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THE IMPACT OF MUSIC ON
POSTOPERATIVE PAIN AND ANXIETY

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the School of Nursing
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at the University of Central Florida
Orlando, Florida

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ABSTRACT

Objective: The objective of this study was to add to the body of knowledge about the impact of music on postoperative pain and anxiety. The specific purpose of this research study was to determine if listening to music and/or having a quiet rest period just prior to and just after the first ambulation on postoperative day 1 can reduce pain and/or anxiety, or impact mean arterial pressure, heart rate, respiratory rate, and/or oxygen saturation in patients following a total knee arthroplasty.

Methods: An experimental repeated measures design was used.

Setting: A postoperative orthopedic unit in a 300-bed community hospital in the southeastern United States.

Sample: Fifty-six patients having a total knee arthroplasty, randomly assigned to either a music intervention group or a quiet rest group.

Measures: A visual analog scale was used to measure pain and anxiety. Physiological measures, including blood pressure, heart rate, oxygen saturation, and respiratory rate, were also obtained.

Results: A repeated measures analysis of variance between and within groups was conducted for pain and anxiety. Statistical findings between groups indicated the music group's decrease in pain or anxiety was not significantly different from the comparison rest group's decrease in pain ($F = 1.120, p = .337$) or anxiety ($F = 1.566, p = .206$) at any measurement point. However, statistical findings within groups indicated that when the groups were combined, the sample had a statistically significant decrease in pain ($F = 6.699, p = .001$) and anxiety ($F = 4.08, p = .013$) over time. Post hoc analyses

showed the significant decrease in pain was from time 1 (just prior to the initiation of music or rest) to time 2 (just after 20 minutes of music or rest) ($t(55) = 4.751, p = .000$).

Post hoc analyses showed the significant decrease in anxiety was from time 1 (just prior to the initiation of music or rest) to time 2 (just after 20 minutes of music or rest) ($t(55) = 2.86, p = .006$). Additionally, anxiety decreased significantly from time 3 (just after physical therapy) and time 4 (after second period of 20 minutes of music or rest period) ($t(55) = 2.222, p = .030$).

Implications: Results of this research provides evidence to support the use of music and/or a quiet rest period to decrease pain and anxiety when initiated just before and just after ambulation on postoperative day 1 following a total joint arthroplasty of the knee. The interventions pose no risks, and have the benefits of improved pain reports and decreased anxiety. It potentially could be opioid sparing in some individuals, limiting the negative effects from opioids. Nurses can offer music as an intervention to decrease pain and anxiety in this patient population with confidence, knowing there is evidence to support its efficacy.

This dissertation is dedicated to the people in my life that have provided support, encouragement, and inspiration to me as I have persevered on this educational journey. It begins with my grandparents, Oscar and Lottie Batton, who provided the inspiration early in my life for me to become a nurse. My parents, Bob and Dixie Hogan, provided encouragement and resources to complete my undergraduate education. My husband and daughter, Wayne and Anna Allred, put up with the stress of graduate studies, and were always encouraging and supportive throughout the process. Finally, my sister and her family, Crystal, Greg, Daniel and Abby Turner, provided comic relief when it was most needed. Thank you to all of you, and Daniel, Abby, and Anna - DBB, it's no way to live.

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CHAPTER ONE: INTRODUCTION

Pain management is important to nursing practice (Ferrell, 1999), and is one of the most common complaints demanding attention and action from nursing (Locin, 1981). It has been established that postoperative pain that is unrelieved can initiate the stress response, interfere with the return to preoperative baseline lung function, and interfere with mobility (Shea, Brooks, Dayhoff, & Keck, 2002). Following surgery, pain is a major symptom (Locin, 1981) and because of the consequences of not treating it, or under treating it, postoperative pain deserves much attention. Nurses on postoperative units use traditional care to treat the pain of the surgical patient population, with the current standard of treatment for postoperative patients including the administration of opioids which have sedative and emetic side effects (Ikonomidou, Rehnstrom, & Naesh, 2004). Due to the high levels of pain that orthopedic patients experience, they present challenges to the traditional use of opioids as a pain management technique (Lukas, 2004). To limit the sedative and emetic side effects of opioids, nonpharmacological interventions that will decrease pain and decrease the amount of opioid medication needed for pain control should be studied to determine their effectiveness in specific populations. An example of a nonpharmacologic intervention that might help improve pain is listening to music.

Music to Control Postoperative Pain

Research has been done using music for the purpose of relieving postoperative pain in several settings, including the operating room, the post anesthesia care unit, and

the postoperative units. Various surgical populations have been studied; however, research on the effectiveness of this nonpharmacologic intervention is rather limited in the orthopedic surgical patient population. A critical review of the literature on the use of music for the purpose to reduce postoperative pain is provided. Researchers studying interventions that reduce pain have many challenges, one of which is how to measure the pain. There are many options when choosing a measure, however there are several things to consider so the appropriate measure is selected.

Measurement of Pain

The measurement of pain is often difficult, due to the subjective and complex nature of the phenomenon. Commonly used instruments to measure acute pain often do not meet criteria reported in the literature as the ideal. The visual analog scale has the reliability and validity data along with the ratio level of data to support its use in the research setting, as it allows for more rigorous statistical analysis. The ease of use of the numeric rating scale makes it attractive for use in the clinical setting. Other measurement tools for pain are used in a variety of settings. A review of available measurement tools to quantify acute pain is presented. The use of the visual analog scale to measure acute postoperative pain in a repeated-measures experimental study is described.

Experimental Research

Following the systematic review of the literature on the use of music for the purpose of relieving postoperative pain, it was determined that gaps existed regarding

the orthopedic surgical population. A research study was developed and implemented with the aim to determine the impact of music on postoperative pain and anxiety. The visual analog scale was used to measure pain in this study, due to the ratio level of data provided and the sensitivity of the scale. The measures were taken at several points in care, just before and just after physical therapy on postoperative day 1. The background, procedures, results, and implications of this research are reported in Chapter 4.

CHAPTER TWO: SYSTEMATIC REVIEW OF THE LITERATURE

This systematic review of the literature focuses on the impact of listening to music for the specific purpose of postoperative pain relief. The literature search was conducted using the Cumulative Index to Nursing and Allied Health (CINAHL) Plus database, using music, pain, and surgery as key words. This search produced 38 references. References that were not research were eliminated.

Using music to relieve postoperative pain has been studied in the operating room setting, the post anesthesia care unit (PACU), and the postoperative units. Several researchers have studied nonpharmacologic interventions for the management of pain specifically in the orthopedic surgical population. Gaps and inconsistencies in the available research on the use of music to control postoperative pain will be identified.

Music in the Operating Room

Listening to music to relieve pain and/or anxiety in the surgical patient has been studied with varying results. One group of researchers used music exclusively in the operating room with patients undergoing abdominal hysterectomy (Nilsson, Rawal, Unestahl, Zetterberg, & Unosson, 2001). There were 3 groups in this study, one group listened to music (n=30), one group listened to music along with therapeutic suggestions (n=31), and a control group heard a recording of operating room noise (n=28). Findings indicate those that listen to music only during the surgical procedure had significantly less pain on the first day after surgery when compared to the control group who did not listen to music (p=0.001). Additionally, the music alone and music

along with therapeutic suggestions groups both required less rescue analgesic on the day of surgery and also had less fatigue at discharge.

Music in the PACU

Research using music exclusively in the PACU has provided some significant findings. Heitz, Symreng, and Scamman (1992) used music in the PACU with a group of general surgical patients. The researchers studied 3 groups, with one of the groups listening to music (n=20), one wearing headphones but hearing no music (n=20), and one group that served as the control (n=20). This research found no statistically significant differences between those that listened to music and those that did not with regards to pain, morphine requirement, hemodynamics, respiration, or length of stay in the PACU. Statistical significance was found with the music group being able to wait longer before requiring analgesia on the nursing unit following the PACU stay ($p < 0.05$).

Taylor, Kuttler, Parks, and Milton (1998) studied the effects of music on pain in a group of abdominal hysterectomy patients in the PACU. The participants (n=61) were divided into one of three groups: an experimental group that listened to music, a group that wore headphones but heard no music, and a control group that received routine care. These researchers found no statistically significant differences regarding pain among the three groups. The small sample size is a limitation in this study, potentially influencing the findings.

Shertzer and Keck (2001) studied music listening in the PACU in a group of same day surgery patients (n=97) having a variety of surgical procedures. No randomization procedure is described. These researchers found no statistically

significant differences for pain between the control group who experienced the typical PACU noise, and the group that listened to music while the PACU staff made attempts to keep extraneous noise at a minimum. Pain measures were taken at 30 minutes postoperatively and at discharge from the PACU. Significant findings were found in the pain scores within the music group, as they decreased significantly across the PACU stay ($p=0.00$).

Nilsson, Rawal, Enqvist, and Unosson (2003) studied music listening alone and music listening along with therapeutic suggestions in the PACU in 182 same day surgical patients (inguinal hernia repair or varicose vein surgery). A control group listened to a blank tape. Findings indicate significantly less pain in those that listened to music alone or with therapeutic suggestions when compared to the control group ($p=0.002$). Additional findings indicate a higher oxygen saturation in the two experimental groups when compared to the control group ($p<0.001$).

MacDonald et al. (2003) also studied music listening in the PACU in same day surgery patients. McDonald (2003) studied the effects of music on 17 patients having minor foot surgery and found no differences in pain perception among those that listened to music when compared to the 23 in the control group that did not. However, there was significantly less anxiety in the patients that listened to the music ($p<0.05$).

Music Preoperatively, Intraoperatively, and in the PACU

Several researchers have studied music preoperatively, during surgery, in the PACU, and in various combinations of these locations. Heiser, Chiles, Fudge, and Gray (1997) studied the effects of music starting in the operating room and continuing into the

PACU. This research used an extremely small sample size with 5 in the experimental group and 5 in the control group, all having the same surgical procedure, lumbar microdiscectomy. Due to the inadequate sample size, inferential statistical analysis of the data was not able to be completed. However, descriptive statistics were used and found no differences between those that listened to music and those that did not among the variables of pain, anxiety levels, and analgesic medication requirements.

Laurion and Fetzer (2003) studied the effects of music and guided imagery on pain, postoperative nausea and vomiting (PONV), and length of stay in a group of same day surgery surgical patients having a variety of gynecologic laparoscopic procedures. The music and guided imagery tapes were used at home preoperatively, and then during the surgery and also during the PACU stay. There were no statistically significant differences between the two experimental groups with regard to pain at discharge from PACU, however the control group reported significantly more pain at discharge from PACU than either of the two experimental groups ($p=0.002$). There were no significant differences among the groups regarding PONV or length of stay.

In another research study using same day surgery patients (inguinal hernia repair and varicose vein surgery), Nilsson, Rawal, and Unosson (2003) compared three groups: a control group ($n=49$) that did not listen to music, a group that listened to music intra-operatively only ($n=51$), and a group that listened to music postoperatively only ($n=51$). The groups listening to music intra-operatively and postoperatively reported significantly less pain at 1 hour postoperatively ($p<0.01$) and at 2 hours postoperatively ($p<0.01$) when compared to the control group.

Ikonomidou, Rehnstrom, and Naesh (2004) studied the effects of music in a group of laparoscopic surgical patients (n=60). The participants in the experimental group listened to music 30 minutes preoperatively and postoperatively, while the control group listened to a blank CD. There were no statistical differences in pain scores between the group that listened to music when compared to the group that did not. There was a significant finding in the postoperative opioid consumption, with the music group requiring less (p=0.04).

Lukas (2004) studied a group of same day surgical patients having knee arthroscopy (n=31) who listened to music for about 20 minutes preoperatively, during the surgical procedure while under general anesthesia, and during the PACU stay. There was no control group, and the measure was a survey given to participants 24 to 48 hours postoperatively via the telephone. The survey included multiple choice and short answer questions. The conclusions of the survey were that 97% of patients reported listening to the music was a positive experience; however, other than percentages, there was no statistical analysis of the data reported. Also, there were no quantitative measures of pain included in the survey or this research.

Music on the Postoperative Unit

One of the earliest descriptions of research using music for pain control in the postoperative patient population was reported by Locin (1981). This researcher studied the effects of music on pain in a group of women with abdominal incisions (gynecologic or obstetric patients). There were 24 matched pairs (paired according to age, type of surgery, educational background, and previous operative experience) in the sample,

with 12 participants in the music group who listened to music for 30 minutes approximately every 2 hours postoperatively, while a control group did not listen to music at all. Statistical findings were significant for pain, with the experimental group having less pain than the control group ($p < 0.05$). The measure used for pain was the Overt Pain Reaction Rating Scale, designed by the researcher, with no reliability or validity data reported.

Research done by Mullooly, Levin, and Feldman (1988) studied the effects of music on postoperative pain and anxiety. The sample included 28 patients that had a total abdominal hysterectomy who were assigned to one of two groups: the control group who did not listen to music, and the experimental group who listened to music for 10 minutes on two consecutive days. Pain and anxiety measures were obtained before and after the music intervention. There were significant findings with the experimental group reporting less pain on day 2 ($p = 0.00$) and less anxiety on day 1 ($p = 0.03$) and day 2 ($p = 0.03$).

Good (1995) studied the effects of music and jaw relaxation on postoperative pain in a group of abdominal hysterectomy patients ($n = 84$). There were four groups of participants in this study: a jaw relaxation group, a group that listened to music, a group that used music and jaw relaxation, and a control group. The music and relaxation interventions were used during the first ambulation following surgery. The findings indicate the interventions were not effective in reducing pain, and they were not significantly different from one another during ambulation.

Pain in the coronary artery bypass graft (CABG) surgical patient population was studied by Zimmerman, Nieveen, Barnason, and Schmaderer (1996). This group of researchers studied 96 participants that listened to music, listened and watched a music video, or had a scheduled rest period with no music or video to determine if there was a difference among these groups with regards to pain and sleep. Data collection was done on postoperative days 2 and 3, with findings indicating the music group had significantly lower pain scores on postoperative day 2 ($p < 0.05$) when compared to the rest group, and the music video group had significantly better sleep on the third morning ($p < 0.05$) when compared to the control group.

A group of researchers studying the effects of music in thoracic surgical patients residing in the intensive care unit used live harp music to determine its effects on anxiety and pain (Aragon, Farris, & Byers, 2002). The participants in this research ($n=17$) listened to a 20 minute session of live harp music, and the researchers found a statistically significant difference in pain and anxiety ratings over time from the baseline data to end of the harp playing and 10 minutes afterward ($p=0.000$). The subjects served as their own controls.

MacDonald et al. (2003) investigated the effects of music on pain and anxiety in a group of women having abdominal hysterectomies. The researchers found no significant differences in pain or anxiety at rest or with movement between a music listening group ($n=30$) and a control group ($n=28$) that did not listen to music. This research provides no evidence that listening to music alleviates postoperative anxiety or pain in this surgical patient population. While the participants were not required to listen

to the music a specific amount of time, they were encouraged to listen to the music and reported listening to it between 2 and 6 hours on the day of the operation. Measures were taken at regular intervals on postoperative days 1, 2, and 3.

Voss et al. (2004) also researched the effects of music on CABG patients on postoperative day 1. This research compared three groups: group 1 listened to 30 minutes of music (n=19), group 2 had a scheduled rest period (n=21), and group 3 had treatment as usual (n=21). Statistical analysis indicated that anxiety, pain sensation, and pain distress all decreased significantly ($p < 0.001-0.015$) in the groups that listened to music or had a scheduled rest.

A large randomized control trial was done by Good et al. (1999) in which 500 major abdominal surgical patients used either music, jaw relaxation, a combination of music and jaw relaxation, or none of these (control group) to determine their effect on postoperative pain at rest and with ambulation on postoperative days 1 and 2. The statistical analysis of the data obtained from this study found significantly less pain in the three treatment groups when compared to the control group ($p = 0.028-0.000$).

Several reports of secondary analyses using these data were published (Good, et al., 2000; Good, Stanton-Hicks, Grass, Anderson, Salman, et al., 2001; Good, Stanton-Hicks, Grass, Anderson, Lai, et al., 2001a; Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002; Good, Anderson, Ahn, Cong, & Stanton-Hicks, 2005). The first report of a secondary analysis describes the pain of 80 participants having gynecologic surgery that served as part of the control group in the larger study that included 500 participants having a variety of surgeries (Good, et al., 2000). The second report of a

secondary analysis describes the pain of 38 intestinal surgical patients who also served as part of the control group of the larger sample of 500 (Good, Stanton-Hicks, Grass, Anderson, Salman, et al., 2001). The conclusions of both analyses include that the participants had significant surgical pain both at rest and with ambulation that was not fully relieved with the use of patient controlled analgesia (PCA).

An additional secondary analysis (Good, Stanton-Hicks, Grass, Anderson, Lai, et al., 2001a) was done to determine the relative effects of music and relaxation and the combination of music and relaxation on postoperative pain across and between 2 days and 2 activities. The findings indicate that the three treatment groups taken together had less pain than the control group across 2 days of each activity, across each day, and across ambulation on each day ($p=0.000-0.001$). This indicates that the interventions were continuously effective.

The next report of a secondary analysis of the data (Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002) was done to determine if the positive effects on relaxation and music found in abdominal surgical patients were also found in patients after gynecological surgery. The original sample included 500 subjects having a variety of surgical procedures, and this secondary analysis selected 311 gynecological surgical patients from the larger sample to determine if the results for improved pain were still significant within this smaller subgroup. Significant findings include the intervention groups having significantly less pain at posttest ($p=0.22-0.001$) on both postoperative days 1 and 2. The three interventions (music, relaxation, and a combination of both) were found to be similar in their effect on pain.

The final report of a secondary analysis was reported more recently, and was done to determine if the positive effects on relaxation and music found in the larger sample of abdominal surgical patients were also found in a smaller subset of the sample following intestinal surgery (Good, Anderson, Ahn, Cong, & Stanton-Hicks, 2005). The original sample included 500 subjects having a variety of surgical procedures, and this secondary analysis selected 167 intestinal surgical patients from the larger sample to determine if the results for improved pain were still significant within this smaller subgroup. Significant findings include the intervention groups having less post-test pain than the control group on both days after rest and at three of six points following ambulation ($p=0.024-0.001$).

Recent research completed by Sendelbach et al. (2006) found the use of music therapy decreased pain and anxiety postoperatively in a group of cardiac surgical patients. A sample size of 50 listened to music for 20 minutes postoperatively, and while pain and anxiety decreased in the experimental group, there was no difference in systolic blood pressure, diastolic blood pressure, or heart rate, when compared to the control group. A verbal rating scale was used to measure pain.

Cepeda, Carr, Lau, and Alvarez (2006) authored a systematic review on the use of music for pain relief. The objective of the systematic review was to evaluate the effect of music on various types of pain, one of which was postoperative pain. Only randomized controlled trials using music to effect pain were included in the review. A total of 14 studies were included in the portion of the review concerning postoperative pain. The implication of the review related to clinical practice was that music should not

be the primary method of pain relief. The implication of the review related to research was that further studies were recommended examining anxiety as an outcome measure, and to research the effects of combinations of nonpharmacological interventions that could potentially have a synergistic effect with music to improve pain. The conclusion of the systematic review was listening to music decreases pain and opioid requirements, but the decrease is small with significance in the clinical setting uncertain.

Music in the Orthopedic Population

Pellino et al. (2005) studied the effects of a kit of nonpharmacologic strategies on pain and anxiety given to patients planning to have an elective total hip or total knee arthroplasty. The kit was considered to be self-explanatory and self-administered and contained a radio/cassette tape player with earphones, a tape of soothing relaxing music, an audiotape that guides patients through progressive muscle relaxation, a plastic massager that is handheld, a soft squeeze ball, and a booklet explaining the various forms of relaxation. There were two groups, an experimental group who received the kit (n=33), and a control group (n=32), who received standard care. The participants kept records of what nonpharmacologic interventions they used from the bag, and this was not controlled by the researcher. Ten participants reported using music on postoperative days 1 and 2. The statistical analysis of the data indicated no significant differences in postoperative pain or anxiety between groups. The experimental group did use significantly less opioid on postoperative day 2.

Masuda, Miyamoto, and Shimizu (2005) studied the effects of listening to music in a group of elderly (over 60 years of age) on postoperative pain and stress during bed rest in a group of orthopedic surgical patients. The sample had a variety of orthopedic surgeries, from spinal surgery to joint surgery to removal of musculoskeletal tumors and trauma. There were two groups in this study, an experimental group that listened to music for 20 minutes in private rooms (n=22), and a control group (n=22). The statistical analysis indicated that the experimental group experienced less pain after 10 minutes of music listening ($p<0.05$) and 20 minutes of music listening ($p<0.001$), when compared to the control group who did not listen to music.

Most recently, McCaffrey and Locsin (2006) used music on the postoperative unit with older adults having hip and knee surgery. The music was played on a bedside compact disc player, set up to automatically play music for 1 hour, 4 times a day. The music was first played while the patient was awakening from anesthesia. Findings include the experimental group who listened to music took less pain medication postoperatively than the control group that did not listen to music. A significant reduction in pain was also found in the experimental group on postoperative days 1 and 3.

