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INDIVIDUALIZED THERAPEUTIC COMPOSITION AS A METHOD OF IMPROVING SLEEP QUALITY IN COLLEGE STUDENTS

NICHOLAS J. LANZ

102 Pages

The life of a college student is often bombarded with circumstances, emotions, and decisions that produce stress and anxiety, affecting sleep quality and daily function. Listening to music designed for relaxation has the potential to decrease stress and improve factors of healthy sleep quality. The purpose of this study was to explore the effects of listening to music uniquely composed for each individual on stress relief and sleep quality in college students. The music therapy intervention utilized in this study was individual composition sessions. The researcher met with each participant individually to compose an instrumental piece of music that was unique to them based on their preferences. The researcher used audio recording and mixing software to create individual audio tracks that were given to each participant. Data collection took place over a four-week period, two weeks for baseline data collection and two weeks for treatment data collection with the implementation of the music. Surveys were administered daily for participants to record their sleep quality and overall wellbeing. After data collection was complete, the researcher conducted an interview with each participant to collect feedback on the experience. Results on sleep quality were mixed, with reports of feeling like overall sleep quality didn't increase, but factors of positive sleep quality increased, such as prolonged deep sleep, less time spent falling asleep, and the ability for the brain to un-focus more easily and calm down. Creating individualized music demonstrates the potential to decrease stress, promote relaxation,

and increase positive factors of sleep quality. With further research, this intervention may also be developed as a viable Music Therapy service to be offered in the future.

KEYWORDS: College; Composition; Music; Sleep; Stress

INDIVIDUALIZED THERAPEUTIC COMPOSITION AS A METHOD OF IMPROVING
SLEEP QUALITY IN COLLEGE STUDENTS

NICHOLAS J. LANZ

A Thesis Submitted in Partial
Fulfillment of the Requirements
for the Degree of

MASTER OF MUSIC

Wonsook Kim School of Art

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2023

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CHAPTER I: INTRODUCTION

The efficiency of the human body's function relies heavily on receiving quality sleep. Current data suggest that sleep positively influences biological processes such as neural plasticity and memory (Abel, Havekes, & Saletin, 2013), emotional regulation (Baron et al., 2012), metabolic functions and energy balance (Schmidt, 2014), synthesis of macromolecules (Mackiewicz, 2007), removal of toxic substances and metabolic waste (Xie, 2013), and preventative cellular maintenance (Vyazovskiy & Harris, 2013). There are a number of disorders that cause sleep deprivation, including insomnia (Chokroverty, 2010; Morin et al., 2015), circadian rhythm sleep disorders (Sateia, 2014; Chokroverty, 2010), sleep apnea (Chokroverty, 2010; Pavlova & Latreille, 2019), hypersomnia/narcolepsy (Chokroverty, 2010; Dauvilliers & Barateau, 2017; Sateia, 2014), parasomnias (Chokroverty, 2010; Pavlova & Latreille, 2019), and restless-leg syndrome/periodic limb movement disorder (Chokroverty, 2010; Innes, Selfe, & Agarwal, 2011). Sleep deprivation creates both short-term and long-term consequences. Short-term consequences include impaired attention and concentration, decreased quality of life, increased rates of absenteeism, decreased productivity, and increased risk of accidents. Long-term consequences of sleep deprivation include increased risk of car accidents, coronary heart disease, heart failure, high blood pressure, obesity, type II diabetes, stroke, memory impairment, and depression (Pruitt, 2010). Additionally, a compounding habit of lack of sleep contributes to increases in stress and anxiety levels which, in turn, negatively affects sleep quality (Nollet, Wisden, & Franks, 2020).

Stress & Anxiety in College Students

The life of a college student is often bombarded with circumstances, emotions, and decisions that produce stress and anxiety. The increased academic load, social situations, and

personal issues that arise increase the likelihood of anxiety, depression, hopelessness, sleep disturbances, headaches, and sometimes contemplations of suicide (O'Donovan & Hughes, 2008). Balancing between work and academic responsibilities has also been shown to increase stress and anxiety (Sprung & Rogers, 2021). Pierceall & Kiem (2007) gathered data from 212 college students using the Perceived Stress Scale and found that 75% were in a moderate stress category, 12% were in a high stress category, and 13% were in a low stress category. During the COVID-19 pandemic, a study examining stress and anxiety levels of undergraduate college students in Kentucky showed that, of the 1,412 surveyed, approximately 88% of students reported moderate to severe stress levels, 44% showed moderate to severe anxiety, and 36% showed moderate to severe depression (Lee, Jeong, & Kim, 2021). Additionally, rates of anxiety in college students increased by 5.9% and rates of depression in college students increased by 3.2% between 2009 and 2015 (Oswalt et al., 2020). Similarly, the Center for Collegiate Mental Health (2021) reported that scores for depression, general anxiety, and social anxiety have consistently increased between 2012 and 2020 for those who have visited counseling centers on college campuses. Other research has shown that anxiety and depression are the two most common mental health issues that have increased among college students, including both undergraduate and graduate students (Mahmoud, Staten, Hall, & Lennie, 2012; Hart Abney, Lusk, Hovermale, & Melnyk, 2019; American College Health Association, 2018; Hyun, Quinn, Madon, & Lustig, 2006; Dixon & Kurpius, 2008; Koops & Keubel, 2021). As a result, these physiological and psychological issues, as well as emotional and academic stress, negatively impact sleep (Lund et al., 2010).

Treatments for Stress & Anxiety in College Students

Many different methods have been utilized as a means of treating anxiety, stress, and other mental health issues in college students. Campus-based mental health programs are grouped into two categories. Gatekeeper trainings are the first, which are focused on prevention and early intervention. These trainings are suicide prevention programs that train participants to recognize symptoms of psychological distress in individuals they interact with and to encourage them to seek further help (Substance Abuse and Mental Health Services Administration, 2021). Second are clinical interventions, including mindfulness-based stress reduction (MBSR), Acceptance and Commitment Therapy, Cognitive Behavioral Therapy (CBT), and Dialectical Behavior Therapy (Substance Abuse and Mental Health Services Administration, 2021). Other methods include meditation (Burns, Lee, & Brown, 2011), counseling and biofeedback (Ratanasiripong, Sverduk, Prince, & Hayashino, 2012), incorporation of simple mindfulness techniques taken from MBSR (Call, Miron, & Orcutt, 2014), emotional support animals (Von Bergen, 2015), online-facilitated mindfulness-based art therapy (Beerse, Van Lith, & Stanwood, 2019), and music listening (Oxtoby, Sacre, & Lurie-Beck, 2013; Osmanoglu & Yilmaz, 2019; Hernandez-Ruiz, 2022; Fiore, 2018; Lee et al., 2016; Ferrer et al., 2014; Gurgen, 2016).

Music-Based Interventions for Stress & Anxiety Reduction

Overview of Music Therapy

The American Music Therapy Association defines music therapy as “the clinical & evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program” (American Music Therapy Association, 2005). With music therapy, a variety of goals can be addressed including but not limited to promoting wellness, alleviating pain,

managing stress, expressing feelings, memory enhancement, improving communication, and improving physical rehabilitation.

The Bonny Method of Guided Imagery & Music

The Bonny Method of Guided Imagery and Music (GIM) utilizes specifically sequenced music, typically from the Western classical style, to elicit “imagery and emotional expression” (Burns, 2001). To use this method with clients, a music therapist must undergo specific training and certification. A typical session begins with a preliminary discussion between client and therapist to highlight relevant issues and to bring focus to the session. The music therapist selects Western-style classical music based on its ability to induce relaxation and aid the client in exploring their subconscious. While listening, the client explores and connects with any deep feelings, memories, emotions, and shares any spontaneous imagery that may have surfaced with the therapist, who in turn helps the patient process, explore, and engage that imagery (McKinney & Honig, 2017; Bonny, 2002). A variety of clinical and nonclinical settings utilize GIM, including treatment for mood disturbances (Körlin & Wrangsjö, 2002), trauma (Clementes-Cortes, 2014; Pickett, 1995), addiction (Borling, 1992), bereavement (Creagh, 2005), cancer care (Bonde, 2005; Hale, 1992), spiritual development (Bruscia, 2002), creativity (Mardis, 2005), medical conditions (Jacobi & Eisenberg, 2001; Merritt, 1993), end of life (Cadrin, 2009; Marr, 1998), and coping with major life events (McKinney, 1993).

Music-Assisted Relaxation

Music-assisted relaxation (MAR) utilizes either live or recorded music and spoken instructions to instill a state of deep relaxation in the patient (Calvary Health Care). There have been significant reductions in anxiety shown with the use of MAR (Hernandez-Ruiz, 2005; Pelletier, 2004; Smythe, 2002; Scheufler, Wallace, & Fox, 2021; Jespersen & Vuust, 2012).

Hernandez-Ruiz (2005) found that women who suffered from domestic violence had higher levels of anxiety and sleep disturbances while at a shelter. Using a music therapy intervention that incorporated progressive muscle relaxation, results showed that the intervention was effective in reducing anxiety levels and improving sleep quality in these women.

Jespersen & Vuust (2012) conducted a music and relaxation study at a camp for refugees. Participants in the intervention group were given a bed with an ergonomic pillow with speakers on either side of the pillow for an immersive experience. The pre-recorded music was intended to be soothing and de-stressing. Results showed that sleep quality as well as overall well-being was higher for the refugees that participated in the music and relaxation intervention.

A study by Scheufler, Wallace, & Fox (2021) investigated the effect of three different music therapy interventions on anxiety and relaxation levels in youths 10-18 years old participating in an intensive interdisciplinary pain treatment program. All three interventions, active music engagement, preferred music listening, and music-assisted relaxation, were effective in decreasing anxiety and increasing relaxation levels in pediatric patients with amplified pain syndromes.

Music-assisted relaxation can also be used in medical settings. Individuals in an ICU unit were treated with music-assisted calming techniques who were on mechanical ventilatory support and dealing with pain. A music therapist guided the patients through relaxation exercises which helped them ground themselves and feel more control in a seemingly helpless situation (Smythe, 2002).

Music Listening

Music listening can have short-term effects on psychological and physiological function (Thoma et al., 2012). In an internet survey of university students, Thoma et al. (2012) found that

habitual music listening was associated with “reducing loneliness and aggression” and “arousing or intensifying specific emotions.” Although, music-listening still appeared to be a multi-faceted behavior further influenced by variables not always related to music listening (Thoma et al., 2012).

Classical and other sedative music has been shown to be an effective aid in reducing anxiety, increasing sleep quality, and decreasing depressive symptoms (Harmat, Takács, & Bodizs, 2008; Chen et al., 2014; De Niet et al., 2009; Chan, Chan, & Mok, 2010; Wang, Sun, & Zang, 2014; Kavurmaci, Dayapoglu, & Tan, 2019; Knight & Rickard, 2001). Using polysomnography, Chen et al., (2014) showed that original sedative music improved sleep quality in university students by prolonging deep sleep. Participants were divided into two groups: short sleep latency and long sleep latency. Two board-certified music therapists composed the sedative music on the piano using a pentatonic scale in a soft Asian style at 60 bpm. The same music was used for all participants. The music was played for an hour while the participants fell asleep. A polysomnography assessment was performed while they slept. Results showed that, for the long sleep latency group, the sedative music was associated with an increase in stages III and IV of sleep and a reciprocal decrease of stage II. Stage II sleep typically constitutes up to 50% of total sleep time and is a true physiological stage of sleep. Stage III and IV are true deep sleep and the most restorative stages for body function (Buysse et al., 1989).

Knight & Rickard (2001) explored the effect of relaxing music on participants’ subjective and physiological response to stress. Undergraduate students participated in a stressor task involving preparation for an oral presentation while listening to Pachelbel’s Canon in D or in silence. The stressor caused significant increases in anxiety, heart rate, and systolic blood pressure in both male and female participants. These stress responses were prevented by

exposure to music. As a result, the findings provided support for claims that music is an effective anxiolytic treatment.

Similarly, Harmat, Takács, & Bodizs (2008) conducted a study with university students between the ages of 19 and 28 with complaints of poor sleep quality. Participants listened to either a CD of relaxing classical music (Group 1), an audiobook (Group 2), or nothing (Group 3). Groups 1 and 2 listened to either music or the audiobook for 45 minutes each night before bedtime for three weeks. Results showed that listening to classical music significantly improved sleep quality compared to Groups 2 and 3. Group 1 also showed a significant decrease in depressive symptoms.

Listening to preferred music can also play a role in improving sleep quality and depression in the elderly (Chan, Chan, & Mok, 2010). Participants listened to their preferred music once a week for 30 minutes each time over four weeks. Data was collected once a week. The experimental group showed statistically significant reductions in geriatric depression scores and an increase in sleep quality at week four compared to the control group (Chan, Chan, & Mok, 2010).

Music listening was also shown to improve cognitive recovery and mood in individuals who had suffered from a middle cerebral artery stroke (Särkämö et al., 2008). During the acute recovery phase, participants were randomly assigned to a music group, and language group, or a control group. The music and language groups listened daily to self-selected music or audiobooks while the control group received no listening material. All groups still received standard medical care and rehabilitation. Results showed that patients in the music group recovered significantly better in areas of verbal memory and focused attention compared to the

language or control groups. Additionally, the music group also experienced lower levels of depression and a confused mood than the other groups (Särkämö et al., 2008).

Purpose for Research

A substantial amount of data exists regarding listening to music and its positive effect on relaxation and sleep quality. There is little research, however, regarding the use of original composed music to enhance sleep quality. Previously composed music has been used in a wide variety of settings to decrease anxiety and improve sleep quality. The question remains whether listening to music created during a songwriting experience with a music therapist is more effective than simply using preferred music. Some promise has been shown in a previous study (Chen et al., 2014), but how do the participants compare the experience to other music they may have used? Should this study produce positive results, there is potential for this method to become a commonly used option among music therapists to address sleep quality issues in clients. Additionally, the amount of time and work required to deliver such a service is unclear. Studying the music-making process and interactions between the researcher and each participant will provide some insight into the factors this process entails. Considering these points, the questions this study seeks to answer are as follows:

1. How will personalized, originally composed music aid in relaxation and increasing sleep quality?
2. What are each participants' thoughts on the experience?
 - i. How does this new music compare to other music they have used to relax and/or fall asleep?
 - ii. How does each participant evaluate this experience?

3. What is the process in composing and producing individualized original music for relaxation and sleep?

CHAPTER II: REVIEW OF LITERATURE

Treatment Strategies for Sleep Disorders/Disturbances

When treating sleep disorders and disturbances, an assessment is performed on the patient regarding onset of symptoms, the pattern since onset, and any associated factors (medical, environmental, stress, lifestyle choices). The patient is also assessed for their meal and sleep schedules, what symptoms occur during sleep (sweating, gasping, coughing, periodic limb movements), and caffeine, alcohol, and nicotine intake. It is also determined whether there is any family history of sleep disorders. A sleep log may also be administered to calculate sleep efficiency, total sleep time, and number of awakenings during the night (Abad & Guilleminault, 2003). Both pharmacological and non-pharmacological treatments exist for most sleep disorders, with some being more beneficial and carrying less risks than others.

