THESIS

FEASIBILITY AND PRELIMINARY EFFECTS OF THE USE OF MUSIC AND MOVEMENT DURING CHILDBIRTH

Submitted by

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In partial fulfillment of the requirements

For the Degree of Master of Music

Colorado State University

Fort Collins, Colorado

Spring 2016

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ABSTRACT

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In 1965, the rate of cesarean birth was 4.5% (Taffel et al. 1987). Presently, the World Health Organization recommends a rate of 15% (WHO, 2009) and yet the current cesarean rate in the United States is double this recommendation, closing in at 32.8% (Hamilton & Martin, 2011). The Lamaze International Education Council addressed the growing cesarean rate in 2004 by publishing an article in the Journal of Perinatal Education which outlined six care practices to promote normal birth. The second care practice, freedom of movement throughout labor, holds promising application for neurologic music therapy. Numerous studies have found ambulation during labor to be effective in increasing oxytocin levels, advancing labor progression, decreasing length of labor, and improving birth outcome. Previous research on music therapy-assisted childbirth has focused exclusively on the use of music listening to decrease pain and anxiety. However, the effect of using music to support ambulation through motor entrainment with laboring mothers has not been studied. In addition, the effects of music in stimulating the release of oxytocin has documented beneficial effects on several patient populations but its use during parturition has not been studied. Pitocin, a synthetic form of oxytocin, is routinely given to induce and augment labor. However, some mothers decline this intervention as it can have unpleasant side effects and disrupts physiologic birth. Likewise, its use can be contraindicated for some mothers such as those with a history of prior cesarean section. As a result, there is a need to identify nonpharmacological interventions which appeal to

laboring mothers and medical staff, support normal labor progression, and improve outcome. The purpose of this pilot study was to identify initial evidence regarding the effect music-facilitated movement has in supporting ambulation during labor, determine the feasibility of recruiting participants from area obstetrical clinics, evaluate prenatal training and labor support procedures, assess participant preferences and hospital staff support of the intervention during labor, and analyze the effect on labor progression and outcome. A single-system design was used for this investigation. One mother responded to the advertisements, met criteria for the study, and participated in three prenatal training sessions. Upon the start of active labor, the participant contacted the investigator, who provided nearly two hours of support while laboring at home. At the time of labor support, the participant served as her own control and an ABAB design was used to assess the effects of music-facilitated ambulation. A FitBit Flex pedometer was worn by the participant to compare ambulation activity between conditions. Data on the participant's use of the intervention and effect on labor progression, as measured by contraction frequency, was collected during that time. Following the birth, data were collected from the online pedometer software, medical records, and through a post-partum interview to determine perceived benefits, preferences regarding use of the strategies and support of the music therapist, implementation of the intervention at the hospital, receptiveness of hospital staff, duration of labor, and birth outcome (vaginal, assisted vaginal, or cesarean section). Visual inspection of the raw movement data failed to identify any effect of the intervention on physiological measures. In addition, there were numerous possible alternative explanations that may have influenced the movement data including passage of time and natural labor progression as well as use of other nonpharmacological interventions.

Outcomes related to feasibility suggest this intervention was perceived positively by both the mother and the healthcare providers. Implications, limitations, and recommendations for future investigations are presented.

ACKNOWLEDGEMENTS

I would like to thank my family and colleagues for supporting me throughout graduate school and this thesis. I'd like to thank those who were willing to be on standby to take care of our children so that I could attend the birth for this project. I'd also like to thank my advisor Blythe LaGasse, and committee members Bill Davis and Terry Nett for staying on this project throughout the years it took to complete. Finally, I would like to thank the participant and her birth team for welcoming me into this special experience.

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CHAPTER 1: INTRODUCTION

Background

Childbirth is a complicated process involving biological, psychological, and cultural influences. Not only do these processes influence childbirth, but they influence each other. Though the process of childbirth has not changed physiologically, its biological complexity has influenced how the medical profession and community respond to it.

Historically, physicians have tried to understand how best to manage and control childbirth. Currently, the most commonly held belief within the medical community is that pregnancy is a disease and should be managed as much as possible (Selin & Stone, 2009. This approach to caring for mothers has influenced childbirth outcomes. Care providers attending obstetrical patients routinely rely on technology such as continuous fetal monitoring and pharmacological therapies including synthetic oxytocin. In many cases the end result has been access to life-saving measures. However, in many other cases managed childbirth approaches have negatively impacted morbidity and mortality risk for mothers and neonates. Likewise, women are demanding more autonomy when it comes to the type of childbirth experience they desire. Some mothers prefer a medicated birth while others prefer a natural childbirth. And yet others request elective cesareans. As a result, cultural influence, specifically patient demands and preferences also impact healthcare providers and their childbirth practices.

What is most concerning is while mothers in the United States have access to the best care providers, drugs, and technology, childbirth outcome statistics show little benefit. Each year 650 women and 25,000 infants die as a result of childbirth (National Center for Health Statistics, 1999-2009). According to the March of Dimes, the United States infant mortality rate decreased

only slightly between 1999 and 2009 from 7.0 per 1,000 live births to 6.4 per 1,000 live births (National Center for Health, 1999-2009). Maternal mortality rates have fared even worse. Between 1999-2007, U.S. maternal mortality rates increased from 9.9 to 12.7 per 100,000 live births (National Center for Health Statistics, 1999-2009).

Meanwhile, the U.S. spends more money on childbirth as outcomes remain unchanged and cesarean rates increase. A cost analysis of maternal and newborn charges found cesarean delivery costs were approximately 40% higher than vaginal births (Corry et al., 2013). With an average national cesarean rate of 32.8% in the United States, the cost of birth is high despite lack of improvement to decrease this rate (National Vital Health Statistics, 2011). This discrepancy calls for research to identify evidence-based solutions that are cost-effective, time-efficient, and appealing to both obstetric care providers and parturients. Nonpharmacological methods have been implemented to improve outcome with minimal cost. Such techniques support the natural process of childbirth while also improving the mother's perceived experience. Research investigating the effectiveness of nonpharmacological techniques is slowly growing. Therefore, evaluating the effects of specific nonpharmacological techniques including music therapy is warranted.

Music therapists have been providing services in childbirth for several decades. Though a small number of music therapists provide services for expectant mothers, literature reviewing guidelines and interventions have been consistent. In general, music has been used to support other techniques such as imagery, breathing, and other strategies taught in childbirth education (Chang & Chen, 2005; Clark, McCorkle, & Williams, 1981; Hanser, Larson, & O'Connell, 1983). The use of recorded music to decrease pain perception, anxiety, and improve the mother's overall experience have become standard practice in music therapy-assisted childbirth

(Browning, 2001; DiCamillo, 1999; Fulton, 2005). However, there have been no studies investigating the effects of music on movement though in a number of writings it has been recommended to be used in this way. In addition, numerous writings on ambulation throughout labor show clear benefit and yet have not discussed the potential for music to support this beneficial activity.

Purpose

The purpose of this pilot study is to investigate the feasibility and preliminary data trends of music in increasing ambulation during active labor.

Research Questions

Research questions to evaluate feasibility include:

What percentage of eligible participants consented?

What percentage of participants implemented the intervention while laboring at home?

What percentage of participants implemented the intervention while laboring at the hospital?

The research questions to evaluate initial trends in data include:

What effect did the music therapy intervention have on contraction frequency, length of the first stage of labor, length of the second stage of labor, total length of labor, and birth outcome?

What were the participant's perceived benefits of the intervention?

Were the participant's perceived benefits the same in both the home and hospital environments?

What were the participant's perceived benefits of the co-investigator providing labor support?

Did the participant feel the amount of home support was sufficient?

According to the participant, were the hospital staff receptive to use of the intervention?

CHAPTER 2: LITERATURE REVIEW

Historical Perspectives of Childbirth

Human childbirth is a complex, variable, and intimate physiological and cultural process. In comparison to non-human primates, human birth is also quite difficult (Davis-Floyd & Cheyney, 2009). This difficulty is caused by what is referred to as the "obstetrical dilemma" and refers to the tight fit between the maternal pelvis and the neonate's head. The human pelvis is characterized as wide and flat. These characteristics are necessary for efficient bipedalism (Davis-Floyd & Cheyney, 2009). However, the opening of the maternal pelvis is a rounded, spacious passageway to accommodate the large-brained human infant. During childbirth, the human fetus, often with a head nearly the same size or bigger than the maternal pelvis, must complete a series of cardinal movements to navigate the changing diameters of the birth canal (Davis-Floyd & Cheyney, 2009). The result is not necessarily a more dangerous birth but rather a longer, more painful labor compared to non-human primates (Davis-Floyd & Cheyney, 2009).

