when they listened to meditation music (Lies & Zhang, 2015; Muhammad et al., 2015). As such, more research could be conducted to ascertain whether instrumental, "ambient" music may be beneficial to performance in an air traffic control environment.

Even with music playing in the background at a reasonable volume prior to 2006, other controllers must discern when another controller was in need of assistance while working live traffic talking to pilots. Voice inflection change in this setting is usually a combination of pitch increasing as well as faster speech. The participants described this phenomenon in the qualitatively collected questions. This is also true when a pilot's voice changes. At times, pilots may be fearful to declare an emergency or ask for assistance because they are worried about it leading to other unmanageable tasks or other repercussions when asking for help. However, air traffic controllers can hear their voice inflections, increased rates of speech, and changes in pitch and become further stressed (Levitin et al., 2018). With music on in the background, one's ability to habituate between passive listening and active listening to others may be possible, while also covering dead air. This is evidenced because air traffic controllers must already "drown out" the voices of others, until it is time to become alerted to changes in timbre and loudness to realize that they possibly need assistance. As such, this is a possible reason why listening to music may not remove or interfere with this valuable technique of detecting an upcoming dangerous situation among air traffic controllers.

At the base of this thesis, integral questions must be raised: (1) Can air traffic controllers distinguish between music frequencies and the operational information being transmitted through human voices?; (2) Is music beneficial to one's mood, thus determining state anxiety and stress? Many facets of these questions have been parsed through decades of research studies, with this research compiled by cognitive psychologist, neuroscientist, and musician Daniel Levitin. Levitin (2016) states:

> Almost all of us, even without musical training, can tell if a singer is offkey; we might not be able to say whether she is sharp or flat,

> or by how much, but after the age of five, most humans have as well a refined ability to detect tones that are out of tune as to discriminate a question from an accusation (in English, a rising pitch indicates a question, a straight or slightly falling pitch indicates an accusation). This comes from an interaction between our exposure to music and the physics of sound. What we call pitch is related to the frequency or rate of vibration of a string, column of air, or other physical source. If a string is vibrating so that it moves back and forth sixty times in one second, we say that it has a frequency of sixty cycles per second. The unit of measurement, cycles per second, is often called Hertz (p. 20).

Overseeing bodies may operate from the assumption that air traffic controllers may not be able to simultaneously process music and human voices in a complex air traffic control environment. However, Levitin (2016) argues that the human brain is capable of distinguishing sound complexity:

> A typical chord is built by playing the first, third, and fifth notes of a scale together. Because the sequence of whole steps and half steps is different for minor and major scales, the interval sizes are different for chords taken in this way from the two different scales… All of us, even without musical training, can tell the difference between these two even if we don't have the terminology to name them; we hear the major chord as sounding happy and the minor chord as sounding sad, or reflective, or even exotic (p.40).

An element that air traffic controllers reported as being a problematic feature for music listening while working was volume. While the greatest reason given for why music shouldn't be allowed on the job was that it was “distracting”, when specifying reasons why, a large portion believed that volume and intensity contributed to this issue. Levitin (2016) notes that:

> Loud music saturates the auditory system, causing neurons to fire at their maximum rate. When many, many neurons are maximally firing, this could cause an emergent property, a brain state qualitatively different from when they are firing at normal rates. Still, some people like loud music, and some people don’t. Loudness is one of the seven major elements of music along with pitch, rhythm, melody, harmony, tempo, and meter. Very tiny changes in…loudness have a profound effect on the emotional communication of music. A pianist may play five notes at once and make one note only slightly louder than the others, causing it to take on an entirely different role in our overall perception of the musical passage. Loudness is also an important cue to rhythms, as we saw above, and to meter, because it is the loudness of notes that determines how they group rhythmically (p.71).

To illustrate this point in an operational setting, when an air traffic controller listens to a co-worker talking to an aircraft, another will take notice even though their voice becomes slightly or incrementally louder, immediately grabbing the others’ attention. When music is playing in the background, one may simply tune it out, and focus on what other controllers are saying; thus, they determine if others are need of assistance to accommodate a pending or actual

emergency situation with an aircraft. This is also true for pilots; in addition to the previously stated voice inflection, changes with the loudness or softness of a pilot's voice often precludes or indicates a stressor or emergency situation.

Humans are capable of differentiating between music and human voices. Levitin (2016) notes that a central function, "even if we are nonmusicians, is recognizing familiar chord progressions, even in the absence of the well-known melody…Related to the topic of scales and major and minor is the topic of tonal consonance and dissonance" (p.73). Because of one's ability to instantly recognize a song, even coming from a distorted source, music could be the great compromise between the complaints about music mentioned in the qualitative answers, resulting in a low to no cost mitigation solution.