Sleep Apnea

Obstructive sleep apnea is characterized by frequent episodes of upper airway collapse during sleep. This results in a lack of oxygen to the body, leading to a disruption of gas exchange in the body and frequent arousals from sleep. Symptoms include breathing that starts and stops during sleep, frequent loud snoring, or gasping for air during sleep. Left untreated, this condition causes excessive daytime sleepiness, cognitive dysfunction, impaired work performance, and a decrease in health-related quality of life. Common causes for sleep apnea include increasing age, changes in hormone levels, lifestyle habits, obesity, and genetic factors (Punjabi, 2008; National Heart, Lung, & Blood Institute, 2022).

Multiple studies have shown that continuous positive airway pressure (CPAP) is the most effective form of treatment for sleep apnea, both for the elderly and middle-aged adults (Balcan & Uğurlu, 2017; McMillan & Morrell, 2016; Martínez-García et al., 2012; McMillan et al.,

2015; Woehrle, Graml, & Weinreich, 2011; Sawyer et al., 2011). Other non-musical treatments for sleep apnea include strength and/or exercise training (da Silva et al., 2017; Kline et al., 2011), diuretics and restricting sodium in the diet (Fiori et al., 2015; Fiori et al., 2018), oral appliance therapy (Lorenzi-Filho, Almeida, & Strollo, 2017; Ng et al., 2005; Phillips et al., 2013), stimulation therapy (Lorenzi-Filho, Almeida, & Strollo, 2017), oropharyngeal exercises (Lorenzi-Filho, Almeida, & Strollo, 2017), nasal EPAP devices (Lorenzi-Filho, Almeida, & Strollo, 2017), and the Winx device (Lorenzi-Filho, Almeida, & Strollo, 2017).

Insomnia

Insomnia is a common sleep disorder characterized by trouble falling asleep, staying asleep, or getting good quality sleep. Symptoms include lying awake for extended periods of time before falling asleep, only sleeping for short periods of time, waking up early in the morning and not being able to fall back asleep, or poor-quality sleep in general. Insomnia can be brought on by stress, age, harmful lifestyle habits, or changes in environment (National Heart, Lung, & Blood Institute, 2022)

Treatments for insomnia utilize various methods. Cognitive behavioral therapy (CBT) remains the most common non-pharmacological treatment (McCrae et al., 2019; Edinger et al., 2001; Mitchell, 2012; Manber, 2008). Pharmacological treatments for insomnia include the use of benzodiazepines (BZD) (Lie, 2015), non-BZD's or "Z-drugs" (Lie, 2015), ramelteon (Zammit et al., 2007), doxepin (Lankford et al., 2012), suvorexant (Michelson et al., 2014), and other off-label treatments such as antidepressants and antipsychotics, although the use of the latter two drugs must be used with discretion (Hermes, Sernyak, & Rosenheck, 2013). Over-the-counter medications such as antihistamines and melatonin are also effective in decreasing the effects of

insomnia but should not be used as main forms of treatment. The use of antihistamines on a regular basis also runs the risk of developing a dependency (Richardson, 2002).

Narcolepsy

Narcolepsy is a chronic neurological disorder that affects the brain's ability to control sleep-wake cycles. Diagnosed individuals may feel well rested right after waking but then feel very sleepy throughout the day. Individuals with narcolepsy are greatly affected during daily activities. They may suddenly fall asleep if they are in the middle of an activity, experience sudden muscle weakness while awake that makes their body go limp or unable to move (cataplexy), vivid hallucinations, or total paralysis just before falling asleep or just after waking up. Research suggests that narcolepsy is caused by a combination of factors that lower levels of hypocretin, a naturally occurring chemical (National Institute of Neurological Disorders and Stroke, 2022)

Pharmacological methods for treating narcolepsy are designed to improve wakefulness and reduce cataplexy attacks (sudden loss of muscle function), sleep disruptions, sleep paralysis, and sleep-related hallucinations (Thorpy, 2020). Various medications exist to address these symptoms including amphetamines, stimulants, wake-promoting agents, modafinil, armodafinil, and sodium oxybate (Thorpy, 2020; Kornum et al., 2017; Szabo et al., 2019; Bassetti et al., 2021). Several medications have also been recently approved and are still in development (Thorpy, 2020).

Non-pharmacological treatments for narcolepsy are often recommended in tandem with medications, although some patients rely solely on non-pharmacological treatments alone (Daniels et al., 2001). Cognitive behavioral therapy has been shown to have some efficacy as an adjunct treatment with medication (Marín Agudelo et al., 2014). Scheduled naps, sleep hygiene,

dietary manipulations, physical activity, and environmental manipulations (avoiding hot rooms, cooler sleeping temperatures) have all shown some effectiveness in reducing symptoms (Neikrug & Ong, 2016).

Musical Treatment Strategies

Less research has been done on the use of musical strategies to treat symptoms of sleep disorders/disturbances, but some studies exist exploring the use of music as a treatment modality. Current musical treatments for and possible methods of reducing these symptoms include didgeridoo playing to strengthen the upper airways in order to diminish symptoms of sleep apnea (Puhan et al., 2006), music therapy interventions to reduce anxiety and pain in hospital patients (Kwekkeboom et al., 2010; Magill, 2001; MacDonald et al., 2003; Nilsson, 2009; Shaw, 2016), and listening to music at night to decrease symptoms of insomnia (Oxtoby, Sacre, & Lurie-Beck, 2013; Lund et al., 2020; Lund et al., 2022; Chang et al., 2012). Music has also been shown to stimulate heart rate and ECG signals in different ways depending on whether the music was sedative or arousing (Dousty, Daneshvar, & Haghjoo, 2011).

When studying adults with chronic insomnia, Chang et al. (2012) found an increase in sleep quality for individuals that listened to sedative music while falling asleep. Participants listened to either their preferred sedative music or selected music, if they expressed no preference, for 45 minutes at bedtime for three days. A polysomnography was performed to collect data. Results showed significantly better scores for rested rating, shortened stage II of sleep, and increased REM sleep for the treatment group compared to the control group. Additionally, no significant difference in sleep quality was found between those who selected their own sedative music and those who had music selected for them.

Nilsson (2009) showed that music can generate biological reactions in the body which may help regulate the body's ability to sleep as well as the autonomic systems for anxiety and arousal. This study centered around patients on bed rest after undergoing open-heart surgery. Participants in the music group received scheduled rest during the first postoperative day. They also listened to relaxing music (60-80 bpm at 50-60 dB) distributed through a music pillow connected to an MP3 player for 30 minutes. In the music group, levels of oxytocin increased significantly in contrast to the control group. Additionally, subjective relaxation levels in the music group increased significantly as well as levels of PaO₂ (oxygen content in arterial blood).

Music is also used as a sleep aid to change one's state of mind; whether to relax, focus, initiate a change in mood, remove negative emotions, or as a means of solace and consolation (Trahan et al., 2018; Gurgun, 2016; Oxtoby, Sacre, & Lurie-Beck, 2013; Saarikallia & Erkkilä, 2007; Bloch et al., 2010). Classical music and ambient/meditative music have been shown to have some effects on sleep quality (Oxtoby, Sacre, & Lurie-Beck, 2013; Bloch et al., 2010). Listening to music during nightly routines can help improve factors thought to increase sleep quality (Oxtoby, Sacre, & Lurie-Beck, 2013). Factors of sleep quality such as sleep latency and sleep efficiency can also be improved by bedtime music listening (Bloch et al., 2010). A correlation was found between bedtime music listening and an improvement in sleep latency, sleep efficiency, and a decrease in depressive symptoms in individuals diagnosed with schizophrenia (Bloch et al., 2010).

In an online survey (n = 651), Trahan et al. (2018) investigated reasons individuals use music as a sleep aid. Of the respondents that use music to help them sleep (62%), higher musicality and younger age were more common on average for music users but higher levels of stress, poorer sleep quality, and less sleep efficiency were also reported. Classical music was the

most common genre reported among music users (31.96%), followed by rock (10.82%) and pop (7.47%). Of the music group, 145 respondents (35.98%) claimed that they used music at least weekly. When asked why they listened to music, Trahan et al. (2018) found four themes from the answers: (1) music offers unique properties that promote sleep, (2) music has been integrated into their normal sleep routine, (3) music induces a physical or mental state conducive to sleep, and (4) music blocks internal or external stimuli that would otherwise disrupt sleep.

Benefits of Composed Music in Music Therapy

Clinical songwriting has shown potential as a treatment for numerous populations in music therapy. Songwriting has been used to achieve many goals in music therapy including increasing verbal communication (Edwards, 1998), increasing socialization and interaction (Hilliard, 2001), improving self-esteem (Edgerton, 1990), increasing emotional expression (Kennelly, 2001), increasing sense of cohesion among group members (Cordobes, 1997), and increasing coping skills (Edgerton, 1990), rebuilding cognitive function (Pfeiffer et al., 2021; Baker et al., 2017), and reducing negative symptoms of posttraumatic stress disorder (Hirschberg et al., 2020). Composing music with clients can be effective in either individual or group settings. Songwriting is not limited to adults and has been used with young children as well as the elderly (Baker et al., 2018; Baker & Stretton-Smith, 2018; Kennelly, 2001; Hilliard, 2001; Jones, 2006).

Baker et al. (2018) worked with family caregivers of individuals living with dementia in a group songwriting program. Songwriting sessions took place over six weeks, giving each participant an opportunity to share their experience caring for a family member with dementia with the group. The participants largely guided the process by sharing individual stories, finding commonalities in their experiences, and brainstorming ways to tell the collective story of the

group. The music therapist was largely responsible for creating the music, and participants were engaged in the music making process. Analysis of the post-interviews suggested that group songwriting allowed family caregivers the opportunity to share their entire journey with others, differentiating the intervention from standard support groups. Participants asserted that group songwriting enabled them to establish connections with other caregivers, create a group identity, and gain insight into their journey as a caregiver, leading to a development of inner strength and personal growth.

Baker et al., (2017) analyzed the lyrics in songs composed by patients with neurological injuries to see how the individual's concept of self was expressed in their composed song post-injury. When writing about their past self (pre-injury), patients wrote songs about family and their personality. Contrastingly, during active rehabilitation, patients' songs showed a focus on their physical self, their personal self, and spiritual and moral reflections. Through this analysis, Baker et al., (2017) showed that songwriting can be an effective method for exploration of concept of self in individuals undergoing inpatient neurological rehabilitation.

When working with veterans suffering from post-traumatic stress disorder (PTSD), Hirschberg et al. (2020) found that collaborative songwriting helped to decrease symptoms of PTSD, namely avoidance and hyperarousal. The study noted that a professional songwriter trained specifically for co-writing collaborative music that works to build trust, release pain, and form new bonds. They did not specify whether this was a board-certified music therapist. The findings suggested that some PTSD symptoms did improve and that depressive symptoms and coping skills marginally improved. After creating the music, participants were instructed to listen to the song daily for 4 weeks as a form of exposure to the challenges and solutions presented in

their lyrics. A relationship was found between the number of times a song was listened to and the degree of change in sleep (Hirschberg et al., 2020).

Summary

The songwriting experience presents itself as a healthy coping tool for individuals who are dealing with a variety of issues, helping them to increase self-esteem, cope with emotional stress, decrease anxiety, and self-reflect, among others (Baker et al., 2017; Hilliard, 2001; Baker et al., 2018; Baker & Stretton-Smith, 2018; Kennelly, 2001; Jones, 2006; Edwards, 1998; Edgerton, 1990; Cordobes, 1997). There is potential for the individual listening to their composed music to experience increased relaxation and an improvement in sleep quality. Listening to preferred music has already been shown to be effective in reducing anxiety and stress, increasing relaxation, and improving sleep (Chan, Chan, & Mok, 2010; Trahan et al., 2018; Gurgun, 2016; Oxtoby, Sacre, & Lurie-Beck, 2013; Saarikallia & Erkkilä, 2007; Bloch et al., 2010; Harmat, Takács, & Bodizs, 2008; Chen et al., 2014; De Niet et al., 2009; Chan, Chan, & Mok, 2010; Wang, Sun, & Zang, 2014; Kavurmaci, Dayapoglu, & Tan, 2019; Knight & Rickard, 2001). More research into combining songwriting and the corresponding music listening interventions will help determine the effectiveness of newly composed music on sleep quality compared to previously written music.

CHAPTER III: METHOD

Participants

Participants were college students between the ages of 18 and 40. The invitation to participate in the study was distributed in a mass email using a university IRB recruitment system. There were seven total participants: six females and one non-binary. Preliminary criteria before participating in the study included an absence of any hearing or auditory processing issues and a current desire to improve sleep quality. Three participants reported being a music student or musician. Three participants had been previously diagnosed with a sleep disorder, including insomnia (two participants) and delayed sleep phase syndrome (one participant). Several participants reported using sleep aids, including melatonin, Benadryl, and prescription medication.

Measures

All surveys were administered using Qualtrics, Illinois State's online survey platform. Participants were given a link for each survey. At the start of the study, participants were asked to document their normal sleep habits and patterns using a questionnaire (Appendix A). The same questionnaire was administered at the end of the study. The questionnaire is not a validated instrument but was adapted from Zeek et al. (2015) with permission. Similar questionnaires have also been used in Veldi, Aluoja, & Vasar (2005) and Janson et al. (1995). Questions 1-3 from Part 2 and 1a-b from Part 4 were used from Zeek et al. (2015). The general questionnaire had 20 questions total and was divided into two sections: (1) demographics and general medical information and (2) information regarding sleep habits and patterns.

To collect baseline data, participants completed a daily survey consisting of ten questions (Appendix C). This survey contained more specific questions and asked participants to document

their sleep quality from the night before. Questions included whether they used a sleep aid, how many hours of sleep they got, whether they had difficulty falling asleep when they first went to bed, whether they woke up during the night and how many times, what they did to help themselves fall back asleep, how refreshed they feel, and any other details they may feel are helpful to the study.

To collect treatment data, a very similar daily ten-question survey was administered (Appendix D). Questions regarding the use of the music were added, including how they used the music to help them fall asleep initially and how they used the music to help them fall asleep if they woke up during the night. A post-treatment phone interview was also conducted with each participant individually. Seven open-ended questions were used to get their thoughts on the study and how they thought their sleep quality was affected pre-treatment and during treatment (Appendix E).

Research Design & Procedures

The results of this descriptive study are both qualitative and quantitative, though no statistical analysis was conducted due to a small sample size and a lack of responses in some surveys.

Pre-Treatment Survey & Baseline Data Collection

Before starting the data collection phase, participants were asked to complete the general sleep questionnaire (Appendix A) that documented each participants' nightly sleep habits. During the two-week baseline data collection phase, participants were instructed to continue their daily routines as normal with no changes while filling out a short questionnaire once a day, preferably soon after waking (Appendix C).

Pre-Treatment Meeting & Composition Session

During the baseline data phase, participants met individually with the researcher to discuss their music preferences and work to compose their own unique piece of music. All sessions were held over Zoom video chat with the researcher and participants in their respective homes. The original intent for these meetings was to be conducted in person, but due to unforeseen difficulty in reserving a campus classroom, each meeting was held over Zoom. During this session, participants were asked their preferences regarding instruments, favorite songs, and musical styles they found relaxing. Appendix B includes specific interview questions. Each meeting lasted between 30 and 60 minutes long. A digital piano was the main instrument used along with a laptop with GarageBand and two recording microphones. As each interview progressed, sample tracks of music were created and played to get each participants' feedback. Each participant left the meeting with an idea of how their individual music would sound. Once preferences were gathered, a personalized composition was written for each participant. Each composition took approximately two days to complete. Piano was the main instrument used in this study, and both were recorded using GarageBand on MacOS connected to an audio interface. GarageBand created various instrument sounds using the digital piano as a base. Only instrumental music was used. Once a sample of each track was completed, they were sent to each of their respective participants for final approval of preference. Any feedback and suggestions were applied to the final track. Once final approval was obtained, each track was looped for approximately six hours and shared with each participant via OneDrive.