To cope with the obstetrical dilemma, our ancestors practiced uniform childbirth behaviors. Hunter-gatherers, horticulturalists, pastoralists, and agriculturalists moved freely during labor and changed positions frequently to manage pain (Davis-Floyd & Cheyney, 2009). They intuitively labored and birthed in upright positions to promote pelvic expansion, use gravity, and maximize efficiency of pushing. Artifacts show evidence of the use of birthing stools and chairs, ropes and poles, and birthing in flexible hammocks. Evidence of frequent ambulation and position change can be found in pictures throughout history (Shilling et al., 2004). Our ancestors ate and drank as desired, were attended by other familiar women, and labored in a familiar place, most often their own home. Newborns and mothers were kept

together immediately after birth and remained close throughout the 12 months of external gestation (Davis-Floyd & Cheyney, 2009).

As mentioned above, human parturients tend to seek out assistance from others which is unlike non-human primates who usually birth alone in the dark. (Davis-Floyd & Cheyney, 2009). This behavior of seeking help from a familiar assistant appears to date back nearly one million years ago when homo erectus and the accompanying large brain changed what was a solitary process to a social process. But the reason for this transformation was not just due to an increase in head-size. Anthropologists theorize the need for human attendants may be due to several related biological reasons unique to homo sapiens. First, it is difficult for a human mother to reach down and deliver her own baby because human babies usually emerge facing away from the mother. Second, human infants are relatively helpless compared to other primate infants. The developmental difference between a neonate and its adult mother is comparatively extreme to other animals. Because of the difficulty of human birth, mothers tend to be exhausted and need an assistant to care for the infant. Finally, the strong maternal emotions (excitement, anxiety, fear, tension, joy, uncertainty) that co-occur in human birth may serve as a protective factor which prompts the mother to seek support for the birth (Davis-Floyd & Cheyney, 2009).

Foundations of Modern Birth

Currently there are two contemporary childbirth approaches, or models of care, practiced in the United States. Namely, these are the physiological approach and the technocratic approach. The physiological approach closely resembles the childbirth practices of our ancestors. In contrast, the technocratic approach emphasizes a process where the physician relies on technology to manage pregnancy and childbirth. Unlike the physiological approach, which

views pregnancy and birth as natural processes, caregivers aligned with the technocratic approach view parturition as a pathology (Selin & Stone, 2009).

According to Albers (2007), the standard model of care for the physiological approach consists of low-technology measures such as continuous labor support, flexible parameters for defining labor progress, and intermittent fetal heart rate monitoring. Moreover, the physiological approach encourages upright positioning and active participation in labor. Medications are avoided unless medically necessary. Nonpharmacologic methods are used for pain relief and vaginal exams are generally limited to every four hours. This approach is promoted by the World Health Organization (WHO) in their recommendations for intrapartum care (Chalmers et al., 2001). In addition, WHO suggests that cesarean section rates should range from 5-15% in a facility. This approach recognizes difficulty and variability in childbirth and advocates that care for laboring women should be both intensive and individualized (Albers, 2007).

Though there is much research supporting the physiologic approach, it is not the most common model of care practiced today. The relatively new technocratic approach, accounting for less than 1% of human history, is the model of care most parturients receive in U.S. medical centers (Davis-Floyd & Cheyney, 2009). Albers (2007) describes the technocratic approach as "mass production-style" care. Others describe it as "excessively interventive and mechanistic" (Selin & Stone, 2009). These characteristics are rooted in historical developments dating back hundreds of years.

Prior to the eighteenth century, pregnancy and birth were centered in the home. Childbearing was viewed as "women's work", involving the mother, her midwife, and several other close, female attendants. Males were nearly completely excluded (Stone, 2009). In contrast, the medical field was exclusively dominated by males at this time. As a result,

pregnancy and birth were insignificant to the field of medicine (Selin & Stone, 2009). And as noted, the midwife was the authoritative figure at the birth. Male practitioners were only present at a birth if the midwife was unavailable and obstetric surgery was rarely practiced (Stone, 2009).

The transformation of birth began with the introduction of birth instruments in the late seventeenth and early eighteenth century. These instruments, including forceps, were used for complications such as when the fetus became obstructed in the birth canal. Equipped with such technologies, obstetric surgeons were able to manage labor and birth (Stone, 2009). This shift in male authority in birth lead to lying-in hospitals and maternity wards. However, the movement of birth from home to hospital did not improve outcome (Davis-Floyd & Cheyney, 2009). In fact, there were massive epidemics of childbirth fever up until the early twentieth century possibly due to unsanitary conditions in hospitals. Once germ theory was implemented, hospitals began using precautions to minimize infection. Iodine was used to cover the mother's body, enemas and public shaving were routine, and infants were separated from their mothers up to several days (Davis-Floyd & Cheyney, 2009).

By the nineteenth century, pregnancy and childbirth care were provided entirely by male, university-trained physicians. As a result of the medicalization of pregnancy and childbirth, strict standards pathologized reproduction and limited the normal course of parturition (Selin & Stone, 2009). With only a single norm, many variations normal to labor, such as rate of dilation, were discounted and seen as cases which required management (Selin & Stone, 2009) including the frequent use of obstetric technologies (Stone, 2009).

Victorian era culture also influenced care for mothers. Developing standards and pathologizing reproduction helped physicians alleviate the moral issues of their work. In addition, cultural pressures on women to follow restricted diets and stay inside lead to lack of

exposure to the sun and subsequent vitamin D deficiency. This vitamin deficiency lead to infants born with Rickets who grew into women with an excessively flattened pelvis. The result was many obstructed labors and cesarean sections. Infection and hemorrhage were common risks from the surgery which led to high morbidity and mortality risk (Selin & Stone, 2009). The industrial revolution also influenced maternity care by viewing the female reproductive system as a production line (Stone, 2009). The uterus was a machine that produces a baby, the product. Likewise, the mother was the laborer who operates the machine while the physician supervised (Stone, 2009).

Though over 100 years have passed since the Victorian era, many of the practices, and certainly the philosophy has remained unchanged. As a result, institution-based childbirth has become the norm over the last 50 years as nearly all women in the United States give birth in the hospital (Albers, 2007). Moreover, hospitals routinely use protocols and interventions regardless of a woman's risk status (Albers, 2007; Albers et al., 1997). For example, birth in the technocratic era often forbids women to eat, drink, or walk during labor, encourages mothers to wear hospital gowns, and routinely requires intravenous lines. Furthermore, pitocin (synthetic oxytocin), prophylactic antibiotics, and pain narcotics are commonly used even for low-risk mothers. However, such limitations are not exclusive to the first stage of labor. During the second stage of labor, women push while laying flat on their backs or in a semi-sitting position (Davis-Floyd & Cheyney, 2009) as they are cared for in an unfamiliar setting by strangers (Albers, 2007). Personal accounts of these protocols as the standard routine for hospital birth are evident in the 2002 Listening to Mothers survey in which 93% of women reported they had electronic fetal monitoring, 63% received epidurals, 30% were given narcotics, 53% were given oxytocin to augment labor, and 71% labored in bed (Declercq et al., 2002).

Some experts suggest that these routine procedures might not be implemented to serve the best interest of mother and baby. For example, continuous fetal monitoring (CFM) is universally used in labor management in the United States despite contrary recommendations in a 2005 Practice Bulletin of the American Congress of Obstetricians and Gynecologists (Albers, 2007; ACOG, 2005). However, it is more likely that the routine use of technology and interventions are due to several factors including maternal preference, lack of staff, clinician preference, and lack of full informed consent (Albers, 2007). Regardless of the cause, there is a growing movement toward minimizing the practices of the technocratic approach while improving morbidity and mortality rates (Davis-Floyd & Cheyney, 2009).