Conclusions

This systematic review of the literature concerning the effects of music on pain demonstrates some questions that have not yet been answered. Some of the studies reviewed provide statistical data supporting listening to music to decrease pain and anxiety, while others do not show statistical significance at all. It is important to

determine if using music as a nonpharmacological adjuvant to traditional care can decrease the pain and anxiety in specific populations of patients so that improvement in patient comfort levels might be obtained, while limiting pharmacologic interventions that can have adverse side effects associated with them. Using music to improve postoperative pain control and to limit the effects of uncontrolled pain, the side effects of opioids, and to ultimately improve outcomes is a relatively simple intervention with great potential. With music having no deleterious side effects and potential positive benefits, recommendations to use music to help control postoperative pain seem unproblematic. However, further research in specific surgical populations is recommended, with music interventions that are simple for both the patient and health care provider.

CHAPTER THREE: MEASUREMENT OF ACUTE PAIN

The objective of this paper is to describe the phenomenon of acute pain, and to explore instruments used to measure it. Theoretical and operational definitions for acute pain are provided. The psychometrics related to each tool reviewed will be discussed. Relevant theoretical models related to acute pain are briefly presented. Issues the researcher or clinician must consider when choosing a measurement tool for acute pain will be discussed.

Relevant measurement issues in terms of advantages and disadvantages of each measurement tool presented are explored. Measurement tools used to measure acute pain were chosen from a review of the relevant pain research as well as the review of several classic textbooks on pain. Research using each tool was reviewed, and when available, reliability and validity data are reported.

The Phenomenon of Acute Pain

The definition of pain that has been adopted by the American Pain Society (APS) (1992) and the International Association for the Study of Pain (IASP) is “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage” (Merskey, 1986, p. S217). This definition reflects the complexity of pain as well as the multidimensionality of the phenomenon, and indicates pain can influence the psychosocial and physical functioning of an individual (McCaffery & Pasero, 1999).

The purpose of pain is to focus attention to the factors that may be causing it (American Medical Association, 2003). However, it is important to note that pain intensity is not determined by tissue damage alone (McCaffery & Pasero, 1999). It has not been shown that there is a relationship between the intensity of the pain reported and identifiable tissue injury (McCaffery & Pasero, 1999).

Acute pain is typically distinguished from other types of pain by its duration. Acute pain is generally referred to as a relatively brief pain that decreases as healing occurs (McCaffery & Pasero, 1999). Others consider acute pain in more specific terms, such as less than 7 days in duration (Rosner, 1996) or no longer than days or weeks (Portenoy & Kanner, 1996).

Pain is a subjective, personal experience (McCaffery & Pasero, 1999). McCaffery's (1968) classic definition of pain, "whatever the experiencing person says it is, existing whenever the experiencing person says it does" (p. 95), makes it clear that pain is a subjective phenomenon. McCaffery's definition often serves as the researcher's operational definition of pain, which is the self-report of pain, using a subjectively reported pain measurement tool. Because of the subjective nature of pain, there is no pure objective measure for the phenomenon (Farrar, Berlin, & Strom, 2003). When studying pain, measurement is primarily the subject's verbal report, providing the most valid measure to this subjective phenomenon (Katz & Melzack, 1999). Cognitively intact adults are able to verbally report their pain using a variety of assessment tools. Following surgery, a verbal report of postoperative pain intensity is often the assessment tool of choice for direct care providers.

Postoperative pain is expected, but only at certain limits (Coll, Ameen, & Mead, 2004). Turk and Melzack (2001) write that effective pain management is dependent upon a reliable and valid assessment. Management of postoperative pain is essential because of the serious consequences of unrelieved pain (Gagliese & Katz, 2003). These consequences include renal, respiratory, and cardiac dysfunction (Cousins, 1994), delirium (Duggleby & Lander, 1994), and immune system suppression (Ergina, Gold, & Meakins, 1993).

Our understanding of pain processing and perception has increased significantly in recent decades; however, despite our increased understanding, pain continues to be a challenge in healthcare for the healthcare providers, the patients, and their families (Renn, 2005). Much research and many scholarly reports focus on interventional research. This research is important, but there remains some controversy and inconsistency in how to actually measure acute pain in research and the clinical setting. This inconsistency related to the measurement of acute pain is evident in the literature. Points to be considered when choosing a measure for acute pain follow, and the most widely used measures for acute pain will be explored.

Measurement

The important requirements of a measure are that it is valid, reliable, consistent, and useful (Melzack & Katz, 2001). Price and Harkins (1992) write that all methods of pain measurement “share a common goal of accurately representing the human pain experience” (p. 112). Criteria for an ideal pain assessment procedure has been developed by Gracely and Dubner (1981) and further refined by Price and Harkins

(1992). These criteria are: have ratio scale properties, be relatively free of biases inherent in different psychophysical methods, provide immediate information about the accuracy and reliability of the subjects performance of the scaling responses, be useful for both experimental and clinical pain and allow for reliable comparison between both types of pain, be reliable and generalizable, be sensitive to changes in pain intensity, be simple to use for pain patients and non-pain patients in both clinical and research settings, and separately assess the sensory intensive and affective dimensions of pain (Gracely & Dubner, 1981; Price and Harkins, 1992). The pain measures used in clinical practice and research do not always meet these criteria.

Several factors should be considered when choosing a pain measure. These factors include knowing the goal of the measurement, and knowing the dimension and type of pain that is to be measured (McGuire, 1992). McGuire (1992) also recommends understanding the nature of the patient population in which the pain is to be measured, and the ease of administering and scoring the measure should also be considered when choosing a pain measurement tool. Determining reliability and validity of the tools being considered can also factor into the decision about which measurement tool to choose for pain assessment (McGuire, 1992).

Pain may seem to be a sensation that is rather simple; however, it is a complex experience that can be influenced by many factors including the context in which the pain takes place (American Psychiatric Association, 1994) and the person's cultural background (Clyde & Kwiatkowski, 2002). Due to the multidimensionality of acute pain, it can be a challenge to measure. Researchers and clinicians often only measure one

dimension of pain, the intensity of it. If pain intensity is the only aspect of pain the researcher or clinician wishes to measure, then unidimensional assessment tools are appropriate. The unidimensional assessment tools that assess acute pain in the adult patient population according to St. Marie (2002) include the numeric rating scale, the visual analog scale, and the verbal descriptive scale. A summary of these measures is provided in Table 1. McDonald and Weiskopf (2001) write that limiting patients to the intensity dimension of their pain could leave out valuable information about their pain that might enhance their treatment. If other dimensions of pain are of interest to the clinician or researcher, such as the nature of pain, the location of pain, and/or the impact of pain on mood and activities, a multidimensional assessment tool would be needed. Most multidimensional pain assessment tools have been developed and tested in those with chronic pain. These tools include the McGill Pain Questionnaire and the Brief Pain Inventory (St. Marie, 2002). The Brief Pain Inventory was constructed to measure pain in cancer patients, and rheumatoid arthritis or chronic orthopedic problems (McGuire, 1992), but has been studied in cancer patients with acute pain following surgery (Tittle, McMillan, & Hagan, 2003). The short version of the McGill Pain Questionnaire has been used in research with a variety of pain types, including postoperative pain (Melzack, 1987). These tools can be used to assess acute pain in the acute care setting, but are typically used when pain is prolonged (St. Marie, 2002). These measures are summarized in Table 2.

While there are other instruments available to measure acute pain, this discussion will be limited to those mentioned. Those measures of acute pain are used

most frequently in research and clinical practice. They are also self-reported measures, and this has been reported to be the most reliable indicator of the intensity and existence of pain (McCaffery & Pasero, 1999).

Unidimensional Measures

Unidimensional measures are designed to measure only one dimension of a phenomenon at a time. In pain measurement, a unidimensional assessment tool is helpful when the cause of the pain is known (St. Marie, 2002). Some have criticized unidimensional measures for pain because they oversimplify the pain experience (St. Marie, 2002). They are, however, typically quick and easy, for both the patient and the direct care provider.

Numeric Rating Scale

The numeric rating scale is a scaling procedure in which subjects use numbers, typically from 0 to 10, with 0 representing no pain, and 10 representing the worst possible pain, with administration of the scale being either visual or verbal (St. Marie, 2002). The advantages to the numeric rating scale include the speed with which it can be administered, as well as its simplicity (St. Marie, 2002). The numeric rating scale can also be easily compared to previous scores, detecting changes from treatment effects (St. Marie, 2002). The numeric rating scale produces interval level data, so parametric statistical procedures can be used (Williamson & Hoggart, 2005). Disadvantages include the inability to use the numeric rating scale in nonverbal or

cognitively impaired patients, and the reliability of the measure decreases with extreme ages and auditory dysfunction (St. Marie, 2002).

Visual Analog Scale

The visual analog scale (VAS) is a scaling procedure that can be used to measure various subjective clinical phenomena (Waltz, Strickland, and Lenz, 2005). It is often used to measure pain. The VAS consists of a 10-cm horizontal line with right angles at each end with word anchors depicting extremes in pain. The far left anchor typically will have “no pain” indicated, and the far right anchor will typically have “pain as bad as it could possibly be” indicated. Subjects marks on the line exactly where they perceive their pain to fall on the continuum of that line. A ruler is used to measure from the far left of the scale to the subject’s mark, and the score is reported as the length measured in millimeters. One advantage of the VAS is it produces ratio level data, allowing more robust parametric statistical procedures for data analysis, making it attractive to researchers (Carlsson, 1983). Clinical practitioners at the bedside who are not interested in analyzing the data, but only using the data to treat the patient they are caring for, may opt to use the more simple numeric rating scale. The VAS is quick, easy to use, easy to score, and easy to compare the results to previous results (St. Marie, 2002). The disadvantages to the VAS include that it is difficult to use in the very young, very old, or cognitively impaired individuals (St. Marie, 2002). Another disadvantage of the VAS is that it must be administered either electronically or with paper (Williamson & Hoggart, 2005). The VAS can measure different dimensions of

pain by using different word anchors on the ends of the line, but only one dimension can be measured at a time.

Verbal Descriptor Scale

The verbal descriptor scale is a set of adjectives that describe pain. There are varying sets of adjectives used, including no pain, mild pain, moderate pain, severe pain, very severe, and worst possible (Acute Pain Management Guideline Panel, 1992). The administration of the scale can be visual or verbal. It is quick, simple, and easy to score, with some patients preferring this scale, instead of rating their pain (St. Marie, 2002). The scale can be difficult to use in very old or very young subjects, and the scale is not useable in cognitively impaired individuals (St. Marie, 2002). Researchers find this scale unusable due to the ordinal level of data that is produced.

Multidimensional Measures

Multidimensional measures are useful when more than one dimension of a phenomenon is of interest. In pain measurement, a multidimensional assessment tool measures not only the intensity of pain, but typically the location and nature of the pain as well (St. Marie, 2002). St. Marie (2002) describes multidimensional measures for pain as measures that might also determine the impact pain is having on mood and activity. The multidimensional measures for pain are typically a bit more cumbersome to administer, and often take more time than unidimensional measures, but do provide more information on the pain than unidimensional measures.

McGill Pain Questionnaire

The McGill Pain Questionnaire is a clinical tool that assesses pain in the sensory, affective and evaluative dimensions based on words that are selected by the patient to describe his or her pain (Melzack & Katz, 2001). The McGill Pain Questionnaire is the most widely used multidimensional pain inventory (Wilke, Savedra, Holzemer, Tesler, & Paul, 1990) and is available in two forms, the long form and short form. The long-form McGill Pain Questionnaire (LF-MPQ) measures the location and pattern of pain over time, the sensory and affective dimensions, as well as the pain intensity (St. Marie, 2002). The time it takes to use the LF-MPQ is not clear in the literature. Flaherty (1996) reports it takes about 30 minutes to complete and can be difficult for some to understand, while reports from the American Medical Association (2003) indicate it takes only 5 to 15 minutes to complete, and is no more a burden to the subject than the VAS or the numeric rating scale (NRS). The short-form McGill Pain Questionnaire (SF-MPQ) was developed in 1987 by Melzack to obtain information from research settings when time is limited, and more than the pain intensity is needed. It measures the sensory and affective dimensions of pain, along with pain intensity, and takes 2 to 3 minutes to complete (St. Marie, 2002).

Brief Pain Inventory

The Brief Pain Inventory (BPI) is a tool which assesses the location, intensity, and pattern of pain (Tittle, McMillan, & Hagan, 2003), and was first developed to measure cancer pain (Cleeland & Ryan, 1994). The tool has a body diagram in which a mark can be made where it hurts, and it also has 11 numeric scales addressing different

dimensions and aspects of pain, including quality of life and functional abilities (American Medical Association, 2002). The administration of the measure is both verbal and visual (St. Marie, 2002) and takes about 15 minutes to complete (McCaffery & Pasero, 1999). The BPI focuses on pain symptoms within the past 24 hours (McCaffery & Pasero, 1999).

Psychometrics

Psychometrics is the science of psychological measurement. It involves the design, implementation, and interpretation of measures of psychological phenomenon. Pain is an example of one of those phenomena. Reliability and validity are two indicators of the psychometric properties of a measure. The psychometrics of acute pain measures follow.

Numeric Rating Scale

The numeric rating scale has been studied by several groups of researchers (Kremer, Atkinson, & Ignelzi, 1981; Jensen, Karoly, & Braver, 1986; de Conno, et al., 1994). The test-retest reliability for the numeric rating scale has been reported to vary from 0.67 to 0.96 (Currier, 1984; Good, et al., 2001). Criterion validity has yet to be established for the numeric rating scale due to the lack of a criterion test measure for pain (Kahl & Cleland, 2005). However, correlation of the numeric pain scale with the visual analog scale has provided convergent validity ranging from 0.79 to 0.95 (Finch, Brooks, Stratford, & Mayo, 2002; Good, et al., 2001).

Visual Analog Scale

The reliability and validity of the VAS was studied by Gallagher, Bijur, Latimer, and Silver (2002) in a population of patients that presented to the emergency room with abdominal pain. The researchers conducted test-retest reliability using intra-class correlation coefficient (ICC) between VAS at 1 minute apart. Their findings indicate that the VAS is a reliable tool in their study population and setting, with ICC = 0.99 (95%CI 0.989 to 0.992). Validity was assessed by performing an analysis of variance (ANOVA), looking for a linear trend with an association between 5 categorical pain descriptors and change in VAS. Their findings indicate the VAS is a valid tool in their study population and setting ($F = 79.4, P < .001$).

Verbal Descriptor Scale

The verbal descriptor scale (VDS) has been studied by several groups of researchers (Littman, Walker, & Schneider, 1985; Machin, Lewith, & Wylson, 1994). There are no reliability data reported in the available literature. However, correlations of the VDS with the VAS were found ranging from 0.81 to 0.89 in several studies, offering good congruent validity (Littman, Walker, & Schneider, 1985; Ohnhaus & Adler, 1975).

McGill Pain Questionnaire

The short-form McGill Pain Questionnaire (SF-MPQ) was studied by Melzack (1987) in postoperative patients and dental patients. This researcher determined concurrent validity with significant correlations ($r = 0.51, p < 0.03$) with the VAS and the SF-MPQ and the LF-MPQ. No reliability data were reported.

Brief Pain Inventory

Tittle, McMillan, and Hagan (2003) used the Brief Pain Inventory in a population of medical and surgical patients with cancer. The researchers found the correlations between the VAS and the BPI were high for the medical group ($r = 0.71$, $p < 0.01$) and the surgical group ($r = 0.73$, $p < 0.01$). Reliability was assessed using Cronbach's alpha, and the coefficient was high for the medical group at 0.95 and the surgical group at 0.97. This data indicates the BPI is a valid and reliable tool to measure pain in medical and surgical patients with similar characteristics as the study population (primarily male and Caucasian).

A comparison of the unidimensional measures of pain is provided in Table 1. A description of the measure, reliability and validity data are reported and relevant measurement issues are described. Table 2 provides a similar comparison for multidimensional measures of pain.

Table 1
Comparison of Unidimensional Measures of Acute Pain

MEASURE DESCRIPTION	REFERENCE AND RELIABILITY/VALIDITY	RELEVANT MEASUREMENT ISSUES
<p>Numeric Rating Scale: The most commonly used rating scale. Subjects rate their pain on a 0 (no pain) to 10 (worst possible pain) scale. Can be done verbally or presented on paper as a line with intervals drawn in from 1 to 10.</p>	<p>Used in research: Jensen, Karoly, Braver, 1986; Good, et al., 2001 Convergent validity 0.79-0.95 Test-retest reliability 0.67-0.96</p>	<p>Produces interval level data – can use parametric statistics Quick, easy to use, easily compared to previous scores, can be translated to other languages Not useable with nonverbal or cognitively impaired adults Decreased reliability with extreme age, or visual or auditory dysfunction</p>
<p>Visual Analog Scale: Consists of a 10-cm line with verbal anchors at each end depicting extreme states of pain. Typically “no pain” at the far left side, and “pain as bad as it could possibly be” at the far right. The subject marks on the line to indicate his/her pain intensity. The clinician measures from the far left to the mark with a ruler and assigns a score, usually the millimeters from the far left to the mark.</p>	<p>Gallagher, et al., 2002 Test-retest reliability using ICC between VAS at 1 minute apart, ICC = 0.99 (95%CI 0.989 to 0.992) Validity: ANOVA for linear trend on association between 5 categorical pain descriptors and change in VAS, (F = 79.4, P< .001)</p>	<p>Direct scaling technique Produces ratio data – parametric statistics can be used Quick, simple to use, easy to score Can be easily translated to other languages Highly sensitive Difficult for very young, very old, or the cognitively or visually impaired Must be administered either electronically or by paper</p>
<p>Verbal Descriptor Scale: Provides a simple way for subjects to rate pain intensity using verbal descriptors of the pain. Descriptors typically include terms such as mild, discomforting, distressing, horrible, and excruciating, or none, mild, moderate, severe, very severe, and worst possible.</p>	<p>Used in research: Littman, Walker, & Schneider, 1985; Machin, Lewith, & Wylson, 1994; Ohnhaus & Adler, 1975 Reliability data not reported Congruent validity with VAS: .81 and .89</p>	<p>Produces ordinal level data – can only use nonparametric statistical procedures Simple to use Can be used rapidly to determine if pain has increased, decreased, or stayed the same Subjects are forced to choose a word that may not apply to their experience</p>

Table 2
Comparison of Multidimensional Measures of Acute Pain

MEASURE DESCRIPTION	REFERENCE AND RELIABILITY/VALIDITY	RELAVANT MEASUREMENT ISSUES
<p>Long-Form McGill Pain Questionnaire (LF-MPQ): Tool used to assess pain in the sensory, affective and evaluative dimensions based on words that are selected by the patient to describe their pain.</p>	<p>Melzack, 1987</p> <p>concurrent validity with significant correlations ($r = 0.51$, $p < 0.03$) with the VAS and the SF-MPQ and the LF-MPQ. No reliability data were reported.</p>	<p>Takes 30 minutes to complete</p> <p>Increased respondent burden</p>
<p>Short-Form McGill Pain Questionnaire (SF-MPQ): Short version of the LF-MPQ, developed when time for measurement is limited and additional information to the pain intensity is needed. Measures the sensory and affective dimensions of pain, along with pain intensity.</p>	<p>Melzack, 1987</p> <p>concurrent validity with significant correlations ($r = 0.51$, $p < 0.03$) with the VAS and the SF-MPQ and the LF-MPQ. No reliability data were reported.</p>	<p>Takes 2 to 3 minutes to complete</p> <p>Less respondent burden than the long form, but more than unidimensional measures</p>
<p>Brief Pain Inventory (BPI): Tool incorporating 11 numeric scales used to assess pain intensity, the impact of pain on general activity, mood, ability to walk, work, relationships, sleep, and enjoyment of life. A body diagram is also on the tool where a subject can mark where their pain is.</p>	<p>Tittle, McMillan, & Hagan, 2003</p> <p>Correlations between the VAS and the BPI were high for the medical group ($r = 0.71$, $p < 0.01$) and the surgical group ($r = 0.73$, $p < 0.01$). Cronbach's alpha: the coefficient was high for the medical group at 0.95 and the surgical group at 0.97</p>	<p>Includes information of functional status.</p> <p>Takes only 5 to 15 minutes to complete.</p> <p>Requires good verbal skills</p>

Theoretical Models Relevant to Acute Pain

For decades the theoretical model most associated with pain was the gate-control theory authored by Melzack and Wall (1965). Their theory was physiologic in nature, and explained pain technically, through anatomical paths. More recently, the Neuromatrix theory has been described in the literature (Melzack, 1999; Melzack, 2001). This newer theory extends the gate control theory by adding components of genetics and experience. These two theories are the most prominent pain theories reported in the literature.

Gate Control Theory

The gate control theory of pain was proposed in 1965 by Melzack and Wall. This theory has an emphasis on the modulation of inputs into the dorsal horns of the spinal cord (Melzack, 1999). The theory proposes that the neural mechanism in the dorsal horn acts like a gate, either facilitating or inhibiting the flow of nerve impulses from peripheral fibers to the central nervous system (Arnstein, 2002). Propositions were added to the theory by Melzack and Wall in 1983, and again in 1996. According to Tse, Chan, and Benzie (2005), the gate control theory is the most influential and studied theory related to the nature of pain to date. Arnstein (2002) writes that prior to his death in 2001, Wall was beginning to discount parts of the gate control theory. Currently, Melzack supports a view somewhat different from the gate control theory, called the neuromatrix (Arnstein, 2002).