During this meeting, the researcher also presented a Bluetooth headband speaker to each participant as a universal means of playing the music. The researcher provided instructions on how to use the headband and asked that this be used to listen to the music. However, the

researcher allowed each participant to use other methods of delivering the music should the headband be uncomfortable and disrupt sleep. The researcher asked each participant to document their thoughts on the headband, whether they used it each night, and the reasoning behind their decision. The researcher also scheduled a time to meet each participant in-person to give them the headband. All of these in-person meetings took place on Illinois State University's campus.

Treatment Phase

During the treatment phase, research was collected over a four-week period: two weeks for baseline data collection and two weeks for treatment data collection. The researcher used the first two weeks to gather the participants' musical preferences and compose the personalized music. During the first two weeks, participants were instructed to continue their daily schedule as normal with no changes. Participants filled out a daily questionnaire (Appendix B) that documented their sleep quality from the night before. Once baseline data had been collected, treatment data was collected over the next two weeks. Participants were instructed to use their personalized music daily in whatever way was best for them to improve their sleep quality. Additionally, they were instructed to fill out the daily questionnaire (Appendix C) with additional questions asking them how they used the music to help them sleep.

Post-Treatment Phase

Once treatment data had been collected, participants were asked to fill out the same general sleep questionnaire that was administered at the beginning of the study. The researcher also conducted a phone interview with each participant to get their thoughts and feedback on their experience. Open-ended questions were used (Appendix D) regarding each participant's overall thoughts, how they felt about the music-making process and their feelings about the music they created, how they used the music to help them sleep, and whether they noticed any

differences in themselves between the baseline and treatment phases (change in mood, alertness, functioning).

CHAPTER IV: RESULTS

Research Question 1 Results

The first research question was as follows: How will personalized, originally composed music aid in relaxation and increasing sleep quality? To answer this question, the researcher used all surveys to determine any differences between the use of music and no music. The pre-treatment survey and baseline surveys were used to collect data on participants' sleep quality before using the music. The post-treatment and treatment surveys were used to collect data on sleep quality during the implementation of the music at bedtime. Results of both the baseline and treatment surveys are reported together for ease of comparison.

Pre-Treatment Survey

Several participants reported using sleep aids, including melatonin, Benadryl, and prescription medication. All participants reported sleeping alone. Participants reported going to bed between 9:00pm and 12:00 every night and waking up between 6:00am and 8:00am every morning. Participants reported getting 5-8 hours of sleep each night. When asked about difficulty falling asleep, two participants reported they never or almost never had any difficulty, four participants reported difficulty falling asleep 3-5 times a week, and one participant reported 'Other' and 'Every night' when asked to expound. Two participants reported falling into a deep sleep almost every time they fell asleep, one participant reported that they do not fall into a deep sleep, and four participants reported sometimes falling into a deep sleep. Two participants reported that they wake up during the night almost every night, one said they wake up in the night 3-5 times a week, two said 1-2 nights a week, and two said 1-3 times a month. After waking up in the night, two participants reported having difficulty falling back asleep, one said they do not have difficulty, and four said they sometimes have difficulty. One participant

reported never feeling refreshed after sleep, five reported feeling refreshed 1-2 days a week, and one reported feeling refreshed 1-3 times a month. Three participants reported feeling tired after waking up 3-5 days a week, three reported feeling tired almost every day, and one reported feeling tired daily under ‘Other.’ Two participants reported feeling daytime sleepiness 3-5 days a week, four reported almost every day, and one reported daily under ‘Other.’ Additionally, participants recorded their level of satisfaction with their sleep quality in the last month on a Likert scale and gave details on their sleep quality (Table 1).

Table 1

Sleep quality Likert scale and report on recent sleep quality

	Sleep Quality	Participant responses
Participant A	4	"I feel like it's affected my schoolwork, emotions, and even daily interactions with people."
Participant B	2	"I have trouble falling asleep and staying asleep. I will have myoclonic jerking and startle awake easily."
Participant C	5	"I've been getting better about keeping a schedule but I struggle to fall asleep and wake up on time. I'm still able to function well, so I feel it averages out."
Participant D	4	No response
Participant E	5	"I am mostly tired when I wake up because I have just begun the semester and it's a lot of walking. I am physically exhausted and it's causing my body to stress out."
Participant F	6	"I've had several nights where I had some trouble falling asleep but had good quality sleep once I did fall asleep. I've only had maybe 2 nights of overall poor sleep. My main complaint would be wanting more sleep as opposed to improving quality."
Participant G	1	"I've always had problems with sleep, comes with the ADHD and anxiety. If I can get to sleep and stay asleep, I'm usually ok, but that's like having a unicorn help me find a four-leaf clover on leap day."

Note: Results from Sleep Satisfaction Likert scale is scaled between 1 and 10 (1 = not satisfied, 10 = highly satisfied).

Baseline & Treatment Surveys

The baseline and treatment surveys were implemented over a period of approximately six weeks total. While each participant had exactly four weeks for data collection, two participants started later than the other five. However, all participants were given an exact four weeks for data collection.

The baseline survey received 75 total entries and the treatment survey received 63 total entries. The results in this section are divided out by question. Most questions were the same between both surveys, with two exceptions (Questions 5 and 7). Question 1 only required the participants to enter the date each time they filled out the survey and therefore was not included in this section.

Question 2: Did you use any sleep aids last night (prescription medication, over-the-counter medication, wine, etc.)? If so, what did you use?

This question was present in both the baseline and treatment surveys. There were 89 total responses to this question in the baseline survey and 68 total responses in the treatment survey. Over the four-week baseline and treatment periods, participants mostly reported not using any type of sleep aid (Figures 1 & 2). The two next most common sleep aids for both periods were reported as melatonin and prescription medication.

Figure 1

Sleep Aids Used during Baseline Period

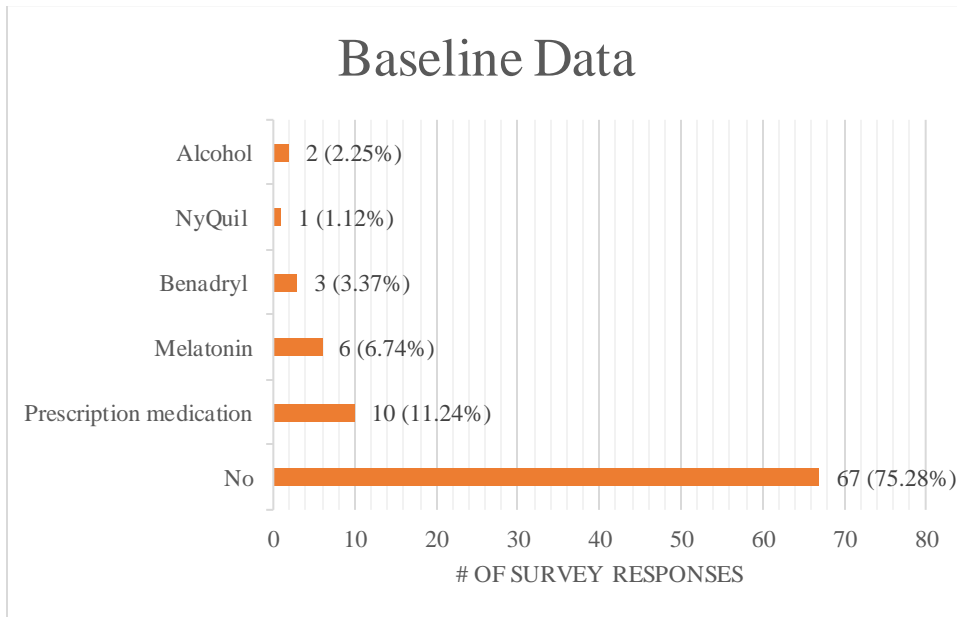
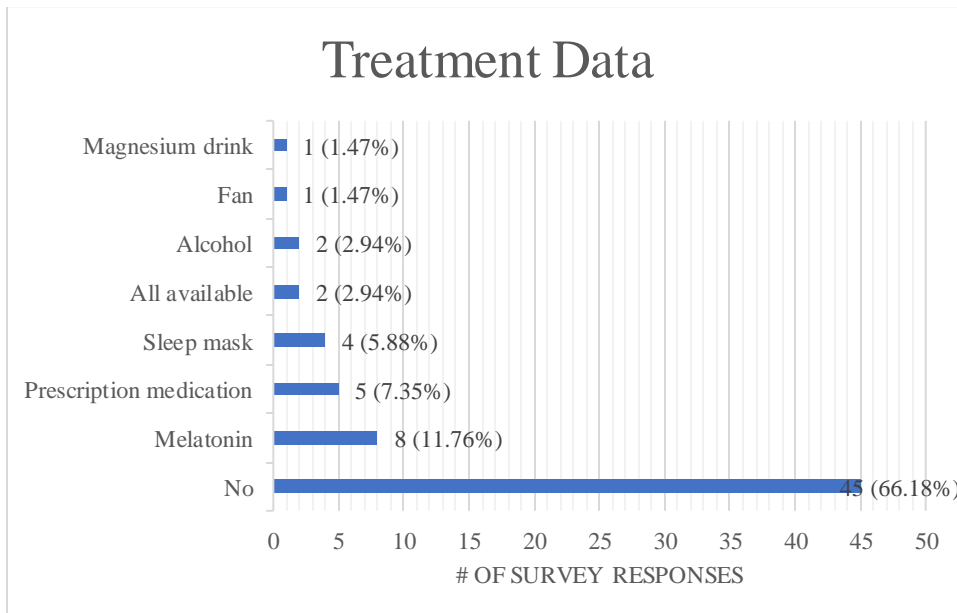


Figure 2

Sleep Aids Used during Treatment Period



Question 3: How many hours of sleep did you get last night?

This question was present in both the baseline and treatment data surveys. There were 89 total responses to this question in the baseline survey and 66 total responses in the treatment survey. The two most frequent number of hours of sleep during the baseline data phase was six hours (15.7%) and 7 hours (14.6%). Nine, eight, and five hours were the next most common responses at 11.2% (Figure 3). During the treatment data phase (Figure 4), the three most frequently recorded responses were eight hours (22.7%), nine hours (19.7%), and seven hours (19.7%).

Figure 3

Hours of Sleep Received during Baseline Period

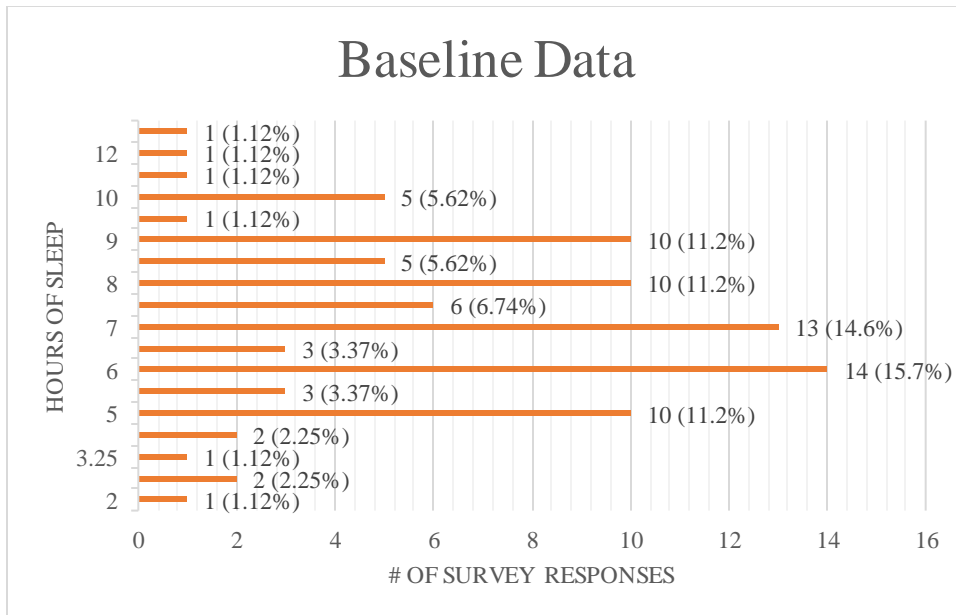
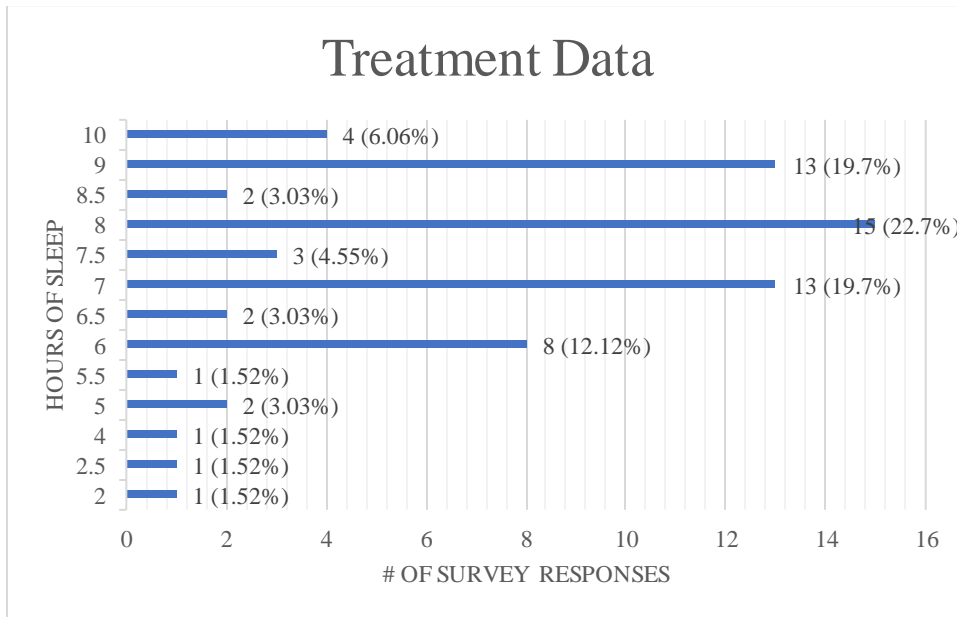


Figure 4

Hours of Sleep Received during Treatment Period



Question 4: Did you have difficulty falling asleep when you first went to bed?

This question was present in both the baseline and treatment data surveys. This question in the baseline survey (Figure 5) had 89 total responses and the treatment survey (Figure 6) had 66 total responses. There was a higher frequency of participants having trouble falling asleep during the period without music (baseline) compared to the period with music (treatment). There were two responses of 'Other' during the second two-week period, both of which had a short entry: (1) "Maybe a little but not as bad as usual," and (2) Yes but not as bad as usual."