Physiology of Childbirth

Parturition is a complex, involuntary process which varies between women and between births for the same woman (Odent, 2011). Labor is made up of three stages and preceded by a number of prelabor events in the weeks prior to labor. Braxton-Hicks contractions, characterized as mild and irregular may be experienced by mothers prior to or during the last four to eight weeks of pregnancy (Lyons, 2006). In the last two weeks the fetal head may drop into the maternal pelvis. This event is referred to as "lightening" (Lyons, 2006). Prelabor cervical changes may also take place in the weeks and days prior to labor. For example, the cervix will soften, efface, and may dilate up to three centimeters. Some mothers may lose their mucous plug and observe a "bloody show" as labor is imminent (Lyons, 2006).

The first stage of labor begins with the onset of uterine contractions and ends when the cervix is completely dilated and effaced (Campbell et al., 2006). This stage of labor varies in length with the average range lasting 6-18 hours in a primigravid mother and 2-10 hours in a multiparous woman. The first stage of labor is subdivided into two phases (Lyons, 2006). The

latent phase, also referred to as “early labor”, is from the beginning of cervical dilation until four centimeters. From that point until full dilation the woman is in the active phase of labor. This phase is characterized by uterine contractions that increase in frequency, duration, and intensity. The rate of dilation also increases during the active phase (Albers, 2007).

Emanuel Friedman was the first researcher to differentiate between the two phases of the first stage (Albers, 2007). Friedman's study of labor progress was based on data collected from the 1950’s and 1960’s (Albers, 2007). Findings from Friedman’s research suggested a normal dilation rate of 1.2-1.5 cm per hour and continues to be used today when defining normal labor progression. However, more recent research suggests there may be more variability in the rate of dilation with some women dilating as slow as 0.3 cm per hour in the case of some contraction patterns (Albers, 2007). In addition, the dilation rate may be affected by arrests of dilation, often two hours in duration. Such arrests are not uncommon and typically these are managed by medical interventions when the technocratic approach of care is preferred by the provider (Albers, 2007).

The second and third stages of labor make up a smaller proportion of childbirth. The second stage of labor begins with full dilation and ends with the delivery of the infant. The duration of this stage lasts longer for first-time mothers (1.5-3 hours) and less for multiparas (5-30 minutes). The third stage begins after the delivery of the infant and ends with the delivery of the placenta which usually occurs within 30-minutes after the birth (Lyons, 2006).

Hormonal Processes

The three stages of parturition are mediated by a hormonal process. It is these hormones that are responsible for the observed variation between women and the complexity of the physiological process of childbirth (Walsh & Downe, 2009). Interestingly, initiation of labor is

credited to a stress response from the infant (Widmaier et al., 2006). Fetal cortisol causes enzymes in the placenta to convert progesterone to estradiol (Widmaier et al., 2006). Estradiol functions to stimulate the hormone prostaglandin and mild contractions are initiated by this hormone (Widmaier et al., 2006). The induction of contractions increases the amount of pressure on the cervix resulting in the stimulation of the hormone oxytocin (Widmaier et al., 2006). As more oxytocin is released, the contractions strengthen and add more pressure on the cervix. This positive feedback process continues until the infant is delivered.

Oxytocin, the Birth Hormone

Oxytocin (OT) is a nine-amino acid cyclic neuropeptide produced in magnocellular neurosecretory cells of the paraventricular nucleus (PVN) and supraoptic nuclei (SON) of the hypothalamus (Carson et al., 2013; Singh, 2011). Interestingly, its molecular structure is very similar to another hormone, vasopressin (Singh, 2011). Oxytocin is released within the central nervous system (neurogenic) as well as peripherally. Central receptors for OT are located within the amygdala, ventromedial hypothalamus, septum, and brain stem (Singh, 2011). Oxytocin is released peripherally in an exocytosis process by the posterior pituitary gland (Carson et al., 2013; Singh, 2011) and binds to G-protein-coupled receptors in target tissues (Singh, 2011). From there it is released into the bloodstream (Singh, 2011). Receptors for circulating OT have been found in the reproductive organs (Singh, 2011), limbic system and brain stem (Gale et al., 2003), and in the heart (Ondrejcakova et al., 2009; Singh, 2011). Receptors have also been found in the thymus, pancreas, and adipocytes (Singh, 2011). As a result, OT is capable of mediating a wide variety of functions (Gale et al., 2003). Oxytocin has a short half-life ranging from 0.8-1.4 minutes. Furthermore, it is destroyed by enzymes in the gastrointestinal tract as well as oxytocinase in the liver and kidney (Singh, 2010).

Oxytocin was discovered by British physiologist Sir Henry Dale in 1906 (Carson et al., 2013). In 1909, William Blair Bell, a British obstetrician and gynecologist, investigated the effects of extracted oxytocin on uterine activity in pregnant women. Bell's investigation found that oxytocin could facilitate uterine contractions, prevent excess post-partum bleeding, and relieve severe constipation (Carson et al., 2013). Over forty years later the nine-amino acid sequence of OT was identified and synthesized by American biochemist Vincent du Vigneaud. Oxytocin was the first neuropeptide to be characterized and synthesized. Vincent du Vigneaud won the Nobel Prize in Chemistry for his work with oxytocin (Carson et al., 2013).

Oxytocin, meaning "quick birth" in Greek, is responsible for numerous functions and is often referred to as the "love" hormone due to its notable role in reproduction. The most relevant function in parturition is the facilitation of uterine contractions which occur as oxytocin increases the permeability of sodium ions across muscle cells and subsequently facilitates the second (birth of the fetus) and third stages (expulsion of the placenta) of childbirth (Singh, 2011). During the second stage, oxytocin has a protective effect on the fetal brain. At this time, OT passes from the mother to the fetus through the placenta and causes gamma aminobutyric acid (GABA) neurotransmitters to have an inhibitory effect on fetal cortical neurons (Singh, 2011). This action functions to protect the fetal brain while passing through the birth canal, a time at which there is vulnerability to hypoxic damage. In addition, following the birth, OT is the preferred treatment in postpartum hemorrhage management (Carson et al., 2013).

Oxytocin has mechanical functions outside of childbirth as well. The milk let-down reflex during breastfeeding is a result of specialized breast cells contracting (Odent, 2012; Singh, 2011). Similar mechanical effects occur during sexual intercourse. Specifically, both uterine contractions during orgasm and the sperm ejection reflex are caused by the release of OT (Odent,

2012). Oxytocin is also credited for its role in parental care and infant bonding (Odent, 2012; Singh, 2011).

Outside of reproduction, Oxytocin plays a role in other physiological processes such as the regulation of water balance, blood osmolality, bone density, appetite and fat metabolism (Carson et al., 2013). Research has also found administering oxytocin peripherally can result in prolonged decreased blood pressure (Ondrejcakova et al., 2009). Other cardiovascular effects include baroreflex control of the heart, reduced heart rate, contractility, and coronary flow (Ondrejcakova et al., 2009).

In addition to its effects on physiological functioning, OT is implicated in social behaviors such as promotion of trust and the reduction of social anxiety (Carson et al., 2013; Chanda & Levitin, 2013), perceptual selectivity to social information (Chanda & Levitin, 2013), and seeking out social contact (Chanda & Levitin, 2013). Furthermore, OT facilitates social bonding and affiliation (Chanda & Levitin, 2013) as well as stimulating positive or negative social emotions (Chanda & Levitin, 2013). This hormone appears to influence the regulation of stress, anxiety and affective motivation as well (Chanda & Levitin, 2013). In addition, cognitive functions include learning and memory tasks (Carson et al., 2013; Gale et al., 2003).

The influence of OT on various pathologies has also been studied. The role of OT on social and behavioral functions has led to research on its implications in autism spectrum disorder (Gale et al., 2003) and Williams Syndrome (Dai et al., 2012). The cardiovascular influence of OT may provide protective factors for heart patients experiencing infarction and similar protective effects have been observed on renal ischemia-reperfusion injury (Ondrejcakova et al., 2009).

Synthetic Oxytocin and Management of Labor Progression

Management of labor progression is dependent upon the theoretical approach around which the birth is oriented. In the case of the technocratic approach to birth, pitocin is most commonly used to maintain or augment labor progression with the goal being a labor in congruence with Friedman's curve. In contrast, the physiological approach to birth utilizes nonpharmacological strategies such as ambulation and positioning as well as continuous labor support.

The functions of OT have been discussed previously and evidence shows this hormone has a major influence on parturition. However, OT itself is influenced. Odent (2012) describes OT as a "shy" hormone because of its release being dependent on environmental factors such as the presence of strangers, observers, room temperature, and lighting. In addition, when adrenaline is released, oxytocin is not secreted (Odent, 2012). In cases when obstetric providers determine that a mother is releasing insufficient amounts of oxytocin, synthetic oxytocin is often used to manage labor.