The Neuromatrix Theory

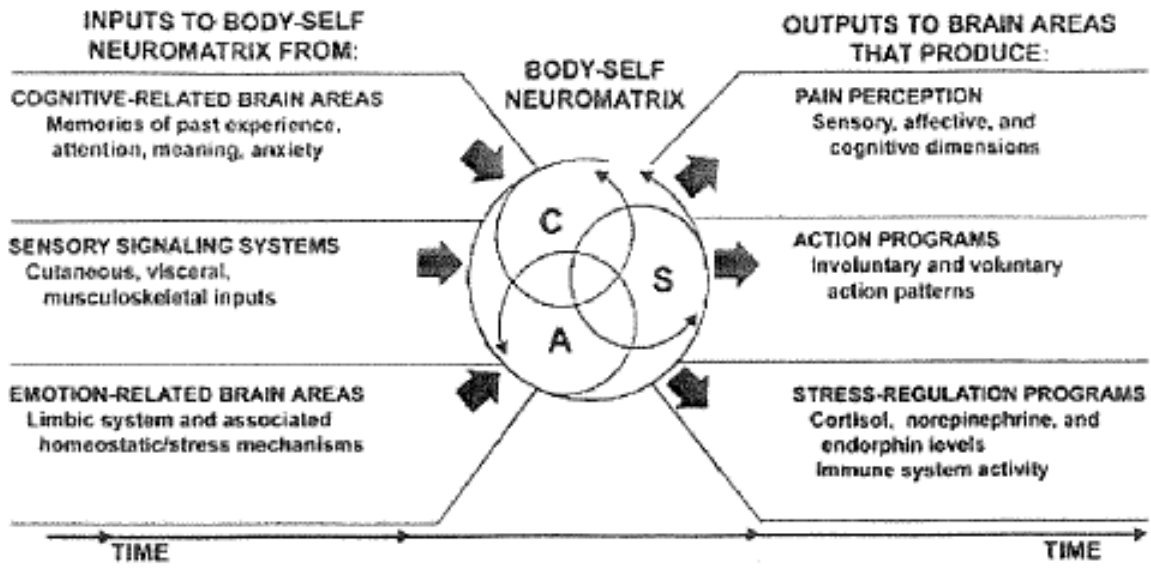
The neuromatrix theory suggests that pain is a multidimensional experience “produced by characteristic ‘neurosignature’ patterns of nerve impulses generated by a widely distributed neural network – the ‘body-self neuromatrix’ – in the brain” (Melzack, 2005, p. 85). The body-self neuromatrix is comprised of sensory, affective, and cognitive neuromodules (Melzack, 2005). Sensory inputs can trigger the neurosignature patterns, but they can also be triggered without sensory input (Melzack, 2001). The neuromatrix theory of pain proposes that the “output patterns of the body-self neuromatrix activate perceptual, homeostatic, and behavioral programs after injury, pathology, or chronic stress” (Melzack, 2001, p. 1378). The neuromatrix is genetically determined, modified by sensory experience, and is the mechanism that generates the neural pattern that produces pain (Melzack, 2005).

Anatomically speaking, the body-self neuromatrix proposed by Melzack (2005) consists of a widespread network of neurons that contains loops between the thalamus and cortex and the cortex and limbic system. The loops are arranged in a way that allows parallel processing in different components of the neuromatrix, and then converge repeatedly which allows interaction between the output products of processing (Melzack, 2005). This cyclical processing that occurs repeatedly along with the nerve impulses that pass through the neuromatrix conveys a distinctive pattern which is termed the neurosignature (Melzack, 2005). The neurosignature is the continuous outflow from the body-self neuromatrix projected to the brain (called the sentient neural hub) where the nerve impulses are “converted into a continuous changing stream of

awareness” (Melzack, 2005, p. 87). Complex muscle actions are then activated by the spinal cord neurons by way of activation of the neuromatrix (Melzack, 2005).

The inputs to the body-self neuromatrix include the cognitive-related brain areas, the sensory signaling systems, and the emotion-related brain areas (Melzack, 2005). The cognitive-related brain areas encompasses memories of past experiences, attention, meaning, and anxiety. The sensory signaling systems include cutaneous, visceral, and musculoskeletal inputs. The emotion-related brain areas include the limbic system and associated homeostatic/stress mechanisms.

The outputs to the brain areas produce pain perception, action programs and stress-regulation programs (Melzack, 2005). Pain perception includes sensory, affective and cognitive dimension. Action programs involve both involuntary and voluntary patterns, and stress-regulation programs include cortisol, norepinephrine, and endorphin levels as well as immune system activity. A graphic representation is provided in Figure 1 (Melzack, 2005), with permission (Appendix O).



C = Cognitive
 A = Affective
 S = Sensory

Figure 1
 The Neuromatrix Theory

Conclusions on the Measurement of Acute Pain

All of the measures reviewed in this paper are appropriate to measure acute pain. Future research in the area of pain measurement should provide additional reliability and validity data for the tools reviewed in this paper. There is a lack of psychometric data reported in the literature on several of the measures, and if these data were provided and found to be adequate, additional measurement choices would be an option for the research community. The visual analog scale appears to be a better choice for use in research due to the level of data it produces and the established reliability and validity in the measurement of pain. The measures that produce lower level data, such as the verbal descriptor scale and the numeric rating scale, are not appropriate for research but may be useful in the clinical setting when a quick, easy

measure is needed to obtain pain intensity information. The unidimensional measures are only appropriate if pain intensity is the only dimension of pain of interest to the clinician or researcher. Multidimensional tools are necessary if additional data other than pain intensity is needed. Either the McGill Pain Questionnaire or the Brief Pain Inventory provides data on the multiple dimensions of pain, but they are more time consuming to administer and score, and add some respondent burden. Each measure has specific advantages and disadvantages; clinicians and researchers needs to know their needs and their population, and choose wisely.

Most instruments used to measure acute pain do not meet the specific criteria reported in the literature as the ideal, but they do serve clinicians and researchers in their pursuit of measuring acute pain. The visual analog scale has reliability and validity data along with the ratio level of data to support its use in the research setting. The ease of use of the numeric rating scale makes it attractive for use in the clinical setting.

CHAPTER FOUR: THE IMPACT OF MUSIC ON POSTOPERATIVE PAIN AND ANXIETY

Moderate to severe postoperative pain is experienced by over 80% of patients having surgery (Acute Pain Management Guideline Panel, 1992). If postoperative pain is inadequately treated it can lead to trouble with rest and sleep, delayed wound healing, patient dissatisfaction, longer hospitalization, and increased costs (Shang & Gan, 2003). It is in the best interest of health care providers to ensure adequate pain relief for the postoperative patient population.

Total joint arthroplasty of the knee is a known painful surgical procedure. A primary nursing intervention following knee surgery is pain management (McCaffrey & Locsin, 2006). In addition to the deleterious effects noted of inadequately treating pain in the postoperative patient, delayed rehabilitation is another effect of under treating pain that can have a particularly negative impact on the orthopedic surgical patient.

Underestimating pain is a tendency nurses have when treating adult surgical patients, resulting in inadequate pain management (Mac Lellan, 2004). Research done by Sloman, Rosen, Rom, and Shir (2005) found that nurses significantly underestimated pain in a sample of 95 adult surgical patients, and suggest education for nurses regarding pain assessment is needed. Nurses tend to shy away from potent narcotics due to the fear of negative side effects these drugs can sometimes have, such as respiratory depression, and some nurses fear patients will become addicted to narcotics, and limit the amounts given to patients in pain (Ersek, 1999). It follows that research to determine the effectiveness of nonpharmacologic interventions for pain,

such as music, massage, or art therapy, would be of use. Nonpharmacological interventions for pain have no deleterious side effects, and provide nurses with options when potent narcotics are not effective, or when the use of potent narcotics is contraindicated.

Nonpharmacological interventions have been recognized as valuable, simple, and inexpensive adjuvants to pharmacological approaches to pain management, and can be especially valuable for independent nursing practice (Hyman, Feldman, Harris, Levin, & Malloy, 1989). Combining pharmacological and nonpharmacological methods of pain control probably yields the most effective pain relief for the patient (McCaffery, 1990). By offering a variety of nonpharmacological methods for pain relief that can be used in combination with more traditional methods, the nurse may make a significant contribution to pain control (McCaffery, 1990; McCaffery & Beebe, 1989).

The aim of this study was to add to the body of knowledge about the impact of music on postoperative pain, anxiety, and physiologic parameters. The specific purpose of this research study was to determine if listening to music and/or having a quiet rest period just prior to and just after the first ambulation on postoperative day 1 can reduce pain and anxiety in patients following a total knee arthroplasty (TKA). This research will assist in filling a gap of knowledge that exists regarding the effects of music to reduce pain and anxiety in this specific patient population, and during the specific time frame around the first ambulation.

Review of the Literature

Several studies have been done using music to treat postoperative pain; however, these studies have mixed results with some showing improved pain relief (Good, Anderson, Ahn, Cong, & Stanton-Hicks, 2005; Masuda, Miyamoto, & Shimizu, 2005), and others showing no improvement in pain (Heiser, Chiles, Fudge, & Gray, 1997; Ikonomidou, Rehnstrom, & Naesh, 2004). Of the published studies on the effects of music to improve postoperative pain, some studies use music only in the operating room (Koch, Kain, Ayoub, & Rosenbaum, 1998), while some limit the use of the music to the post anesthesia care unit (Shertzer & Keck, 2001). This review will be limited to research using music on the postoperative unit for the purpose of controlling pain.

Music used on the postoperative unit for the use of pain control was first studied by Locin (1981). Women with abdominal incisions were paired according to age, type of surgery, educational background, and previous operative experience. The experimental group listened to music postoperatively, while the control group did not. The music group had less pain than the control group at statistically significant levels ($p < 0.05$). The measure used for pain was the Overt Pain Reaction Rating Scale, designed by the researcher with no reliability or validity data reported.

Additional research on the postoperative unit was conducted in 1988 by Mullooly, Levin, and Feldman. These researchers had a sample of 28 abdominal hysterectomy patients who were assigned to either a control group or experimental group. The experimental group listened to music for 10 minutes on two consecutive days. Results

were significant with the experimental group reporting less pain on postoperative day 2, and less anxiety on postoperative day 1.

Good (1995) researched the use of music and jaw relaxation for the purpose of pain reduction in a group of 84 abdominal hysterectomy patients. The sample was divided into four different groups: a jaw relaxation group, a music group, a jaw relaxation and music together group, and a control group. The interventions were used during the first ambulation after surgery. None of the interventions studied were effective in reducing pain.

A group of researchers studied the use of music to control pain in the coronary artery bypass graft (CABG) surgical patient population (Zimmerman, Nieveen, Barnason, & Schmaderer, 1996). This group of researchers studied 96 participants that listened to music, listened and watched a music video, or had a scheduled rest period with no music or video to determine if there was a difference among these groups with regards to pain and sleep. Data collection was done on postoperative days 2 and 3, with findings indicating the music group had significantly lower pain scores on postoperative day 2 ($p < 0.05$) when compared to the rest group, and the music video group had significantly better sleep on the third morning ($p < 0.05$) when compared to the control group.

Thoracic surgical patients residing in the intensive care unit were studied by a group of researcher's using live harp music to determine its effects on anxiety and pain (Aragon, Farris, & Byers, 2002). The participants in this research ($n=17$) listened to a 20 minute session of live harp music, and the researchers found a statistically

significant difference in pain and anxiety ratings over time from the baseline data to end of the harp playing and 10 minutes afterward ($p=0.000$). The subjects served as their own controls.

The effect of music on postoperative pain and anxiety in a group of women having abdominal hysterectomies was studied by MacDonald, et al. (2003). The researchers found no significant differences in pain or anxiety at rest or with movement between a music listening group ($n=30$) and a control group ($n=28$) that did not listen to music. This research provides no evidence that listening to music alleviates postoperative anxiety or pain in this surgical patient population. The participants were not required to listen to the music a specific amount of time, but they were encouraged to listen to the music and reported listening to it between 2 and 6 hours on the day of the operation. Measures were taken at regular intervals on postoperative days 1, 2, and 3.

The effect of music on CABG patients on postoperative day 1 was studied by Voss, et al. (2004). There were three groups in this research: group 1 listened to 30 minutes of music ($n=19$), group 2 had a scheduled rest period ($n=21$), and group 3 had treatment as usual ($n=21$). Statistical analysis indicated that anxiety, pain sensation, and pain distress all decreased significantly ($p<0.001-0.015$) in the groups that listened to music or had a scheduled rest.

Good et al. (1999) conducted a large randomized control trial in which 500 major abdominal surgical patients used either music, jaw relaxation, a combination of music and jaw relaxation, or none of these (control group) to determine their effect on

postoperative pain at rest and with ambulation on postoperative days 1 and 2. The statistical analysis of the data obtained from this study found significantly less pain in the three treatment groups when compared to the control group ($p=0.028-0.000$).

Several reports of secondary analyses using this data were published (Good, et al., 2000; Good, Stanton-Hicks, Grass, Anderson, Salman, et al., 2001; Good, Stanton-Hicks, Grass, Anderson, Lai, et al., 2001; Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002; Good, Anderson, Ahn, Cong, & Stanton-Hicks, 2005). The first report of a secondary analysis describes the pain of 80 participants having gynecologic surgery that served as part of the control group in the larger study that included 500 participants having a variety of surgeries (Good, et al., 2000). The second report of a secondary analysis describes the pain of 38 intestinal surgical patients who also served as part of the control group of the larger sample of 500 (Good, Stanton-Hicks, Grass, Anderson, Salman, et al., 2001). The conclusions of both analyses include that the participants had significant surgical pain both at rest and with ambulation that was not fully relieved with the use of patient controlled analgesia (PCA).

An additional secondary analysis (Good, Stanton-Hicks, Grass, Anderson, Lai, et al., 2001) was done to determine the relative effects of music and relaxation and the combination of music and relaxation on postoperative pain across and between 2 days and 2 activities. The findings indicate that the three treatment groups taken together had less pain than the control group across 2 days of each activity, across each day, and across ambulation on each day ($p=0.000-0.001$). This indicates that the interventions were continuously effective.

The next report of a secondary analysis of the data (Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002) was done to determine if the positive effects on relaxation and music found in abdominal surgical patients were also found in patients after gynecological surgery. The original sample included 500 subjects having a variety of surgical procedures, and this secondary analysis selected 311 gynecological surgical patients from the larger sample to determine if the results for improved pain were still significant within this smaller subgroup. Significant findings include the intervention groups having significantly less pain at posttest ($p=0.22-0.001$) on both postoperative days 1 and 2. The three interventions (music, relaxation, and a combination of both) were found to be similar in their effect on pain.

The final report of a secondary analysis was reported more recently, and was done to determine if the positive effects on relaxation and music found in the larger sample of abdominal surgical patients were also found in a smaller subset of the sample following intestinal surgery (Good, Anderson, Ahn, Cong, & Stanton-Hicks, 2005). The original sample included 500 subjects having a variety of surgical procedures, and this secondary analysis selected 167 intestinal surgical patients from the larger sample to determine if the results for improved pain were still significant within this smaller subgroup. Significant findings include the intervention groups having less post-test pain than the control group on both days after rest and at three of six points following ambulation ($p=0.024-0.001$).

Research completed recently by Sendelbach et al. (2006) found the use of music therapy decreased pain and anxiety postoperatively in a group of cardiac surgical

patients. A sample size of 50 listened to music for 20 minutes postoperatively, and while pain and anxiety decreased in the experimental group, there was no difference in systolic blood pressure, diastolic blood pressure, or heart rate, when compared to the control group. A verbal rating scale was used to measure pain.

Cepeda, Carr, Lau, and Alvarez (2006) authored a systematic review on the use of music for pain relief. The objective of the systematic review was to evaluate the effect of music on various types of pain, one of which was postoperative pain. Only randomized controlled trials using music to effect pain were included in the review. A total of 14 studies were included in the portion of the review concerning postoperative pain. The implication of the review related to clinical practice was that music should not be the primary method of pain relief. The implication of the review related to research was that further studies were recommended examining anxiety as an outcome measure, and to research the effects of combinations of nonpharmacological interventions that could potentially have a synergistic effect with music to improve pain. The conclusion of the systematic review was listening to music decreases pain and opioid requirements, but the decrease is small with significance in the clinical setting uncertain.

Music in the Orthopedic Population

Recently completed research by Pellino et al. (2005) studied the effects of a kit of nonpharmacologic strategies on pain and anxiety given to patients planning to have an elective total hip or total knee arthroplasty. The kit was considered to be self-explanatory and self-administered and contained a tape of relaxing music along with a

radio/cassette tape player with earphones. Also included in the kit was, an audiotape that guided patients through a progressive muscle relaxation exercise, a plastic massager that is handheld, a soft squeeze ball, and a booklet explaining the various forms of relaxation. There were two groups, an experimental group who received the kit (n=33), and a control group (n=32), who received standard care. The participants kept records of what nonpharmacologic interventions they used from the bag, and this was not controlled by the researcher. Ten participants reported using music on postoperative days 1 and 2. The statistical analysis of the data indicated no significant differences in postoperative pain or anxiety between groups. The experimental group did use significantly less opioid on postoperative day 2.

The effects of listening to music on postoperative pain and stress during bed rest in a group of elderly (over 60 years) orthopedic surgical patients was studied by Masuda, Miyamoto, and Shimizu (2005). The sample had a variety of orthopedic surgeries, from spinal surgery to joint surgery to removal of musculoskeletal tumors and trauma. There were two groups in this study, an experimental group that listened to music for 20 minutes in private rooms (n=22), and a control group (n=22). The statistical analysis indicated that the experimental group experienced less pain after 10 minutes of music listening ($p < 0.05$) and 20 minutes of music listening ($p < 0.001$), when compared to the control group who did not listen to music.

McCaffrey and Locsin (2006) recently used music on the postoperative unit with older adults having hip and knee surgery. A bedside compact disc player was used to play the music, and it was set up to automatically play music for 1 hour, 4 times a day.

The music was first played while the patient was awakening from anesthesia. Findings include the experimental group who listened to music took less pain medication postoperatively than the control group that did not listen to music. A significant reduction in pain was also found in the experimental group on postoperative days 1 and 3.

The research described in this review provides mixed results. Some researchers control the music intervention, while others allow the patient to control it. Some sample sizes are relatively small, while others are quite large. It has been reported that the research methodology in much of the research done to determine if music can reduce postoperative pain is very poor; limiting the conclusions that can be drawn from these studies (Dunn, 2004).

Conceptual Framework: Auditory Pathways

The theoretical framework guiding this study involves auditory neural pathways. Auditory neural pathways suggest that music potentially could inhibit the intensity of pain and improve mood, decrease anxiety, and enhance relaxation (Shertzer & Keck, 2001). The effectiveness of music in relieving pain is thought to be through distraction and the release of endorphins (Pellino, et al., 2005). Shertzer and Keck (2001) suggest that the neural pathway of audition that leads to improved mood and decreased anxiety goes through the thalamus to the amygdala via an inhibitory process. The amygdala is associated with emotion and plays a role in the emotional component of pain and a person's ability to obtain meaning from pain experiences (Shertzer & Keck, 2001).

The neural pathway from the thalamus also leads to the periventricular and periaqueductal gray (Shertzer & Keck, 2001). The periventricular and periaqueductal gray is a zone of neurons in the midbrain that inhibits pain by playing a role in the descending pain modulation (Bear, Connors, & Paradiso, 2001), with the neurons in this area being excited by opiates and endorphins. Periaqueductal gray neurons send descending axons to the raphe nuclei (which uses the neurotransmitter serotonin) and locus coeruleus (which uses the neurotransmitter norepinephrine) (Bear, Connors, & Paradiso, 2001). These structures project axons to the dorsal horns of the spinal cord where enkephalins are released, leading to an inhibition of peripheral pain pathway neurons (Shertzer & Keck, 2001) and depressing nociceptive activity of the neurons (Bear, Connors, & Paradiso, 2001). As the locus coeruleus releases norepinephrine, a catecholamine, this in turn causes increased heart rate and blood pressure (Shertzer & Keck, 2001).

The neural auditory pathway leads to the hypothalamus as well as the thalamus (Shertzer & Keck, 2001). The hypothalamic neural path goes through the hippocampus (associated with memory and learning) and the anterior cingulate cortex (associated with a variety of emotional and cognitive tasks) to enhance relaxation and distraction (Shertzer & Keck, 2001). A schematic of these pathways is provided in Figure 2.

These auditory neural pathways provide a physiological framework to support this research. This model suggests there is a neurophysiological basis for the hypothesis that music might lead to decreased pain. The release of endorphins and enkephalins, which occur naturally in the brain and have opiate and analgesic activity,

will inhibit peripheral pain pathway neurons because they bind to opiate receptors. The decreased anxiety and distraction provided by other parallel mechanisms act to decrease the perception of pain in individuals. The inhibition of the release of the catecholamine norepinephrine from the locus coeruleus could lead to decreased heart rate and decreased blood pressure.