In order to understand the possible benefits of music to air traffic controllers, overseeing bodies must fully discern: (1) Is the specific music too simple or too complex?; (2) What sounds are predictable and what sounds are challenging for the music listener? To separate unpleasant versus pleasant sounds, research finds that there are solutions. Levitin (2016) states that:

> Musicians refer to the pleasing-sounding chords and intervals as consonant and the unpleasing ones as dissonant. A great deal of research has focused on the problem of why we find consonant some intervals and not others, and there is currently no agreement about this. So far, we've been able to figure out that the brain stem and the dorsal cochlear nucleus—structures that are so primitive that all vertebrates have them—can distinguish between consonance and dissonance; this distinction happens before the higher level, human brain region—the cortex—gets involved. Although the neural

> mechanisms underlying consonance and dissonance are debated, there is widespread agreement about some of the intervals that are deemed consonant (p.74).

This idea is central to the question about music preference. Levitin (2016) notes that:

> A single note cannot, by itself, be dissonant, but it can sound dissonant against the backdrop of certain chords, particularly when the chord implies a key that the single note is not part of. Two notes can sound dissonant together, both when played simultaneously or in sequence, if the sequence does not conform to the customs we have learned that go with our musical idioms (p.75).

A large portion of air traffic controllers noted that certain types of music, which provide consonant sounds, may improve the morale and focus among those in their work environments. However, not all music genres and music volumes may be helpful. An important finding from this study was that (1) preferred music, (2) those instrumental in nature, and (3) music types agreed upon by all workers may be beneficial to productivity among air traffic controllers. Research has shown that, "Current neuropsychological theories associate positive mood and affect with increased dopamine levels, one of the reasons that many of the newer antidepressants act on the dopaminergic system. Music is clearly a means for improving people's moods" (Levitin, 2016, p. 191). Additionally, Levitin (2016) notes that, "Music, or any art form for that matter, has to strike the right balance between simplicity and complexity in order for us to like it. Simplicity and complexity relate to familiarity, and familiarity is just another word for a schema" (p. 235). With more research on music preferences and air traffic controller performance, overseeing bodies may examine strategies to increase music-related performance, and add to

broad performance improvements widely reported by the participants in this study. Finally, the results show that music may mitigate the status of handling insurmountable workload tasks in congruence with psychophysiological states among air traffic controllers. Levitin (2016) notes that:

> Safety plays a role for a lot of us in choosing music. To a certain extent, we surrender to music when we listen to it—we allow ourselves to trust the composers and musicians with a part of our hearts and our spirits; we let the music take us somewhere outside of ourselves (p. 242).

Limitations

The nature of the independent and dependent variables was self- reported Music-Related Performance responses. Therefore, data related to physiological markers of stress were not available in this analysis, leaving less concrete evidence for music-related performance improvements among air traffic controllers. Additionally, many of the measures involved in the study produced non-normal distributions when analyzed through a frequency analysis. For example, the quantitative results showed that males report that music does not increase Music-Related Performance to the same extent as females. However, the small sample size of females in relation to men make this finding difficult to conclude, as the results were not statistically significant (p = .058). As such, future research must isolate the two genders in a more balanced way in order to fully understand these effects. The regressions used to examine the hypotheses did implement bootstrapping as a nonparametric approach that is less dependent on symmetrical sampling and normal distributions in comparison to traditional parametric tests (Preacher & Hayes, 2008). However, the results of this study should be interpreted with caution. The

researcher did prompt the participants to give reasons why music should not be allowed in an air traffic control environment. Without this qualitative measure, the results may have appeared to show a greater acceptance and perceived support for music listening at work among air traffic controllers.

Directions of Future Research

Future studies that investigate the individual differences and mood responses to music are needed to understand how performance may be impacted by music in high stress occupations. For example, a future study could compare the interaction of music, stress, and performance among different types of high stress occupations, such as air traffic controllers and information technology workers (Lesiuk, 2005; 2008). Additional research is needed to understand the psychological factors within air traffic control that could inform music therapy professionals in ways to assist those in high stress occupations. Since the results showed that males were less likely to report that music improved factors such as work-related focus, pacing, and other indicators of performance, future research should also examine gender differences between music-related performance among air traffic controllers and other high-stress occupations. Since the data showed non-normal distributions of demographic factors such as gender that led to differences between Music-Related Performance, future studies should increase the number of females in the sample in order to more aptly differentiate the meaning behind these findings that approached significance. Future interventions may have to consider demographic variables, among other such as personality type, to conclude whether music is an effective treatment for stress among a broad range of air traffic controllers.