Synthetic versions of oxytocin are nearly identical to natural oxytocin at the molecular level (Rooks, 2009). Pitocin and Syntocinon are two of the human prepared versions of OT (Singh, 2011). However, when OT is given intravenously, as is the case in parturition, there are no central effects due to the blood-brain barrier (Rooks, 2009; Singh, 2011). For this reason, the social and behavioral effects of OT are not observed when the synthetic form is given during childbirth. Another differentiation of intravenous synthetic oxytocin is that it is given continuously. This is in contrast to the pulsatile release of natural oxytocin which is more effective and efficient. Larger amounts of synthetic oxytocin are needed to produce the same effects of its natural form (Rooks, 2009).

In addition to needing more synthetic oxytocin to get a desirable contraction pattern, there are other negative effects of this intervention. When mothers receive high doses of synthetic OT for a prolonged period of time there is a desensitization effect on oxytocin receptors in uterine muscle cells (Rooks, 2009). This effect increases a mother's risk of post-partum hemorrhage (Rooks, 2009). These serious side effects have led to oxytocin being involved in half of all paid obstetric litigation claims (Rooks, 2009). In addition, synthetic oxytocin is on the Safe Medication Practices list of 'high alert" drugs (Rooks, 2009). Despite these side effects, synthetic oxytocin continues to be used to induce and augment labor in nearly 50% of all births in the United Sates (Davis-Floyd & Cheyney, 2009). In many of these cases, the use of synthetic oxytocin to induce or augment labor is for the convenience of the provider or patient (Rooks, 2009).

Nonpharmacological Approaches for Labor Progression

In contrast to synthetic oxytocin, nonpharmacological techniques for labor progression can be characterized as nonintrusive, noninvasive, low-cost, effective, and lacking adverse side effects (Brown et al., 2001). Likewise, such techniques increase the parturient's perceived sense of control and empowerment, which may result in higher satisfaction with the birth experience (Brown et al., 2001). This is in contrast to the sense of dependence and vulnerability promoted by the medical approach to childbirth (Albers, 2007).

One of the most common nonpharmacological strategies is the use of positioning. Women have labored in upright positions throughout history (Albers et al., 1997). Evidence of this can be seen in historical pictures across cultures (Shilling et al., 2004). Today, women in most areas of the world not influenced by Western society continue to labor upright (Andrews & Chrzanowski, 1990). In contrast, though Western mothers tend to prefer ambulation, recumbent

positions and bed confinement during labor are common practice in the United States (Albers, 2007). Care providers encourage recumbent positions because they provide optimal accessibility for continuous electronic fetal monitoring, cervical dilation exams, and the use of forceps (Andrews & Chrzanowski, 1990). Though preferred by care providers, supine positioning in labor has negative side effects such as decreased contraction strength, increased length of labor and maternal hypotension, fetal heart decelerations, decreased cord blood pH, and lower Apgar scores (Andrews & Chrzanowski, 1990).

In addition to being preferred by mothers, upright positions provide numerous benefits to mother and baby. When a laboring woman is in an upright position, gravitational forces are optimized (Andrews & Chrzanowski, 1990). Because of their advantage in using gravity, upright positions facilitate more intense contractions, shorten the length of labor (Andrews & Chrzanowski, 1990), and maximize the curve of the human birth canal, known as the "Curve of Carus" (Davis-Floyd & Cheyney, 2009). As a result, rapid cervical dilation and fetal descent can be observed (Andrews & Chrzanowski, 1990). These benefits have been confirmed by magnetic resonance imaging (MRI), which has found that kneeling and squatting increase anterior-posterior and transverse diameters of the pelvic cavity and outlet (Albers, 2007).

Interestingly, though upright positioning intensifies labor, there appears to be no ill effect on the parturient's comfort level (Andrews & Chrzanowski, 1990). Moreover, choosing her laboring position, provides the woman with a sense of independence and increases her psychological comfort level (Andrews & Chrzanowski, 1990). In the case of a labor which has slowed, changing position can help the labor find its rhythm again (Shilling et al., 2004). Furthermore, when left to freely choose, a woman frequently changes position and alternates between standing, squatting, sitting, and kneeling (Shilling et al., 2004). In fact, Shilling et al.

(2004) suggest that when a mother is left to choose her position, she intuitively assumes one which results in a faster, more effective labor.

In addition to instinctively changing positions, moving freely during labor is a behavior observed in both humans and their closest living primates (Floyd-Davis, 2009). Numerous benefits are associated with freedom of movement during birth. For example, movement is an instinctive self-comfort measure (Floyd-Davis, 2009) and active response to pain (Shilling et al., 2004). Ambulation facilitates upright positioning and uses gravity to facilitate descent and rotation of the fetus through the birth canal while simultaneously increasing the size and shape of the pelvis to better accommodate the large-brained infant (Davis-Floyd & Cheyney, 2009; Shilling et al., 2004). Movement also provides a distraction from pain, a sense of control (Albers et al., 1997; Shilling et al., 2004), and decreases muscle tension while speeding up labor (Shilling et al., 2004). Moreover, ambulation improves blood flow both to the uterus and infant by preventing the compression of blood vessels (Davis-Floyd & Cheyney, 2009). Because of its positive effects on pain and comfort level, mothers who freely ambulate show lower use of narcotic analgesia (Albers et al., 1997).

Various movements and positions have their own unique advantages. Benefits specifically for walking in labor include shorter labor, improved uterine contractility, less need for pitocin augmentation, decreased need for pain medication, and decreased frequency of instrumental delivery (Bloom et al., 1998). Activities such as rhythmical rocking and circular movements on a birth ball help to open the pelvis (Simkin & Bolding, 2004). Similarly, squatting helps open the outlet of the pelvis and facilitate downward movement of the fetus (Simkin & Bolding, 2004).

Hands and knees position decreases back pressure and rotates the fetus into the anterior position (Simkin & Bolding, 2004). Furthermore, changing positions frequently helps assist fetal decent (Simkin & Bolding, 2004).

Perhaps one of the most important benefits of mobility in labor is the significant reduction it has on operative delivery (Albers et al., 1997). With an overall cesarean rate in excess of 30% in the United States, this is a benefit to be considered by parturients, care providers, and facilities. Childbirth education classes teach mothers movement and position strategies including pelvic rocking, lunging, squatting, slow dancing, knee/chest positions, and climbing stairs (Shilling et al., 2004). Unfortunately, many providers and hospitals are not knowledgeable nor supportive of a mother's use of these mobility strategies (Albers, 2007).

Positioning and movement during labor go hand in hand. Together they provide many benefits such as reduced pain (Brown et al., 2001), decreased muscle tension, increased sense of control, normalcy, and autonomy (Albers, 2007), increased uterine contraction intensity (Albers et al., 1997), use of gravity to optimize the mother's efforts, and aids fetal positioning descent through the pelvis (Chalk, 2004). Upright positioning and movement as a strategy is a self-regulated, low-technology care measure which supports physiologic birth without harmful side effects (Albers et al., 1997). Its use in labor should be made available to all mothers seeking this type birth experience.

In addition to upright positioning and mobility, continuous labor support is also a nonpharmacological strategy effective for supporting physiological birth. According to Albers (2007), at least part of the efficacy of nonpharmacological methods may be due to the supportive human presence that goes along with their use. Continuous labor support is characterized as one on one bedside care beginning in early labor and includes providing a constant physical presence

and emotional support. In addition, information and advice about coping with labor as well as providing physical comfort measures are characteristic of continuous labor support (Hodnet et al., 2003).

Dick-Read, a known and respected author on natural childbirth during the 1940's, wrote on the importance of continuous labor support as a way to intervene in the fear-tension-pain cycle (Albers, 2007). Hodnett et al. (2003) also cites other benefits including less use of pain medication including epidurals, more spontaneous vaginal births, less cesareans, more satisfaction with the birth experience, less risk of postpartum depression, improved maternal self-esteem, more confidence in mothering, and increased breastfeeding success. Continuous labor support also has a positive hormonal effect by decreasing levels of cortisol and epinephrine, both of which inhibit natural oxytocin and are released in response to fear and stress. In childbirth, they serve an adaptive function by preventing a fragile infant from being delivered under dangerous conditions (Davis-Floyd & Cheyney, 2009). Unfortunately, they may also be released by the mother in response to being in the hospital and feeling observed by strangers.

