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Musical Applications in Anxiety Management and Relaxation

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Musical Applications in Anxiety Management and Relaxation

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This thesis for honors recognition has been approved for the Department of **Psychology**.

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Abstract

Music has served as an important element of most cultures, but its use as a therapeutic intervention to relieve anxiety, control pain, and manage disease remains new. Limited research exists to explain how music relieves anxiety and pain. Explanations include plasma cortisol control, cardioregulatory nuclei control, norepinephrine and epinephrine control, entrainment, and distraction. The majority of research is focused on reporting music’s significant effect on reducing anxiety, pain, and discomfort for individuals undergoing anxiety-provoking events, painful medical procedures, or hospitalization.

This study tested the effects of the sound environment (music and no music) on differences in individual subjects’ pulse rates. Ten undergraduate student subjects were introduced to an anxiety-provoking situation that included having to complete as many paper-and-pencil mazes as possible in 30 minutes and being recorded with a camcorder. At five minute intervals, subjects’ pulse rates were recorded. During one paper-and-pencil maze session, the external condition was silence; during the other session, the external condition was music. The results of the study found that there was a significant difference ($t_6 = 2.0000, p < 0.0462$) in pulse rate changes as a function of the sound condition. When subjects were under the music condition, their pulse rates dropped significantly more from the beginning pulse rate to the ending pulse rate than did the pulse rates of subjects in the control group with no music condition. The conclusion from this research is that music can significantly decrease physiological responses to anxiety.
Musical Applications in Anxiety Management and Relaxation

Increased physiological anxiety is generally associated with an increase in blood pressure, heart rate, respiration rate, muscle tension, and peripheral vasoconstriction (decreased skin temperature) (Zimmerman, Pierson, & Marker, 1988). Research also indicates that anxiety elevates cortisol, epinephrine, and norepinephrine levels (Watkins, 1997; McKinney, Antoni, Kumar, Tims, & McCabe, 1997; Bartlett, Kaufman, & Smeltekop, 1993; Miluk-Kolasa, Obminski, Stupnicki, & Golec, 1994). Sapolsky, Krey, and McEwen (1985) found that prolonged levels of corticosterone (also called cortisol) in rats was correlated with hippocampal neuron destruction (as cited in McKinney, Antoni, Kumar, Tims, & McCabe, 1997). Albrecht (1979) reported that many experts believe that nearly 80% of all medical conditions may be stress related and that as many as 25% of Americans suffer from serious psychological and physical disorders related to stress (as cited in Thaut & Davis, 1993). Moreover, McEwen, De Kloet, and Rostene (1986) noted that immunosuppression, hypertension, osteoporosis, and accelerated tumor growth have also been correlated with prolonged elevation of corticosterone (as cited in McKinney, Antoni, Kumar, Tims, & McCabe, 1997). Thus, if anxiety is increased, cortisol levels increase as well as the risk of destruction to the body.

For thousands of years, music has been an integral element of most cultures. According to Watkins (1997), the Bible relates how David played music with a harp to relax King Saul. Confucius, Plato, and Aristotle all theorized that music favorably affected people; both the ancient Greeks and Romans used music, believing that it had powerful healing powers. Yet, even though music has played an important role in
history, its acceptance as a therapeutic intervention to relieve anxiety, control pain, and manage disease remains new and limited.

History of Music Therapy’s Development

Before the twentieth century, musical interventions in the United States were limited to a few isolated cases. Among the most significant of the music therapy practices, reported Davis (1989), was at Utica State Hospital in New York, which was established in the latter quarter of the nineteenth century (as cited in Davis, 1993).

At the onset of the 1900s, three women worked to establish music therapy as a clinical practice within the United States. These three pioneers were Eva Augusta Vescelius, Isa Maud Ilsen, and Harriet Ayer Seymour, who all developed theories about music as a therapy, practiced their theories in hospitals and mental asylums, and established organizations to advocate music therapy (Davis, 1993). Davis and Gfeller (1992) noted that although the music therapy programs that Vescelius, Ilsen, and Seymour developed lasted only a few years, “their work established music therapy as a viable therapeutic modality that was recognized by such organizations as the Red Cross and United States Army” (as cited in Davis, 1993, p. 35).

Both Ilsen and Seymour administered music therapy to injured, shell shocked American soldiers who had returned from World War I to American hospitals for surgery, medical care, or reconstruction work (Davis, 1993). According to the American Music Therapy Association, with veterans of World War I and II returning to veteran hospitals across the United States, community musicians went to these hospitals to play for the thousands of men (1998). When the patients notably responded to the music both physically and emotionally, physicians and nurses requested that musicians be hired at
the veteran hospitals. With this onset of musicians being hired at hospitals, it became evident that some prior training was necessary before the musicians could practice within the hospitals. Thus, in 1944, Michigan State University founded the first music therapy degree program. Following the introduction of music therapy degree programs, the National Association for Music Therapy was founded in 1950, and the American Association for Music Therapy became established in 1971. The two organizations merged in 1998 to form AMTA – the American Music Therapy Association (AMTA, 1998).