Figure 5

Number of Reports of Difficulty Falling Asleep during Baseline Period

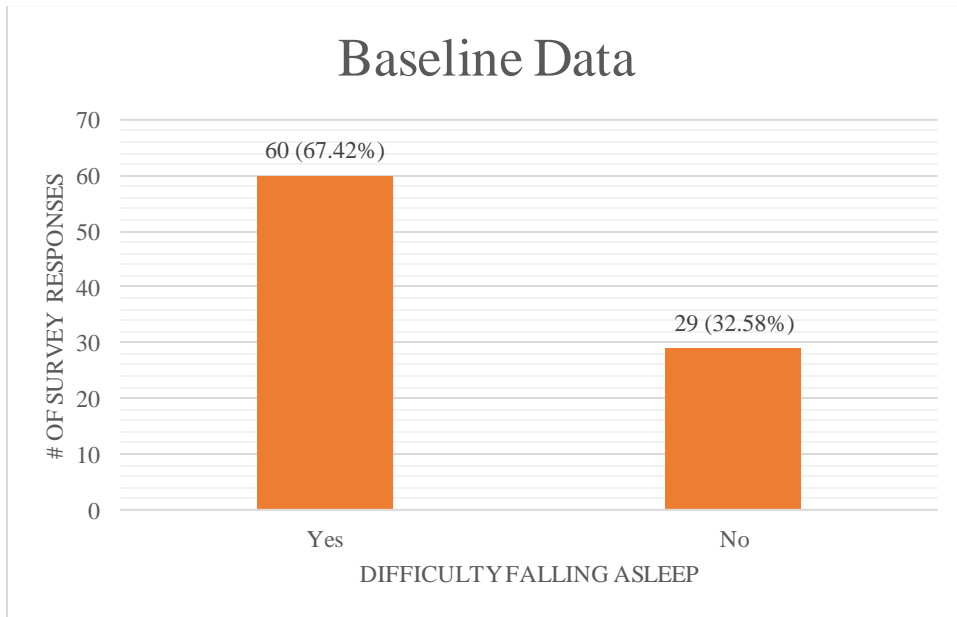
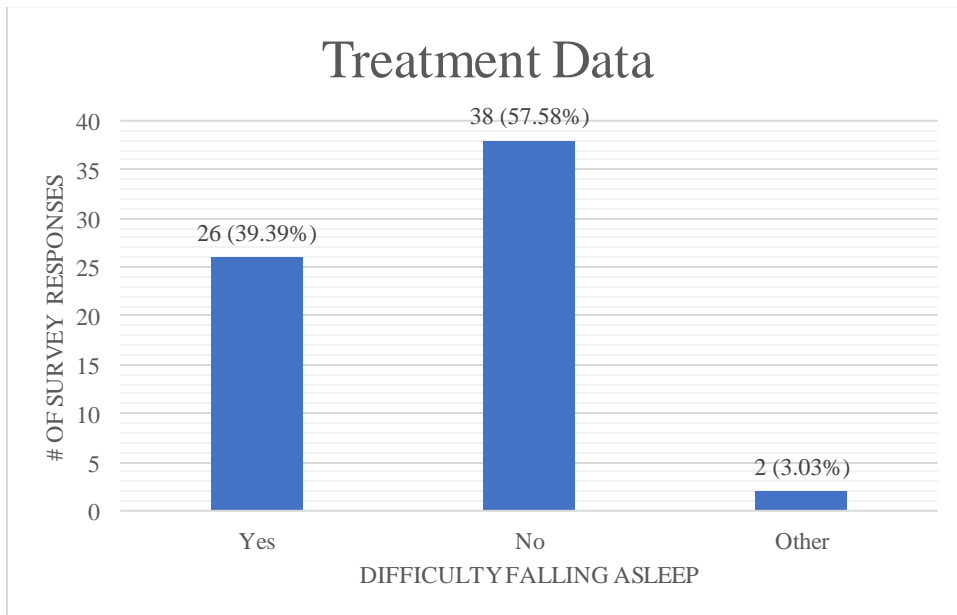


Figure 6

Number of Reports of Difficulty Falling Asleep during Treatment Period

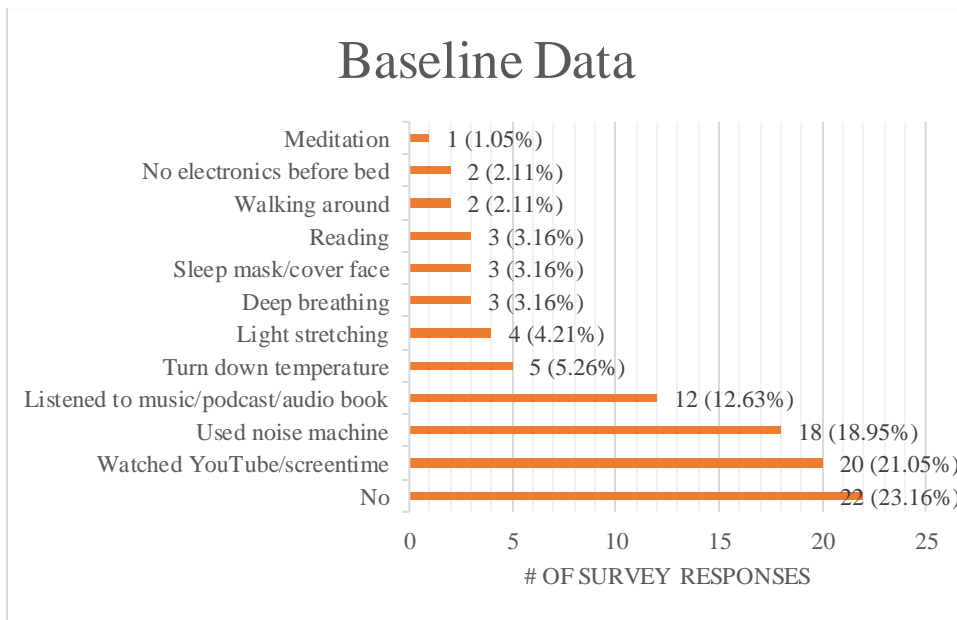


Question 5 (Baseline): Did you do anything to help fall asleep when you first went to bed? If so, what did you do?

This question was only present in the baseline survey. Most responses reported not using any sleep aids, while screentime and the use of a noise machine were the next highest response frequency (Figure 7).

Figure 7

Methods Used to Fall Asleep during Baseline Period

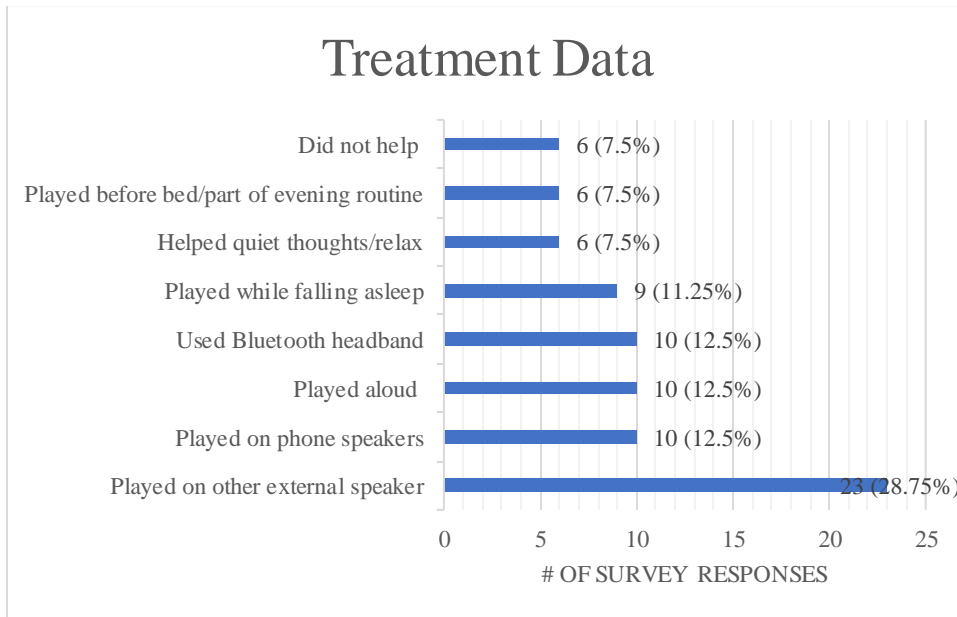


Question 5 (Treatment): How did you use the music to help you sleep?

This question was only present in the treatment data survey. There were a low number of responses saying that participants used the Bluetooth headband (Figure 8). There were some issues with the Bluetooth headband speakers which are noted in the post-interview results. Most responses reported using some kind of external speaker, such as phone speakers.

Figure 8

Use of Music during Treatment Period



Note: The survey response “Played aloud” was unclear as to what speaker was used to play the music and was therefore kept as its own response.

Question 6: Did you wake up during the night? If so, how many times?

This question was present in both surveys. There were 87 responses to the question in the baseline survey (Figure 9) and 64 responses in the treatment survey (Figure 10). There was a higher percentage of zero times woken up in the treatment survey (62.5%) compared to the baseline survey (47.1%).

Figure 9

Number of Times Reported Waking Up during Baseline Period

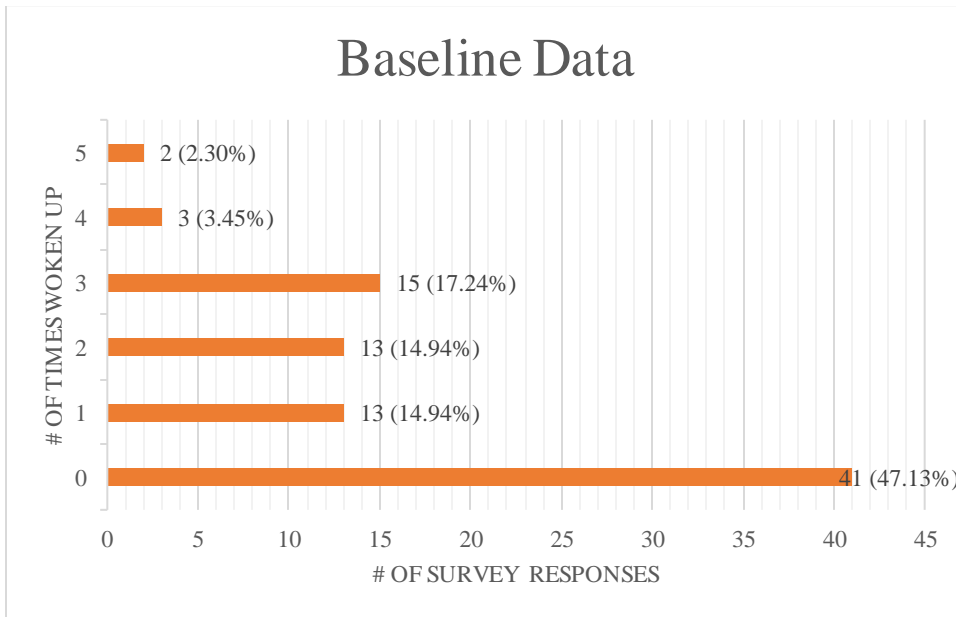
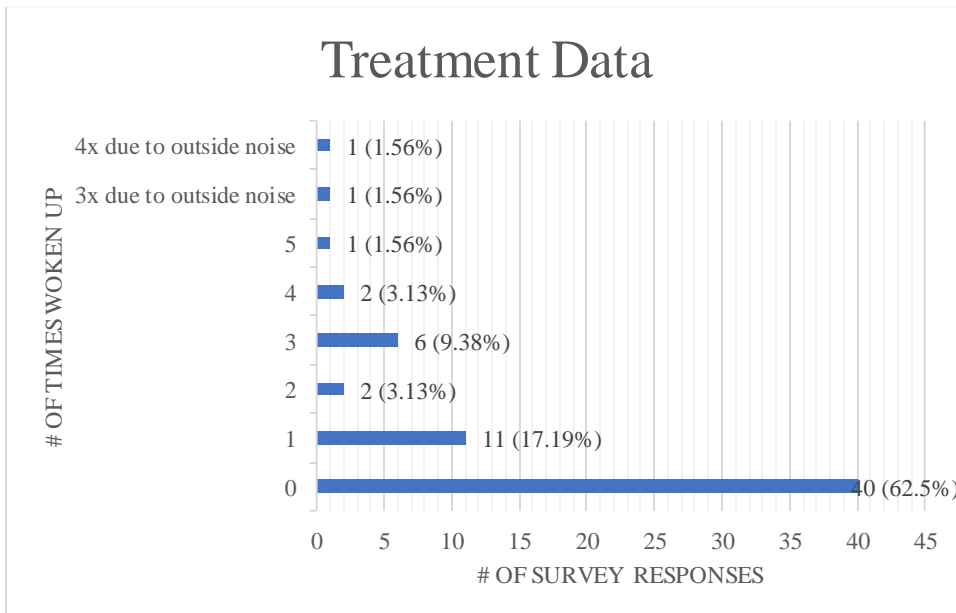


Figure 10

Number of Times Reported Waking Up during Treatment Period

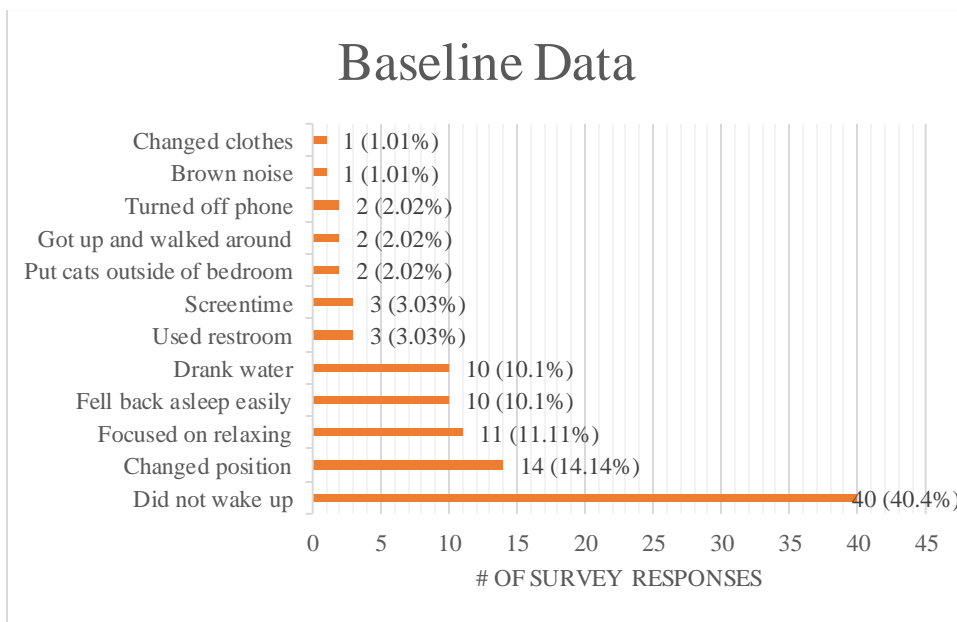


Question 7 (Baseline): What did you do to help yourself fall back asleep?

This question was only present in the baseline data survey. Participants most frequently reported not waking up in the night during this period (Figure 11). For those that did wake up in the night, the top responses included changing position, focusing on relaxing, and getting a drink of water.