Music in Obstetrics

Chanda & Levitin (2013) suggest that research has found music to have the ability to cause changes in neurochemical domains including oxytocin. For instance, a study by Grape et al. (2003) found an increase in serum oxytocin levels in student musicians during a 30-minute singing lesson. The effects of music on oxytocin levels in hospitalized patients have also been studied. Nilsson (2009) observed higher levels of oxytocin in open-heart surgery patients who listened to experimenter-selected music for 30-minutes one day after surgery. These effects may be connected to the aesthetic pleasure experienced in response to music. Chang et al. (2008) cited a study which found endorphins were released from the pituitary gland in response to

listening to music; resulting in a decrease in adrenocorticotropic hormone in the blood. In their study, Chang et al. (2008) suggested that music influences the interaction between the thalamus and the reticular activating system resulting in changes in emotions, musculature, and autonomic functions.

While there appears to be evidence supporting the use of music to increase oxytocin, it is not yet known exactly how this mechanism works. According to Chanda & Levitin (2013), "It remains unknown whether music causes release of oxytocin at levels commensurate with other activities or with the effective dosages of exogenous oxytocin used experimentally" (p.188). Nonetheless, evidence supporting non-drug therapies, including music, and their ability to regulate oxytocin and other hormones is promising though in need of further research.

Music and Movement in Childbirth

Though there is a significant amount of literature on music and movement with various rehabilitation populations, very little has been written regarding music and movement in childbirth. And what has been written is theoretical. There are no studies to date investigating the effects of music on positioning and ambulation in childbirth. Moreover, the writings that do exist are authored primarily by nurses and other medical professionals rather than music therapists.

One speculated function of music on movement in childbirth is the ability of music to motivate ambulation. Becket (2011) observed that, "some rhythms invoke a powerful urge to move" and continues "music may provide an incentive to keep moving with the rhythm of the music, keeping her body relaxed and flexible as labour progresses" (p. 473). Brown et al. (2001) argue that rhythmic movements can influence pain perception by increasing the mother's tolerance for pain. Shilling et al. (2004) cite slow dancing to music as a strategy to support

movement and positioning. Biasiolli (2011) theorizes that walking while listening to music can distract the mother and cause her to "lose track of time" (p.11).

Chanda & Levitin (2013) argue that many human activities are rhythmic. Walking, talking, clapping, dancing, sexual activity, and rocking an infant are naturally rhythmical. When considering this, the use of music or rhythm in a natural physiological process such as childbirth seems to fit within this perspective and could serve as a rationale for the study of music and movement in childbirth. Moreover, research evaluating the effect of prenatal movement training as well as the possible role of music in encouraging ambulation in unfamiliar settings, such as the hospital, is needed.

Music Therapy-Assisted Childbirth Programming

Interest in music therapy-assisted childbirth first emerged in the literature in the 1980's. The role of music therapy in childbirth has mainly focused on its function in decreasing pain and anxiety while increasing relaxation. The music therapy techniques have very much paralleled Lamaze techniques which also focus on the fear-tension-pain cycle.

Those who have studied music therapy-assisted childbirth have cited the many and diverse functions of music in childbirth. Psychological functions of music in childbirth include music provides an auditory focal point (Beckett, 2011; Clark, McCorkle, & Williams, 1981), improves mood, reduces anxiety, provides a familiar environment (Beckett, 2011), increases sense of control (Beckett, 2011; Browning, 2001), decreases stress (Browning, 2000), motivates movement (Beckett, 2011), optimizes use of imagery (Browning, 2001), renews energy level during second stage of labor (Browning, 2002), increases satisfaction with the birth (Browning, 2001), and promotes family-infant bonding (Browning, 2002). Physical functions of music in childbirth have been cited as well. Namely, music distracts from pain (Beckett, 2012; Browning,

2000; Clark, McCorkle, & Williams, 1981), decreases use of pain medication (Browning, 2001), and supports pelvic rocking (Browning, 2000) and breathing (Browning, 2001). Moreover, Sidorenko (2000) adds music therapy-assisted childbirth reduces length of hospital stays for high-risk pregnant women.

Descriptions of music therapy-assisted childbirth services from prenatal training to support at the birth have also been described in the literature. Though there have not been any large empirical studies identifying one effective protocol, the suggestions offered in the available studies are valuable and are worth discussing.

Prenatal Training

The inclusion of prenatal training is quite common across the music therapy literature. Prenatal visits have numbered in frequencies of two sessions (Hanser et al., 1983), three sessions (Browning, 2000), five sessions (Gonzalez, 1989), and six sessions (Clark et al., 1981; DiCamillo, 1999). In contrast, Fulton (2005) did not meet with the mothers until admission to the hospital. Prenatal sessions have been offered in group and individual formats. DiCamillo (1999) offered six sessions which included four group sessions and two private sessions.

Information and training activities at prenatal sessions consist of assessing music preferences, music selection, and training in relaxation techniques. At some point during the prenatal training period, the music therapist creates a personalized listening program for the mother. In addition, mothers are encouraged to participate in home practice. These prenatal training sessions also provide opportunities for the mother and therapist to build rapport and trust.

Providing Support at the Birth

An important issue of consideration in providing music therapy-assisted childbirth services is the feasibility of attending the birth which may last on average 12 hours or more. A number of studies included birth attendance by the music therapist as part of the protocol. For example, Browning (2001) attended mothers at the start of labor prior to hospital admission. In other research, the music therapist did not attend the labor until the patient was admitted to the hospital or birth center (Clark et al., 1981; Hanser et al., 1983; DiCamillo, 1999; Fulton, 2005). Gonzalez (1989) did not attend any part of the birth but rather provided prenatal training and post-partum follow up.

Support provided by the music therapist at the birth primarily consists of facilitating recorded music. Clark et al. (1981) selected music appropriate for each stage of labor. In a study by Hanser et al. (1983), the therapist observed the mother's breathing and played the corresponding music. In a case study by DiCamillo (1999), the music therapist set up the music and then observed the mothers every 30-minutes and adjusted the music as needed.

Post-Partum Follow Up

In addition to prenatal and birth services, a post-partum visit or phone interview is typically provided to assess the mother's perception of the value of music therapy-assisted childbirth. These visits take place as soon as within 72 hours of birth (Browning, 2001) and up to three weeks post-partum (Fulton, 2005). Furthermore, post-partum programming most often includes the completion of a questionnaire to assess the effectiveness of the music therapy-assisted childbirth program.

CHAPTER THREE: METHOD

Recruitment

. The Research Integrity and Compliance Review Office (RICRO) at Colorado State University approved the study on December 18, 2014. Recruitment for this study occurred between February 1, 2015-June 30, 2015. The population for recruitment was a convenience sample of expectant mothers due during this time. All participants were eligible if they were to deliver at the same hospital located in the Midwest with the provider of their choice. The co-primary investigator contacted doulas (professional labor support provider), childbirth educators, physicians, and midwives and provided them with a flyer about the research study to pass out to their patients. Flyers were mailed or hand-delivered to eight clinics that provide obstetrical services. The flyer was also shared on Facebook. If interested, volunteer participants could contact the researcher by phone or email. Once the researcher confirmed the participant met criteria for the study, the mother was invited to enroll.

The researcher-selected criteria for inclusion in the study included: (a) nulliparous or multiparous women with an estimated due date between April 15, 2015-June 30, 2015, (b) women planning to labor at home before hospital admission and deliver vaginally without epidural analgesia, (c) participation in three music therapy prenatal sessions and one post-partum follow up visit, (d) willing to use the music therapy movement techniques during the labor process, (e) agree to wear a pedometer provided by the researcher while laboring at home and the hospital, (f) able to be observed for two hours while laboring at home, (g) go into labor spontaneously on or after the 38th week, and (h) upon discharge from the hospital agrees to

obtain a copy of the hospital records from the birth or extract the requested physiological data from them and provide this to the co-primary investigator for data analysis.

There were no inquiries regarding participation in the study until the third month of recruitment. The co-primary investigator received a message on Facebook regarding the study. Follow up communications were sent via email. The contact log (see Appendix A) was used to screen the participant for criteria-based eligibility. The participant emailed responses to questions from the contact log.