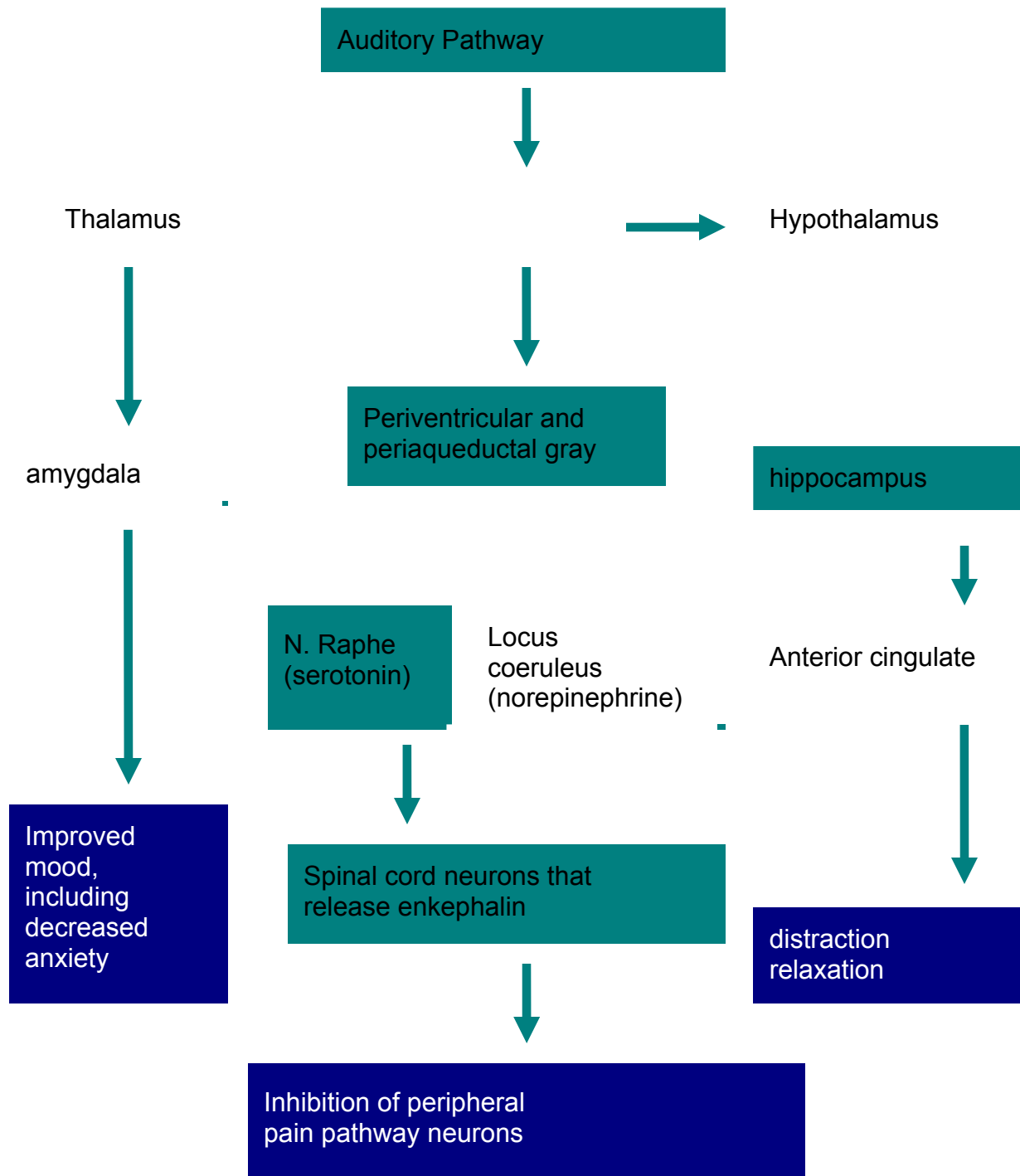


Figure 2
Conceptual Framework

Research Questions

The specific research questions were:

1. What is the effect of listening to music and/or a quiet rest period on pain when used as an adjuvant with traditional pain management in orthopedic patients when compared to similar patients who do not listen to music just prior to and just after ambulation on postoperative day 1?
2. What is the effect of listening to music and/or a quiet rest period on anxiety when used as an adjuvant with traditional pain management in orthopedic patients when compared to similar patients who do not listen to music just prior to and just after ambulation on postoperative day 1?
3. What are the effects of listening to music and/or a quiet rest period on opioid consumption in the 6 hours following a music intervention in orthopedic patients who listen to music when compared to similar patients who do not listen to music on postoperative day 1?
4. What are the effects of listening to music and/or a quiet rest period on physiologic parameters (blood pressure, heart rate, respiratory rate, and oxygen saturation) at rest in the orthopedic surgical patient population?

Design

An experimental design was used to examine the effects of music and/or a quiet rest period on postoperative pain, anxiety, and physiological parameters. The dependent variables were pain, anxiety, and physiologic parameters, including blood pressure, heart rate, respiratory rate, and oxygen saturation. The independent

variables were a music intervention and a quiet rest period. A table of the independent and dependent variables is provided with both theoretical and operational definitions (Table 3).

Table 3
Theoretical and Operational Definitions

CONCEPT	THEORETICAL DEFINITION	OPERATIONAL DEFINITION
Pain	An unpleasant sensory and affective experience associated with tissue damage following surgery	Pain intensity as marked by the research participant on a visual analog scale, consistently measured using a metal ruler with millimeter calibrations
Anxiety	Unpleasant emotion triggered by current circumstances and/or anticipation of future events, stimulated by real or imagined dangers	Level of anxiety as marked by the research participant on a visual analog scale, consistently measured using a metal ruler with millimeter calibrations
Blood pressure	The force of blood exerted on the inside walls of blood vessels	Measured using a standard automatic blood pressure monitoring machine available in the hospital and calibrated by the biomedical department just prior to the initiation of the research
Heart rate	The number of times the heart beats per minute	Measured using a standard automatic blood pressure monitoring machine available in the hospital and calibrated by the biomedical department just prior to the initiation of the research
Respiratory rate	The number of times the person breathes per minute	Measured manually by the investigator by observation of the chest rising and falling for 30 seconds and multiplied by 2
Oxygen saturation	The amount of oxygen carried by hemoglobin in the blood	Measured using a standard pulse oximetry monitoring machine with finger probe, available in the hospital and calibrated by the biomedical department just prior to the initiation of the research
Music Intervention	Listening to music with a personal compact disc player using individual headphones	Self-selected music played on personal compact disc player at volume level of patients choosing, for at least 20 minutes
Quiet Rest Period	Resting in bed with limited interruptions	Resting in bed with no painful procedures performed, limited interruptions, eating and viewing television allowed

Setting and Sample

Data were collected on an orthopedic unit in a hospital within a healthcare system that has over 2,000 patient beds in central Florida. Within this hospital system, the very first total knee replacement in the state of Florida was performed. The subjects for this study consisted of all patients who were scheduled for a total knee arthroplasty (TKA) at the participating hospital that met the inclusion criteria. The inclusion criteria were an age range of 45 to 84, American Society of Anesthesiologists (ASA) Physical Status Classification of 1, 2, or 3; scheduled for total knee arthroplasty, no appreciable deficits in hearing or vision; able to communicate in English; admitted to orthopedic floor postoperatively; alert and oriented to person, place, time, and situation; and patient controlled analgesia (PCA) ordered for postoperative pain relief. Exclusion criteria included the inability to see sufficiently to mark visual analog scale, current use of antipsychotic medications, allergy to traditional opioid medications, and admission to the ICU postoperatively and/or hemodynamically unstable

A letter was submitted to the surgeons that perform this surgery to inform them about the study, and to obtain their permission to approach their patients for potential participation in the study (Appendix D). Once informed consent was obtained, subjects were randomly assigned to one of two groups: the experimental group (listens to music) or the comparative rest group (does not listen to music, but has a quiet rest period). The rationale of a group having a quiet rest period was to create a group experiencing the same circumstances as the experimental group, with the exception of listening to music. This was an attempt to isolate the intervention so that results could

be specifically linked to the music. Randomization was done using a random number chart and sealed envelopes with assignment only known to the independent person preparing the envelopes.

The size of the sample was based on a power analysis for repeated measures analysis of variance. For a power of .80, $\alpha = 0.05$, and large effect size based on preliminary data from this study and past studies, it was determined a total of 56 participants were needed, with 28 in the comparative rest group, receiving a quiet rest period, and 28 in the experimental group, receiving a music intervention.

Measures

The measures used in this study included the McGill Pain Questionnaire Short Form (MPQ-SF), a visual analog scale (VAS) for pain, and a VAS for anxiety. Blood pressure, heart rate, respiratory rate, and oxygen saturation were also measured.

Demographic and Clinical Data

Demographic data, including age, gender, marital status, ethnicity, religion, and education were collected preoperatively from the patient as well as the patient's medical record. Surgical information, as well as medication usage was obtained postoperatively from the patient's medical record.

The Visual Analog Scale for Pain and Anxiety

The visual analog scale (VAS) was used to measure pain and anxiety. The VAS is a scaling procedure that can be used to measure various subjective clinical phenomena (Waltz, Strickland, & Lenz, 2005). It is often used to measure pain. The

VAS consists of a 10-cm horizontal line with right angles at each end with word anchors depicting extremes in pain. The far left anchor typically will have “no pain” indicated, and the far right anchor will typically have “pain as bad as it could possibly be” indicated. Subjects mark on the line exactly where they perceive their pain to fall on the continuum of that line. A ruler is used to measure from the far left of the scale to the subject’s mark, and the score is reported as the length measured in millimeters. One advantage of the VAS is it produces ratio level data, allowing more robust parametric statistical procedures to be used with the data, making it attractive to researchers (Carlsson, 1983). The VAS is quick, easy to use, easy to score, and easy to compare the results to previous results (St. Marie, 2002). The VAS can measure different dimensions of pain by using different word anchors on the ends of the line, but only one dimension can be measured at a time.

The reliability and validity of the VAS was studied by Gallagher, Bijur, Latimer, and Silver (2002) in a population of men and women ($n = 40$) with a mean age of 40 (age range 15 – 88) that presented to the emergency room with abdominal pain. The researchers conducted test-retest reliability using intra-class correlation coefficient (ICC) between VAS at 1 minute apart. Their findings indicate that the VAS is a reliable tool in their study population and setting, with ICC = 0.99 (95% CI 0.989 to 0.992). Validity was assessed by performing an analysis of variance (ANOVA), looking for a linear trend with an association between 5 categorical pain descriptors and change in VAS. Their findings indicate the VAS is a valid tool in their study population and setting ($F = 79.4$, $P < .001$).

In pain rating scales, the ability of that scale to detect change is the sensitivity, and the more levels in a tool, the more sensitive that tool will be (Williamson & Hoggart, 2005). The VAS provides a sensitive measure, able to detect a small change in pain, and is preferable over the verbal rating scale (VRS) due to its small number of categories which requires a larger change in pain before detection (Williamson & Hoggart, 2005). Jensen, Turner, and Romano (1994) indicate that the lack of sensitivity of the VRS may lead to over or under-estimation of changes in pain. The VAS has greater sensitivity to change than the VRS, making it a better measure with respect to sensitivity (Jensen, Karoly, & Braver, 1986).

A VAS was also used to measure anxiety with verbal anchors at each end indicating no anxiety at the far left, and most anxious at the far right. Concurrent validity of the VAS to measure the self-report of anxiety has been demonstrated when scores were compared to Spielberger's (1983) State Anxiety Inventory (SAI) in group of adult patients in a critical care unit with acute ischemic heart disease. A strong positive correlation was found between the VAS and the SAI ($r=0.70$) (Elliot, 1993).

The McGill Pain Questionnaire

The McGill Pain Questionnaire is a clinical tool that assesses pain in the sensory, affective and evaluative dimensions based on words that are selected by patients to describe their pain (Melzack & Katz, 2001). The McGill Pain Questionnaire is the most widely used multidimensional pain inventory (Wilke, Savedra, Holzemer, Tesler, & Paul, 1990) and is available in two forms, the long form and short form. The long-form McGill Pain Questionnaire (LF-MPQ) measures the location and pattern of pain over time, the

sensory and affective dimensions, as well as the pain intensity (St.Marie, 2002). The reported time it takes to use the LF-MPQ varies in the literature. Flaherty (1996) reports it takes about 30 minutes to complete and can be difficult for some to understand, while reports from the American Medical Association (2003) indicate it takes only 5 to 15 minutes to complete, and is no more a burden to the subject than the VAS or the NRS . The short-form McGill Pain Questionnaire (SF-MPQ) was developed in 1987 by Melzack to obtain information from research settings when time is limited, and more than the pain intensity is needed. It measures the sensory and affective dimensions of pain, along with pain intensity, and takes 2 to 3 minutes to complete (St. Marie, 2002).

The SF-MPQ was studied by Melzack (1987) in adult postoperative patients, obstetrical patients, and dental patients. Melzack determined concurrent validity with significant correlations ($r = 0.51$, $p < 0.03$) with the VAS and the SF-MPQ and the LF-MPQ. No reliability data were reported. Data on the sensitivity of the SF-MPQ has not been reported, but the sensitivity data for the LF-MPQ has shown that it is sensitive to interventions designed to reduce pain (Briggs, 1996). The MPQ uses a VRS to assess change in pain, so the sensitivity might be underestimated (Melzack & Katz, 2001).

Permission to use the SF-MPQ can be found in Appendix E.

Physiological Parameters

Pain causes stress, and in turn causes the cardiovascular system to respond by activating the sympathetic nervous system (Pasero, Paice, & McCaffery, 1999). The activation of the sympathetic nervous system causes increased heart rate, blood pressure, and oxygen demand. Measuring heart rate, blood pressure, and oxygen

saturation could provide evidence that music decreases the sympathetic nervous system stimulation from the stress of pain, thereby decreasing the heart rate and blood pressure, and decreasing oxygen demand as indicated by improving oxygen saturation percentages. Borgbjerg, Nielsen, and Franks (1996) report that pain acts as a respiratory stimulant, as indicated by clinical experience. It would follow that if pain were controlled, an individual's respiratory rate would normalize. Flor, Miltner, and Birbaumer (1992) report that in pain studies with postoperative patients, cardiovascular measures have been used to document the effects of postoperative pain in addition to the positive effects of psychological interventions.

Blood pressure, heart rate, and oxygen saturation were measured using a portable bedside monitor (Medical Data Electronics Escort Series E100 ICU/CCU), with the same machine used exclusively and consistently throughout this research. The biomedical engineering department of the hospital calibrated this machine according to manufacturer directions just prior to the start of data collection and determined the machine was in proper working order. Respiratory rate was measured by the principal investigator by counting the number of respirations in a 30 second period and multiplying by 2, which provided a respiratory rate per minute value.

Data Collection Procedures

Prior to any data collection, institutional review board approval was obtained from both the hospital (Appendix G) and the University of Central Florida (Appendix H). Additionally, approval was obtained from the Office of Research Administration from the

hospital (Appendix J). All consenting and data collection was done by the principal investigator with no assistance from other researchers.

Consent Process

Consent of participants was obtained during the patient's preoperative visit to the preadmission testing unit (PAT). The principal investigator reviewed the PAT schedule daily to determine which patients should be approached for participation in the study. All patients between the ages of 45 and 84 having a TKA performed by the supporting surgeons were approached and determination of potential participation was explored considering each item in the inclusion and exclusion criteria. If the inclusion and exclusion criteria were satisfied, then the opportunity to participate in the research was offered to the patient. After verbal consent was obtained, written consent was obtained, (Appendix A), as was consent to review protected health information (Appendix K). Demographic data were collected and the McGill Pain Questionnaire Short Form (Appendix L) was administered (permission from author, Appendix E). All research participants were taught how to use the visual analog scale for pain and anxiety. Randomization into either the comparative rest group or the experimental group was then determined by a sealed envelope system. If the participant was randomized into the experimental group, the participant selected his or her music of choice from the various easy-listening compact discs (CD) available (Table 4), and this CD was reserved for that participant for the day after his or her surgery. Easy-listening music was offered because music with harmonious melody and pleasant rhythms has been

shown to produce a calming effect and an increased sense of well-being (MacClelland, 1982).

Table 4
Compact Disc Selection

Lifescapes ®	Celtic Flutes
Lifescapes ®	World Flutes
Lifescapes ®	Beethoven's Moonlight
Lifescapes ®	Native American Flute and Guitar
Lifescapes ®	Peaceful Harp
Lifescapes ®	Chopin's Nocturne

Data Collection

Data collection was done on postoperative day 1, using a standard format (Appendix M), and began 20 minutes prior to physical therapy. The data collected included the McGill Pain Questionnaire Short Form, a VAS measurement of pain and a VAS measurement of anxiety, as well as heart rate, blood pressure, respiratory rate, and oxygen saturation. Coordination with each subject's nurse and physical therapist was done each morning to determine the schedule for physical therapy for the research participants. Subjects in the experimental group listened to music continuously for 20 minutes prior to physical therapy, and for a rest period of about 20 minutes after physical therapy. Subjects in the comparative rest group did not listen to music but had visits by the investigator at the same points in care as the experimental group to control

for effects of investigator presence. Data collection occurred at four points during this time: prior to the beginning of the music, after listening for 20 minutes and prior to physical therapy, just after physical therapy, and after the 20 minute rest period following physical therapy. The SF-MPQ was administered before the initiation of the music intervention in the experimental group. Subjects in the comparative rest group were visited by the principal investigator 20 minutes before their scheduled physical therapy at which time the SF-MPQ was administered. At the conclusion of the last measurement of pain, anxiety, and vital signs, subjects in the experimental group were asked to complete a questionnaire about their experience listening to music (Appendix N). The amount of opioid used from the initiation of the music intervention to 6 hours later was recorded.

Intervention

The music intervention consisted of a variety of easy-listening compact discs (CD) that was played on personal CD players with headphones. The music had 60-80 beats per minute or less, to decrease the chance of increasing the heart rate due to entrainment. The selection of CD's that was available to participants promoted relaxation. The music did not have lyrics and had a sustained melodic quality, with no strong rhythms or percussion. The music had a soothing quality as this has been shown to decrease anxiety and improve comfort and relaxation (Heitz, Symreng, & Scamman, 1992; Good, 1996).

Data Analysis Procedures

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) for windows (version 14). Exploratory data analyses were performed to determine if assumptions were met, to screen the data for accuracy, missing data, and outliers, prior to addressing the research questions. Descriptive statistics were computed, and a repeated measures analysis of variance (RMANOVA) was conducted to evaluate the relationship between a music intervention and a quiet rest period on pain and anxiety scores, and physiologic variables. Between groups analysis was done to determine if the groups differed significantly from each other with regards to pain, anxiety, and physiological parameters. Within groups analysis was done to determine if both groups combined had significantly decreased pain or anxiety scores over time, or had an effect on physiological parameters. Finally, an analysis of covariance was done to determine if pain or anxiety scores were different between the groups when the scores on the first measure of pain and anxiety were used as a covariate.

Results

Demographic Data

A total of 56 patients participated in the study (25 males, 31 females; mean age 63.89, range 46-84 years). There were no significant differences found in the comparative rest group when compared to the experimental group regarding any of the demographic characteristics, including gender, age, marital status, ethnicity, religion, or education (Table 5). Additionally, there were no significant differences found between

the two groups when considering any of the clinical characteristics, such as the American Society of Anesthesiologist (ASA) physical status, body mass index (BMI), type of anesthesia, the use of a femoral block, scores on the McGill Pain Questionnaire, or the type of patient controlled analgesia ordered (Table 6) between patients in the experimental group and control group.

Table 5
Comparison of the Demographic Characteristics of Two Groups

Characteristics	<u>Group</u>			Statistical Test
	Experimental (n=28) n (%)	Rest (n=28) n (%)	Total (n=56) N (%)	<i>p</i> value
Gender				
Female	14 (50)	17 (60.7)	31	Chi-square <i>p</i> = .420
Male	14 (50)	11 (39.3)	25	
Age				
Mean (SD) [Range]	64.25 (9.61) [46-81]	63.54 (9.62) [47-84]		<i>t</i> -test <i>p</i> = 0.782
Marital Status				
Single	0	1	1	Chi-square <i>p</i> = .490
Married	21	17	38	
Widowed	4	4	8	
Divorced	3	6	9	
Ethnicity				
Caucasian	25	24	49	Chi-square <i>p</i> = .950
African-American	1	1	2	
Hispanic	1	1	2	
Other	1	2	3	
Religion				
Christian	17	17	34	Chi-square <i>p</i> = .532
Catholic	4	6	10	
Jewish	1	1	2	
Other	6	4	10	
Education				
< 12 th grade	2	1	3	Chi-square <i>p</i> = .917
High School	6	7	13	
Some college	11	10	21	
College grad	9	10	19	

Table 6
Comparison of the Clinical Characteristics of Two Groups

Characteristics	<u>Group</u>				Statistical Test <i>p</i> value
	Experimental (n=28)		Rest (n=28)		
	n	(%)	n	(%)	
ASA number					
1	1	(4)	0	(0)	Chi-square <i>p</i> = .541
2	18	(64)	17	(61)	
3	9	(32)	11	(39)	
BMI					<i>t</i> -test
Mean (SD)	31.873 (6.29)		33.577 (6.56)		<i>P</i> = .326
Type of Anesthesia					Chi-square
General		16		16	<i>p</i> = 1.000
Spinal		12		12	
Femoral Block					
Yes		26		26	
No		0		0	
Type of PCA					Chi-square
Dilaudid		21		15	<i>p</i> = .094
Morphine		7		13	
MPQ-SF					<i>t</i> -test
Preoperative					
Mean (SD)	13.43 (8.47)		10.30 (9.98)		<i>p</i> = .214
Postoperative					
Mean (SD)	15.86 (10.64)		14.93 (12.29)		<i>p</i> = .764

Research Question 1: Music and Pain

A repeated measures analysis of variance was used to answer part of the first research question, which was to determine the effect of listening to music on pain when used as an adjuvant with traditional pain management in orthopedic patients when compared to similar patients who do not listen to music just prior to and just after ambulation on postoperative day 1. The mean pain scores and standard deviations for the experimental group and the comparison rest group are provided in Table 7.