Figure 11

Methods Used to Fall Back Asleep during Baseline Period

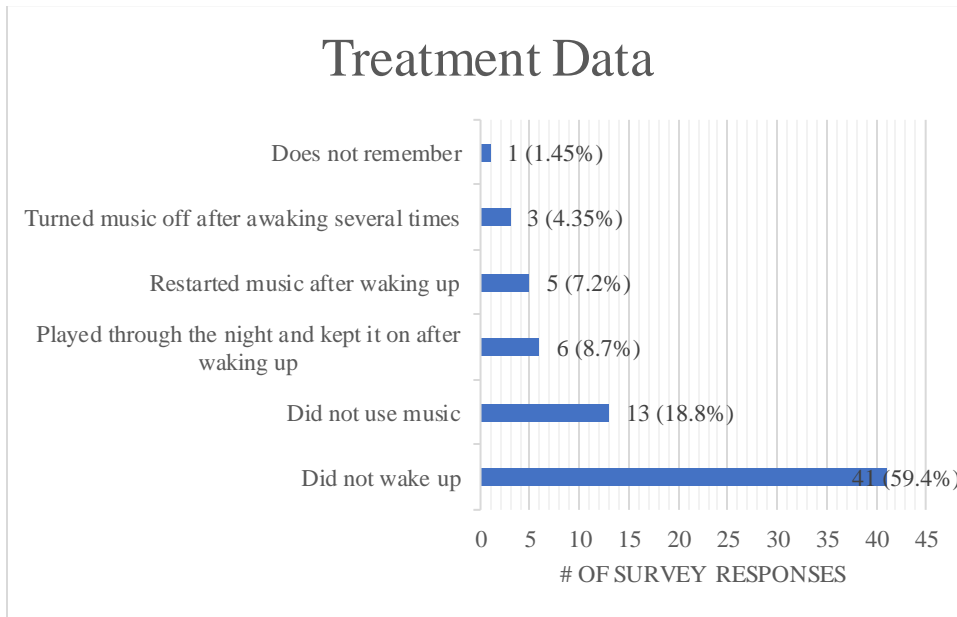


Question 7 (Treatment): Did you or how often did you use the music when you woke up?

This question was only present in the treatment survey. There was a total of 69 responses over the two-week period, 59.4% of which reported not waking up during the night (Figure 12). For those who did wake up in the night, the top responses were not using the music (18.8%), the music was still playing when they woke up and they kept it playing (8.7%), and they restarted the music after waking up if it had finished playing (7.2%).

Figure 12

Use of Music to Fall Back Asleep during Treatment Period

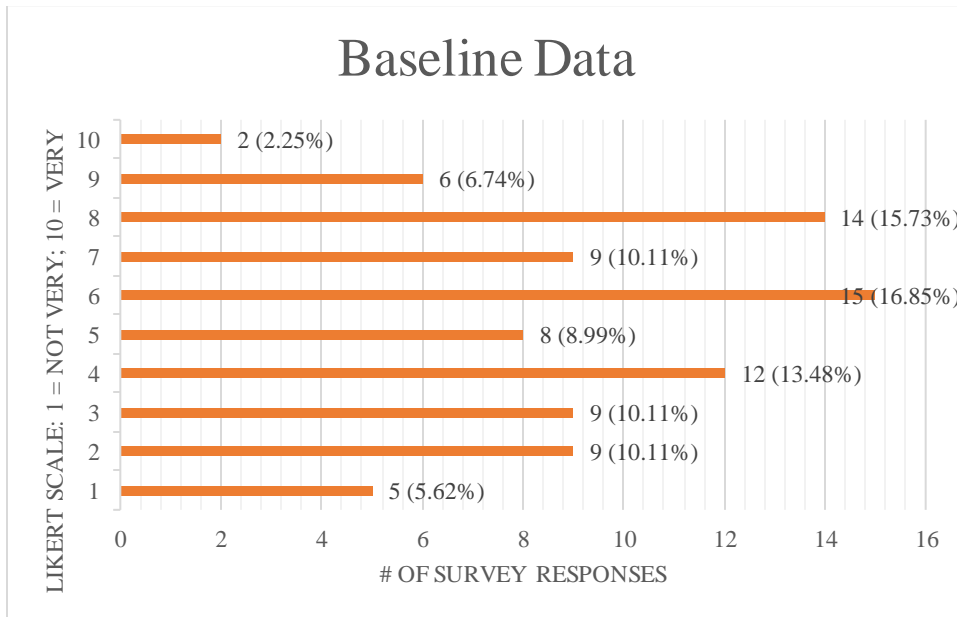


Question 8: How refreshed/alert do you feel this morning?

This question was present in both surveys. There were 89 total responses in the baseline survey (Figure 13) and 66 total responses in the treatment survey (Figure 14). There was a higher number of survey responses reporting a 10 on the Likert scale in the treatment survey compared to the baseline survey. The two most frequent responses in the baseline survey were a 6 (16.9%) and an 8 (15.7%). The two most frequent responses in the treatment survey were a 10 (19.7%) and an 8 (15.2%).

Figure 13

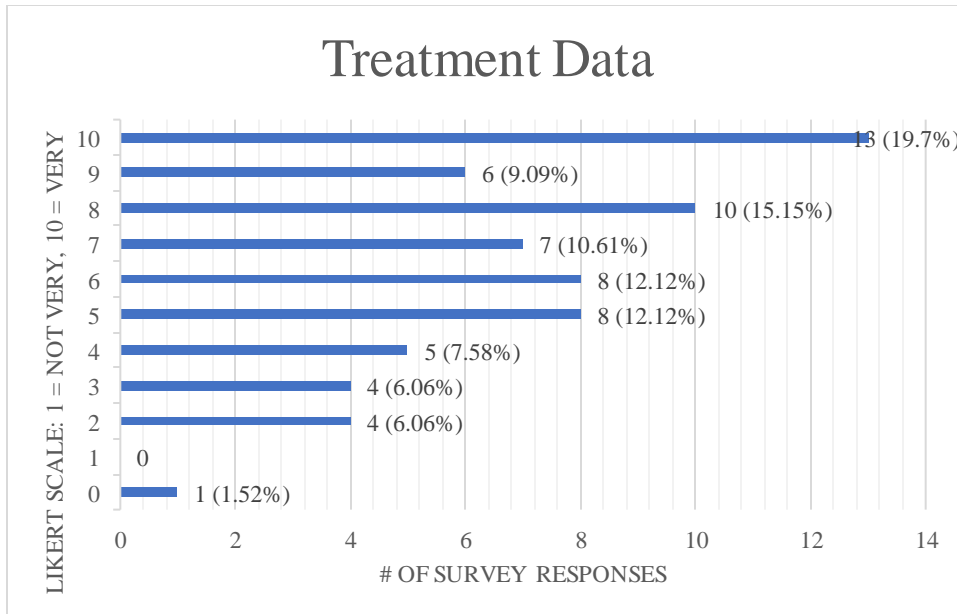
Level of Alertness and Feeling Refreshed during Baseline Period



Note: Results are scaled between 1 and 10 (1 = Not very; 10 = Very).

Figure 14

Level of Alertness and Feeling Refreshed during Treatment Period



Note: Results are scaled between 1 and 10 (1 = Not very; 10 = Very).

Question 9: Please expound on your previous answer.

This question was included in both surveys. Along with filling out the daily Likert scale, participants wrote a sentence explaining their reasoning for choosing the number on the scale. There were 89 total responses to this question on the baseline survey and 65 total responses on the treatment survey.

The responses in the baseline survey could be separated into four categories corresponding to each participant's level of feeling refreshed after sleep. There were seven responses that all similarly reported feeling highly refreshed and ready for the day. Eighteen responses all had a similar wording, stating that they felt pretty good, but were still a little tired. Thirty-five responses more commonly reported feeling okay and able to function, but still feeling pretty tired and needing sleep. Twenty-eight responses had a similar report of feeling very tired and having low energy during the day, either due to sickness, stress, or lack of sleep. One response stated that the participant did a tai chi workout before bed but couldn't be sorted into one of the four categories due to insufficient information. A full list of each of these responses can be found in Appendix A.

The responses in the treatment survey could also be separated into the same four categories as above. Twenty responses all similarly reported feeling great, alert, refreshed, and ready for the day. Fourteen responses could be grouped into a "feeling pretty good" category, with statements mentioning feeling a little tired but otherwise feeling fully functional and alert. The third category had 21 responses, saying that participants were able to function during the day but still felt tired and needed more sleep. Lastly, 10 responses all had similar wording of feeling "terrible" or not feeling alert at all and experiencing headaches due to lack of sleep. A full list of these responses can be found in Appendix B.

Question 10: Please include any other details that may be helpful.

This question was included in both surveys. There were 25 total responses for the baseline surveys and 28 total responses for the treatment surveys. Most responses from both surveys were unique in their wording and description and therefore were difficult to group into categories. Most responses included possible factors that may have affected sleep quality, including sharing a bed for one night, alcohol consumption, and outside noise, among others. A full list of responses from each survey is listed under Appendices C and D.

Post-Treatment Survey

This was the same survey as the pre-treatment survey, administered after the two-week treatment period. There were only three responses to this survey. Of the three responses, none reported a sleep disorder diagnosis. One participant reported using melatonin and prescription medication as a sleep aid. One participant reported usually going to bed at 9:00pm, one reported 10:00pm, and one reported between 11:00pm and midnight. All three respondents reported sleeping alone. One respondent reported waking up at 6:00am, one reported 7:00am, and the third reported waking up between 6:00am and 7:00am. Two participants reported getting typically eight hours of sleep each night and one reported getting six to seven hours of sleep. One respondent reported having difficulty falling asleep almost every night during the treatment phase, one reported three to five nights a week, and one reported never or almost never having difficulty. Two respondents reported falling into a deep sleep almost every night and the third reported they sometimes fall into a deep sleep. Two participants reported never or almost never waking up in the night and the third reported one to two days a week. One participant reported never having difficulty falling back asleep if they woke up, one reported sometimes having difficulty, and one reported almost always having difficulty falling back asleep. One respondent

reported feeling refreshed in the morning one to two days a week, one reported feeling refreshed three to five days a week, and the third reported they felt refreshed almost all the time. One participant reported feeling tired after waking up and experiencing daytime sleepiness almost every day, one participant reported these one to two days a week, and the third reported almost never feeling tired after waking up or experiencing daytime sleepiness. All three participants reported their sleep quality in the last month as an 8 or higher on the Likert scale. Written responses were also recorded (Table 2).

Table 2

Sleep quality Likert scale and report on sleep quality during treatment phase

	Sleep Quality	Participant Responses
Participant A	9	I don't know why, but the music really was nice, and helped me get to sleep and it felt like [I slept] deeper and felt more refreshed the next day! Prior to the study my sleep cycle was hard to maintain and get the recommended amount of hours and even when I did, I didn't feel fully rested. But the music really did make a difference in my opinion.”
Participant C	9	“There were some faults in my sleep schedule, but towards the end of the month, I started sleeping much better and had a much more consistent schedule.”
Participant D	8	“I was more mindful of my sleep these past few weeks, and I feel that has had a positive impact on my sleep overall.”

Note: Results from Sleep Satisfaction Likert scale is scaled between 1 and 10 (1 = not satisfied, 10 = highly satisfied).

Research Question 2 Results

The second research question and its parts are as follows: What are each participants' thoughts on the experience? How does this new music compare to other music they have used to relax and/or fall asleep? How would each participant evaluate this experience? To answer these questions, the researcher conducted individual interviews after the treatment phase to get each participant's thoughts and feedback on the experience.

Post-Treatment Interviews

Participant A

Participant A requested a quiet piano piece for her music with a simple melody in the right hand over top lower, repeated fifths intervals in the left hand. After playing a few keys, she decided that E-flat major sounded the most soothing to them. This piece was composed in E-flat major in a 4/4 meter at approximately 90 bpm (*moderato*, moderate speed), although the tempo of the piece fluctuates a good deal, often going slower than 90 bpm (beats per minute). The dynamic of the piece typically stays around *piano* (softly).

Participant A reported the process was enjoyable and has already informed friends about the experience. The participant felt that the music-making procedure was painless and appreciated the personalized touch of the process. Tailoring music to the individual's preferences developed satisfying music much more quickly than searching through countless songs.

When asked about sleep quality while using the music, the participant reported that the music seemed to help reach deeper sleep compared to not using music. The participant reported that after the fourth night, the music helped the brain "un-focus," "detach," and "go into a fog." This made falling asleep easier. The participant reported going to sleep with music later in the

night since sleep came more quickly. Participant A reported feeling more refreshed with the music as the music helped promote deeper sleep. The participant also reported feeling more productive during the day as going to sleep later with music allowed more time to complete tasks. Participant A communicated that melatonin was only used twice during the music phase and that, on two occasions, there was noise from people outside at night, but the “music was better than a sound machine at tuning out the noise.”

When asked about the headband Bluetooth speakers, the participant stated that the headband kept slipping off and so phone speakers were the main form of music delivery for the treatment phase. The participant reported that the sound quality was satisfactory and did not disrupt sleep. Participant A reported using the music occasionally after the treatment stage and plans on continuing to use the music.

Participant B

Participant B requested a slow, sustained string melody with piano accompaniment. After hearing a simple improvised piece played in a few keys, she decided on C minor. This piece was composed in a 2/4 meter at approximately 45 bpm (*lento*: slow or sluggish tempo). The piano accompaniment is lower sustained notes underneath constant moving sixteenth notes, giving the music a “flowing” feel despite the slow tempo. The string melody is mostly sustained quarter notes staying in middle pitch range on the piano. The tempo stays relatively constant throughout and the dynamics remain around a *mezzo piano* (moderately softly).

Participant B stated that the experience was enjoyable and beneficial. The participant felt that the personalized music was better than other music used to relax as it didn’t require as much thought. It could just be listened to. Participant B typically played the music while getting ready

for bed and let it continue playing while falling asleep. While getting ready for bed the music was played over phone speakers and then the headband speaker was used while in bed.

The participant stated that hours of sleep didn't change between the baseline phase and treatment phase, but the level of feeling rested was higher during the treatment phase. The participant felt that less time was spent falling asleep during the treatment phase and more time was spent actually sleeping during the night. The participant also reported that the music was still being used after the treatment phase. Falling asleep was made "better and easier" with the music. The participant also reported coupling the music with white noise, specifically rainfall.

Participant C

Participant C preferred more instruments in her music, but not so complex as to distract the brain. The participant decided on the key of A-minor, and the music was composed at 46 bpm (*largo*: slowly, broadly) in a 2/4 meter. The participant requested a flute melody with string and piano accompaniment. Two simple flute melodies were written to be the main focus of the piece. The string accompaniment consisted of quarter and half notes to make a simple, sustained harmony. The piano accompaniment was again lower, sustained notes underneath moving sixteenth note phrases to give the feeling of movement and flow despite the slow tempo. The tempo stays consistent throughout and the dynamics remain around *mezzo piano*.

Participant C thought the music created was peaceful and simple. There was nothing "jarring or annoying" about the music and it was "simple, but not so simple that it was boring." Participant C also said that the lack of lyrics was helpful because there was "nothing to latch on to." She also noted that the loop was very seamless, and it was very difficult to tell where the loop ended and repeated. The participant stated that working on the music over Zoom made the process more challenging but found hearing music samples and giving input helpful and

enjoyable. The participant liked the personalized portion and felt it was better than trying to find music that fit preferences.

The participant reported having some issues when playing the music. The participant uploaded the music to Spotify, but it would not always play. On some nights, the participant reported not wanting to play the music and just wanted quiet instead. Towards the end of the treatment phase, the music became repetitive, and the participant was able to pick out different parts, which affected relaxation. The music was most often played out on phone speakers. The headband speaker had trouble holding a charge. However, Participant C reported the headband as being comfortable to wear and it did not hurt to lay on. Sound quality was comparable to that of the phone speakers. The participant reported playing the music while laying down to sleep.