Participant

The participant was a mother in her mid-forties with an estimated due date of May 25th, 2015. The mother had four prior deliveries including two cesareans and two vaginal deliveries and was planning an unmedicated, vaginal birth with an obstetrician in a local hospital.

Research Design

Due to the natural variability of childbirth, a single-system ABAB repeated measures design was used so that the participant would serve as her own control. The independent variable was music-facilitated movement. Dependent variables included percentage of eligible participants who consented, percentage of participants who implemented the intervention while laboring at home, percentage of participants who implemented the intervention while laboring at the hospital, contraction frequency, length of the first stage of labor, length of the second stage of labor, total length of labor, mode of delivery (vaginal, assisted vaginal, or cesarean), participant's perceived benefits of the intervention in both home and hospital settings, participant's perceived benefits of the co-investigator providing home labor support, whether or not the participant felt the duration of home labor support was sufficient, and whether the participant felt hospital staff were supportive of the intervention.

Three prenatal training sessions were provided in the participant's home during the three weeks prior to the birth. While in active labor, the participant was observed for two hours by the co-primary investigator under no music (A) and music conditions (B). Each condition was 30-minutes in length. This pilot study evaluated the feasibility of providing music therapy-assisted childbirth services and assessed the preliminary effects of music on movement (walking, swaying while kneeling or standing, hip circles, pelvic rocking, moving on a birth ball, partner dancing) to facilitate labor progression during the first stage of labor. In addition, this investigation determined possible effects on childbirth outcome, participant use of the techniques, and perceived benefits.

Measures

Three researcher-designed forms were used to collect data on the research questions regarding feasibility, perceived effects of music therapy-assisted childbirth, and acceptance of hospital staff regarding use of music and movement to support labor progression. The information collected from the contact log was analyzed to answer the research question: "What percentage of eligible participants consented?"

Participant activity during active labor was collected using a pedometer. At the post-partum visit, the specific physiological information from a copy of the participant's hospital birth record was extracted (see Appendix C). The physiological information included fetal monitoring documentation (contraction frequency, duration, and intensity), duration of first and second stages of labor, total length of labor, delivery method, and medications received.

Instruments

An observation form was used to collect data during home labor support (see Appendix B). This form recorded compliance using the pedometer, ambulation behavior during both music

and no music conditions, and the subject's use of the music and movement training technique to support active participation and labor progression. Data recorded from all completed observation forms were analyzed to answer the question, "What percentage of participants implemented the intervention while laboring at home?"

A post-partum follow up visit was completed within two weeks of delivery. A written questionnaire (see Appendix D) was completed to evaluate the participants' perceptions of music therapy-assisted childbirth as well as perceived hospital staff acceptance of patient use of music therapy. The questionnaire asked the following research questions:

1. According to the participant, were hospital staff receptive to the participant's use of the intervention?
2. Did the participant use the music and movement technique at the hospital throughout labor?
3. Did the participant wear the pedometer throughout labor at the hospital?
4. Did the participant perceive the intervention as beneficial at home and/or the hospital?
5. Were there differences in the perceived benefits at home versus the hospital?
6. Did the participant believe the support of the music therapist was beneficial?
7. Was home labor support with the music therapist sufficient?

In addition to the contact log, observation form, and questionnaire, a FitBit Flex wireless accelerometer was provided to each participant for use during labor. This waterproof pedometer, a commercial device worn on the wrist, poses no known safety concerns. The FitBit Flex synced activity data to the researcher's phone and computer. Data provided measured the amount of pelvic movements, counted as steps, throughout the music and non-music conditions. The participant began wearing the device once the music therapist arrived for labor support and

continued wearing it for a minimum of two hours at home. The music therapist recorded the start and stop time for each music and non-music condition. Once the home observation ended and the patient transferred to the hospital, the patient was instructed to continue to wear the Fitbit Flex and use music and movement as much as preferred throughout the remainder of labor.

Participant-selected recorded music served as the music stimulus for ambulation. The recorded music was played free field (iPhone and Bluetooth speaker), which was the preference of the participant. Identification of appropriate music for movement was addressed during prenatal training. The participant's music was organized and stored using Spotify, a free digital music program downloaded to the participant's phone. Music was organized by participant-selected genres including Motown and contemporary Christian music.

At the post-partum interview, the physiological data were collected from the hospital records. Data extracted from the chart included: (a) time and date of hospital admission and discharge, (b) length of first stage labor, (c) length of second stage labor, (d) medications received and requested, (e) position and ambulation behavior documented by staff, (f) maternal vital signs, (g) information from electronic fetal monitoring, (h) method of delivery, and (i) infant Apgar scores.

Procedure

Once enrolled in the study, three prenatal training sessions were scheduled. Trainings were provided at the participant's home. The length of each session lasted 60 minutes and occurred over three consecutive weeks.

The purpose of the first session was to educate the participant on the benefits of the intervention, and demonstrate the ambulation movements (walking, swaying, hip circles, pelvic rocking, moving on a birth ball, partner dancing). The music therapist assessed the participant's

music resources (radio, CD's, Spotify, Pandora, iTunes) and assisted the mother in music selection appropriate for movement. The subject was encouraged to practice the movements with the preliminary music until the next session.

At the second prenatal session, the researcher discussed the participant's progress. Any changes to the music were made and the music therapist practiced the technique with the mother, providing support and feedback as needed. The researcher provided oral and written (email) instructions for the labor support procedure to be followed at the onset of labor.

The third training session was a labor rehearsal. The mother, her spouse, and the mother's two doulas were present. Timing patterns associated with active labor contractions were implemented to simulate the childbirth experience. The researcher provided support and feedback for the mother. Any final changes to the play list were completed. Final instructions on the procedure for labor home support and use of materials and technique at the hospital were reviewed.

The participant contacted the music therapist on May 25th, 2015 and shared she was beginning to have contractions. The mother was able to rest through them and did not feel the need to move so she was instructed to keep the co-primary investigator updated as labor progressed. The mother contacted the co-primary investigator at approximately 12:45am on May 26th, 2015 and stated her contractions were more intense and she was ready to use the music and movement technique to cope with labor. The co-primary investigator arrived at the participant's home at approximately 1:10am. The music therapist unpacked, applied the FitBit accelerometer to the mother's wrist and began data collection at 1:15am. At the time of home labor support, music was played continuously for 30-minutes following an initial condition of 30-minutes with no music. Each condition began at the start of the first contraction and ended when the last

contraction of the condition terminated. During the music condition, the subject-prepared play list was implemented to assess the effects of music therapy and movement training on ambulation behavior. The participant selected contemporary Christian music throughout both music conditions. Data on the participant's use of the intervention and effect on labor progression were collected during that time. During the silence condition, no music was played and ambulation data were observed and documented.

The design of this study required the co-investigator to fully respect the mother's autonomy. Specifically, the participant could choose to ambulate or rest at any given time or request for music to be turned on or off regardless of the condition (music or no music). If a request was made prior to the end of the condition, the current condition could end and the next condition would automatically be initiated. Furthermore, the participant could choose to transfer to the hospital at any time and was not required to stay home for the full two hours of home labor support. The participant only requested to end the second music condition, the reason being to transfer to the hospital.

At the end of labor support, the researcher synced data from the pedometer to the online software, which provided the number of steps per 15-minute intervals. All other data for the entire labor support period were recorded on the observation form. Before the music therapist left, the mother was encouraged to continue using their music and movement technique as she chose throughout the remainder of labor at home and at the hospital.

The participant transferred to the hospital without the researcher. The mother brought her music to the facility and continued to wear the Fitbit accelerometer. Two weeks after the birth, the music therapist visited the mother at home for the post-partum follow up and collected the pedometer. The Post-Partum Questionnaire was completed at that time and the process of

extracting the data from the medical records began. This process was completed after two more post-partum visits.

Validity and Reliability

This study used a single system ABAB design with the participant serving as her own control. The purpose of using a repeated measures design was to control for threats to internal validity. This design also attempted to limit history and novelty effects. The participant selected a healthcare provider of her choice to attend the birth.

Data Analysis Procedures

Outcome measures were identified through visual inspection of raw data collected during music and no music conditions throughout home labor support. Accelerometer readings, data extracted from the medical records, and responses to the post-partum questionnaire were collected and analyzed for feasibility.