Mauchly's test indicated that the assumption of sphericity had been violated [$\chi^2(2) = 27.12, p < .05$], therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .83$). The results showed no statistically significant differences in pain scores between the comparison rest group and the experimental group at any measurement point ($F = 1.120, p = .337$). A repeated measures analysis of variance within groups was also conducted to determine if the intervention group and the comparison rest group, when combined, had significantly lower pain scores over time. Mauchly's test indicated that the assumption of sphericity had been violated [$\chi^2(5) = 28.53, p < .05$], therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .81$) and results indicate a statistically significant difference over time in pain scores ($F = 6.699, p = .001$). Paired samples *t*-tests were then conducted as a post hoc analysis to determine at what time the significant difference occurred. This analysis indicated that when combined, the intervention group who received music and the comparison rest group who received a quiet rest period had statistically significant lower pain from time 1 (just prior to music or quiet rest period) to time 2 (after 20 minutes of music or quiet rest period). The mean pain score at time 1 was 49.41, and at time 2 was 36.36 [$t(55) = 4.751, p = .000$] (Figure 4).

A one-way between-groups repeated measures analysis of covariance was conducted to compare the effectiveness of the music intervention and the quiet rest period on pain. Participants' scores on the baseline (Time 1) visual analog scale for pain were used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity,

homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pre-intervention pain scores, there was no significant difference between the two groups on post-intervention pain scores [$F(1, 53) = .53$, partial eta squared = .01].

Table 7
Pain Data

	Group Assignment	Mean	Standard Deviation	N
VAS Pain Time 1 Baseline	Experimental	52.39	25.168	28
	Rest	46.43	25.678	28
	Combined Sample	49.41	25.371	56
VAS Pain Time 2 Just after 20 minutes of music or rest	Experimental	36.50	23.793	28
	Rest	36.21	26.853	28
	Combined Sample	36.36	25.138	56
VAS Pain Time 3 Just after physical therapy	Experimental	44.54	28.213	28
	Rest	47.96	27.700	28
	Combined Sample	46.25	27.756	56
VAS Pain Time 4 Just after 20 minutes of music or rest	Experimental	41.21	25.764	28
	Rest	45.11	31.181	28
	Combined Sample	43.16	28.408	56

Research Question 2: Music and Anxiety

A repeated measures analysis of variance was used to answer the first part of the second research question, which was to determine the effect of listening to music on

anxiety when used as an adjuvant with traditional pain management in orthopedic patients when compared to similar patients who did not listen to music just prior to and just after ambulation on postoperative day 1. The mean anxiety scores and standard deviations for the experimental group and the comparative rest group are provided in Table 8. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(2) = 18.93, p < .05$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .85$). The results showed no statistically significant differences in anxiety scores between the comparative rest group and the experimental group at any measurement point ($F = 1.566, p = .206$). A repeated measures analysis of variance within groups was then conducted to determine if the intervention group and the comparative rest group, when combined, had significantly lower anxiety scores over time. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(5) = 19.72, p < .05$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .83$) and results indicate a statistically significant difference in anxiety scores over time ($F = 4.08, p = .013$). Paired samples *t*-tests were then conducted as a post hoc analysis to determine at what time the significant difference occurred. This analysis indicated that when combined, the intervention group and the comparison rest group had statistically lower anxiety from time 1 (just prior to music or rest period) to time 2 (after 20 minutes of music or rest period). The mean anxiety scores at time 1 was 31.09 and at time 2 was 24.70 ($t(55) = 2.86, p = .006$). Additionally, anxiety was determined to also decrease significantly from time 3 (just after physical therapy) and time 4 (after second period of 20 minutes of music or rest period)

with mean anxiety scores at time 3 of 34.77 and time 4 of 29.13 ($t(55) = 2.222, p = .030$).

A one-way between-groups repeated measures analysis of covariance was conducted to compare the effectiveness of the music intervention and the quiet rest period on anxiety. Participants' scores on the baseline (Time 1) visual analog scale for anxiety were used as the covariate in this analysis. Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, homogeneity of regression slopes, and reliable measurement of the covariate. After adjusting for pre-intervention anxiety scores, there was no significant difference between the two groups on post-intervention anxiety scores [$F(1, 53) = .25, \text{partial eta squared} = .05$]

Table 8
Anxiety Data

	Group Assignment	Mean	Standard Deviation	N
VAS Anxiety Time 1 Baseline	Experimental	36.07	27.355	28
	Rest	26.11	23.259	28
	Combined Sample	31.09	25.65	56
VAS Anxiety Time 2 Just after 20 minutes of music or rest	Experimental	27.07	22.730	28
	Rest	22.32	22.319	28
	Combined Sample	24.70	22.448	56
VAS Anxiety Time 3 Just after physical therapy	Experimental	35.79	24.467	28
	Rest	33.75	28.786	28
	Combined Sample	34.77	26.490	56
VAS Anxiety Time 4 Just after 20 minutes of music or rest	Experimental	27.93	20.783	28
	Rest	30.32	28.674	28
	Combined Sample	29.13	24.842	56

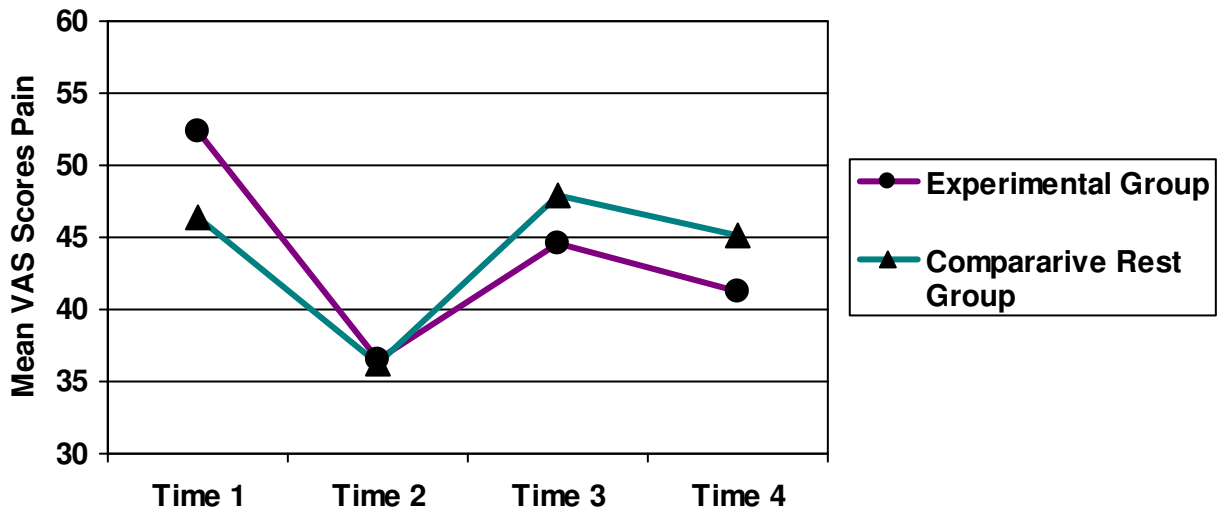


Figure 3
 Mean VAS Pain: Comparison Rest Group vs. Experimental Group

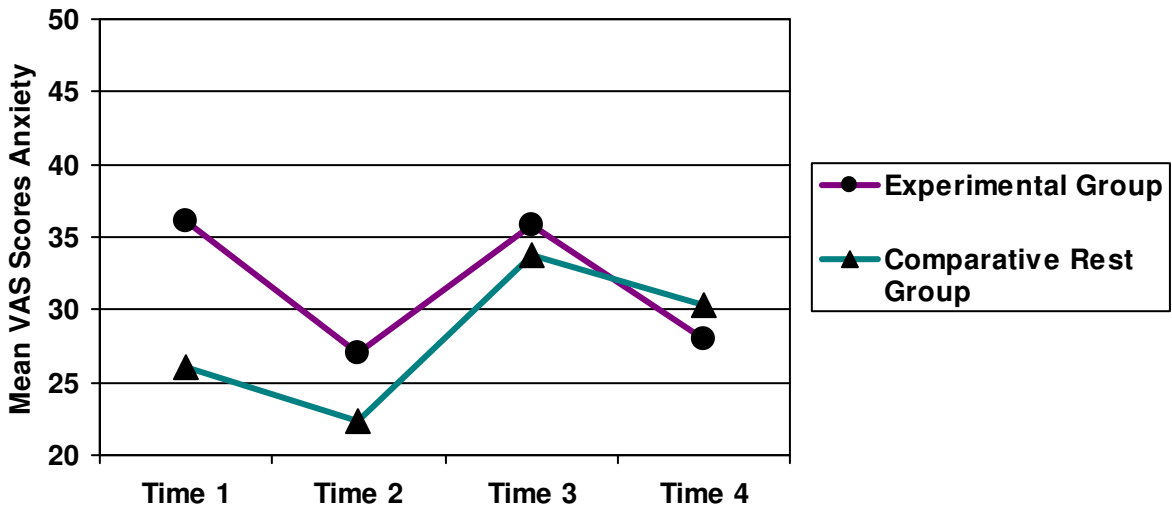


Figure 4
 Mean VAS Anxiety: Comparison Rest Group vs. Experimental Group

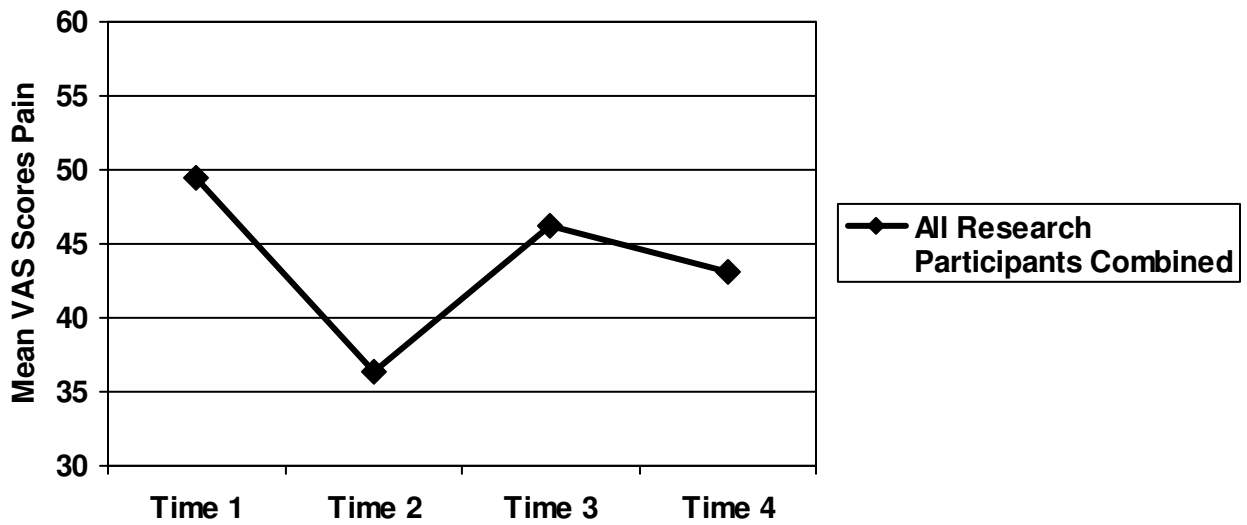


Figure 5
Mean VAS Pain: All Research Participants Combined

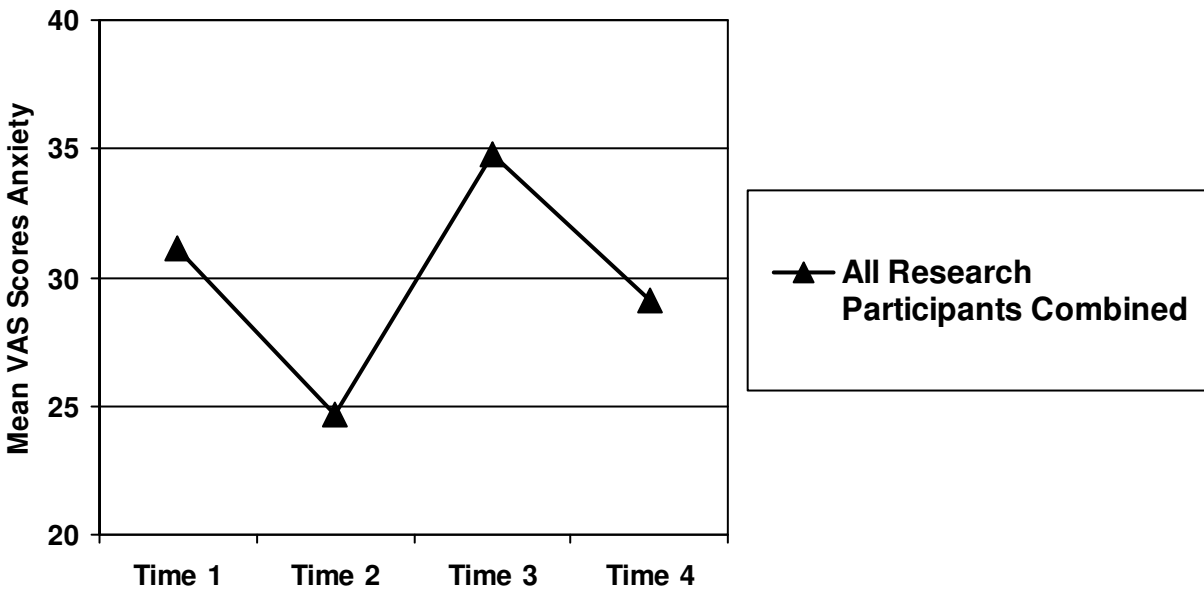


Figure 6
Mean VAS Anxiety: All Research Participants Combined

Research Question 3: Music and Opioid Consumption

Chi-square analysis was done to answer third research question, which was to determine the effects of listening to music on opioid consumption in the 6 hours following the music intervention in orthopedic patients who listen to music when compared to similar patients who do not listen to music on postoperative day 1. Results indicate no significant difference between the two groups regarding the administration of oral pain medications within 6 hours of the intervention, Pearson $X^2(1, N=56) = .747$, $p = 0.388$, with 93% of the participants in the experimental group receiving oral pain medications within 6 hours, and 86% of the participants in the quiet rest group receiving them. There was no difference between groups regarding which oral pain medication was administered, Pearson $X^2(5, N=56) = 8.083$, $p = 0.152$, with 89% of the participants in the experimental group and 82% of the participants in the quiet rest group receiving Percocet. Two participants (7%) in the quiet rest group received Lortab, and 3 participants (11%) in the quiet rest group did not receive any oral pain medications within 6 hours of the intervention (11%). One participant (3.6%) in the experimental music group received Dilaudid, one participant (3.6%) received Darvocet, and one participant (3.6%) received Vicoden.

All research participants received PCA following surgery, either Dilaudid or Morphine, at equivalent doses. No participant had a basal rate of opioid administration on the PCA, and all participants had their PCA discontinued the first morning after surgery and as needed oral pain medications were ordered by the physician.

Research Question 4: Music and Physiological Parameters

Analysis of variance with repeated measures was used to answer the fourth research question, which was to examine the effects of listening to music on physiologic parameters, including mean arterial pressure (MAP), heart rate, respiratory rate, and oxygen saturation at rest in the orthopedic surgical patient population. A summary of MAP and heart rate data can be found in Table 9. The MAP data indicated that the assumption of sphericity had been violated with a significant Mauchly's test ($\chi^2 (2) = 9.357, p < .05$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .903$). There were no statistically significant differences in MAP found at any time between the comparative rest group and the experimental group ($F = .388, p = .658$). A repeated measures analysis of variance within groups was then conducted to determine if the intervention group and the comparative rest group, when combined, had significantly lower MAP over time. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2 (2) = 9.077, p < .05$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .892$) and results indicate a statistically significant difference in MAP over time ($F = 10.002, p = .000$). A paired sample *t*-test was conducted as a post hoc analysis to determine at what time the significant difference occurred. This analysis indicated that when combined, the intervention group and the comparison rest group had statistically lower MAP from time 1 (just prior to music or rest period) to time 2 (after 20 minutes of music or rest period). The MAP at time 1 was 94.239 and at time 2 was 92.143 ($t(55) = 2.358, p = .022$). Additionally, MAP was determined to also decrease significantly from time 1

(baseline) and time 4 (after second period of 20 minutes of music or rest period) with MAP at time 1 of 94.239 and time 4 of 89.234 ($t(55) = 3.885, p = .000$).

Mauchly's test done with the heart rate data indicated that the assumption of sphericity had been violated ($\chi^2(2) = 11.09, p < .05$), therefore degrees of freedom were corrected using Huynh-Feldt estimates of sphericity ($\epsilon = .88$). The results showed no statistically significant differences in heart rate at any time between the comparative rest group and the experimental group at any measurement point ($F = .145, p = .865$). A repeated measures analysis of variance within groups was then conducted to determine if the intervention group and the comparative rest group, when combined, had significantly lower heart rate over time. The results indicated no significant differences in heart rate at any time when the groups were combined.

The respiratory rate data indicated no violations of assumptions, with Mauchly's test for sphericity not significant ($\chi^2(2) = 4.635, p = .099$), and no statistically significant differences were found at any time between the comparative rest group and the experimental group ($F = .172, p = .843$). A repeated measures analysis of variance within groups was then conducted to determine if the intervention group and the comparative rest group, when combined, had significantly lower respiratory rate over time. The results indicated no significant differences in respiratory rate at any time when the groups were combined.

For the data regarding oxygen saturation, Mauchly's test for sphericity was not significant ($\chi^2(2) = 3.13, p = .209$), so assumptions had not been violated, and no statistically significant differences were found at any time between the comparative rest

group and the experimental group ($F = .880, p = .418$). A repeated measures analysis of variance within groups was then conducted to determine if the intervention group and the comparative rest group, when combined, had significantly different oxygen saturation over time. The results indicated no significant differences in oxygen saturation at any time when the groups were combined. A summary of the respiratory rate and oxygen saturation data can be found in Table 10.

Table 9
Physiological Data: MAP and Heart Rate

	Group Assignment	Mean	Standard Deviation	N
MAP, Time 1 Baseline	Experimental	95.786	12.346	28
	Rest	92.693	13.841	28
	Combined Sample	94.239	13.089	56
MAP, Time 2 Just after 20 minutes of music or rest	Experimental	92.707	12.527	28
	Rest	91.579	14.943	28
	Combined Sample	92.143	13.674	56
MAP, Time 4 After PT, and just after 20 minutes of music or rest	Experimental	90.275	13.817	28
	Rest	88.293	15.117	28
	Combined Sample	89.284	14.384	56
Heart rate, Time 1 Base line	Experimental	85.79	13.549	28
	Rest	86.68	13.795	28
	Combined Sample	86.23	13.555	56
Heart rate, Time 2 Just after 20 minutes of music or rest	Experimental	83.04	14.369	28
	Rest	88.18	12.887	28
	Combined Sample	85.61	13.770	56
Heart rate, Time 4 After PT, and just after 20 minutes of music or rest	Experimental	85.21	14.449	28
	Rest	86.64	11.295	28
	Combined Sample	85.93	12.870	56

Table 10
Physiological Data: Respiratory Rate and Oxygen Saturation

	Group Assignment	Mean	Standard Deviation	N
Respiratory rate Time 1 Base line	Experimental	17.64	1.726	28
	Rest	17.79	1.663	28
	Combined Sample	17.71	1.681	56
Respiratory rate Time 2 Just after 20 minutes of music or rest	Experimental	18.00	1.805	28
	Rest	18.21	1.912	28
	Combined Sample	18.11	1.846	56
Respiratory rate Time 4 After PT, and just after 20 minutes of music or rest	Experimental	18.07	1.844	28
	Rest	17.96	1.972	28
	Combined Sample	18.02	1.892	56
Oxygen saturation Time 1 Base line	Experimental	95.07	3.589	28
	Rest	96.21	2.455	28
	Combined Sample	95.64	3.101	56
Oxygen saturation Time 2 Just after 20 minutes of music or rest	Experimental	95.71	2.760	28
	Rest	96.32	2.245	28
	Combined Sample	96.02	2.512	56
Oxygen saturation Time 4 After PT, and just after 20 minutes of music or rest	Experimental	95.14	2.663	28
	Rest	95.96	2.742	28
	Combined Sample	95.55	2.710	56

Questionnaire Results

Results from a 4-item questionnaire given to the experimental group indicated that listening to music was an overall positive experience. Eighty-four percent of respondents reported that they somewhat agreed or totally agreed that the music helped them forget about their pain for a while. Additionally, 92% somewhat agreed or totally agreed that the music helped improve their general mood, and 88% agreed that the music was an added enjoyable experience for them. None of those questioned reported that they would rather not have listened to the music.