Definitions of Anxiety, Music, and Music Therapy

Spielberger (1972) defined anxiety as “an emotional state consisting of feelings of tension, apprehension, nervousness, and worry, and activation or arousal of the autonomic nervous system” (as cited in White, 1992, p. 58). The researcher also identified two different components of anxiety: state anxiety and trait anxiety. State anxiety is characterized as being a temporary emotional state that reflects an individual’s perception of the stressful event. Spielberger defined trait anxiety, by contrast, as reflective of the individual differences in anxiety tendency and the frequency to enter an anxiety state (state anxiety) (as cited in White, 1992).

Music is the arrangement of sound consisting of melody, harmony, tone, pitch, and rhythm. Music therapy is the use of music to restore, maintain, and improve physiological, physical, emotional, mental, and spiritual health and well-being. Aldridge (1993) reported that most nursing and medical interventions typically use anxiolytic music (anxiety reducing music) (as cited in Watkins, 1993). According to Standley (1986), most music therapy research reported that music with a slow rhythm, soft pitch,
and no vocal timbre reduced physiological responses to stress (as cited in Watkins, 1993). Bolwerk (1990), White (1992), Kaempf (1989), and Updike (1987) specified the following characteristics of anxiolytic music: low pitch, slow tempo, no percussion, simple repetitive rhythm, consonance of harmony, often string instrumentation, and recognizable instrumental and vocal timbre (as cited in Watkins, 1993).

Methodology

In 1944, Harriet Ayer Seymour published a textbook for music therapy clinical practice entitled *An Instruction Course in the Use and Practice of Musical Therapy*. In the textbook, she set forth minimal requirements for a music therapist, basic principles of music therapy, and general methodology. In 1944, Seymour recommended that music therapists have a basic knowledge of music, the ability to play simple music well, the eagerness to help alleviate pain and induce healing, and the ability to observe client reactions to the music (Davis, 1996).

Seymour believed that the combination of music and thought helped to relieve stress, alleviate fear, reduce pain, and renew hope and courage. Developed from this combination of positive thought and music was the client/therapist relationship, which was the groundwork for the music therapy devised by Seymour (Davis, 1996).

The instructions Seymour discussed in *An Instruction Course in the Use and Practice of Musical Therapy* dictated what type of music should be used. Popular music was rarely to be used, and absolutely never was jazz music to be applied as a therapeutic intervention. Seymour suggested music selections that were most appropriate for certain hospital wards. For example, Strauss waltzes, Chopin waltzes, *Ave Maria* by Schubert, *Wild Irish Rose*, and folk music of all nations were to be used on mental wards; yet on
wards with war-shocked patients, Seymour suggested the use of “any good Tango,” the Prelude to *Meistersinger*, *Parade of the Wooden Soldiers*, *Alleluia* by Mozart, and *Toreador Song* by Bizet (Davis, 1996, p. 40). Seymour also described the type of instrumentation that was most desirable. A combination of instruments with or without voice could be used, but a trio consisting of a violin, a cello, and a piano along with a singer was the best arrangement, according to Seymour. The length of the music therapy program depended on the type of illness. It was suggested that thirty minutes be the length of programs for orthopedic and tuberculosis patients and children who were not seriously ill. Programs were suggested to last only fifteen minutes on wards where children were seriously ill (Davis, 1996).

The technique of musical therapeutic intervention was also set forth. For individual sessions with clients, Seymour recommended that the therapist suggest a phrase to a client, and then the client was to repeat the word either audibly or silently while the therapist played suitable music. Seymour believed that pairing the music and the thought together would relieve the client’s stress, reduce his or her fear, and alleviate his or her pain. Examples of suggested phrases included “There is one presence, there is one power,” “Onward, onward,” and “Healing spirit thou dwellest within” or simple words like “joy” and “peace” (Davis, 1996, p. 38). For group music therapy sessions, Seymour wrote that therapists should first gain permission from the physician in charge and then meet with a nurse, physician, or attendant to gain background information about each client. After meeting with hospital staff, the therapist then was to devise a musical program that would account for the information learned about each client, as well as the suitable style, length, and number of musicians. When it came to implementing the
actual musical plan, the therapist and musicians were to move through the hospital ward
and begin playing the music softly. After patient reactions were observed, the music’s
style and volume could be adjusted accordingly. Upon completion of the program,
Seymour suggested that the therapist meet together with the musicians and the head nurse
to measure the effect of the visit to the ward (Davis, 1996).

Although Seymour wrote this textbook in the 1940s before music therapy had
become an organized discipline, many of the key elements of her program are similar
today. According to the American Music Therapy Association (AMTA) (1998), music
therapists today work with a diversity of people of all ages: children, adolescents, adults,
and the elderly. Those who may benefit from music therapy may suffer from a mental
illness, a terminal illness, a developmental or learning disability, substance abuse,
physical disease and/or disability, and acute and chronic pain. Likewise, music therapists
also work with people who are not suffering from a clinical diagnosis. Instead of just
working in medical hospitals, AMTA (1998) cites the following places where music
therapists commonly work: “psychiatric hospitals, rehabilitative facilities, outpatient
clinics, day care treatment centers, agencies serving developmentally disabled persons,
community mental health centers, drug and alcohol programs, senior centers, nursing
homes, hospice programs, correctional facilities, halfway houses, schools, and private
practice” (p. 1).