CHAPTER 4: RESULTS

Feasibility

One expectant mother responded to the advertisement on Facebook. There were no responses to the flyers. It is uncertain how many of the physicians, midwives, childbirth educators, and doulas shared the flyers with their patients. The contact log (see Appendix A) was used to screen the mother for eligibility. Questions to determine eligibility were emailed to the mother. The mother's responses were emailed to the co-primary investigator for evaluation. The responses indicated the participant met all criteria for inclusion in the study. The participant signed the informed consent form at the beginning of the first prenatal session.

The participant was a mother in her mid-forties and had an unmedicated, vaginal birth in a local hospital for her 6th child (fifth delivery) on May 26th, 2015. All three prenatal training sessions were completed in the three weeks prior to the birth. The mother implemented the intervention in both the home and hospital throughout her labor. Movement data were collected using a FitBit Flex pedometer worn on the participant's wrist beginning at 1:15am. The mother continued to wear the pedometer until after delivery of the infant as was the protocol.

Initial Trends

The movement data were synced from the pedometer to the co-primary investigator's smart phone application. The synced data for May 26th, 2015 from 1:15am until 8:10am were recorded onto a spreadsheet. Data from home labor support are represented in Figure 1. Visual inspection of the movement data comparing conditions failed to reveal any differences.

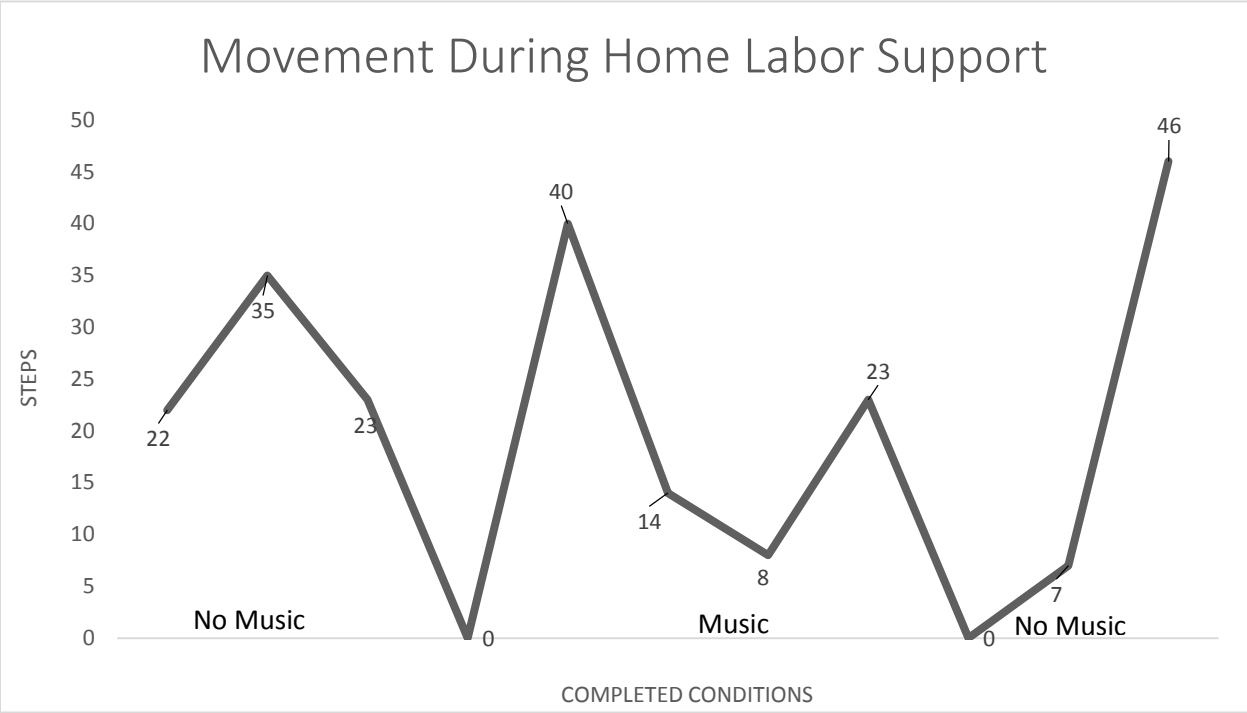

Figure 1: Movement data during home labor support

Contraction frequency during home labor support was documented through observation by the co-primary investigator and participant self-report (see Appendix B). Contraction frequency during labor at the hospital was measured intermittently by fetal monitoring equipment and is shown in Table 1.

Table 1

Contraction Frequency During Home Labor Support

Condition	Time and Condition	Contraction Frequency	Contraction Duration
No Music	1:15-1:30	2-4 minutes	30 seconds
No Music	1:30-1:45	4-6 minutes	45-60 seconds
Music	1:45-2:00	4 minutes	35-55 seconds
Music	2:00-2:15	3-4 minutes	35-40 seconds
No Music	2:15-2:30	2-4 minutes	30-48 seconds
No Music	2:30-2:45	3-4 minutes	40-50 seconds
Music	2:45-3:00	2-3 minutes	45-55 seconds
Music condition ended at 2:51. Patient transferred to hospital.			

No contraction frequency data were documented during transportation to the hospital between 3:00-3:15. Because these data were not documented continuously, unlike during home labor support, there are gaps in the data. See Table 2.

Table 2

Contraction Frequency and Duration While Laboring in Hospital

Time	Frequency	Duration
3:15-3:30	No data	No data
3:30-3:45	No data	No data
3:45-4:00	No data	No data
4:00-4:15	2-3 minutes	50-120 seconds
4:15-4:30	2-4 minutes	50-80 seconds
4:30-4:45	3-4 minutes	60-80 seconds
4:45-5:00	3-4 minutes	60-80 seconds
5:00-5:15	No data	No data
5:15-5:30	3-4 minutes	60-80 seconds
5:30-5:45	No data	No data
5:45-6:00	No data	No data
6:00-6;15	3 minutes	60-90 seconds
6:15-6:30	3 minutes	60-90 seconds
6:30-6:45	3 minutes	60-90 seconds
6:45-7:00	3-4 minutes	60-90 seconds
7:00-7:15	3-4 minutes	60-90 seconds
7:15-7:30	3 minutes	60-90 seconds

Length of the first stage of labor, length of the second stage of labor, total length of labor, and birth outcome data were extracted from the participant's medical record (see Appendix C). The first stage of labor began at approximately 10:00pm on May 25th, 2015 and lasted nine hours and 20-minutes. The second stage of labor began at 7:20am on May 26th, 2015 and lasted 50-minutes. A male infant was born vaginally at 8:10am on May 26th, 2015. Infant Apgar scores were 8/10, 9/10, and 9/10.

A post-partum questionnaire (see Appendix D) was completed during the post-partum visit on June 18th, 2015. The mother felt the hospital staff were receptive to her use of music and movement. She used music and movement throughout her labor at the hospital until transition and felt music and movement were beneficial both at home and in the hospital. She also responded that the benefits were equal in both settings. Finally, the mother indicated the amount of home labor support was sufficient.

Questions nine and ten of the post-partum questionnaire were open-ended. In response to the question, "what do you feel were the benefits of music and movement when used at home", the mother responded, "It allowed me to concentrate on my body's process and to relax more and at a deeper level of relaxation". In response to the question, "what do you feel were the benefits of music and movement when used at the hospital', the mother responded, "It allowed me to have my own space, create a personal space in an unfamiliar environment, like an emotional blanket".

In addition to the responses to the interview questions, the participant offered the following statements;

"I would not have done this for myself. Having a music therapist forced me to do this. Practicing like in Lamaze class required me to practice".

"I wanted music off during transition. But, I thought if I had the music on when I got stuck while pushing I think I could have gotten through it faster".

"Having the layer of music at the hospital was protective".

CHAPTER 5: DISCUSSION

The purpose of this pilot study was to investigate the feasibility and preliminary data trends of music in increasing ambulation during active labor. The first question regarding feasibility was what percentage of eligible participants would consent. Although flyers were delivered to eight obstetrical clinics and the study was advertised on Facebook for four months, there was an extremely low response. There are several possible reasons for this. First, it is uncertain whether any of the doulas, midwives, childbirth educators, and physicians shared the information with their clients. The recruitment procedure did not include follow up measures with the providers. Another possible reason for low response may have been the requirements of the study, which included the co-primary investigator providing prenatal training sessions as well as attending part of the labor in the participant's home. For many women, this could be perceived as an invasion of privacy during a very intimate and intense experience. The idea of being observed during labor could have deterred participants who otherwise would have considered participating in music and movement training.