Discussion

Following surgery, the focus has traditionally been on the use of pharmacological interventions for pain management. Current research suggests there may be a role for nonpharmacologic interventions that can be used in addition to traditional pain management. The results of this research suggest that music or a quiet rest period during the time just before and just after physical therapy decreases pain and anxiety when used in conjunction with traditional pharmacological interventions in an orthopedic surgical population.

The difference in pain scores between the music intervention group and the quiet rest group is not statistically significant; however, the pain scores in the music intervention group did decrease by 30.3%, while the quiet rest group's pain scores only decreased by 22% from time 1 to time 2. This decrease is clinically significant and indicates that offering a music intervention is slightly more effective than a quiet rest period to decrease pain. Similarly, the difference in anxiety scores between the music

intervention group and the quiet rest group is not statistically significant; however, the anxiety scores in the music intervention group decreased by 25%, while the quiet rest group's anxiety scores only decreased by 14.4% from time 1 to time 2. The decrease is clinically significant and indicates that offering a music intervention is slightly more effective than a quiet rest period to decrease anxiety.

Findings from this study are not consistent with other research done by Voss, et al., 2004, in which the effects of music and a rest period on pain and anxiety were examined. Voss et al. (2004) found a statistical difference in pain and anxiety scores between subjects in the music group and subjects in the rest group. The sample used in this research was cardiac surgical patients. Similarly, Sendelbach, Halm, Doran, Miller, and Gaillard, (2006) examined the effects of music and rest on postoperative pain and anxiety in cardiac surgical patients and found statistically significant results, including less pain and anxiety in the music intervention subjects. The significant difference in the research described in this report and previous studies examining the effects of music and rest on postoperative pain and anxiety is that the music and rest in this study is provided just prior to and just after a known painful experience, the first ambulation following a total knee arthroplasty. This research is the first research done comparing these particular interventions at this specific point in care in this patient population, making it unique, with no availability of similar research for comparison.

The lack of a statistically significant difference between groups in this study regarding blood pressure and heart rate data is consistent with other studies that have examined the effects of music and rest on physiological parameters (Sendelbach, Halm,

Doran, Miller, and Gaillard, 2006). Sendelbach and her colleagues did not find statistically significant differences between systolic blood pressure, diastolic blood pressure, and heart rate between participants in a music intervention group and a rest group.

This research began using music as an intervention to be compared to a control group who received a quiet rest period. This design was planned to isolate the music intervention so that listening to the music was the only difference between the two groups. The quiet rest group was to be a control group. After collecting data for several weeks, it became apparent that the group receiving a quiet rest period was in fact receiving an intervention. Providing an environment with little interruption was changing their situation enough so that the quiet rest group did not really act as a control group, but as a second intervention group.

Due to the two groups in this study having their respective interventions around a known painful and anxiety-provoking point in care, there may have been an inability of the participants to concentrate on the music or quiet rest. Patients having a total knee arthroplasty are fully aware that the first time they attempt to stand following surgery that pain is certain. This in turn causes anxiety, with the anticipation of the pain. It has been suggested that music is more effective if patients are able to concentrate on the music (Good, et al., 1999). If a music intervention and a quiet rest period were provided at other points in care, results may be different.

Limitations

Several limitations accompany this study. Despite efforts by the researcher to maintain a quiet and uninterrupted rest period for both groups, occasional disruptions occurred. It is unclear how much influence the disruptions had on reports of pain and anxiety or physiological measures in either group.

Attrition of participants occurred at a greater rate than anticipated. To obtain the sample of 56, a total of 75 participants consented, with 19 participants that consented eventually not participating. Reasons for the attrition included admission to the intensive care unit or progressive care unit postoperatively (n = 2), delayed physical therapy due to blood administration (n = 2), surgery cancelled (n = 3), self-reported excessive pain (n = 3), tone-deaf not reported at time of consenting (n = 1), withdrew from study with no reason given (n = 2), excessive nausea (n = 1), and did not receive physical therapy due to low blood pressure (n = 3). One additional research subject was excluded due to incomplete data, and one subject was unable to fill out the visual analog scale postoperatively due to excessive drowsiness.

An additional limitation of the study includes the inconsistent practice of the nursing staff when providing “as needed” oral pain medications. While there was no statistically significant difference between the two groups regarding the administration of opioid medications, a difference was noticed by the researcher among the nursing staff, with some providing oral medications more liberally in anticipation of pain, rather than waiting for the pain to be at a certain level before administering the medication. Standardization of this practice should be considered, with understanding that the

administration of pain medication in anticipation of a predicted painful event is appropriate.

Implications

Further research using music and/or rest periods as an adjuvant to traditional pain management is needed. Research using music for longer periods of time, at varying times of the day, and at different points in care might provide evidence to support the use of music to improve pain. Research using music with a variety of populations experiencing pain could also provide evidence that would allow the use of music to be expanded in different settings.

Having rest periods with caregiver presence or music available in the clinical setting to be used as an adjuvant with traditional pharmacological interventions for pain management should be considered. The intervention poses no risks, with potential benefits of improved pain reports and decreased anxiety. It potentially could be opioid sparing in some individuals, limiting the negative effects from opioids.

Educating nurses and nursing students about pain and the various treatment choices is needed. Teaching and understanding the pharmacological options for pain management is important, but it is equally important for nurses to understand the nonpharmacological options that can be used to provide pain relief. In light of the research presented, nurses can be informed that there is evidence to suggest that music and rest are options that can lower pain and anxiety scores, and these options should be considered when treating patients in pain. Adding music and/or a quiet rest

period as nonpharmacologic interventions to existing protocols to improve pain and anxiety should be considered.

Conclusion

In conclusion, the results of this research provides evidence that indicates pain and anxiety are reduced while listening to music or having a rest period when initiated just before and just after ambulation on postoperative day 1 following a total joint arthroplasty of the knee. While not statistically significant, data suggests a music intervention is more effective than a quiet rest period in decreasing pain and anxiety in this sample, which is significant for the clinical setting. Additionally, the research results support the use of a music intervention based on survey data suggesting that overwhelmingly patients enjoyed the music, reported the music helped them to forget about their pain for a while, and improved their general mood. Use of this intervention could be implemented into the routine plan of care for this patient category. The intervention poses no risks, and has the potential to limit the amount of narcotics necessary to achieve pain relief, which decreases the chances of experiencing the side effects of narcotics, specifically, respiratory depression. Nurses can offer music as an intervention to decrease pain and anxiety in this patient population with confidence, knowing there is evidence to support its efficacy.

APPENDIX A: INFORMED CONSENT

Informed Consent

Research Study Title: The Impact of Music on Postoperative Pain and Anxiety

Principal Investigator: Kelly Allred, RN, MSN, CCRN
UCF School of Nursing
PO Box 162210
Orlando, FL 32816-2210
Phone #: (407) 342-4774

This is a consent form to participate in a research study. Please read this consent document carefully before you decide to participate in this study and ask me any questions that you may have.

Purpose of the research study: The purpose of this research study is to examine the effects of music on pain and anxiety following knee replacement surgery (total knee arthroplasty). This study is being conducted as part of my doctoral studies and is not being conducted on behalf of Florida Hospital.

What you will be asked to do in this study: You will be randomly assigned (like a flip of a coin) to be in a control group or an experimental group. If you are assigned to the control group, you will receive standard care that all receive following a knee replacement. You will be visited by the researcher and asked to rate your pain and anxiety on a scale at several points in time just before and after you walk the first and second time after your surgery. The principal investigator will also take your blood pressure, heart rate, respiratory rate, and oxygen saturation reading (clip on the end of your finger) at the same points in time that you are rating your pain and anxiety levels. If you are assigned to the experimental group, you will receive standard care that all receive following a knee replacement. You will be visited by the principal investigator and asked to rate your pain and anxiety on a scale at several points in time just before and after you walk the first and second time after your surgery. The researcher will also take your blood pressure, heart rate, respiratory rate, and oxygen saturation reading (clip on the end of your finger) at the same points in time that you are rating your pain and anxiety levels. In addition, you will be listening to music that you choose from a music library for 20 minutes before you walk, while you walk, and for 20 minutes after you walk. All participants, no

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matter which group assignment you receive, will continue to receive all pain medications prescribed by your surgeon. This research will not effect the traditional treatment of your pain in any way. The research will require a total of 80 participants.

Time required: Approximately 1 hour on the first two days after your surgery.

Cost/Compensation: There is no cost to you for participation in this research. Nor will you be paid for your participation.

Risks: There are no anticipated or foreseeable risks associated with this study.

Benefits/: There is no benefit to you for participation.

Alternatives: There are no alternatives to this research, you may agree to participate or refuse to participate. The care you receive will consistently be the routine standard of care whether you participate or not.

Confidentiality: Your identity will be kept confidential. Data concerning your pain and anxiety levels during your hospital stay will be collected. Other data including your age and date of surgery will also be collected. Your information will be assigned a code number. The list connecting you to this number will be maintained under lock and key, with access only to the researcher. All coded data maintained on a computer will be password protected and always in possession of the principal investigator. When the study is completed and the data have been analyzed, the list will be destroyed. Your name will not be used for any report. This information will be used only by the principal investigator to determine if listening to music has any impact on anxiety or pain following a total knee replacement. Your individual information will not be reported to anyone, but analyzed with the data from other participants of this research study. It is anticipated that this research will be submitted for publication in a nursing research journal within the next 8 months. Your authorization of the use of your information can be revoked at anytime without penalty.

Voluntary participation: Your participation in this study is voluntary. There is no penalty for not participating.

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Right to withdraw from the study: You have the right to withdraw from the study at any time without penalty or loss of benefits to which you are otherwise entitled. Please notify the principal investigator when she next visits you of your decision to withdraw.

Significant new findings developed during the course of this research which may relate to your willingness to continue participation in the research will be provided to you.

Whom to contact if you have questions about the study: Kelly Allred, Doctoral Candidate, School of Nursing, PO Box 162210, Orlando, FL, 32816-2210, (407) 342-4774 OR Dr. Jacqueline Byers, Faculty Supervisor, College of Nursing (407) 823-2744.

Whom to contact about your rights in this study: Since you are a patient at Florida Hospital, please contact the Florida Hospital IRB at (407) 303-5581. The Institutional Review Board is a group of individuals who have approved this study to be conducted at Florida Hospital. The UCF IRB also approved this study. You may contact them at (407)823-2901.

_____ I have read the informed consent above and it has been explained to me.

_____ I voluntarily agree to participate in the research.

Participant Signature

Person Obtaining Consent Signature

Participant Printed Name

Person Obtaining Consent Printed Name

Date

APPROVED

SEP 19 2006

FLORIDA HOSP. IRB

Date

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APPENDIX B: RESEARCH PROPOSAL

RESEARCH PROPOSAL

The Use of Music for Postoperative Pain and Anxiety

Kelly D. Allred, MSN, RN, CCRN
University of Central Florida
Orlando, FL

ABSTRACT

Problem/Significance. Pain is a common symptom following surgery and can be a challenge to control in some patients. A relationship between pain and anxiety has been established such that increased anxiety increases pain. Many postoperative patients complain that their pain is poorly treated, and they suffer the consequences of untreated and/or under treated pain. These consequences include activation of endocrine and metabolic stress responses which leads to an impaired immune function and impairment of the healing process. Further consequences of pain include impaired mobility, which is an important aspect of care for the surgical patient population. Potent pain medications are often used, with side effects that can be serious. Using nonpharmacologic treatment options for pain management in addition to traditional pharmacologic treatment may be a way to improve pain and anxiety, and limit the consequences of untreated or under treated pain and the side effects of opioid medications in the surgical patient population. **Purpose.** The purposes of this study are to determine if listening to music will decrease reported pain and anxiety scores in patients postoperatively following orthopedic surgery during rest, just before and just after physical therapy on postoperative day 1. Additionally, the effects of listening to music on blood pressure, heart rate, respiratory rate, and oxygen saturation measurement will be addressed. **Methods.** An experimental repeated measures study will be conducted in a community orthopedic hospital with a sample of patients undergoing total joint arthroplasty of the knee. The Visual Analog Scale (VAS) will be used to measure pain and anxiety, and physiologic measures will be obtained as well. A sample size of 56 will be obtained with 28 listening to music (experimental group), and 28 that will not (control group). Data will be analyzed with descriptive statistics as well as with analysis of variance (ANOVA) with repeated measures. **Implications.** The results of this research could support the practice of providing music to patients following orthopedic surgery to decrease pain and anxiety. This will subsequently decrease the consequences of untreated or under treated pain and potentially could improve outcomes in this patient population.

The Use of Music for Postoperative Pain and Anxiety

Pain is a common symptom following surgery. It has been reported that over half of the 23 million Americans who have surgery each year do not get adequate pain relief from traditional methods (Agency for Health Care Research and Quality, 1992). Current and traditional pain management strategies include the use of strong medications that can have adverse side effects. There are several nonpharmacologic pain management strategies that could serve to decrease pain and anxiety in the postoperative patient population. One of these strategies is listening to music.

Specific Aims:

The purpose of this study is to investigate the effects of listening to music on postoperative pain and anxiety on postoperative day 1 following major orthopedic surgery. This study addresses several of the research priorities recommended by the National Institute of Nursing Research (NINR) (1994) Priority Expert Panel on Symptom Management: Acute Pain. Specifically, one of the recommendations made by the NINR Panel was to test the effectiveness of pharmacologic and nonpharmacologic pain management strategies both simultaneously and singly.

Research questions:

1. Will orthopedic patients who listen to music as an adjuvant to traditional pain management have less pain than similar patients who do not listen to music just before and just after physical therapy on postoperative day 1?
2. Will orthopedic patients who listen to music as an adjuvant to traditional pain management have less anxiety than similar patients who do not listen to music just before and just after physical therapy on postoperative day 1?
3. Will orthopedic patients who listen to music as an adjuvant to traditional pain management use less opioid medication during the 6 hours following a music intervention on postoperative day 1?
4. What are the effects of listening to music on blood pressure, heart rate, respiratory rate, and pulse oximetry (physiologic measures) at rest in the orthopedic surgical patient population?

Background and Significance:

Pain management is important to nursing practice (Ferrell, 1999), and is one of the most common complaints demanding attention and action from nursing (Locin, 1981). It has been established that pain that is unrelieved can initiate the stress response, interfere with the return to preoperative baseline lung function, and interfere with mobility (Shea, Brooks, Dayhoff, & Keck, 2002). Following surgery, pain is a major symptom (Locin, 1981) and because of the consequences of not treating it, or under treating it, postoperative pain deserves much attention. Nurses on postoperative units use traditional care to treat the pain of the surgical patient population, with the current standard of treatment for postoperative patients including the use of opioids which have sedative and emetic side effects (Ikonomidou, Rehnstrom, & Naesh, 2004). To limit the sedative and emetic side effects of opioids, nonpharmacological interventions that will

decrease pain and decrease the amount of opioid medication needed for pain control should be studied to determine their effectiveness in specific populations.

Nonpharmacological interventions have been recognized as valuable, simple, and inexpensive adjuvants to pharmacological approaches to pain management, and can be especially valuable for independent nursing practice (Hyman, Feldman, Harris, Levin, & Malloy, 1989). Combining pharmacological and nonpharmacological methods of pain control will probably yield the most effective pain relief for the patient (McCaffery, 1990). By offering a variety of nonpharmacological methods for pain relief that can be used in combination with more traditional methods, the nurse may make a significant contribution to pain control (McCaffery, 1990; McCaffery & Beebe, 1989).

Related Research:

Music in the Operating Room

The use of music to relieve pain and/or anxiety in the surgical patient has been studied with varying results. One group of researchers used music in the operating room only and found that those that listen to music only during the surgical procedure had significantly less pain on the first day after surgery when compared to the control group who did not listen to music ($p=0.001$) (Nilsson, Rawal, Unestahl, Zetterberg, & Unosson, 2001). In another research study, Nilsson, Rawal, and Unosson (2003) compared three groups: a control group that did not listen to music, a group that listened to music intra-operatively, and a group that listened to music postoperatively. The groups listening to music intra-operatively and postoperatively reported significantly less pain at 1 hour postoperatively ($p<0.01$) and at 2 hours postoperatively ($p<0.01$) when compared to the control group that did not listen to music at all.

Music in the Post Anesthesia Care Unit

Research using music just in the post anesthesia care unit (PACU) has provided some significant findings. Nilsson, Rawal, Enqvist, and Unosson (2003) studied the use of music in the PACU in same day surgical patients (inguinal hernia repair or varicose vein surgery) and found significantly less pain in those that listened to music when compared to the control group that did not ($p=0.002$). McDonald et al. (2003) also studied the use of music in the PACU in patients having minor foot surgery and found no differences in those that listened to music when compared to those that did not, however there was statistically less anxiety ($p<0.05$) in the patients that listened to the music.

Shertzer and Keck (2001) studied the use of music in the PACU in a group of same day surgery patients. These researchers found no statistically significant differences for pain between the control group and the group that listened to music at 30 minutes postoperatively or at discharge from the PACU. Significant findings were found in the pain scores in the music group, as they decreased significantly across the PACU stay ($p=0.00$).

Heitz, Symreng, and Scamman (1992) used music in the PACU with a group of general surgical patients. This research found no statistically significant differences

between those that listened to music and those that did not with regards to pain, morphine requirement, hemodynamics, respiration, or length of stay in the PACU. Statistical significance was found with the music group being able to wait longer before requiring analgesia on the nursing unit ($p < 0.05$).

Music Preoperatively, Intraoperatively, and in the PACU

Several researchers have used music both preoperatively, during surgery and in the PACU (Laurion & Fetzer, 2003; Lukas, 2004). Lukas (2004) found 97% of patients reported listening to the music was a positive experience, however there was no statistical significance reported. Laurion and Fetzer (2003) found significantly more pain at discharge from the PACU in the group that did not listen to music ($p = 0.002$) when compared to those that did.

Heiser, Chiles, Fudge, and Gray (1997) studied the use of music in the operating room continuing into the PACU. This research used an extremely small sample size ($n = 5$) and inferential statistical analysis of the data was not done. However, descriptive statistics were used and found no differences between those that listened to music and those that did not among the variables of pain and anxiety levels, and analgesic medication requirements.

Ikonomidou, Rehnstrom, and Naesh (2004) had a group of laparoscopic surgical patients listen to music preoperatively and again postoperatively in the PACU and found no statistical difference in pain scores between the group that listened to music when compared to the group that did not. There was a significant finding in the postoperative opioid consumption, with the music group requiring less ($p = 0.04$).

Music Used for Procedural Pain

The use of music for the control of pain during typically painful procedures has been studied by several groups of researchers (Broscious, 1999; Davis, 1992; Fratianne, et al., 2001). Listening to music during dressing change and debridement of burn wounds was studied by Fratianne et al. (2001). A statistically significant decrease in pain was found and reported by the group at varying times when listening to music when compared to when they did not listen to music (time 1 to time 2, $p = 0.008$; time 1 to time 4 $p = 0.004$).

Davis (1992) studied the use of music during various gynecological procedures in a physician's office, and found no statistical difference in reported pain between the group that listened to music during the procedure when compared to the group that did not. The use of music during chest tube removal was studied by Broscious (1999). Her research found no statistical difference between the group that listened to music during the procedure and the group that did not listen to music with regards to self-reported pain, physiological responses, and narcotic intake after tube removal.

Music Used Postoperatively

One of the earliest descriptions of research using music for pain control in the postoperative patient population was reported by Locin (1981). This researcher used music to control pain in women with abdominal incisions (gynecologic or obstetric

patients). The music group listened to music for 30 minutes approximately every 2 hours, while a control group did not listen to music at all. Statistical findings were significant for pain, with the experimental group having less pain than the control group ($p < 0.05$).

Pain in the coronary artery bypass graft (CABG) surgical patient population was studied by Zimmerman, Nieveen, Barnason, and Schmaderer (1996). This group of researchers compared listening to music, listening and watching a music video, or a scheduled rest period with no music or video to see if there was a difference among these groups with regards to pain and sleep. Data collection was done on postoperative days 2 and 3, with findings indicating the music group had significantly lower pain scores on postoperative day 2 ($p < 0.05$) when compared to the rest group, and the music video group had significantly better sleep on the third morning ($p < 0.05$) when compared to the control group.