The goals of music therapists today often include pain management and stress
reduction like that of the 1940s, but goals are devised according to the type of population.
The goals of music therapy for a healthy individual might be to use music for stress
reduction and relaxation, support for physical exercise, or assistance during pregnancy
labor and delivery. For individuals medically hospitalized, music therapists might aim to alleviate pain, elevate mood, promote movement, lessen fear and muscle tension, and calm. Goals for those in a psychiatric hospital might be quite different: exploring personal feelings, improving mood and emotional state, practicing problem solving, and resolving conflicts. Music therapists might focus on strengthening communication skills and physical coordination for the special learners in a school. For individuals in a nursing home, the objectives may be to maintain a high level of physical, mental, and social activity as well as stimulate senses and intellect (AMTA, 1998).

A “typical” session does not exist in the field of music therapy. Because of the broad diversity of needs, the interventions and the sessions are quite different depending on the need of the client and the individual treatment plan. A music therapist always assesses the emotional, physical, mental, communicational, and cognitive functioning of the client. Depending on the therapist’s assessment, the music therapist then designs a session for the individual (or group). Standley (1986) suggested, however, an element of the client’s participation in the planning of the music therapy session. He advised that the patient be allowed to control as much of the therapy as possible, such as the volume of the music and the choice of music (as cited in Watkins, 1993). Likewise, Standley also suggested the following: use of the patient’s preferred music and equipment, use of earphones as much as possible, making verbal suggestions that the music will relax, and showing reinforcement in response to the signs of relaxation (as cited in Watkins, 1993). The music therapy session might follow any one of the following interventions set forth by the AMTA: “music improvisation, receptive music listening, song writing, lyric discussion, music and imagery, music performance, and learning through music” (1998,
Following each session, regardless of the type of intervention used, the therapist will follow up and evaluate the session; music therapists may also participate in interdisciplinary treatment planning.

Although Seymour advocated the use of a combination of instruments consisting of a violin, a cello, and a piano with vocal accompaniment, other researchers have proposed using other types of musical instruments. Schroeder-Sheker (1993) advocated the use of a harp, whereas Lingerman (1995) agreed with Seymour, supporting the use of stringed and woodwind instruments (as cited in Olson, 1998). Bailey (1983) also partly agreed with Seymour, suggesting singing to be a highly valuable accompaniment (as cited in Olson, 1998).

Like the debate over what instruments are best to induce relaxation, discussion has arisen over whether the administration of live music is significantly better at reducing anxiety than that of the administration of tape-recorded music. A study by Bailey (1983) found that patients who listened to live music reported significantly less anxiety, decreased physical pain and discomfort, more positive moods, and more vigor as compared to those who listened to tape-recorded music (as cited in Olson, 1998).

Still another often debated aspect of music therapy is whether the use of subject-selected music is more or less effective than the use of music chosen by the experimenter or music therapist. Thaut et al. (1993) found that there were no significant differences in state anxiety, depression, hostility, and perceived relaxation between subject-selected music groups and experimenter-selected music groups. However, Mornhinweg's findings contradicted this finding (1992). The researcher tested the effects of three different types of music on subjects' state anxiety and heart rates. Findings showed that
the experimenter-chosen baroque/classical music and New Age music produced decreases in range and mean heart rate, but the student-chosen popular music caused an increase in range and mean heart rate.

How Music Affects the Body

In 1939, Seymour wrote a pamphlet, *How to Use Music for Health*, which set forth three levels at which she theorized that music therapy worked: vibratory, emotional, and spiritual. She proposed that the vibratory elements of music affected the physiological body including nerves, glands, muscles, and bones. The emotional elements of music positively affected health and were helpful for stress. Finally, according to Seymour, the spiritual level of music could profoundly affect the listener (Davis, 1996).

Since the time of Seymour, much research has been completed to explain how music physiologically relieves anxiety. At this point, the clear explanation for how music causes relaxation is unknown.

Five theories exist which seek to explain music’s anxiolytic effect. However, in order to understand most of these theories, an explanation must be made about how auditory stimuli are processed in the brain and what brain organs are involved in music processing.

In the ascending auditory pathway, sound stimuli enter the outer ear and into the cochlea of the inner ear. In the cochlea, auditory stimuli are received by the epithelial hair cells connected to nerves of the cranial nerve VIII. When the hair cells are moved by the sound waves of auditory stimuli, changes occur in the cell membrane, creating an action potential which diverges and delivers impulses to both the dorsal and ventral
cochlear nuclei. Lateral inhibition is the occurrence by which strong auditory impulses inhibit weaker impulses. Lateral inhibition takes place within both the cochlear nuclei, but less so in the ventral cochlear nuclei.

The pathway through the dorsal cochlear nuclei is called the core region. From the dorsal cochlear nuclei, the strongest auditory impulses are transported to the inferior colliculus nuclei. The information from the dorsal cochlear nuclei travels through the inferior colliculus nuclei to the medial geniculate nucleus in the thalamus and then finally to the auditory association cortex of the temporal lobe.

The pathway through the ventral cochlear nuclei is called the belt region. From the ventral cochlear nuclei, the action potential travels to the trapezoid body and the superior olivary complex located in the medulla. The information from these two organs travels to the inferior colliculus nuclei where the visual, somesthetic, and auditory input are combined. Then the somatic, vestibular, and auditory input are combined at the medial geniculate nucleus, and this information is finally sent to the auditory association cortex in the temporal lobe.