Listening to music helped increase motivation to sleep. Playing the music while lying in bed helped associate the music with sleep and helped the participant get into the mindset of sleep. The participant did report that it took some time to get used to the music. At first, the participant wanted to listen and analyze the music, but adjusted after a few days. The participant was not sure if there was a difference in time spent falling asleep between the baseline and treatment phases, but she did feel that she woke up feeling better during the treatment phase. Participant C reported using the music on some nights after the treatment phase was completed. When asked for feedback, Participant C suggested that a longer treatment phase might help with sleep quality as it will give individuals a longer period to adjust to the music.

Participant D

Participant D preferred piano for the main instrument with strings being added sequentially. The participant requested something simple and “meditative.” This piece was written in E-flat major in a slow, but no particular tempo. The piano was only made up of

sustained chords, often seventh chords to provide an open and ethereal mood. For the strings, a cello was added playing sustained notes to fit with the piano chords and then violins enter after a four-chord progression of cello and piano. All parts played sustained notes. The dynamics of the piece stayed around *piano*.

This participant was contacted three times to set up a post-treatment interview but did not respond. No results are included in this section. The participant did fill out the surveys and those results are included above.

Participant E

Participant E requested only piano for their music. The music was written with a simple melody over top sustained notes in the left hand with sixteenth note phrases to again give the feel of “flowing.” This piece was written in F major at 55 bpm (*larghetto*: somewhat slow, a little faster than *largo*) and stays constant throughout. The dynamic of the piece remains around *mezzo piano*.

Participant E enjoyed having a piece of music that was tailored to their preferences. The participant indicated that the researcher was very receptive to what they wanted during the music-making process. Listening over Zoom made the music hard to hear at times, but the participant was still happy with the results. The participant felt that the music was exactly what they wanted. Having the same nightly music helped build a consistent routine. Regarding the headband speaker, the phone kept disconnecting from it and the sound quality was not the best. The participant ended up playing the music on a TV at low volume. The participant used a sleep mask to block out the light from the TV screen.

Participant E did not notice much improvement in sleep quality over the course of 4 weeks and felt it fluctuated, but they did report becoming more aware of their sleep quality and

how much sleep they were getting. Knowing that the survey needed to be filled out each day helped build a habit and provided motivation to get up in the morning. The survey provided a simple task that could be accomplished each day. After completion of the treatment phase, the participant reported using the music while studying. Participant E stated that they enjoyed the piece enough that they added it to their circulation of music.

Participant F

Participant F requested a piece with an Irish feel with piano and strings. A piece was composed in F major in a 6/8 meter at 106 bpm (*allegretto*: light, graceful, moderately fast). The piano track consisted of a simple melody in the right hand with a repeated open fifth F chord in the left hand. The strings entered after eight measures of the piano, playing a constant drone on the F chord.

Participant F found the music-making process interesting. Creating music for sleep provided a new perspective on music. The participant noted that the music would play in the brain whenever taking a nap. Participant F felt the music was accurately developed to the preferences described. The simple melody of the music made it easy for the brain to follow along without expending too much energy. The participant found that the music still played in the mind without the music. The participant did note that she would change the key next time. She stated that the piano was not her first choice, but they didn't mind it. Strings or the kalimba would be a preferred instrument in the future.

The participant was satisfied with the comfort of the headband. The music helped with relaxation in the evening and calm racing thoughts. Participant F also stated that she wished the headband speaker had a setting where the volume slowly decreased over time. Participant F played the music when going to bed and laid down until relaxed. The headband was occasionally

removed when half-asleep but was often kept on through the night. The participant also found that the music added to anxiety if she was already anxious.

Participant F noted that her quality of sleep stayed relatively constant. The participant did state that she felt she fell asleep more quickly after getting used to the music. It took the participant 2-3 days to adjust to the music and integrate it into her routine. She also reported having less “anxious” dreams with the music. When asked if she used the music after the treatment period, the participant reported using the music occasionally while stretching before bed.

Participant G

Participant G requested a simple piano melody accompanied by a bassoon and string one-chord drone. This piece was composed in G minor at approximately 58 bpm in a 4/4 meter (*adagio*: slowly, stately). The bassoon and strings stay sustained for the whole piece, with the bassoon playing a sustained chord on a low G and B-flat and the strings staying on a sustained low G. The piano melody consists only of quarter notes but changes between a one-note melody and a chorded melody. The tempo fluctuates slightly, and the dynamic of the piece remains around *piano*.

Participant G found the process “interesting.” The participant felt that doing a project like this on a large scale would be difficult. Participant G stated she got used to the music by the end of the treatment period, but it was still interesting enough that it held her attention. If they fell asleep the music did not wake her up. The participant liked the music but felt that the music would be better with one melody line instead of two different melody phrases. She felt that simplifying the music even more would help with sleep and help the brain un-focus. The music was interesting enough for the participant that it sometimes hindered sleep. Having no emotional

connection to this music like they would with preferred music helped the brain detach and unfocus.

Participant G noted that her mood was low during the first half of the treatment period, resulting in low quality sleep, but the second half was better as she adjusted to the music. The participant noted that her mental state stayed constant during the baseline phase and improved during the treatment phase. The participant stated that it took longer to fall asleep while adjusting to the music, but otherwise, time spent falling asleep remained constant over the 4-week period. The headband did not fit well, and the volume did not reach a low enough volume to be comfortable. The participant reported using her phone speakers for most of the treatment period. Getting the volume low enough was imperative for her. The participant also confirmed using the music while reading after the treatment phase was completed.

Research Question 3 Results

The third research question was as follows: What is the process in composing and producing individualized original music for relaxation and sleep? To answer this question, the researcher observed and evaluated the steps utilized while writing and arranging the music, including the pre-treatment interview with each participant. The researcher also recorded time spent on the full process.

Composition Process

Pre-Treatment Meeting

The researcher met with each participant individually to guide them through creating their own music for the treatment phase. During this meeting, information was gathered from each participant, asking questions regarding whether they had any previous musical experience, their music preferences, any instruments they found relaxing, and preferred styles of music. Once

this basic information was collected, the researcher began improvising short pieces on the piano and getting their feedback. As the music started to form, more detailed musical questions were asked: what tempo of music they preferred, whether they wanted a distinct melody or just chords, whether they wanted multiple instruments, did they prefer a major or minor key, and what key signature sounded best to them. They were also asked to describe the music they wanted in their head, asking them to provide as many adjectives as possible. Answers included “meditative,” “relaxing,” “open,” “simple,” “calming,” “spacey,” and “uninteresting.” The researcher continued improvising on the piano during this time and developing the music to the individual’s preferences. By the end of the meeting, approximately two to three minutes of composed music had been completed, which was played for each person to get their initial approval. Each of those tracks was saved on the keyboard to be recorded onto a laptop later. Each session was ended by showing the Bluetooth headbands to each participant, instructing them on how to use it, and informing the participants that the music would be developed over the next few days and a fully arranged track would be sent for them to listen to and provide feedback.

Composition & Arranging

Each composition took between four and five hours collectively to complete. Time was spent composing lines of music, equalizing, mixing, and mastering the sound, arranging each part to work complementary to each other, cutting tracks to fit together within a proper meter, and creating a loop with smooth transitions between each repetition of the piece. Each composition was not completed sequentially and were often developed concurrently. This process took place during the baseline data collection phase and was completed by the time each participant was ready to progress to the treatment phase. All compositions varied in their style,

tempo, and complexity. A common request was for the music to be simple so as not to distract the brain and prolong time spent falling asleep. This was a common request among the musicians in the group since they acknowledged a tendency to analyze the music, which would keep them awake. Some compositions comprised a simple piano melody with a one-note drone in the background. Other compositions utilized a wider mix of instruments with no clear melody, but instruments creating small melodies together to create one full piece. One composition simply had a piano playing slow, sustained chords overlaying a quiet string ensemble playing sustained chords for a “meditative” feel.

Once the initial piano track was completed and saved from the pre-treatment meeting, the audio was played on the keyboard speakers and recorded using two microphones, one over each keyboard speaker. The microphones were connected to a PreSonus Audio Box iTwo, an audio interface, which was then connected to an Apple MacBook Pro. GarageBand, a MacOS mixing and recording software program, was used to equalize and mix the audio tracks and arrange the pieces. Once the track was uploaded, the sound of the piano track could be manipulated, equalized, have reverb added, and receive other enhancements. All participants requested the piano be a part of their music, and so the original track was kept in the final piece, although small adjustments would be made as needed. For participants that requested instruments for which the researcher lacked skill, GarageBand was used to create various instrument sounds to add to the tracks. Instruments requested included strings, oboe, bassoon, and flute. Using the keyboard hooked up to the laptop through the audio interface, the instruments could be created by playing the keyboard and using GarageBand to create these sounds. The sounds could be adjusted and equalized as needed to give a more accurate representation of these instruments. Once approximately five minutes of material had been

created, each final track was emailed to its corresponding participant to get their final approval. If participants had suggestions or feedback, the music was adjusted as needed until it met the participant's standards.

Once each participant felt that the music accurately portrayed their preferences, each track was looped for approximately six hours, this being the maximum amount of time allowed in GarageBand. Each full track was uploaded to OneDrive and shared with each participant as it was completed. The full time spent on this entire process took approximately 15 days collectively.

Equipment Used

A Yamaha P-125 88-key weighted action digital piano was the main instrument used for the composition process. The piano was connected to the PreSonus AudioBox iTwo audio interface, which was connected to a MacBook Pro laptop. GarageBand was the software program used to create and master the music. Also connected to the audio interface were two dynamic recording microphones, a Shure SM57 and a Samson Q7. Each microphone was clipped to a boom stand placed closed to the piano speakers. Audio Technica ATH-M50X studio headphones were used for audio playback.

CHAPTER V: DISCUSSION

Summary

The purpose of this study was to observe and evaluate the effectiveness of original, personalized music on sleep quality in college students. The Music Therapy intervention that was implemented involved composing a piece of relaxing, instrumental music unique to each participant based on their preferences. All participants seemed actively engaged in creating a piece of music with the researcher. Each participant played their music at bedtime and kept a record of their sleep quality and overall wellbeing during that time.

Meeting over Zoom was not as effective as meeting in-person, mostly due to sound quality issues. However, this medium still allowed the participants to adequately hear the music being developed and work with the researcher to create a piece specifically for them. The method used to record and produce the music was an appropriate and effective way to compose music for this setting. Participants did not report having any negative effects from the sound quality of the music itself.

Using the music as a means of improving overall sleep quality showed mixed results. Based on participant interviews, the music was effective for some in decreasing time spent falling asleep and helping the brain detach, relax, and fall into a deep sleep. Others found that using the music at bedtime did not necessarily help improve sleep quality but helped create a routine that may have aided in establishing a healthy bedtime to receive optimal hours of sleep. After the music was added, hours of sleep increased and difficulty in falling asleep decreased. There were also more frequent reports of feeling more alert and refreshed in the morning during the treatment phase. During the treatment phase, the Bluetooth headband speakers were used fewer times than expected due to issues with sound quality/volume, holding a charge,

connectivity, and discomfort. These problems were not constant for every participant, but these were some issues noted in surveys. Survey responses suggested that using an external speaker may be a better option in some cases.

Overall, participants found the process enjoyable and intriguing. Participants appreciated the personal touch to the music, feeling like they could create something that was specifically for them. During the music phase, most participants felt that the music helped calm racing thoughts and help the brain detach and un-focus, prompting deeper and quicker sleep. It did take some time to adjust to the music, but after an adjustment period, relaxation and certain characteristics of healthy sleep increased.

There were mixed reviews as to whether overall sleep quality increased during the treatment phase. Participants most commonly reported an increase in certain factors that often contribute to better sleep quality. Specifically, less racing thoughts/anxiety, less time spent falling asleep, deeper sleep, and increased relaxation were more prevalent during the treatment period. Oxtoby, Sacre, & Laurie-Beck (2013) found similar results in individuals with insomnia, finding that the music listening group significantly improved in factors theorized to improve sleep quality but did not necessarily significantly improve in actual sleep quality. The results from this study also show some congruency with Chen et al. (2014), which found that original sedative music helped prolong deep sleep, which correlated with an increase in sleep quality in college students. One participant reported that they felt more refreshed in the morning because the music helped promote deeper sleep, which shows some similarity with the results from Chen et al. (2014).

Limitations

As this was one of the first studies to utilize this Music Therapy intervention of original composition, there were several limitations. The following suggestions are to be considered when recreating this project or pursuing further study with this intervention.

Concerns with Telehealth sessions

Due to scheduling conflicts, all pre-treatment sessions were conducted via telehealth. Working on the music utilizing this method came with some difficulties, namely the sound quality of the music being played and the audio cutting out periodically. Participants C and E both reported having difficulty hearing the music over Zoom. In the future, in-person sessions will likely be the most effective method of facilitating a composition session with an individual.

Time Spent Composing Music

Four and a half hours were spent on average creating each composition. Many elements went into creating the music such as recording, editing, mixing, and mastering. While this was not a completely overwhelming task for seven participants, this would be a considerable time commitment for a Music Therapist offering this service. Conceivably, this process could become much more efficient with time and practice. There is also the option of utilizing Music Therapy sessions exclusively for composition, giving the client and therapist an ample amount of time to work on the music together and allowing the client to become more deeply involved in the composition process. This would also allow the time spent composing and producing the music to be billable, since any work done by the music therapist outside of business hours cannot be billed as a service.

Method of Playing the Music

There were mixed reviews of the Bluetooth headband speakers, namely in sound quality, connectivity, holding a charge, and comfort. An external speaker was the most common method of playback, and this may be the most effective way to deliver the music in a more comfortable and relaxing manner. Individuals will also have more control with an external speaker, having the ability to better control volume and placement in the room. It is also feasible that a higher quality Bluetooth headband may be a simple solution as well. It may be that simply assessing each individual's preference for music delivery will be the most effective solution.

Small Sample Size

There were only seven participants in this study. Larger test pools are needed to test the effectiveness of this intervention and to collect additional numerical data. With a larger sample size, numeral data could be analyzed to determine the statistical significance of such an intervention. More information could be gathered on how participants view the composition process, how they feel creating their own music, more effective ways of using the music to promote good sleep, and additional ways of using the music during the day to promote relaxation and stress relief.

Survey Completion not Consistent

Only three participants filled out the final post-treatment survey. Although inferential statistical analysis was not a goal of this study, any statistical analysis that could have been conducted on the data would have been difficult due to the lack of responses. This also made it difficult to determine how overall sleep quality was affected for each participant.

Self-Administration of Music not Consistent

According to survey responses, the music was not always helpful in falling asleep or helping participants fall back asleep if they woke up. As a result, the music was not always used. Participants reporting on their sleep quality may not have taken that into account when filling out the surveys. It is possible that the data may have shown the participant slept well and woke up feeling refreshed, but not necessarily because they used the music.

Length of Composition Limited

Each track could not be looped for longer than six hours due to the limitations of the program. Because of this, participants recorded waking up in the night to find the music had stopped playing. For future studies and clinical applications, it is worth ensuring that the music can be played for at least eight hours to eliminate the possibility of arousing the client from sleep.