Voss et al. (2004) also researched the effects of music on CABG patients. This research included the comparison of three groups: group 1 listened to 30 minutes of music, group 2 had a scheduled rest period, and group 3 had treatment as usual. Statistical analysis indicated that anxiety, pain sensation, and pain distress all decreased significantly ($p < 0.001-0.015$) in the groups that listened to music or had a scheduled rest.

Another group of researchers studying thoracic surgical patients used live harp music to determine its effects on anxiety and pain (Aragon, Farris, & Byers, 2002). This research found a statistically significant difference in pain and anxiety ratings over time from the baseline data to end of the harp playing and 10 minutes afterward ($p = 0.000$).

MacDonald et al. (2003) found no significant differences in pain or anxiety at rest or with movement between a music listening group and a control group that did not listen to music in women following total abdominal hysterectomy. This research provided no evidence that listening to music alleviates postoperative anxiety or pain in this surgical patient population.

A large randomized control trial was done by Good et al. (1999) in which 500 major abdominal surgical patients used either music, relaxation, a combination of music and relaxation, or none of these (control group) to determine their effect on postoperative pain at rest and with ambulation. The statistical analysis of the data obtained from this study found significantly less pain in the three treatment groups when compared to the control group ($p = 0.028-0.000$).

Two secondary analyses were done on this data (Good et al., 2001a; Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002). The first secondary analysis (Good et al., 2001a) was done to determine the relative effects of relaxation, music and their combination on postoperative pain across and between 2 days and two activities. The findings indicate that the three treatment groups taken together had less pain than the control group across 2 days of each activity, across each day, and across ambulation on each day ($p = 0.000-0.001$). This indicates that the interventions were continuously effective.

The second secondary analysis of the data (Good, Anderson, Stanton-Hicks, Grass, & Makii, 2002) was done to determine if the positive effects of relaxation and

music found in abdominal surgical patients were also found in patients after gynecological surgery. Significant findings included the intervention groups having significantly less pain at posttest ($p=0.22-0.001$) on both postoperative days 1 and 2. The three interventions (music, relaxation, and a combination of both) were found to be similar in their effect on pain.

Research done by Mullooly, Levin, and Feldman (1988) studied the effects of music on postoperative pain and anxiety. The sample included 28 patients that had a total abdominal hysterectomy who were assigned to one of two groups: the control group who did not listen to music, and the experimental group who listened to music for 10 minutes on two consecutive days. Pain and anxiety measures were obtained before and after the music intervention. There were significant findings with the experimental group reporting less pain on day 2 ($p=0.07$) and less anxiety on day 1 ($p=0.04$) and day 2 ($p=0.00$).

The research described in this proposal is similar to the work done by Good et al. (1999). The sample population to be studied is different, and the sample size will be less, but measures of pain and anxiety will be done before and after physical therapy. However, this proposed research will only test one intervention, music therapy, as opposed to music and relaxation.

This review of the literature concerning the effects of music on pain demonstrates some questions that have not yet been answered. The orthopedic surgical patient population has yet to be studied, and little has been done with the use of music following physical therapy, a known painful requirement necessary after orthopedic surgery. Some of the studies reviewed provide statistical data supporting the use of music to decrease pain and anxiety, while others do not show statistical significance at all. This proposed research will be a controlled experimental study with an adequate sample that will provide data on the use of music to control pain and anxiety in the orthopedic surgical population, and will study the effects of music when provided just before and just after physical therapy. It is important to determine if the use of music as a nonpharmacological adjuvant to traditional care can decrease the pain and anxiety in this population of patients to improve patient comfort and to limit the effects of uncontrolled pain, and to ultimately improve outcomes.

Conceptual Framework:

The theoretical framework guiding this study involves auditory neural pathways. Auditory neural pathways suggest that music potentially could inhibit the intensity of pain and improve mood, decrease anxiety, and enhance relaxation (Shertzer & Keck, 2001). The effectiveness of music in relieving pain is thought to be through distraction and the release of endorphins (Pellino, et al., 2005). Shertzer and Keck (2001) suggest that the neural pathway of audition that leads to improved mood and decreased anxiety goes through the thalamus to the amygdala via an inhibitory process. The amygdala is associated with emotion and plays a role in the emotional component of pain and a person's ability to obtain meaning from pain experiences (Shertzer & Keck, 2001).

The neural pathway from the thalamus also leads to the periventricular and periaqueductal gray (Shertzer & Keck, 2001). The periventricular and periaqueductal

gray is a zone of neurons in the midbrain that inhibits pain by playing a role in the descending pain modulation (Bear, Connors, & Paradiso, 2001), with the neurons in this area being excited by opiates and endorphins. Periaqueductal gray neurons send descending axons to the raphe nuclei (which uses the neurotransmitter serotonin) and locus coeruleus (which uses the neurotransmitter norepinephrine) (Bear, Connors, & Paradiso, 2001). These structures project axons to the dorsal horns of the spinal cord where enkephalins are released, leading to an inhibition of peripheral pain pathway neurons (Shertzer & Keck, 2001) and depressing nociceptive activity of the neurons (Bear, Connors, & Paradiso, 2001).

The neural auditory pathway leads to the hypothalamus as well as the thalamus (Shertzer & Keck, 2001). The hypothalamic neural path goes through the hippocampus (associated with memory and learning) and the anterior cingulate cortex (associated with a variety of emotional and cognitive tasks) to enhance relaxation and distraction (Shertzer & Keck, 2001).

These auditory neural pathways provide a physiological framework to support this research. This model suggests there is a neurophysiological basis for the hypothesis that music might lead to decreased pain. The release of endorphins and enkephalins, which occur naturally in the brain and have opiate and analgesic activity, will inhibit peripheral pain pathway neurons because they bind to opiate receptors. The decreased anxiety and distraction provided by other parallel mechanisms act to decrease the perception of pain in individuals.

Design:

An experimental repeated measures design will be used for this research. The dependent variables are pain, anxiety, and vital signs, including blood pressure, heart rate, respiratory rate, and oxygen saturation reading. The independent variable is a 20 minute music intervention.

Operational definitions of variables:

Pain: pain intensity on a visual analog scale

Anxiety: anxiety intensity on a visual analog scale

Music Intervention: the use of music to aid in the restoration, maintenance, and improvement of mental and physical health (Bruscia, 1989)

Subjects and Sampling:

The subjects for this study consists of all patients who are scheduled for a total knee arthroplasty (TKA) at the participating hospital that meet the inclusion criteria. The sample will be randomly assigned to one of two groups: the experimental group (listens to music) or the control group (does not listen to music).

Inclusion criteria:

1. Age 18 or older
2. ASA rating of 1 or 2
3. Scheduled for major orthopedic surgery (THA or TKA)

4. Able to hear and see
5. Able to communicate in English
6. Admitted to orthopedic floor postoperatively
7. Sufficiently alert and cognizant to complete VAS
8. PCA ordered for postoperative pain relief

Exclusion criteria:

1. Unable to hear or see
2. History of psychiatric disorders
3. History of chronic pain problems
4. Previous experience with relaxation techniques
5. Allergy to traditional opioid medications
6. Admission to the ICU postoperatively and/or hemodynamically unstable

A power analysis will be performed to determine the desired sample size. A random sampling of research on the use of music with postoperative pain has sample sizes that range from 17 to 500. It was determined from the literature that a standard deviation of 20 mm on the VAS for pain was expected (Ikonmidou, Rehnstrom, & Naesh, 2004). For the results to have 80% power, a moderate effect size of 0.5 and an alpha level of 0.05, it is estimated that 60 subjects are required, 30 in each group. Allowing for a possible 20% withdrawal rate, 72 subjects will be enrolled in the study. Similar results were obtained in the power analysis reported by Zimmerman, Nieveen, Barnason, and Schmaderer (1996). A statistician will be consulted prior to beginning this proposed research to confirm the results of this power analysis. Due to the complexity of determining sample size when using ANOVA with repeated measures, it is recommended in the literature that a statistician be consulted to assist with determining sample size (Dawson & Trapp, 2004).

Instruments/Study Procedures:

Patients scheduled for total knee arthroplasty will be identified from the appointment schedule in the preadmission testing (PAT) department. Subjects meeting the inclusion criteria will be approached by the principal investigator (PI) just after their PAT appointment to determine interest in participating in the proposed research. The PI will use a script so that the information will be presented consistently to all potential research participants. The PI will obtain written consent for participation in the study, and demographic data will be obtained. The subject will be randomly assigned to the experimental group (listens to music) or the control group (does not listen to music). All research participants will receive traditional standard care and all research participants will be taught how to use the visual analog scales for pain and anxiety. Those assigned to the experimental group will then pick out a music compact disc (CD) from a selection of easy-listening music. Easy-listening music is being offered because music with harmonious melody and pleasant rhythms have been shown to produce a calming effect and an increased sense of well-being (MacClelland, 1982). The chosen music will be

reserved for the participant so that when it is time to listen to the music, the selection is available.

The data collection will be done on postoperative day 1 (Appendix K). Coordination with each subject's nurse and physical therapist will be done each morning to determine the schedule for ambulation for the research participants. The experimental group will listen to music continuously for 20 minutes prior to ambulation, and for a period of about 20 minutes after ambulation. Data collection will occur at four points during this time: prior to the beginning of the music, after listening for 20 minutes, just after ambulating, and after the rest period following ambulation. The control group will be visited by the PI approximately 20 minutes before their scheduled ambulation, just prior to ambulation, at the end of ambulation, and after the rest period following ambulation. Data collection for the control group will occur in the same sequence as the experimental group. The control group will not listen to music but will have visits by the PI at the same points in care as the experimental group to control for effects of PI presence. At the conclusion to the last measurement of pain and anxiety and vital signs, the experimental group will be asked to complete a questionnaire about their experience listening to music (Appendix M).

The visual analog scale (VAS) will be used to measure pain (Appendix L). The VAS is a 10-cm horizontal line with verbal anchors at each end indicating no pain at the far left, and pain as bad as it could be at the far right. The VAS provides interval level data and is considered a more sensitive measure of pain intensity than the visual descriptor scale (McGuire, 1997). The VAS is useful in the research setting as it appears to be more sensitive than the categorical scales at measuring smaller changes (Carroll, 1993), and patients mark the VAS with remarkable consistency and is useful with frequent measures, such as with postoperative pain (Bowsher, 1993). The horizontal orientation of the VAS has been shown to be more sensitive and uniform with respect to score distribution (Ogon, et al., 1996). The reliability of the VAS was reported by Revill, Robinson, Rosen, and Hogg (1976) with repeated measures ($r=0.95$, $p<0.001$). Validity of the VAS seems to have been assumed, and subjective ratings of pain intensity may be considered valid, regardless of the scale used (McGuire, 1997). Correlations between the VAS and the visual descriptor scale (VDS) range from 0.66 to 0.89 ($p=0.01$ to $p=0.001$) (Littman, Walker, & Schneider, 1985; Ohnhaus & Adler, 1975).

In a report by Good et al. (2001b), the VAS was compared to the numerical rating scale (NRS), and the test-retest reliability of the VAS in a group of postoperative patients was .73 to .82, with convergent validity of the scales reported from $r=.72$ to .85, and discriminate validity at $r=.65$ to .78. These researchers recommended that the VAS be used in research.

A VAS will also be used to measure anxiety with verbal anchors at each end indicating no anxiety at the far left, and most anxious at the far right (Appendix L). Concurrent validity of the VAS to measure the self-report of anxiety has been demonstrated when scores were compared to Spielberger's (1983) State Anxiety Inventory (SAI). A strong positive correlation was found between the VAS and the SAI ($r=0.70$) (Elliot, 1993).

Vital signs, including heart rate, blood pressure, and respiratory rate will be measured and recorded. In addition, oxygen saturation will be monitored and recorded. Flor, Miltner, and Birbaumer (1992) report that in pain studies with postoperative patients cardiovascular measures have been used to document the effects of postoperative pain in addition to the positive effects of psychological interventions.

Human Subjects:

Approval for the study will be obtained from the Institutional Review Board (IRB) at the University of Central Florida, the Nursing Research Committee at Florida Hospital-Orlando, and the IRB at Florida Hospital-Orlando. Informed consent will be obtained from research participants prior to any data collection and participants will be able to withdraw from the research at any time without consequence.

Potential Risks: There are no anticipated risks associated with this study. The participants will be asked to read and sign an informed consent to participate in the study, which some may find inconvenient. The data collection process will involve the research participant actively marking a point on a line which some may find inconvenient as well. All participants will receive the traditional standard of care. The experimental group will have an additional intervention, listening to music, which poses no physical, psychological, or financial risk to the subject.

Potential Benefits: Benefits to the participants of this study include the possibility of improved pain and anxiety. There will be no financial benefit to participants of this research. There are potential benefits to nursing and future orthopedic surgical patients depending on the results of this proposed research. The integration of music therapy into the standard of care for this population of patients is a possibility if the results of this research indicate that listening to music decreases pain and anxiety, either at rest or with ambulation.

Confidentiality: All patient-identifying information will be coded to protect the identity of research participants and ensure confidentiality. All research materials will be maintained under lock and key, with access only to the principal investigator.

Timetable and Resources:

The resources needed for this study are as follows:

Music CD's (20 @ \$10.00 each)	\$200.00
Portable CD players (10 @ \$25.00 each)	\$250.00
Batteries for CD players (40 @ 3.50/4)	\$35.00
Paper/Copy Costs (504 @ 6 cents each)	\$30.24
Researcher Time	Donated

Potential funding sources for this study include the local Epsilon Chapter of Sigma Theta Tau (nursing honorary), the Florida Nurses Foundation, and the Florida

Nurses Association. The American Society for Pain Management Nursing and the National Association of Orthopaedic Nurses are also potential source of funding.

The timetable for this study is as follows:

May 2006	UCF IRB Approval Institutional IRB Approval
June 2006 – September 2006	Begin study Collect data
October 2006	Data analysis
November 2006	Report and article(s) for submission Submit abstracts for presentation
December 2006	Follow-up to participating institutions

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APPENDIX C: LETTER TO PHYSICIANS



School of Nursing

May 15, 2006

Dear Physician,

My name is Kelly Allred and I work per diem in the post anesthesia care unit at Winter Park Memorial Hospital. I also attend the University of Central Florida where I am pursuing my PhD in Nursing.

I have completed all of the course work required for this degree and am now beginning my dissertation. My dissertation research involves studying the effects of music on postoperative pain and anxiety at rest and with ambulation in patients following a total knee arthroplasty. I will have a control group that does not listen to music and an experimental group that will listen to music for 20 minutes prior to ambulating, during ambulation, and for a 20 minute rest period following ambulation, on postoperative days 1 and 2. ALL participants will receive standard postoperative care, including all pain medications ordered by you, the surgeon. This research will in no way change the current standards of care that your patient receives. I will only be adding listening to music to the routine care of those in the experimental group.

This research is voluntary and recruitment of participants will be done in the preadmission testing unit (PAT). There will be no coercion in the recruitment process. The participants will be randomized into the control group or experimental group.

This research requires IRB approval, and with the IRB packet I would like to include this letter indicating you are aware of my research and you will allow me to conduct this research with your patients that satisfy the inclusion and exclusion criteria. I would be happy to provide you with any additional information at your request.

I will provide a copy of this letter to you for future reference. By signing below you are indicating you are aware of this research and are allowing me access to your patients for this research only. I will not commence this research until IRB approval is obtained from both Florida Hospital and the University of Central Florida.

Thank you,

Kelly Allred MSN, RN, CCRN
Doctoral Candidate
University of Central Florida
407-342-4774
kellyallred@cfl.rr.com

Jacqueline Byers, PhD, RN, CNAA
Professor
University of Central Florida
407-823-6311
jbyers@mail.ucf.edu

Physician Signature

APPENDIX D: PERMISSION TO USE MCGILL PAIN QUESTIONNAIRE

Dear Kelly,

You have my permission to use the SF-MPQ in your interesting study.

Attached are the SF-MPQ in English and Spanish for the US, along with instructions for scoring.

Best wishes.

Ronald Melzack

At 01:58 PM 5/15/2006, you wrote:

Hello Dr. Melzack,

My name is Kelly Allred and I am a PhD candidate at the University of Central Florida in Orlando. I am currently writing my dissertation proposal in which I would like study the effects of music therapy at rest and after ambulation following a total knee arthroplasty. With your permission I would like to use your tool, the Short Form McGill Pain Questionnaire, to measure pain in this study.

If you require further information, please let me know. I look forward to your response.

Kelly Allred, MSN, RN, CCRN
Doctoral Candidate
University of Central Florida
kellyallred@cfl.rr.com

- * * * * *
Chantale Bousquet
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* * * * *

APPENDIX E: IRB APPROVAL FROM HOSPITAL



Florida Hospital
Institutional Review Board
212 E. Winter Park Street
Orlando, FL 32804
Telephone: (407) 303-5581
Fax: (407) 303-3638
FWA: 00002060

September 19, 2006

Kelly Allred
UCF School of Nursing
P.O. Box 162210
Orlando, FL 32816-2210
Orlando FL

Dear Ms. Allred:

FH IRB# 06.10.03 ORA#1647-1850; Sponsor#: N/A
Title: The Impact of Music on Postoperative Pain and Anxiety
Sub inv: none

Supporting Documents: IRB Forms; Proposal; Informed Consent and Authorization dated 08/29/06; Reviews Preparatory to Research for team member; Email dated 08/29/06 with note to serve as official acceptance from the FHMSRC Chariman; Request for waiver of IRB fee dated 08/10/06 kch

Florida Hospital IRB Approval Date: 09/19/06

FH IRB Expiration Date: 09/11/07

Meeting Date for FH IRB Notification: 10/10/06

Informed Consent/Authorization Approval Date: 09/19/06; Approval Expires no Later than 09/11/07

In response to your request and on behalf of the Florida Hospital IRB, the IRB granted expedited approval to the study as noted above, based on categories approved in 21 CFR 56.110 and 45 CFR 46.110. Unless the informed consent requirement was waived, you are required to use the IRB approved informed consent.

Prior to the expiration dated noted above, the IRB must be made aware of the status of your project(s). A progress report will be required. [21 CFR 56.109 (f)] If the project has not been completed, you may request renewed approval.

It is your responsibility to ensure that approval has been gained for this study from the Office of Research Administration and other appropriate hospital committees and/or departments prior to initiating this study at Florida Hospital.

It is your responsibility to remain in compliance with all applicable state and federal regulations regarding research as well as adhering to the Florida Hospital IRB *Handbook for the Protection of Human Research Subjects*.

You are reminded that a change in the study requires resubmission and approval of the IRB prior to initiation of the change in the study or informed consent.

It is the responsibility of the principal investigator to report to the Chair of the Institutional Review Board within 10 days, and in writing, any related unanticipated problems involving risks to subjects or others, such as adverse reactions to biological drugs, radioisotopes or to medical devices.

Florida Hospital Institutional Review Board complies with federal and state regulations and GCP guidelines. Failure of the principal investigator or members of his/her research team to abide by the Florida Hospital IRB *Handbook for the Protection of Human Research Subjects* or failure to abide by FDA/OHRP Regulations governing this research may result in suspension and/or termination of this study.

Florida Hospital Institutional Review Board has the authority to review all documentation and the informed consent process for studies approved through the Florida Hospital IRB.

On behalf of Fouad Hajjar, M.D., IRB Chairperson, this letter is signed by:

Laura Orem, CIP, CIM
Program Manager
Florida Hospital IRB

APPENDIX F: IRB APPROVAL FROM UNIVERSITY OF CENTRAL FLORIDA



Office of Research & Commercialization

July 19, 2006

Kelly Allred
5713 Magnolia Bloom Terrace
Oviedo, FL 32765

Dear Ms. Allred:

With reference to your protocol #06-3621 entitled, "The Impact of Music on Postoperative Pain and Anxiety" I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 7/13/2006. The expiration date for this study will be 7/12/2007.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

A handwritten signature in black ink that reads "Barbara Ward, CIM".

Barbara Ward, CIM
IRB Coordinator

Copies: IRB File
Jacqueline Byers, Ph.D.

APPENDIX G: NATIONAL INSTITUTES OF HEALTH HUMAN PARTICIPANT
PROTECTIONS EDUCATION FOR RESEARCH CERTIFICATE



Human Participant Protections Education for Research Teams

Completion Certificate

This is to certify that

Kelly Allred

has completed the **Human Participants Protection Education for Research Teams** online course, sponsored by the National Institutes of Health (NIH), on 09/10/2004.

This course included the following:

- key historical events and current issues that impact guidelines and legislation on human participant protection in research.
- ethical principles and guidelines that should assist in resolving the ethical issues inherent in the conduct of research with human participants.
- the use of key ethical principles and federal regulations to protect human participants at various stages in the research process.
- a description of guidelines for the protection of special populations in research.
- a definition of informed consent and components necessary for a valid consent.
- a description of the role of the IRB in the research process.
- the roles, responsibilities, and interactions of federal agencies, institutions, and researchers in conducting research with human participants.