An additional pathway exists for the processing of auditory stimuli which parallels that of the ascending auditory pathway. From the auditory cortex of the temporal lobe, information can be sent to the medial geniculate nucleus of the thalamus, to the locus ceruleus nuclei at the junction of the midbrain and the pons, or to the inferior colliculus nuclei of the midbrain. Livingston (1991) found that the information processed in the inferior colliculus nuclei is projected to the superior olivary complex and the cochlear nuclei (dorsal and ventral) (as cited in Watkins, 1997).
Romanski, Clugnet, Bordi, and LeDoux (1993) identified in rats an auditory pathway connecting the thalamus to the amygdala and a descending pathway from the auditory cortex to the amygdala lateral nuclei (as cited in Watkins, 1997). From the amygdala, Nitecka and Frotscher (1989) found that information in humans is projected to the hypothalamus, and Cassell and Gray (1989) found an additional pathway from the amygdala which projected to the dorsomedial cardioregulatory nuclei and the ventrolateral cardioregulatory nuclei in the medulla (as cited in Watkins, 1997).

**Plasma Cortisol Axis Explanation**

The endocrine system controls the release of corticotropin-releasing hormone (CRH) from the hypothalamus in the brain. Elevated levels of CRH stimulate the release of adrenocorticotropic hormone (ACTH) from the anterior pituitary. With the secretion of ACTH, plasma cortisol (corticosterone) is released from the adrenal glands. Plasma cortisol (also called cortisol or corticosterone) helps break down proteins and convert it to glucose, helps make fats available for energy, increases blood flow, and stimulates behavioral responsiveness (Carlson, 1998). In other words, cortisol is responsible for preparing the body for “fight or flight.”

If the connection exists between the amygdala lateral nuclei and the amygdaloid nuclei which project to the hypothalamus, this pathway would explain music’s effects on physiological relaxation by the fact that hypothalamic nuclei control the endocrine system, responsible for hormone release (e.g., corticotropin-releasing hormone). Nitecka et al. (1989) found that stimulation of the basolateral region in the amygdala inhibited the endocrine system, whereas stimulation of the centromedial region in the amygdala resulted in excitation of the endocrine system (as cited in Watkins, 1997). The amygdala
lateral nuclei is located in the basolateral region; thus, stimulation of the amygdala lateral nuclei would result in the stimulation of the basolateral region and subsequently the inhibition of the endocrine system and the inhibition of the release of corticotropin-releasing hormone. Nitecka et al. (1989) theorized that by stimulating the basolateral amygdaloid region, levels of corticotropin-releasing hormone release may be decreased by the direct inhibition of hypothalamic nuclei and by preventing the stimulation of the centromedial region in the amygdala (as cited in Watkins, 1997). Yet research still needs to confirm that a pathway does exist between the amygdala lateral nuclei and the amygdaloid nuclei which connect to the hypothalamus.

Cardioregulatory Nuclei

The pathways from the amygdala to the hypothalamus and the amygdala to the cardioregulatory nuclei potentially explain how music regulates anxiety responses. Research by Cassell et al. (1989) and Cox, Jordan, Patton, Spyer, and Wood (1987) suggested that “reduction of the stress response in the cardiovascular system (decreased blood pressure and heart rate) may be mediated by release of inhibitory neurotransmitters or by withdrawal of sympathetic activity” (Watkins, 1997, p. 47). Because cardioregulatory nuclei regulate cardiovascular reflexes (e.g., blood pressure, heart rate), if the pathway between the amygdala lateral nuclei and the cardioregulatory nuclei in the medulla exists in humans, it would explain how music controls cardiovascular reflexes.

Norepinephrine and Epinephrine Release

Studies have shown that in the descending auditory pathway, the auditory association cortex in the temporal lobe projects to the locus ceruleus at the junction of the midbrain and the pons. Johnson, Kamilaris, Chrousos, and Gold (1992) found that the
locus ceruleus stimulates the central and peripheral sympathetic nerves to release norepinephrine and also stimulates the adrenal medulla to secrete epinephrine (as cited in Watkins, 1997). With the secretion of norepinephrine and epinephrine, blood pressure and heart rate are increased, thereby creating more physiological anxiety within the body. Because the locus ceruleus is involved in norepinephrine and epinephrine secretion and is a point in the auditory pathway that processes auditory stimuli, music mediates anxiety by limiting the release of norepinephrine and epinephrine.

Entrainment Theory

Brown (1980) found that subjects with increased anxiety subjected to a slow external rhythm, exhibited synchronized heart rates with the external rhythm (as cited in Summers, Hoffman, Neff, Hanson, & Pierce, 1990). This study implicated that an external rhythm can decrease anxiety levels and slow internal body rhythms (e.g., heart rate, respiratory rate). This phenomenon, called entrainment, happens when “two vibrating or oscillating bodies beat or pulse in synchrony with each other” (Summers et al., 1990, p. 67). Leonard (1981) theorized that even a single-celled organism will oscillate at different frequencies at every level, be it atomic, molecular, or a cellular level (as cited in Summers et al., 1990). Darner (1966), Brady, Luborsky, and Kron (1974), and Hoffman (1980) found that a rhythmic sound of 60 beats per music slowed or lowered body-mind rhythms, such as blood pressure (as cited in Summers et al., 1990). According to Olson (1998), live music forms a flow of energy and vibrations from the singer and the instrument to the listener. Olson theorizes that this vibratory energy is transferred through what she calls an electromagnetic field which surrounds every living person. This electromagnetic field vibrates at different frequencies, depending on the
individual's perceived mental, physical, and emotional states. Campbell (1997) reported that Chinese medicine maintains that disease results from energy flow blockages caused by imbalances, or disharmonies (as cited in Olson, 1998). Supporting this theory of entrainment is the finding by Williams (1993) that “deep space,” the earth’s magnetic field, and human brain wave activity in a relaxation state (alpha or theta) all vibrate at about 7.8 Hz per second (as cited in Olson, 1998).