Subjectivity of Data

The data collected in this study was comprised exclusively of self-observation and participant report. As such, the data is highly subjective. The possibility exists that other factors may have attributed to an increase in factors of healthy sleep quality with participants realizing. The question remains as to the specific biological reaction to individualized music. Future studies should consider more statistical measures when exploring this area. Perhaps sleep studies can be conducted utilizing polysomnography to analyze brain waves of participants while listening to their individualized original music. Quantifiable data will help determine the efficacy of such an intervention for improving relaxation and sleep.

Clinical Implications & Recommendations

More research is required to determine if this Music Therapy intervention is truly a viable method of improving sleep quality in individuals. However, I do believe composing original music carries a great deal of potential for Music Therapists seeking to develop new and possibly more effective ways of promoting relaxation and quality sleep in their clients. This intervention provides a personal touch for the client that is not always available with other methods.

Individuals have the opportunity to get their music out and create something that accurately represents their personality and preferences. The Music Therapist acts as a guide with the proper tools to help their clients create something beautiful. I think the personalized aspect brings two extra facets to the table, a connection between therapist and client and a sense of accomplishment knowing that the music the individual is listening to is theirs.

The composition session and writing process went very smoothly. All participants were open and descriptive when discussing their musical preferences. Each participant seemed happy with the final product. The musical preferences were satisfyingly distinct from the other and each composition brought its own unique qualities. The mixing and mastering process was somewhat meticulous and time-consuming, but the process became more efficient as I progressed through each piece. The work was time-consuming and meticulous at times but also engaging and manageable. Each individual's preferences and requests were realistic and reasonable.

The equipment used in the composition process could be a financial issue, depending on the Music Therapy program and resources available. Two microphones with boom mic stands, a Yamaha keyboard, a MacBook Pro, an audio interface, studio headphones, and assorted cables were used for this project. This must be taken into consideration when giving thought to offering this intervention as a service. There are many less expensive equipment options available that

can deliver appropriate quality for such a service. There is also the option to purchase each piece of equipment over time as funds become available.

As mentioned in the Limitations, in-person sessions will most likely be the most effective when composing music with clients. The composition process could be its own session with a client and they will have an opportunity to have hands-on experience creating music and writing something that is truly their own. The individual will be able to see their music forming and developing and be able to hear the music in its entirety, with no risk of audio distortion from a telehealth session.

Two of the participants each provided a specific feedback point that bears recognition. Based on the statements from Participant E, it seems that they had the poorest response to the intervention. Participant E played the music on their TV and used a sleep mask to block out the light. They also stated that their sleep quality fluctuated frequently. It is possible that the TV light may have affected sleep, despite having a sleep mask. In a clinical setting, clients may benefit from a discussion of appropriate mediums of playing the music, talking through what methods they would find most comfortable and relaxing. It may require experimentation on the client's part to figure out what works best for them. In future studies, there is potential for research into the effectiveness of various means of playing the music for relaxation and encouraging sleep.

Participant F stated that she wished the Bluetooth headband speaker had a setting that allowed the volume to decrease slowly over time. This idea warrants further exploration in future research. Examining how volume affects relaxation and sleep quality may also be studied further.

Lastly, the simplicity of the music and its effect on relaxation and sleep quality could be studied further. A few comments were made on the complexity of the music and how it affected relaxation and prolonged sleep. This may be purely dependent on individual preference, but there is still room for exploration in this area.

Conclusion

Relaxation and receiving quality sleep is essential for optimal health and body function. The use of music and Music Therapy interventions can have positive effects on factors of healthy sleep and decrease stress (Hernandez-Ruiz, 2005; Pelletier, 2004; Smythe, 2002; Scheufler, Wallace, & Fox, 2021; Jespersen & Vuust, 2012; Thoma et al., 2012; Harmat, Takács, & Bodizs, 2008; Chen et al., 2014; De Niet et al., 2009; Chan, Chan, & Mok, 2010; Wang, Sun, & Zang, 2014; Kavurmaci, Dayapoglu, & Tan, 2019; Knight & Rickard, 2001). Composing music as a Music Therapy intervention has the potential to prolong deep sleep (Chen et al., 2014).

This study has touched into the field of composition interventions coupled with music listening as a means of relaxation, stress relief, and promoting better sleep. Allowing individuals to involve themselves in the composition process helps effectively create a unique piece of music that only that person can identify with. Giving clients a direct part in creating music decreases the need for the individual to search through music trying to find something that relaxes them. Utilizing the Music Therapist's skill in musicianship and composition, a piece of music can be created that is unique to the individual, musically appealing, and stress-relieving. Further study into this intervention and its effectiveness may support the viability of the use of personalized music as a sleep aid and stress reducer in future Music Therapy services.

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APPENDIX A: BASELINE SURVEY RESPONSES TO LIKERT SCALE

After a previous night of poor sleep, heavy exercise during the day, and staying up later than usual, I was extremely tired when I went to bed and so I sleep deeply and undisturbed.
Although my sleep amount was the almost the same and I still feel tired, I also don't feel as stressed or as emotional as the other days.
Awake but want to go back to sleep
Better than my worst nights, but still not great.
Blech.
Could have slept more, but had good sleep over all
Decent quality sleep but felt tired and wanted to sleep more.
Feeling a bit better than normal.
Feeling pretty good.
Felt pretty awake, could have went back to sleep if I tried but I stayed awake
Felt really tired, I missed my first class because I needed to sleep some more
Had good quality sleep, but I want to sleep more so I still feel tired
Had to get up to help my friend with her car but then I had a slow morning, making it easy to warm up to the day
Hit snooze a few times this morning but feel refreshed in time for class
I always feel tired.
I am sick causing me to feel worse this morning.
I could barely stay awake in class today
I did not sleep well and woke up extremely tired and wanting to go back to sleep
I did tai chi before I went to sleep

I don't feel refreshed or awake. I am more emotional today than normal (irritated, sad, etc.).
I feel almost fully rested, still a little tired. But the biggest thing is my mind would [not] shut off last night, so even my dreams were annoying/restless, so even though I got enough hours of sleep it feels like I didn't.
I feel awake enough to be productive, but my eyes feel like they just want to be closed
I feel better than I do most mornings.
I feel good today, but I'm still feeling half asleep even though I've been awake for a while, also not as refreshed. Feel like my energy is lower too. However today I do feel more alert.
I feel good, but not 100%, I'm not as alert as normal and I feel like I could have slept in more to get my full rest.
I feel great, 2 days of good rest and feeling clear minded, in control and ready to go!
I feel like I can't keep my eyes open
I feel like I got no sleep and could lay down again for a full night
I feel like I overslept to the point of I couldn't wake up right
I feel like I should be more tired, but I somehow feel rested too. I think it may hit me tomorrow but for now, I'm doing better than 02/01/23.
I feel like I barely slept and need to go back to bed
I feel ok but I slept in an hour past when I wanted to wake up b/c I was so tired
I feel okay getting up. I got some caffeine and am feeling more awake now.
I feel pretty good today, not fully alert as of now, but I'm feeling refreshed and ready for the day!
I feel pretty well rested, just a little groggy.

I feel really good today, the only thing not making it a 100% day is that I think I don't feel fully refreshed as I could be.
I feel refreshed and also less stressed now that I finally got a good night's sleep. But, still a little tired.
I feel rested, but not to the degree I wish I was. I still feel fatigued, drowsy and not fully alert.
I feel tired, low energy and drowsy. I really just want to go back to bed and sleep some more.
I feel very awake but not awake enough to feel focused and ready, I've been yawning ever since I got up
I feel very functional, I have energy to do the things I need to do but I also feel like I could take a nap at my desk if I wanted to
I fell asleep around 4am and had to get up at 6am for class at 7. I was barely able to function and had to leave early for feeling sick
I finally got a good night of sleep and didn't have to wake up to an alarm.
I had been out with friends last night which had me up very late. I drank a good amount and this affected my sleep.
I had intended to get up earlier but felt so tired I slept more. I still felt tired when I got up but had so much anxiety about needing to get up for the day I couldn't sleep more.
I had to use an epi pen yesterday and still have side effects from the med
I only got like 3 or 3.5 hours. I'm exhausted. I don't usually have to have coffee to exist for the day.
I slept in, set no alarm, was still up decently early but haven't had to rush to do anything, had a slow wake-up to ease myself into the day
I slept less than normal but I feel refreshed and ok

I think I overslept, so I'm still feeling tired/ fatigued. I also don't feel fully alert.
I try to wake up at 6 but felt like trash so I slept for another hour and feel better. This is the average
I was a bit sleepy and out of it because I did not sleep well.
I was able to get up and get moving without wanting to go back to sleep, but if I wanted to I could have gone back to sleep.
I was groggy all day and debilitating tired
I was productive this morning but feel like I was hit by a truck when I woke up
I was tired but could still function
I was up relatively late last night so I didn't set an alarm for myself this morning. Feeling very refreshed
I went to bed at 8pm but didn't actually fall asleep until around 12am (with the assistance of melatonin). Also I rolled around a lot more than normal last night.
I went to bed at about 1 and that messed up my sleep schedule.
I woke up and was still very tired and wanting to fall back asleep, I hit my snooze button once
I woke up around 12:50 pm because I had stayed up till 3am the previous night. When my sleep schedule is off, even if I do get a good amount of sleep, I still feel exhausted.
I woke up groggy and laid in bed for over an hour
I woke up in the morning and went back to sleep for a few more hours
I woke up pretty well, but throughout the day I will get tired
I woke up prior to my alarm clock, so I feel rested just not at my normal energy level that I can be at.
I woke up tired and had to get caffeine before continuing to work this morning

I woke up with Strep throat and even though I slept extra long it almost felt like too much sleep.
I'm ready to take on the week!
I'm still yawning. Had to wipe sleep out of my eyes. Besides that, I'm good to go!
I'm still exhausted, but I have assignments to do so I cannot sleep in.
I'm still tired but better than some other days
I'm stressed and always sleep less well when I'm stressed.
I've gotten a couple nights of sleep without needing to set an alarm
I've had a couple bad night's sleep in a row.
My mind feels refreshed, but my body still wants to sleep
Not nearly enough sleep and poor-quality sleep
Overslept a little- would have felt better if I got up an hour ago
Pretty awake but if I wanted to I could go back to sleep
Refreshed and ready to take on the day!
Slept in slightly but have been alert and productive all day, much more so than usual
Slept poorly all night, but I did sleep a bit because I had a few dreams.
Still very tired. Woke up before my alarm.
Took forever to fall asleep, felt absolutely groggy to wake up, struggling to not yawn every 30 seconds
Two nights of not being able to sleep well has taken a toll on me. I'm tired, more emotional and I've got a headache.
Was very tired last night, went to bed early, woke up feeling refreshed

Woke up and could have gone back to sleep if I didn't have to get up for school, but was fine otherwise

Woke up and didn't want to get up, wanted to go back to sleep

Woke up and want to go right back to sleep

wanted to go back to sleep, hit snooze one time

APPENDIX B: TREATMENT SURVEY RESPONSES TO LIKERT SCALE

10/10 feeling great! I thought I felt good yesterday, but I woke up right away feeling ready for the day as well as energized.
3 days' worth of good sleep.
Above average, but still left yawning. I have a headache, but I think that's unrelated.
Best sleep I've had this week!
Did not get enough/very quality sleep
Feel awake, but stayed up so late and kept waking up
Feel pretty refreshed, was ready to wake up and feel ready for the day
Feeling good, just like I should! Feeling great! Refreshed, alert, ready for the day!
Feeling great! Woke up to my alarm, but didn't stay in bed groggy or tired, I just got up right away and started my day. Feeling refreshed, alert, productive and ready to go!
Felt very awake and alert this morning, woke up naturally and slowly
Got the right amount of sleep, good quality
I accidentally slept in and now I'm very tired. I suspect if I didn't accidentally [fall] back asleep I'd be fine, but I did and now I'm tired
I actually feel pretty ok. I think it's knowing I have break now.
I am very tired and want to go back to sleep but I have class
I couldn't sleep, I felt like I didn't need to. Had to take a melatonin around 1am and [fell] asleep around 2am. Still feel slightly rested but feeling a little foggy and low energy.
I didn't set an alarm.
I ended up sleeping in my chair in the living room for an hour. And then in my bed for an hour or 2.

I feel decently awake, just didn't sleep for too long so my eyelids feel heavy. My brain feels awake, however.

I feel good and easy to get out of bed

I feel great today! A little fatigued and tired but hardly noticeable. I would say a 9.5 but it wasn't an option. I feel alert and almost 100% refreshed!

I feel great! Energized, productive, awake, and overall feeling fully rested! Slept like a log.

I feel great! Rested and ready for the day!!

I feel great, I can't complain or think of anything wrong with how I feel. Feeling rested and ready for the day.

I feel like I've got a mental fog, probably due to recent stress. However, I feel awake enough to do things

I feel pretty good! Not fully rested, but almost. Feeling a little drowsy, but other than that I'm feeling good this morning.

I feel pretty refreshed despite waking up late and rushing to get ready

I feel rested and ready for the day. I feel energized and refreshed. Not as much as I could be put pretty darn good.

I feel rested and really hyper this morning, I'm in a great mood, woke up before my alarm, and just feel ready for the day!

I feel rested, but still a little tired.

I feel slightly groggy, but I think it may be due to the weather. I feel I've slept sufficiently and I feel awake enough for class :)

I feel so great today, I let myself sleep in a little bit as a reward from my test yesterday and it was a great decision. I feel awake and ready for the day. I feel like I could go back to bed if I wanted to, which is why I didn't select 10

I fell asleep peacefully and woke up naturally. I feel refreshed and ready for what I have to do today

I felt good this morning and other than needing a min. to wake up felt easy to get out of bed.

I felt like I reached a deeper sleep. I felt very heavy when I woke up and continued to want to go back to sleep.

I felt like I went to a different world while I slept. I get such a deep sleep.

I felt rested this morning and didn't need a lot of time trying to get up

I felt well rested and good enough to do things during the day

I had such a busy weekend I just wanted to sleep in but I couldn't. I feel relatively groggy but not terrible

I have a massive headache and just don't feel as refreshed after last night.

I really had a hard time falling asleep and waking up, I feel pretty groggy and not alert

I slept a lot and had time to have a slow wake up this morning, I feel great and wish I could sleep like this every night

I slept until I woke up.

I usually don't feel as tired the first day of getting little sleep, it usually hits me the second day. So, I feel tired and not refreshed but I know tomorrow I'll feel a lot more tired whether my sleep was good or not.

I was SO tired last night, I just crashed and I happened to wake up naturally at 7, but I feel great

I went to bed really late and didn't set an alarm so I woke up naturally and even though I was rushing this morning, I feel like I went to bed really peacefully

I'm ok, my head is strange today though. Not sure if it has anything to do with the music or not.

I'm yawning, but I'm OK.

It felt like my brain turned off easy at night and getting up was hard but not impossible

Needed to sleep more

Not as alert nor refreshed. But I'm still feeling good with only 7hr of sleep in me. I feel like an hour more sleep would have changed my answer a lot.

Not the best quality sleep, but pretty good

Not very good quality sleep

Poor quality sleep and not enough

Pretty tired but I was able to get up for school

Thank you for this track! I might not have gotten a lot of sleep tonight, but the song is perfect!

Tired but honestly awake and able to do stuff

Trying to catch up from 2 hours of sleep. So I'm still exhausted.