National Institutes of Health
<http://www.nih.gov>

APPENDIX H: LETTER OF APPROVAL FROM OFFICE OF RESEARCH
ADMINISTRATION FLORIDA HOSPITAL



September 21, 2006

Lindell Joseph
 Clinical Research Coordinator
 FH Nursing Research

Re: P.I.: Kelly Allred
 Sponsor Protocol # n/a
 FH Project # 1647-1850 - **APPROVED**
 FH IRB #2006.10.03
 ORA review *MB*
 Budget review *WB budget waived*

Dear Lindell:

Florida Hospital Medical Center has given administrative approval effective September 21, 2006, for the performance of the investigative protocol "The Impact of Music on Postoperative Pain and Anxiety" at its Orlando campus with Kelly Allred as the Principal Investigator.

The hospital has assigned project number 1674-1850 to the protocol for internal reference and accounting processing. Please use this project number when working with the Office of Research Administration and on all documents (purchase orders, vouchers, memoranda, reporting patients, etc.) relating to this project.

Sincerely,

Harry F. Skidmore, Administrative Director
 Office of Research Administration

cc: Laura Orem, IRB

APPENDIX I: AUTHORIZATION TO USE PROTECTED HEALTH INFORMATION FOR
RESEARCH

**FLORIDA HOSPITAL
AUTHORIZATION TO USE AND DISCLOSE
PROTECTED HEALTH INFORMATION FOR RESEARCH PURPOSES**

The privacy laws, including the Health Insurance Portability & Accountability Act (HIPAA) and other federal and state laws, rules and regulations, protect your individually identifiable health information ("Protected Health Information"). The privacy laws require you to sign this Authorization which describes your rights and explains how your Protected Health Information will be used and disclosed for this research study entitled The Impact of Music on Postoperative Pain and Anxiety.

You authorize Kelly Allred to use and disclose your Protected Health Information for the purposes described below. You also authorize your doctors, Florida Hospital personnel and individuals who provide health care services at Florida Hospital ("Health Care Providers") to disclose your Protected Health Information for the purposes described below.

Your Protected Health Information, which may be used and disclosed for this research study, includes:

- Tests or procedures that are performed as part of this research study
- Prior or future tests or procedures that may impact this research study
- Portions of your entire medical record which are maintained at Florida Hospital or your doctor's office that the Researchers or Health Care Providers believe are necessary to conduct this research study and monitor your treatment and participation in this research study

Your Protected Health Information will be used and disclosed by the Researchers and Health Care Providers for:

- Conducting this research study
- Ensuring that the research meets legal, institutional or accreditation requirements
- Conducting public health activities, including reporting of adverse events where you or others may be at risk of harm
- Treatment, payment or health care operations, as set forth in the Florida Hospital Notices of Patient Privacy Practices, if some or all of the Protected Health Information produced by this research study is maintained in your Florida Hospital medical record
- To determine if music alters the perception of pain or anxiety when used in addition to traditional pain management practices

The Researchers and Health Care Providers may disclose your Protected Health Information to:

- The Florida Hospital's Institutional Review Board/Office
- Government representatives, when required by law.
- Hospital representatives
- The University of Central Florida after the information has been de-identified

To the extent any recipient of your Protected Health Information is not required to comply with these privacy laws, the information may no longer be protected by such privacy laws once it is disclosed to the recipient and, therefore, may be subject to re-disclosure by the recipient.

The Researchers and Health Care Providers agree to safeguard your Protected Health Information by using and disclosing it only as stated in this Authorization and as directed by state and federal law.

APPROVED	APPR. EXPIRES BY
SEP 19 2006	SEP 11 2007
FLORIDA HOSP. IRB	FLORIDA HOSP. IRB

You will not be allowed to review your Protected Health Information that is created or obtained specifically for this research study, or treatment information contained in your medical record that is applicable to this research study, until after this research study is complete. When this research study is over, you will once again have the right to access this Protected Health Information.

You do not have to sign this Authorization. If you decide not to sign the Authorization:

- It will not affect your treatment, payment or enrollment in any health plans or affect your eligibility for benefits.
- You will not be allowed to participate in this research study.

After signing the Authorization, you can change your mind and revoke this Authorization by sending a written letter to: Kelly Allred @ PO Box 162210, Orlando, FL, 32816-2210 to inform her of your decision. If you revoke this Authorization, you understand that:

- Researchers may still use and disclose the Protected Health Information **already** collected for this research study to maintain the integrity of this research study.
- Your Protected Health Information may still be used and disclosed should you have an adverse event (a bad effect). If such adverse event occurs, the Researchers or Health Care Providers may need to review your entire medical record.
- You will not be allowed to continue to participate in this research study.
- You will not have access to your Protected Health Information created or obtained specifically for this research study or treatment information contained in your medical record that is applicable to this research study until the research study is complete.

This Authorization does not have an expiration date.

If you have not already received a copy of the Florida Hospital Privacy Notice, you may request one.

If you have any questions or concerns about your privacy rights, you should contact the Florida Hospital's Privacy Officer at PH: (407) 303-9659.

APPROVED
SEP 19 2006
FLORIDA HOSP. IRB

2

APPR. EXPIRES BY
SEP 11 2007
FLORIDA HOSP. IRB

Authorization and Signatures

I am the Research Subject or am authorized to act on behalf of the Research Subject. I have read this Authorization, and I will receive a copy of this Authorization after it is signed.

Signature of Research Subject or
Research Subject's Legal Representative*

Date

Printed Name of Research Subject or
Research Subject's Legal Representative*

Representative's Relationship
to Research Subject

*Please explain Representative's Relationship to Research Subject and include a description of Representative's Authority to act on behalf of Research Subject:

Authorization 07.01.04, supercedes all previous versions. All other versions obsolete 07.01.04

APPROVED
SEP 19 2006
FLORIDA HOSP. IRB

3

APPR. EXPIRES BY
SEP 11 2007
FLORIDA HOSP. IRB

APPENDIX J: MCGILL PAIN QUESTIONNAIRE SHORT FORM

Participant Number	
Date	

Short-Form McGill Pain Questionnaire

Pain Rating Index (PRI): Place a check mark (✓) in the column that represents the degree to which you feel that type of pain.

	0	None	1	Mild	2	Moderate	3	Severe
Throbbing	0		1		2		3	
Shooting	0		1		2		3	
Stabbing	0		1		2		3	
Sharp	0		1		2		3	
Cramping	0		1		2		3	
Gnawing	0		1		2		3	
Hot-Burning	0		1		2		3	
Aching	0		1		2		3	
Heavy	0		1		2		3	
Tender	0		1		2		3	
Splitting	0		1		2		3	
Tiring-Exhausting	0		1		2		3	
Sickening	0		1		2		3	
Fearful	0		1		2		3	
Punishing-Cruel	0		1		2		3	

Visual Analog Scale (VAS): Place a mark on the line that represents the degree to which you feel pain.

[_____]
 No pain Pain as bad as it could possibly be

Present Pain Inventory (PPI): Place a check mark (✓) in the column that represents the degree to which you feel pain right now

0	No Pain	
1	Mild	
2	Discomforting	
3	Distressing	
4	Horrible	
5	Excruciating	

Used with permission from Ronald Melzack

APPENDIX K: DATA COLLECTION TOOL

DATA COLLECTION TOOL: Experimental Data

EXPERIMENTAL GROUP _____ CONTROL GROUP _____
PARTICIPANT NUMBER _____ PERSON AMBULATING (PT/RN) _____
EXPERIMENTAL GROUP LISTENS TO MUSIC THROUGHOUT THIS PERIOD
CONTROL GROUP GET A VISIT AND MEASURES TAKEN
INTERVENTION (POST OP DAY 1)

TIME 1 – PRIOR TO MUSIC THERAPY

DATE/TIME _____ / _____
ALERT _____ ORIENTED TO PERSON/PLACE/TIME/CIRCUMSTANCES _____
VAS PAIN _____
VAS ANXIETY _____ HR _____ BP _____ RR _____ O2 SATURATION _____
CPM ORDERS _____ AGGRESSIVE (60° to 90°) OR ROUTINE (0° to 60°)

LENGTH OF TIME PT LISTENED TO MUSIC _____ (N/A for control group)
(subject should listen to music for at least 20 minutes prior to ambulation)

TIME 2 – JUST AFTER MUSIC THERAPY (PRIOR TO AMBULATION)

VAS PAIN _____
VAS ANXIETY _____ HR _____ BP _____ RR _____ O2 SATURATION _____

TIME 3 – JUST AFTER AMBULATION

VAS PAIN _____
VAS ANXIETY _____

TIME 4 – AFTER 20 MINUTE RECOVERY PERIOD (FOLLOWING AMBULATION)

VAS PAIN _____
VAS ANXIETY _____ HR _____ BP _____ RR _____ O2 SATURATION _____

AMOUNT OF OPIOID MEDICATION ADMINISTERED FROM INTERVENTION ONSET TO 6 HOURS LATER: _____

APPENDIX L: VISUAL ANALOG SCALES

Intervention Time 1

[_____]
No pain Pain as bad as
it could possibly be

[_____]
No anxiety Most anxious

Intervention Time 2

[_____]
No pain Pain as bad as
it could possibly be

[_____]
No anxiety Most anxious

Intervention Time 3

[_____]
No pain Pain as bad as
it could possibly be

[_____]
No anxiety Most anxious

Intervention Time 4

[_____]
No pain Pain as bad as
it could possibly be

[_____]
No anxiety Most anxious

APPENDIX M: QUESTIONNAIRE FOR EXPERIMENTAL GROUP

Patient Questionnaire

1. Listening to music helped me to forget about my pain for awhile.

Disagree ____ Somewhat disagree ____ Neutral ____ Somewhat agree ____ Totally agree ____

2. The music helped me improve how I feel, or my general mood.

Disagree ____ Somewhat disagree ____ Neutral ____ Somewhat agree ____ Totally agree ____

3. The music was an added, enjoyable experience for me.

Disagree ____ Somewhat disagree ____ Neutral ____ Somewhat agree ____ Totally agree ____

4. would rather not have listened to the music during my hospitalization.

Disagree ____ Somewhat disagree ____ Neutral ____ Somewhat agree ____ Totally agree ____

Other comments and suggestions are welcome!

APPENDIX N: CIRRICULUM VITAE

KELLY ALLRED, MSN, RN, CCRN

I. EDUCATION

Year	Degree	Institution	Clinical Major	Role Preparation
2007 (Anticipated)	PhD	University of Central Florida, Orlando, FL	Acute Pain Management	Scientist/Research and Education
1993	MSN	University of Florida, Gainesville, FL	Adult Health	Clinical Nurse Specialist
1988	BSN	Florida State University, Tallahassee, FL	Nursing	Generic Nurse

II. LICENSURE/CERTIFICATION

RN	Florida
CCRN (Critical Care)	1991 to present (<i>inactive 1997-1999</i>)
ACLS (Advanced Cardiac Life Support)	1989 to present

III. EMPLOYMENT

ACADEMIC APPOINTMENTS:

08/2002-Present	Adjunct Instructor , University of Central Florida School of Nursing, Main Campus, Orlando, FL
01/1995-05/1996	Adjunct Instructor , University of Central Florida School of Nursing, Brevard Campus, Cocoa, FL

CLINICAL APPOINTMENTS:

08/2006-present	Nurse Researcher , Center for Nursing Research and Education, Florida Hospital, Orlando, FL
05/1998-08/2006	Staff Nurse , (Supplemental Staff), Post Anesthesia Care Unit, Florida Hospital (Winter Park Memorial Hospital, Winter Park, FL)
03/1995-07/1997	Staff Nurse , (Supplemental Staff), Post Anesthesia Care Unit and Pain Management Unit, Health First, Holmes Regional Medical Center (Melbourne, FL) and Palm Bay Community Hospital (Palm Bay, FL)

- 09/1993-03/1995 **Clinical Nurse Specialist**, Surgical Services, Health First, Holmes Regional Medical Center (Melbourne, FL) and Palm Bay Community Hospital (Palm Bay, FL)
- 07/1990-09/1993 **Staff Nurse III**, Post Anesthesia Care Unit, Health First, Holmes Regional Medical Center, Melbourne, FL
- 05/1988-07/1990 **Staff Nurse II**, Surgical Intensive Care Unit, Health First, Holmes Regional Medical Center, Melbourne, FL
- 01/1988-05/1988 **Staff Nurse I**, Respiratory Care Unit, Health First, Holmes Regional Medical Center, Melbourne, FL

IV. PUBLICATIONS

MASTERS THESIS:

- 1993 **Allred, K. D.** (1993). Functional Ability and Pain Control: Epidural Analgesia versus Patient Controlled Analgesia in Total Joint Arthroplasty. Ann Arbor, MI: UMI.

NON-REFEREED REGIONAL/STATE:

- 2005 **Allred, K.D.** & Byers, J.F. (2005). Research Infrastructure in Florida Health Care Organizations. *The Florida Nurse*, 53(3).

ABSTRACTS:

- 2006 **Allred, K.D.** (2006). Using middle range theory to improve acute pain outcomes. *Proceedings of the American Society for Pain Management Nursing, 2006 Annual Meeting*. Orlando, FL: ASPMN.
- 2006 **Allred, K.D.** (2006). The use of virtual reality to treat acute pain, a systematic review. *Proceedings of the American Society for Pain Management Nursing, 2006 Annual Meeting*. Orlando, FL: ASPMN.
- 2006 **Allred, K.D.** (2006). Using middle range theory to improve acute pain outcomes. *Proceedings of the Sigma Theta Tau (STT), Theta Epsilon Chapter, 14th Annual Research Conference*. Orlando, FL: STT.
- 2005 **Allred, K.D.** & Byers, J.F. (2005). FONE Survey on Nursing Research Resources. *Proceedings from the FONE Fall 2005 Conference*, Palm Beach Gardens, FL: FONE.
- 2005 **Allred, K. D.** (2005). Analysis of the concept of acute pain. *Proceedings of the Sigma Theta Tau (STT), Theta Epsilon Chapter, 13th Annual Research Conference*. Orlando, FL: STT.
- 2005 **Allred, K. D.** (2005). Analysis of the concept of acute pain. *Proceeding of the Southern Nurses Research Society, 19th Annual Conference*. Atlanta, GA: SNRS.
- 2005 **Allred, K. D.** (2005). Analysis of the concept of acute pain. *Proceedings from the Graduate Research Forum*, University of Central Florida, Orlando, FL.

- 2004 **Allred, K. D.** (2004). Balance between analgesia and side effects: A middle range theory. *Proceedings of the Sigma Theta Tau (STT), Theta Epsilon Chapter, 12th Annual Research Conference*. Orlando, FL: STT.

V. RESEARCH

- 2006-2007 **The Effect of Music on Postoperative Pain and Anxiety** (Doctoral Dissertation, University of Central Florida, College of Health and Public Affairs)
- 2005-2006 **Using Middle Range Theory to Improve Acute Pain Outcomes** (Doctoral Student, University of Central Florida, College of Health and Public Affairs & Florida Hospital, Winter Park Memorial Hospital)
- 2005 **Research Infrastructure in Florida Health Care Facilities** (Doctoral Student, University of Central Florida, College of Health and Public Affairs)
- 1993 **Functional Ability and Pain Control: Epidural Analgesia versus Patient Controlled Analgesia in Total Joint Arthroplasty** (Graduate Student, University of Florida, School of Nursing)

VI. PRESENTATIONS

REFEREED NATIONAL:

- 03/31/2006 **Using Middle Range Theory to Improve Acute Pain Outcomes**, American Society for Pain Management Nursing, *ASPMN Annual Conference 2006*, Orlando, FL
- 03/31/2006 **Using Virtual Reality to Improve Acute Pain: A Systematic Review**, American Society for Pain Management Nursing, *ASPMN Annual Conference 2006*, Orlando, FL

REFEREED REGIONAL/STATE:

- 05/04/06 **A Middle Range Theory to Improve Acute Pain Outcomes**, *Sigma Theta Tau, Research Conference*. Theta Epsilon Chapter, Winter Park, FL.
- 10/7/2005 **FONE Survey on Nursing Research Resources**, *FONE Fall 2005 Conference*, Palm Beach Gardens, FL.
- 10/07/2005 **Research Infrastructure in Florida Healthcare Facilities**, *Sigma Theta Tau and the UCF School of Nursing Alumni Chapter, Research, Renewal and Roses Faculty Scholarship Showcase*, Orlando, FL.
- 3/29/2005 **Analysis of the Concept of Acute Pain**, *Sigma Theta Tau, Research Conference, Theta Epsilon Chapter*, Winter Park, FL
- 3/22/2005 **Analysis of the Concept of Acute Pain**, *Graduate Research Fourm, University of Central Florida*, Orlando, FL.
- 2/3/2005 **Analysis of the Concept of Acute Pain**, *Southern Nurses Research Society, 19th Annual Conference*, Atlanta, GA.

3/30/2004 **Balance between Analgesia and Side Effects: A Middle Range Theory,**
Sigma Theta Tau, Research Conference, Theta Epsilon Chapter, Winter Park, FL

INVITED (NON-REFEREED) REGIONAL/STATE/LOCAL PAPERS:

10/09/1995 **Malignant Hyperthermia,** Holmes Regional Medical Center Corporate Education Department, Melbourne, FL. (Part of *Medical-Surgical Crisis Management* continuing education offering, total 6.0 CEU's)

05/03/1994 **Breast Feeding After Anesthesia,** Holmes Regional Medical Center Corporate Education Department, Melbourne, FL. (Presented for 1.0 CEU)

04/25/1992 **Care of the Chronic Respiratory Disease Patient Receiving General Anesthesia,** Space Coast Association of Post Anesthesia Care Nurses, Melbourne, FL. (Presented for 1.5 CEU)

VI. AWARDS

2005 **The Honor Society of Phi Kappa Phi,** University of Central Florida

1987 **Outstanding College Students of America,** Florida State University

1987 **Golden Key National Honor Society,** Florida State University

1987 **National Deans List,** Florida State University

1987 **Sigma Theta Tau International Honor Society of Nursing,** Florida State University

1987 **Collegiate Scholastic All-American,** Florida State University

VII. PROFESSIONAL ACTIVITIES & COMMUNITY SERVICE

PROFESSIONAL ORGANIZATIONS:

2004 – present **Southern Nursing Research Society**

2004 – present **American Society for Pain Management Nursing**

1991-Present **American Association of Critical Care Nurses (AACN)**

1990-1997 **Space Coast Association of Post Anesthesia Nurses**

COMMUNITY SERVICE:

2000-Present Saint Margaret Mary Catholic School, Girl Scout Leader, Troop 2097

2000-Present Saint Margaret Mary Catholic School, Clinic Volunteer

APPENDIX O: PERMISSION TO USE NEUROMATRIX THEORY FIGURE

Dear Kelly,

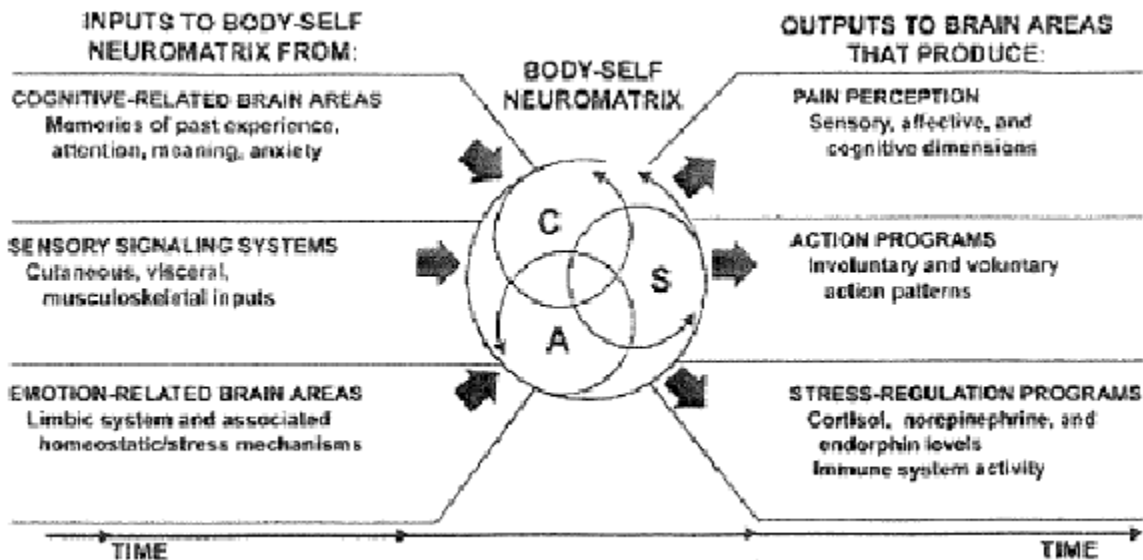
I am delighted that you plan to use the “neuromatrix” figure in your doctoral dissertation. You have my permission as well as my best wishes for great success and happiness in your career!

Ronald Melzack

I am writing to ask permission if I can use the schematic below of the neuromatrix theory in my doctoral dissertation studying the impact of music on postoperative pain and anxiety. I wrote to you previously to ask permission to use the McGill Pain Questionnaire Short Form and you graciously granted me permission. I will not put the schematic below in my dissertation without your permission.

Thank you,

Kelly Allred, MSN ,RN, CCRN
Doctoral Student
University of Central Florida
Orlando, Florida



REFERENCES

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