**Distraction Theory**

Although not explanatory of physiological effects caused by music, McCaffery and Beene (1989) and Snyder (1985) mention that music may serve as a distraction from the painful or stressful event at hand (as cited in White, 1992). Through distraction, the pain or stress is forgotten and anxiety is relieved.

**Clinical Studies**

Multiple studies have researched the effects that music has had on subjects in diverse anxiety-producing situations, commonly associated with surgical procedures or medical situations.

Stress related to cardiac problems is one such situation explored by researchers. White (1992) administered experimenter-chosen classical music to twenty stable patients who had sustained myocardial infarction (a heart attack). Their state anxiety ratings were 40 or above, which was at least one half of one standard deviation above the mean state anxiety ratings of 865 undergraduate college students. The experimental group experienced statistically significant decreases in the three dependent variables of heart rate, respiratory rate, and state anxiety scores. The control group (n = 20), who had no music therapy exposure, also experienced a statistically significant decrease in state
anxiety scores as well. However, the degree of reduction was significantly greater in the experimental group than in the control group in regard to state anxiety scores and respiratory rates. In contrast to this finding, Barnason, Zimmerman, and Nieveen (1995) found no statistically significant differences between the heart rate, mood ratings, systolic blood pressure, or diastolic blood pressure of patients after coronary artery bypass grafting. Another study also failed to find a statistically significant difference in blood pressure, heart rate, skin temperature, or state anxiety scores of three groups: control group with no music, experimental group with synthetic silence, and experimental group with music (Zimmerman et al., 1988).

As with cardiac medical problems, pregnancy and delivery also subject patients to very high stress and anxiety levels. Using music during pregnancy, delivery, and newborn care has become one of the fastest growing fields of music therapy, according to Campbell (1997) (as cited in Olson, 1998). In Hanser, Larson, and O’Connell’s (1983) study, music was used to decrease pain, cue rhythmic breaking, and help mothers in labor to relax in an effort to reduce anxiety and pain; all women reported fewer pain responses during the delivery when music was present (as cited in Olson, 1998). Liebman and MacLaren (1991) researched the results of administration of relaxing music to pregnant adolescent women in their third trimester of pregnancy. Results of the study indicated that the women receiving relaxation music maintained significantly lower levels of state anxiety than the women in the non-music control group. However, deficiencies in experimental design restrict the implications of this study.

According to Miluk-Kolasa, Obminiski, Stupnicki, and Golec (1994), surgery itself may be a very severe stressor, but even the information that surgery is to take place
can evoke severe anxiety. Miluk-Kolasa et al. (1994) divided hospitalized men into three groups: a control group of patients who stayed hospitalized but were not awaiting surgery, a group of patients who were awaiting planned surgery and were administered a music therapy program, and a third group also awaiting planned surgery but who were not administered a music therapy program. Saliva samples were taken before the stressor and then at 15 minutes intervals. The stressor produced a 50% rise in cortisol (stress hormone) in the saliva samples. Patients who were administered music therapy experienced gradual decreases in cortisol levels, and at the end of the music session, cortisol levels were significantly lower than the initial levels prior to the stressor.

Cardiac problems, surgery, and pregnancy are among the most commonly researched in music’s effect on the anxiety caused by these states. Yet many other procedures have been studied. Davis (1992) researched the effects of music on pain and anxiety of women undergoing gynecological procedures, including colposcopy (microscopic examination), punch biopsy (removal of tissue with punch action instrument), and cryosurgery (removal of tissue by freezing). The researcher found that the experimental group showed lower pulse rates, fewer overt pain reactions, less self-reported anxiety, and lower respiration rates than the control group while undergoing the most painful part of the procedure, cervical scraping. Yet these variances were not significantly different. The only significant difference between the experimental and control groups reported was the overt pain reactions and the respiratory rates during the punch biopsy. The experimental group exhibited significantly lower overt pain reactions and respiration rates.
Winter, Paskin, and Baker (1994) also studied the effects of music on patients undergoing same-day gynecological surgery, undergoing exploratory laparoscopies, laparoscopic tubal ligation, ovarian cysts excision, and intrauterine device removal. All subjects completed a State-Trait Anxiety Inventory (STAI) test upon arrival to the surgical holding area. A second STAI was completed just before subjects were taken into the operating room. Also, subjects' blood pressures and heart rates were taken upon arrival and just prior to being taken to the operating room. Any changes in the state anxiety scores, blood pressure, and heart rate would indicate changes in the subjects’ anxiety levels. Winter et al. (1994) found that subjects who were exposed to music in the surgical holding area had significantly lower STAI scores before going into the operating room than upon arrival to the surgical holding area. The control group who was not exposed to music showed a difference in STAI scores but it was in a marked increase in STAI before entering the operating room. No statistical differences were found in blood pressure or heart rates between the two groups.