Implications

In a systematic review, researchers found that music is an economical, non-pharmacological, simple, and non-invasive intervention to prevent occupational stress and burnout among highly-stressed professionals (Rastipisheh et al., 2019). The results of this study show that music may not be capable of providing a global treatment; although, the findings suggest that, given the reported increases in work performance, it may have a robust effect on the rebuilding of connections between different brain regions and neural networks (Sihvonen, et al., 2017). However, it is widely accepted that music can increase neuroplasticity in the brain. For example, the brains of musicians exhibit structural differences compared to others, which align with the functional application of music listening in the context of neuroplasticity (Herholz & Zatorre, 2012; Kraus & Chandraskeran, 2010; Schlaug, 2001).

Although the results of this study show that music listening may enhance music-related productivity, there is still much room for error within air traffic control facilities if not properly implemented. For example, the overall results of this study do not account for individual differences in music related performance response and music preferences (Lesiuk, 2009). Therefore, music may be an effective and no-cost intervention to improve performance and reduce stress among air traffic controllers if there is agreement about the genre, volume, and helpfulness towards working among all working in the same air traffic control environment. If implemented properly, the results of this study show that music could possibly improve performance and reduce stress if measures were taken to ensure those listening benefit from its effects. The results of this study show that a majority of air traffic controllers believe that overseeing bodies have a responsibility to ensure a working environment that promotes health and wellbeing, with a reduction of stress. In 2016, the FAA wrote, “Between the hours of 10:00

PM and 6:00 AM, radios and appropriate printed reading material will be permitted in operational areas, as traffic permits. The operation of weather radios shall be permitted in operational areas". Small changes to music listening permissibility have shown that the FAA is open to changing policies if shown that they are in the best interest for the air traffic control personnel and the public. If air traffic controllers showed small performance improvements after the implementation of this measure, a broader allowance for music listening may produce performance improvements on an even wider scale.

Summary

The purpose of this study was to examine the interactions between music listening, stress, and performance among air traffic controllers. The research questions included: (1) What is the relationship between air traffic controller perceived performance and music listening?; (2) What is the relationship between air traffic controller stress level and music listening?; (3) Should music listening be considered an ethical and/or effective solution to improve emotional and physiological outcomes among air traffic controllers? The results showed that as ratings increased for (1) agreement that participants listened to music while working, (2) time spent listening to music; (3) beliefs that music improved work performance, (4) beliefs that music should be allowed at work, (5) beliefs that the FAA and DOT have a responsibility to reduce stress; (6) preferred music listening frequency, and (7) experiencing stress during air traffic control increased, Music-Related Performance also significantly increased. However, the extent to which participants agreed that oversight organizations have done a good job at ensuring health and wellbeing among air traffic controllers did not affect Music-Related Performance. A qualitative analysis showed that air traffic controllers reported a range of stress symptoms, varying from emotional to physical responses. While some participants felt that music should not

be permissible while working live air traffic and in certain work environments, others felt that music reduced stress, improved morale, and enhanced coordination and focus in an air traffic control setting. Through these reported increases of performance as a direct result of music listening, these findings indicate that music therapy may increase awareness to these neurobiological processes. Therefore, further research is needed in order to understand this expression and avoid cyclical traumatization such as that associated with auditory stimuli in air traffic controllers (Benismon et al., 2008). The results of this study show that oversight organizations for air traffic control may have an ethical responsibility to reduce stress-induced emotional and physical symptoms among employees. However, more research is needed to uncover how music listening interventions may possibly be effective in an air traffic control environment.

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APPENDIX

Access to Music among Air Traffic Controllers:

Perceptions, Performance, and Ethics

All surveys are anonymous.

1. To what occupation category (currently or previously) do you belong?

Check all that apply.

Federal Aviation Administration (FAA) Air Traffic Controller

Federal Contract Tower (FCT) Air Traffic Controller

Department of Defense (DOD) Air Traffic Controller

U.S. Military (All branches) Air Traffic Controller

2. What is your work status with respect to Air Traffic Controlling?

Current Air Traffic Controller

Retired Air Traffic Controller

Former Air Traffic Controller but not retired

3. How many years of experience do you have working as an Air Traffic Controller?

(Total years at all air traffic control facilities)

1-5 years

6-10 years

11-15 years

16-20 years

21-25 years

26-30 years

31-35 years

36-40 years

41+ years

4. Please select the type of air traffic control facility you work in or have worked at:

Check all that apply

Tower (ATCT)

Center (ARTCC)

Terminal Radar Approach Control (TRACON/RAPCON)

Combined Tower/ TRACON (Up/Down) or TRACAB

Traffic Management Coordination (TMU/ ATCSCC)

5. Of the air traffic control facilities you selected in the previous question, which are open 24 hours?

Check all that apply.