Would have liked to have slept more, but overall good sleep

feel refreshed and ready to take on the day!

feeling average

feeling not great, was sick yesterday

middle of the road. Energy is present, but motivation is not.

middling awakeness

pretty good sleep! I'm still yawning but I think that's just because I took melatonin and my prescription meds

still yawning. I'll probably nap later today

APPENDIX C: BASELINE SURVEY EXTRA DETAILS

<p>Around 12am, I tried doing a breathing technique I learned a few years ago, and also made my room colder, to help me sleep.</p>
<p>Been very stressed about a class, may impact falling asleep</p>
<p>Couldn't get comfortable in bed even though I was tired, brother-in-law was making a lot of noise when I was trying to fall asleep.</p>
<p>Each time I woke up was after a dream.</p>
<p>Felt very tired and went to bed early- only afternoon classes, so I wasn't anxious about needing to get up in the morning</p>
<p>Forgot to mention I use a white noise machine!</p>
<p>Had a hard time feeling comfortable in bed while trying to fall asleep- tossed and turned until I fell asleep.</p>
<p>Had a hard time winding down after work and my room was a little too cold to be comfortable, so I had a harder time falling asleep.</p>
<p>Had a little trouble getting my neck comfortable to fall asleep but was faster to get comfortable than usual. I probably would have slept longer but I am sensitive to light.</p>
<p>Had coffee this morning. Might've helped.</p>
<p>Had very vivid dreams all night- woke up after each dream</p>
<p>Hit the snooze button once</p>
<p>I didn't feel tired at all during the day/evening so I was worried I wouldn't be able to fall asleep again, but I had no problems.</p>
<p>I feel like I'm in a fog today. However, I'm not emotional nor stressed or heavily fatigued right now</p>

<p>I felt like my mind couldn't turn off, or "switch" to sleep mode. The longer I couldn't sleep the more stressed I became.</p>
<p>I had a friend from home sleeping over for the weekend in my room.</p>
<p>I may have had caffeine too late in the day which made me stay awake.</p>
<p>I saw my dad lose consciousness yesterday over zoom, and EMS called. So might be why I'm more emotional.</p>
<p>I think my sleep quality is determined by whether I take my ADHD meds or not. It seems on days when I don't I can't get to sleep.</p>
<p>I think the Tai Chi helped relax me, maybe? I still struggled to go to sleep but not as badly as usual.</p>
<p>My arm fell asleep last night and that was uncomfortable when I woke up in the middle of the night, but I don't know if that's why I woke up or not</p>
<p>Sometimes when I wake up in the middle of the night I hit my vape (nicotine). This may play into sleep.</p>
<p>The people above me were having a party, making it hard to fall asleep</p>
<p>Took 4 hours of lying in bed to fall asleep (between 10pm-2am). Slept very well the night before and did not feel tired at any point in the day or night despite moderate exercise in the afternoon.</p>
<p>Woke up at 1:30 am with a migraine so I took some ibuprofen to help</p>

APPENDIX D: TREATMENT SURVEY EXTRA DETAILS

Caffeine too close to bed
Had a lot of anxiety before bed
Had caffeine a little too close to bed
Had to respond to three emergency emails tonight. (Two relating to my job.) This is probably why I failed to return to sleep after waking up so late.
I had a dental appointment yesterday and they did do sedation, might have played a role.
I had a lot of my mind last night, and worked on class work up to bedtime, so it took a little while longer to simmer down.
I had gone to bed around 10pm and woke up at 4am to go to Chicago for a doctor's appointment. I could have slept longer if I didn't need to leave
I had to turn on a YouTube video to help me fall back asleep
I have a lot more dreams when I listen to the music while I sleep.
I have no idea why I couldn't sleep. I didn't even have caffeine after 12 noon.
I pretty much fell asleep pretty quick weirdly enough. I thought I'd be tired today due to the previous night, but I feel great!
I put on a YouTube video to help me fall asleep because the music wasn't letting me go to sleep for like an hour. I'm unsure if it is because of the light or if it's from the sound. I'm going to try again with the music tonight!
I realize at some point during the night the music can't load any further on my phone, I only noticed this because I looked at the activity on the link you sent, and it always stops at a certain point (~2hr). It's not been an issue but thought you should know.
I was up later than normal, making me more tired, making it easier to fall asleep

I was woken up by my apartment neighbors playing LOUD music and waited for the cops to come for the noise complaint
I'm so ready for break.
Listened on my phone speaker so I didn't have to deal with headphones.
My fiancé visited, stayed the night
Only afternoon classes the next day, so no anxiety about waking up
People were once again yelling and screaming last night but they quieted down quicker than normal.
The headphones worked for me the first night but just annoyed me last night for some reason so I took em off for the night
There were drunk people right below my window, yelling and screaming. Cops were called later in the night but it went from around 11pm-3am. The music actually helped, and I've never fallen asleep so quickly.
This might sound crazy but the music makes me feel like I go into a deeper sleep then without music.
Was sharing a bed, sleeping in other bed than my own
Was sleeping in a different bed than normal- was uncomfortable physically through the night
Yesterday I had a procedure done and was under anesthesia from 12pm - 3pm.
Slightly sore throat, but that might just be from teaching

APPENDIX E: GENERAL SLEEP QUALITY QUESTIONNAIRE

1. Please indicate your gender
 - a. Male
 - b. Female
 - c. Non-binary
 - d. Prefer not to say
 - e. Other (prompt to fill-in)
2. Please indicate your age.
3. Have you been diagnosed with a sleep disorder (insomnia, narcolepsy, etc.)?
 - a. Yes
 - b. No
4. If so, please indicate your diagnosis.
5. Do you currently use any sleep aids (prescription pills, over-the-counter medications, wine, etc.)?
 - a. Yes
 - b. No
6. If so, please indicate what you use.
7. Do you sleep by yourself or with someone else?
 - a. By myself
 - b. With someone else
 - c. Other (prompt to fill-in)
8. What time do you usually go to bed?
9. What time do you normally wake up to begin your day?

10. How many hours of sleep do you typically get each night?

11. How often do you have difficulty falling asleep?

- a. Almost every night
- b. 3-5 days a week
- c. 1-2 days a week
- d. 1-3 times a month
- e. I don't have difficulty falling asleep
- f. Other (prompt to fill-in)

12. Do you fall into a deep sleep?

- a. Yes, almost every time
- b. No
- c. Sometimes
- d. Other (prompt to fill-in)

13. How often do you wake up while sleeping?

- a. Almost every night
- b. 3-5 days a week
- c. 1-2 days a week
- d. 1-3 times a month
- e. I don't wake up
- f. Other (prompt to fill-in)

14. Do you have difficulty getting back to sleep once you wake up?

- a. Yes, almost every time
- b. No

- c. Sometimes
- d. Other (prompt to fill-in)

15. How often do you feel refreshed after sleep?

- a. Never/almost never
- b. Almost every night
- c. 3-5 days a week
- d. 1-2 days a week
- e. 1-3 times a month
- f. Other (prompt to fill-in)

16. How often during the week do you feel tired after waking up?

- a. Never/almost never
- b. Once/twice a week
- c. 3-5 days a week
- d. Almost every day
- e. Other (prompt to fill-in)

17. How often during the week do you feel daytime sleepiness?

- a. Never/almost never
- b. Once/twice a week
- c. 3-5 days a week
- d. Almost every day
- e. Other (prompt to fill-in)

18. Are you satisfied with the sleep you've had in the last month?

- a. Likert scale 1-10 (1 = Very little, 10 = Highly)

19. Please expound on your previous answer.

APPENDIX F: PRE-TREATMENT INTERVIEW QUESTIONS

1. Are there any instruments that you enjoy listening to? What do you find calming or relaxing?
2. Are there any ambient sounds that are calming for you (wind, waves, white noise, birds, etc.)?
3. What instruments/sounds do you find relaxing?
4. What are some favorite genres that you find relaxing? What have you used in the past to relax or to fall asleep? What have you found most relaxing?

APPENDIX G: DAILY SLEEP QUESTIONNAIRE WITHOUT MUSIC (BASELINE)

1. Please indicate the date.
2. Did you use any sleep aids last night (prescription medication, over-the-counter medication, wine, etc)? If so, what did you use?
3. How many hours of sleep did you get last night?
4. Did you have difficulty falling asleep when you first went to bed?
 - a. Yes
 - b. No
5. Did you do anything to help you fall asleep when you first went to bed? If so, what did you do?
6. Did you wake up during the night? If so, how many times?
7. What did you do to help yourself fall back asleep? If you did not wake up during the night, please answer accordingly.
8. How refreshed/alert do you feel this morning?
 - a. Likert Scale 1-10 (1 = Not very, 10 = Very)
9. Please expound on your previous answer.
10. Please include any other details that may be helpful.

APPENDIX H: DAILY SLEEP QUESTIONNAIRE WITH MUSIC (TREATMENT)

1. Please indicate the date.
2. Did you use any sleep aids last night (prescription medication, over-the-counter medication, wine, etc)? If so, what did you use?
3. How many hours of sleep did you get last night?
4. Did you have difficulty falling asleep when you first went to bed?
 - a. Yes
 - b. No
5. How did you use the music to help you sleep?
6. Did you wake up during the night? If so, how many times?
7. Did you or how often did you use the music when you woke up? If you did not wake up during the night, please answer accordingly.
8. How refreshed/alert do you feel this morning?
 - a. Likert scale 1-10 (1 = Not very, 10 = Very)
9. Please expound on your previous answer.
10. Please include any other details that may be helpful.

APPENDIX I: POST-TREATMENT INTERVIEW QUESTIONS

1. What are your overall thoughts of the study?
2. What are your thoughts and feelings about the music-making process?
 - a. How did you feel about the music you created?
 - b. How did this new music compare to the other music you use to relax and/or fall asleep?
3. During the treatment period, how did you use the music to help you sleep?
4. What did you notice, if anything, about yourself during the two weeks without music compared to the two weeks with music (change in mood, alertness, functioning, etc.)?
5. Did you notice any differences in how quickly you fell asleep between music and no music?

APPENDIX J: PARTICIPANT CONSENT FORM

You are being asked to participate in a research study conducted by Nick Lanz, Student Music Therapist (Dr. Andrea Crimmins, Principal Investigator: Music Therapy, Illinois State University). The purpose of this study is to gain insight into the effects of personalized music on sleep quality and anxiety. In this study, you will participate in a one-one-one session with the researcher during which you will create relaxing music that is tailored to your preferences. This music will be used to improve sleep quality and reduce stress and anxiety. Data will be collected via electronic surveys in Qualtrics, a post-treatment interview, and the music-creation session. With your consent, video recording will be obtained during the music-creation session and audio recording will be obtained during the post-treatment interview.

Why are you being asked?

You have been asked to participate because you are over 18 years of age and a student at Illinois State University, have no hearing or auditory processing issues, and have expressed a desire to improve your sleep quality. You are ineligible to participate if you are currently located in the European Economic Area.

Your participation in this study is voluntary. You will not be penalized if you choose to skip parts of the study, not participate, or withdraw from the study at any time.

What would you do?

If you choose to participate in this study, you will fill out a number of surveys, including two 20-question surveys at the beginning and end of the study and daily 10-question surveys over a 4-week period. You will also participate in a music-creation session with the researcher, during which you will create music with the researcher based on your preferences. **This interview will take place in-person on ISU campus and will be video-recorded. This recording is optional.**

During the first two weeks of the 4-week period, you will fill out a daily 10-question survey without changing any habits or behaviors and send each survey to the researcher. It is during this period that you will be creating the music. During the last two weeks of the 4-week period, you will listen to your music as you fall asleep each night using a sports headband with built-in Bluetooth speakers. You will also fill out a daily survey and send it to the researcher each day. At the end of these four weeks, you will wait a week before filling out the same 20-question survey you filled out at the beginning of the study. At this time, you will also be interviewed by the researcher. This can be done in-person or via video chat or phone call. **This interview will be audio recorded. This recording is optional.** In total, your involvement in this study will last approximately 5 ½ weeks. The music-session will last 60-90 minutes, and the ending interview will last 30-45 minutes.

Are any risks expected?

Any risks that may be experienced in this study are minimal. There may be risk of an unexpected emotional response while making or listening to the music. Creating music can be a vulnerable and emotional time, which is expected and understandable. Music can invoke feelings and emotions, both positive and negative. Additionally, you may experience some discomfort during the music-creation session since there will be a camera recording.

Any other risks that may be present are not more than what would be experienced in everyday life.

To reduce these risks, you will be reminded at the start of the music-creation session that you have every right to stop the session should you feel discomfort and want to discontinue. The

researcher will validate any emotions you may experience and encourage you to explore them and be open to whatever emotions may arise from this experience. The researcher will be ready to end the session at any moment should any unexpected emotional responses occur and you wish to discontinue. Additionally, the researcher will place the camera behind you so only the back of you is visible and the researcher is in view. The researcher will also ask you for verbal confirmation before starting video and audio recording, even if you signed the consent to record. You will have the option to quit the recording at any time if you feel uncomfortable and the recording will be deleted.

Will your information be protected?

We will use all reasonable efforts to keep any provided personal information confidential. All survey responses and recordings will be recorded in Qualtrics and stored on a password-protected personal laptop. Only the researcher will have access to your responses and data. Once the study has been completed and the data has been written up, all survey information, recordings, and any other identifiable data will be permanently deleted. Information that may identify you or potentially lead to reidentification will NOT be released to individuals that are not on the research team. Once completed, this research will be published in ProQuest, a university database. This research may also be presented at public symposiums in the future. No data that will identify you will be distributed.

However, when required by law or university policy, identifying information (including your signed consent form) may be seen or copied by authorized individuals.

We need to make you aware that in certain research studies, it is our legal and ethical responsibility to report any life-threatening situations and/or illegal activity on the ISU campus, campus-controlled locations, or involving ISU students to appropriate authorities. However, we

are not seeking this type of information in our study, nor will you be asked questions about these issues.

Could your responses be used for other research?

Your information will not be used or distributed for future use, even if identifiers are removed.

Will you receive anything for participating?

There will be no monetary compensation for participating, however, you will be allowed to keep the music created during the study as well as the speaker headband to use or discard as you would like.

Who will benefit from this study?

The benefits greatly outweigh the risks. The music created in this study has the potential to decrease anxiety and stress and improve sleep quality. As a result, you may experience a positive change in mood, emotions, and thought throughout the day. Should this method prove effective, it may develop into a healthy and beneficial service offered by music therapists in the future to help foster healthy coping mechanisms for anxiety and to improve sleep quality.

Whom do you contact if you have any questions?

If you have any questions about the research or wish to withdraw from the study, contact Nick Lanz at njlanz1@ilstu.edu or (234)-525-7810. Or you can contact the Principal Investigator, Dr. Andrea Crimmins, at amcrimm@ilstu.edu. You are free to withdraw at any time should you feel the need.

If you have any questions about your rights as a participant, or if you feel you have been placed at risk, contact the Illinois State University Research Ethics & Compliance Office at (309) 438-5527 or IRB@ilstu.edu.

Documentation of Consent

Sign below if you are 18 or older and willing to participate in this study.

Signature _____ Date _____

Your signature below indicates that you agree to be video recorded.

Signature _____ Date _____

Your signature below indicates that you agree to be audio recorded.

Signature _____ Date _____

You can print this form for your records.