Palakanis, DeNobile, Sweeney, and Blankenship (1994) found that subjects who were exposed to music while undergoing flexible sigmoidoscopy (colon cancer screening test) had significantly decreased State-Trait Anxiety Inventory scores, heart rates, and mean arterial pressure compared to patients receiving the same procedure without music.

Patients receiving ventilatory assistance are subjected to high levels of stress associated with fear, thirst, sleeplessness, discomfort, agitation, confusion, communication difficulties, and immobility. Chlan (1998) found that ventilatory assisted patients who participated in a music therapy session experienced a significant decrease in anxiety, evidenced by decreases in heart rate and respiration rates. A significant
difference was also found in the reported levels of anxiety between the experimental group who received a music therapy session and the control group who did not.

In a study by Caine (1991), premature and low-birth-weight infants were grouped into an experimental group and a control group. The experimental group received two five-minute music interventions daily while hospitalized in the Newborn Intensive Care Unit and confined to isolettes. The results of the study showed that the experimental group had significantly shorter stays in the hospital, lower initial weight loss, and higher nonstress behaviors. Thus, the results from the study implied that music is helpful in reducing stress levels for premature and low-birth-weight neonates as well as reducing time of hospitalization and initial weight loss.

Another group often studied in relation to music therapy is the terminally ill. Curtis (1986) researched the effect of three interventions on the self-report of four variables: pain relief, physical comfort, relaxation, and contentment of hospitalized terminally ill patients. The three interventions included (1) no intervention, (2) background sound, and (3) music. No significant differences were found between these three interventions in any of the four variables, although the difference in contentment scores approached significance (p < 0.069).

Chiropractic patients participated in a study by Strauser (1997). One group was a preferred-music listening group (group members chose the type of music they preferred to listen to), another was a music visualization group (New Age music was selected by experimenter), and the other group was a non-music control group. Analysis showed that participants in all three groups had decreases in anxiety, not only in the experimental
groups but also in the non-music control group. These results suggested that sitting in silence can result in just as much relaxation as listening to music can.

Research has not only been recorded for music’s use in the medical setting; it has also been applied in general situations to induce relaxation. Summers, Hoffman, Neff, Hanson, and Pierce (1990) tested the effects of 60-beat-per-minute music on nursing students taking a test. Students were pretested three weeks prior to the test using the STAI. Prior to the examination, subjects recorded their pulse rates and completed another STAI. The test was then administered to the subjects. One group of subjects (the experimental group) was administered music while taking the test, while the control group was given no music during the test. The results of the study showed no significant differences between the control and experimental groups. However, the control group’s post-test pulse rate standard deviation was larger than the experimental group’s. According to the researchers, the results could be interpreted as clinically relevant.

Davis and Thaut (1989) studied the influence of subject-preferred relaxing music on the physiological response and psychological response of subjects. Each subject was tested individually. The subject completed a State Anxiety Inventory prior to entering the testing area and indicated current relaxation on a 7-point scale. The subject was then taken into the testing area and seated in a recliner chair; baseline physiological data was acquired, including vascular constriction, heart rate, muscle tension, and finger skin temperature. After the baseline period passed, the subject-selected relaxing music was administered to experimental group subjects for 20 minutes while physiological data continued to be taken. After the completion of the music administration, the subject completed another State Anxiety Inventory and again indicated current level of relaxation.
on a 7-point scale. The researchers reported that the subjects' perceived levels of anxiety decreased consistently from pre to posttest conditions; however, the decrease was significant only for the State Anxiety Inventory. For physiological responses to the music, the only statistically significant result was found with the vascular blood flow, with music producing significantly higher vascular constriction.

Thaut (1989) studied the effects of three different music treatments on psychiatric prison patients. One group was a music group therapy involving the following steps: discussion of current mood, thoughts, and feelings; formulation of a personal agenda of what to work on during music therapy; the selection and the administration of music; and verbal communication between the therapist and the patient on his or her experiences. The second music treatment group participated in instrumental group improvisation, during which patients played instruments using improvisational schemes to express and communicate musical and emotional themes. The third group was a music and relaxation group, using progressive muscle relaxation techniques. Each participant took a pretest and posttest on the self-report scales devised by the researcher. Each scale was a question with a response rating from 1 to 10. Scale 1 related to mood with 1 being very sad and/or depressed and 10 being very happy and/or cheerful; scale 2 related to relaxation with 1 being very tense and/or anxious and 10 being very relaxed and/or peaceful; and scale 3 related to thoughts about themselves and life with 1 being negative, angry, and/or confused and 10 being positive and/or having good thoughts about him- or herself. The results of this study produced significantly higher posttest ratings over pretest ratings on all scales (mood/emotion, relaxation, and thoughts about self).
Rather than measuring the effect of music on perceived relaxation, heart rate, or respiration rate, some studies have pursued music’s effect on hormones and endorphins. Bartlett, Kaufman, and Smeltekop (1993) found that there was a significant decrease in cortisol levels in subjects exposed to music treatment. Moreover, the researchers reported a significant increase in Interleukin-1 (a polypeptide hormone present in the brain and responsible for mediating the body’s immune system response) in one experimental group. McKinney, Antoni, Kumar, Tims, and McCabe (1997) also reported significant decreases in cortisol levels as well as differences between pre- and postsession depression, fatigue, and total mood disturbance levels for subjects who underwent a 13-week guided imagery and music therapy program (GIM). McKinney, Tims, Kumar, and Kumar (1997) divided 84 undergraduate students into four groups: silent imaging, music listening, music imaging, and control. They found that subjects in the music imaging group (spontaneous imaging to selected music followed by a relaxation period) produced significantly decreased plasma β-endorphin levels. Neither the silent imaging group nor the music listening group experienced a significant decrease in plasma β-endorphin levels. McKinney, Tims, Kumar, and Kumar (1997) theorized that these results suggest that the combination of music and spontaneous imaging followed by relaxation induction has a much stronger effect than either of the variables alone.