Tower (ATCT)

Center (ARTCC)

Terminal Radar Approach Control (TRACON/RAPCON)

Combined Tower/ TRACON (Up/Down) or TRACAB

Traffic Management Coordination (TMU/ ATCSCC)

6. Please indicate the degree to which you agree with this statement:

Air Traffic Control is stressful.

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

7. What is your age?

18-20

21-25

26-30

31-35

36-40

41-45

46-50

51-55

56-60

61-65

66-70

71+

8. Do you identify as:

Female

Male

Neither Identify

I choose not to say

9. How many years of education have you completed?

12 years (High school)

12-16 years (College)

17+ years (Graduate school)

10. Please answer this question in 1 to 3 sentences.

Can you describe what 'stress' is for you?

……

11. Please indicate the degree to which you agree with this statement:

I listen to music while working.

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

12. Thinking about your working week, approximately how many hours do you spend listening to music at work?

0-5 hours

6-10 hours

11-15 hours

16-20 hours

21-25 hours

26-30 hours

31-35 hours

36-40 hours

41+ hours

13. How many hours do you work per week on average, including overtime as an Air Traffic Controller?

0 - 40 hours

41-48 hours

49-56 hours

57+ hours

14. What type of music do you prefer to listen to in your workplace?

Check all that apply.

Art (Classical)

Avant-garde and Experimental

Blues

Country

Easy Listening

Electronic (e.g. Dub, EDM, House, Techno, Trance)

Contemporary Folk

Hip-hop (e.g. Rap)

Jazz

Pop

Rhythm & Blues and Soul (e.g. Alternative R&B, Funk)

Rock (e.g. Alternative Rock, Metal, Punk)

Regional (e.g. African, Eastern Europe, Asian, Caribbean and Caribbean-influenced, Latin)

Religious

Traditional Folk

Other

15. Who picks the music to listen to at work <u>on the operational control floor</u> while providing air traffic control services or any of its related functions during the Day, Swing, or <u>Mid-Shift</u>)? Include your experience from all facilities worked.

*****Survey responses are anonymous*****

Check all that apply.

Anyone

First person to arrive in the area

The person with most seniority

The person with the highest workload

I'm the only person in the room/ area

Me- as I listen to music through headphones/ earphones/ earbuds

Owner of the music equipment (Other than headphones/ earphones/ earbuds)

No one because music listening is prohibited on the operational control floor at all times (including the Mid-shift) at my facility**.**

16. Who picks the music to listen to at work in places <u>other than the operational control floor</u> (e.g. breakroom, lunchroom, other common areas)? Include your experience from all facilities worked.

Check all that apply.

Anyone

First person to arrive in the area

The person with most seniority

I'm the only person in the room/ area

Me- as I listen to music through headphones/ earphones/ earbuds

Owner of the music equipment (Other than headphones/ earphones/ earbuds)

17. Answer the extent to which you agree with these statements.

*****Survey responses are anonymous*****

I listen to music:

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

-While working live air traffic on the Day and Swing Shifts (6AM to 10PM)

-While working live air traffic on the Mid Shift (10 PM to 6 AM)

-During Computer-Based Instruction/ training (CBI, eLMS, CEDAR required read items)

-During breaks or relaxing

18. Answer the extent to which you agree with these statements.

Listening to music at work:

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

-Improves my focus

-Helps me relax

-Improves my mood

-Makes me less bored

-Distracts me from unwanted thoughts

-Blocks out surrounding noise

-Makes me less tired

-Makes me happier

-Helps my creative flow

-Inspires/stimulates me

-Provides a different perspective

-Helps me pace my work

-Creates a suitable atmosphere

19. Please answer the extent to which you agree with the following statements.

I listen to music at work when:

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

-I'm alone

-I'm in an open office/public space

-With colleagues

-I use headphones/ earphones/ earbuds only

20. How often do you listen to preferred music at work?

(1= Never; 2 = Sometimes; 3 = About half the time; 4 = Most of the time; 5 = Always.)

21. Please answer the extent to which you believe in this statement:

I believe my performance is improved by music being allowed at work.

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

22. Please answer the extent to which you believe in this statement:

I believe music should be allowed at work.

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

23. Please answer the extent to which you believe in this statement:

The Federal Aviation Administration (FAA) and Department of Transportation (DOT) have a responsibility to ensure that Air Traffic Controllers have an environment and culture that reduces stress.

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

24. Please answer the extent to which you believe in this statement:

The FAA and DOT have done a good job to promote health and wellbeing among Air Traffic Controllers.

(1= Strongly Disagree; 2 = Somewhat Disagree; 3 = Somewhat Agree; 4 = Strongly Agree).

25. Are there any reasons why you wouldn't listen to music in the workplace?

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26. Please tell us any additional information or comments that you would like to add in relation to music listening in the workplace.

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