Thus, research has convincingly showed that music decreases perceived anxiety as well as the physiological conditions associated with anxiety. The present study sought to add to the research base, which would support that music is an effective therapeutic mediator of anxiety. Much research has focused on the effect music has on anxiety
associated with medical problems and painful procedures. The intention of the researcher was to study the effects of music on everyday anxiety experienced by most people undergoing daily hassles, frustration, and common problems. In the experimenter’s study, pulse rates of subjects were taken prior to the subjects’ exposure to the experimental conditions and at subsequent 5-minute intervals. Subjects were presented with two anxiety-provoking stimuli: a camcorder to videotape their actions and 23 paper-and-pencil mazes to complete. A music condition was presented to the experimental group, and a non-music condition was presented to the control group.

The independent variable was the environmental condition (music and non-music), and the dependent variable was pulse rate. The experimenter hypothesized that pulse rates would decrease over time under the experimental condition (music), but would remain the same or increase during the control condition (non-music). This hypothesis was expected by the experimenter because of the results found by researchers that indicate that music is helpful in reducing heart or pulse rate (Palakanis et al., 1994; Chlan, 1998). Likewise, a multitude of studies previously reviewed reported significant decreases in physiological and psychological anxiety resulting from musical interventions.
Method

Participants

A sample of ten undergraduate student subjects (five males and five females) of various majors was recruited from around the college campus. Subjects ranged in age from 18 to 34 and in grade levels from freshman to senior. It was assumed that the subjects were well, had few health problems, and were capable of measuring their pulse rates. Subjects were randomly assigned to groups by drawing experiment times out of a bowl for either 7 p.m. or 8 p.m. Five subjects participated in the 7 p.m. experiment and five subjects participated in the 8 p.m. experiment. Both experiments were held in the Carroll College Psychology House on Wednesday, February 10, 1999.

Materials

A Sanyo MCD-Z11 transportable stereo system, capable of playing compact discs, was used to administer the music condition. A Canon E440 camcorder was mounted upon a K-Mart Focus tripod to act as an anxiety-provoking stimulus. A Seiko wristwatch was used to time the experiment and pulse rate recordings.

Twenty-three mazes developed by Roger Moreau were taken from Mountain Mazes (1996) and Great Explorer Mazes (1997) and used to formulate a packet of mazes that would be presented to each subject on a clipboard with a pencil. A pulse record sheet was also provided for each subject (see Appendix A).

The music used was developed by Dr. Andrew Weil (1997) entitled Sound Body, Sound Mind: Music for Healing. According to Weil, the music was “a symphony of brainwaves . . . music based on themes from Mozart, Mahler, Brahms, and Bach.
combined with healing sound frequencies” (Weil, compact disc back cover). The music was specifically designed to induce relaxation of listeners.

Procedure

The researcher set up the experimental conditions prior to the arrival of the subjects. A lounge area of the Carroll College Psychology House was used for the experimental condition room and a conference room in the same building was used as a subject holding area where subjects would record a baseline pulse rate, void of the anxiety-provoking stimuli. In the subject holding area, chairs were arranged against a wall facing another chair where the experimenter would sit.

In the experimental condition room, the camcorder was mounted upon the tripod and set at the back of the room, facing where the subjects would be seated. The camcorder was plugged into an electrical outlet and prepared for recording. The stereo system was also plugged in and set facing the subjects at a distance of twelve feet away. The volume of the stereo was set at the second of ten notches, believed to be a non-distracting but perceivable volume level. The compact disc was placed in the stereo system and also cued to the appropriate place. A couch and two chairs were arranged in places where the camcorder could record all subjects simultaneously. Clipboards holding a pulse rate record sheet, the maze packet, and a pencil were placed in seatable areas of the couch and chairs.

When the subjects arrived, they were brought to the subject holding area until all subjects arrived. After all subjects’ arrival, participants were thanked for their participation, and the researcher introduced herself. Baseline pulse rates were acquired for a period of fifteen seconds. The subjects were then moved to the experimental
condition room and seated. Subjects were told to record their first pulse rate on the pulse record sheet. They were also asked to record their sex, age, and year in school on the pulse record sheet. Following this completion, basic instructions were given. Subjects were told that under the pulse record sheet on their clipboard, 23 mazes existed that required completion. They were told that the goal was to complete as many mazes as possible in 30 minutes; mazes were to be completed in order as they appeared in the packet, and mazes could not be started from the “end” and worked backward. Furthermore, the subjects were told that every five minutes they would be interrupted so that a pulse rate could be taken for fifteen seconds, and that the researcher would be tape-recording their actions using the camcorder set up in front of them. For the experimental group, subjects were told that music would be played while they worked on the mazes.

After giving instructions and explanations, the subjects were instructed to begin the mazes. At the start, the camcorder was set to start recording and the stereo was set to begin playing music. The time of the beginning of the experiment was recorded and every five minutes after the onset of the experiment, the researcher announced that five minutes had gone by and that it was time to get another pulse rate. After five seconds, the researchers said “go,” timed fifteen seconds, and then said “stop.” The subjects were then instructed to record their pulse rate. After thirty minutes and a final pulse rate recording, the subjects were told that thirty minutes had passed and that the experiment had ended. They were instructed to leave their clipboard where it was, thanked, and allowed to leave. After subjects from the first group left, the mazes and pulse rate sheets were removed from the clipboards and fresh mazes and pulse rate sheets were put in for the next set of participants.
After the completion of both experimental sessions, the data were analyzed using StatMost.

Design

The design the experimenter used was a pretest-posttest control group design with analysis of differences. The independent variable was the sound environment: music or no music, and the dependent variable was the pulse rate. The null hypothesis was the following: There is no difference in pulse rate as a function of the sound environment.

Because the data from the fifth experimental group subject was inaccurate, this data was excluded from the results. To maintain an equal number of subjects in each group, the fifth subject of the control group was excluded as well, changing the sample size to 8.

Subjects were assigned to the two groups (control and experimental) based on the time each subject drew from the bowl. Previously, the experimenter had chosen that the experiment at 7 p.m. would be the experimental condition (with music) and that the experiment at 8 p.m. would be the control condition (no music).

Results

Based on the results of the experiment, the researcher rejected the null hypothesis. This study found that there was a significant difference in pulse rate changes as a function of the sound condition (see Appendix B for raw data). Pulse rates reduced significantly from the start of the session to the end of the session when music was presented. Figures 1 and 2 illustrate the difference in the beginning pulse rate compared to the ending pulse rate for each subject depending on his or her group, music or non-music.
Figure 1. Pulse rates as a function of the sound condition
Figure 2. Pulse rate differences as a function of the sound condition
The mean difference in pulse rate for subjects under non-music conditions was -4.0 ($SD = 5.6569$). The mean difference in pulse rate for subjects under music conditions was 4.0 ($SD = 5.6569$). The difference in the two means was statistically significant with $t_{6} = 2.0000$, $p < 0.0462$ (a one-tailed test with 6 degrees of freedom). There was a significant difference in pulse rate as a function of the sound condition. When subjects were under the music condition, their pulse rates dropped significantly more from the beginning pulse rate to the ending pulse rate than did the pulse rates of subjects in the control group with no music condition.

Discussion

The results of the experiment support the experimenter’s hypothesis that relaxing music does have a significant impact on lowering pulse rates for people under anxiety and/or stress. These results support and reinforce the findings discovered by Palakanis et al. (1994) and Chian (1998). In contrast, these findings contradict the results of Barnason et al. (1995), Zimmerman et al. (1988), Davis (1992), Winter et al. (1994), and Summers et al. (1990), who found no statistically significant differences in heart or pulse rate under music conditions.

Implications of the present study indicate that music is a useful tool for relaxation and anxiety management. The fact that pulse rates of subjects who listened to music decreased significantly more than the pulse rates of subjects who did not listen to music indicates that music can alter the physiological processes associated with anxiety, including heart rate, respiration rate, and blood pressure.

This research provides a firmer foundation for understanding the relationship between music and the physiological and psychological processes associated with
anxiety. Further research should test a larger sample size, since only 10 subjects were tested in the present study. Having subjects take their own pulse rates can result in unreliable data, as evidenced by the inaccurate data reported by one subject that had to be extracted from the data report. In the future, heart rate monitors, in addition to devices that measure respiration rate, skin temperature, and muscle tension could provide more reliable data as well as a greater breadth of data to further understand the physiological responses to music. Other suggestions for subsequent study include the testing of different types of music and different volumes, and testing higher anxiety levels than those tested in this study.
References


Appendix A

Pulse Record Sheet

Subject #: 1
Group #: 1

Beginning Pulse Rate (00:00) ______________
Pulse Rate #2 (05:00) ______________
Pulse Rate #3 (10:00) ______________
Pulse Rate #4 (15:00) ______________
Pulse Rate #5 (20:00) ______________
Pulse Rate #6 (25:00) ______________
Pulse Rate #7 (30:00) ______________
Ending Pulse Rate (35:00) ______________
## Appendix B

Raw Data: Pre-Session Pulse Rates, Post-Session Pulse Rates, & Differences

Table A1

<table>
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<th>Subject</th>
<th>Pre-session</th>
<th>Post-session</th>
<th>Difference</th>
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<td>3</td>
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<tr>
<td>Music Subject #2</td>
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<td>24</td>
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</tr>
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<td>22</td>
<td>0</td>
</tr>
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<td>19</td>
<td>1</td>
</tr>
<tr>
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</tr>
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<td>21</td>
<td>-1</td>
</tr>
<tr>
<td>Non-Music Subject #7</td>
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<td>19</td>
<td>-2</td>
</tr>
<tr>
<td>Non-Music Subject #8</td>
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<td>-2</td>
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