The second and third feasibility questions were regarding the extent to which the participant would implement the intervention during labor. While laboring at home, the mother implemented the intervention throughout the first music condition. However, during the second music condition, the mother ended the protocol 23-minutes early in order to transfer to the hospital. While laboring at the hospital, the mother implemented the intervention until she reached transition and then requested the music be turned off. The participant wore the FitBit Flex pedometer from the beginning of labor support and throughout the duration of labor and delivery.

The first research question related to the effect of the music therapy intervention on contraction frequency, length of second stage of labor, total length of labor, and birth outcome could not be answered due to several threats to internal validity. First, because there was only one participant, comparison between mothers to evaluate the effects of music on these variables could not be completed. To that end, the repeated measures design in this study proved less valuable than anticipated due to the numerous confounding variables involved with this population. Normal labor is a natural, physiological process and progresses naturally without intervention. The instruments used to collect physiological data could not possibly determine whether changes were due to music or other factors such as environment and nonpharmacological pain management including use of the Jacuzzi and support of the mother's partner and doulas.

The remaining research questions were related to perceived benefits as well as receptiveness by hospital staff. The participant provided positive responses regarding both the benefits and receptiveness of professional healthcare providers and the music and movement intervention. However, these responses should not be generalized outside of this preliminary study. With that, the data collected are promising enough to warrant future research using a larger sample.

Limitations

There were a number of limitations in this feasibility study. The sample was extremely small, limiting any generalization of results regarding feasibility and initial trends. Measurement of the data was also limited. The contraction frequency data during home labor support were collected through observation by the co-primary investigator and self-report from the participant, both of which were biased. Likewise, contraction frequency data were only collected

intermittently while the participant labored at the hospital. In addition, these data were collected through fetal monitoring and not human observation. Thus, it was impossible to compare the two settings. Finally, while the pedometer tracked movement, which resulted in a large amount of data, it was not possible to qualify the type of movements nor draw any conclusions regarding effects of the intervention. Likewise, this particular pedometer counted arm movements as well. Therefore, its level of sensitivity does not appear to be appropriate for this type of research.

Implications

Prior research on music therapy-assisted childbirth has primarily focused on passive uses of music therapy on relaxation, pain, and anxiety during labor. Similarly, research on movement in childbirth has not investigated the effects of music on movement. This feasibility study was the first investigation to look at both music and movement in childbirth. Though the effects of this intervention are yet to be determined, preliminary data are positive and future research with a larger sample and a more controlled design is needed.

Suggestions for Future Research

In this study, the co-primary investigator only attended two hours of the labor. Although the participant felt this was adequate, it did not allow sufficient data collection, which limited external validity. And while it can be difficult for researchers to attend spontaneous births, doing so would enable greater qualitative and quantitative data collection especially regarding specific movements as well as music selections used during labor. A survey of music therapists who attend births may provide valuable data on practical issues related to serving expectant mothers while also providing music therapy to other populations.

The most difficult component of this study was recruitment. The response rate was extremely low. Perhaps the number of participants would have been larger if the protocol had

included face-to-face meetings with midwives, physicians, childbirth educators, and doulas to review the study and then additional follow up communications to encourage recruitment. Furthermore, though the study was advertised on Facebook to expectant mothers, meeting with potential participants in person, such as at childbirth education classes, may have increased the sample size as well. Specifically, future recruitment efforts should include passing out flyers at medical offices and childbirth education classes. In addition, the option to complete the prenatal training in a class setting rather than privately might be more attractive to mothers.

This study attempted to determine the effects of music and movement on contraction frequency, length of labor, and birth outcome. Other possible variables that might be influenced by music and movement include fetal position and systemic levels of oxytocin. Determining to what extent music and movement affect these variables would prove valuable to mothers with malpositioned babies or labors progressing slowly.

The current investigation focused on unmedicated, spontaneous births. Research investigating the effects of music and movement on mothers who are being induced or whose labors are being augmented due to slow progress may also be valuable. In addition, it is not known how this intervention may affect mothers who use pharmacological pain management including epidurals. The use of music and movement by mothers with a low dose epidural may also be beneficial.

Finally, an important consideration for future research is study design. A large, randomized controlled trial with multiple groups could potentially identify the effects of music and movement. However, due to the natural variability of the labor process as well as other variables that can influence childbirth, it may not be possible to create truly comparable groups. Further analysis of existing research designs used in childbirth is warranted.

Conclusion

Music therapy-assisted childbirth services are not only beneficial for expectant mothers but this type of work is very rewarding for the practitioner providing this intervention. However, research has been limited not only by the number of studies investigating the use of music in childbirth, but also by the emphasis on passive music therapy interventions. The purpose of this pilot study was to determine whether this type of research is feasible and whether the initial trends in data support future, larger studies. In addition, this investigation reviewed the extent to which several instruments could measure the effects of a music and movement intervention. The outcomes of this study should not be generalized to use in clinical practice. Rather, the preliminary data gathered from this single case study provide a promising rationale to increase the current research base, re-evaluate research design with this unique population, and analyze active uses of music therapy-assisted childbirth. Future research may also serve to inform practitioners regarding the underlying mechanisms of music and movement in childbirth and possibly other populations.

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APPENDIX A:

Contact Log

Name, phone, email	Estimated Due Date, Parity	Type of labor and delivery planned (i.e.unmedicated vaginal)	Where do you plan to labor? Where do you plan to deliver?

APPENDIX B:

Data Collection Form: HOME labor observation

Date:
Participant:
Estimated Due Date:
How far along is participant? _____ weeks _____ days

Labor Support Start Time: End Time:

Condition 1 (no music 30-minutes): Start time: End Time:

Did participant wear the pedometer throughout? Yes No
If "no", what time was the device removed?
Did participant leave music *off* throughout? Yes No
If "no", what time was the music turned on?

Circle any movements observed during this condition:
Walking Swaying Hip Circles Pelvic Rocking

Birth Ball Partner dancing

Contraction Log:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:

Condition 2 (music 30-minutes): Start time: End Time:

Did participant wear the pedometer throughout? Yes No
If "no", what time was the device removed?
Did participant leave music *on* throughout? Yes No
If "no", what time was the music turned off?

Circle any movements observed during this condition:
Walking Swaying Hip Circles Pelvic Rocking

Birth Ball Partner dancing

Contraction Log:

Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:
Start time: End time:

Condition 1 (no music 30-minutes): Start time: End Time:

Did participant wear the pedometer throughout? Yes No

If "no", what time was the device removed?

Did participant leave music *off* throughout? Yes No

If "no", what time was the music turned on?

Circle any movements observed during this condition:

Walking Swaying Hip Circles Pelvic Rocking

Birth Ball Partner dancing

Contraction Log:

Start time: End time:
Start time: End time:
Start time: End time:
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Start time: End time:
Start time: End time:

Condition 2 (music 30-minutes): Start time: End Time:

Did participant wear the pedometer throughout? Yes No

If "no", what time was the device removed?

Did participant leave music *on* throughout? Yes No

If "no", what time was the music turned off?

Circle any movements observed during this condition:

Walking Swaying Hip Circles Pelvic Rocking

Birth Ball Partner dancing

Contraction Log:

Start time:	End time:
Start time:	End time:
Start time:	End time:
Start time:	End time:
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Start time:	End time:
Start time:	End time:
Start time:	End time:
Start time:	End time:

APPENDIX C:

Data Retrieved from Medical Record

Participant:

Who completed this form? Participant Co-investigator

Time and date of hospital admission and discharge:

Length of first stage of labor:

Length of second stage of labor:

Method of delivery: Vaginal Assisted Vaginal Cesarean Section

Infant Apgar Scores: First Set __/10 Second Set ___/10

Medications received and requested during labor (list all oral and IV medications and time given):

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication:

Time recorded: Medication

Position and ambulation behavior documented by staff:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

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Time recorded: Position:

Time recorded: Position:

Time recorded: Position:

Maternal vital signs (indicate which vital sign and the measurement)

Time recorded: Vital Sign

Time recorded: Vital Sign

Time recorded: Vital Sign

Time recorded: Vital Sign

Time recorded: Vital Sign

Time recorded: Vital Sign

Time recorded: Vital Sign

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Time recorded:	Vital Sign
Time recorded:	Vital Sign
Time recorded:	Vital Sign
Time recorded:	Vital Sign
Time recorded:	Vital Sign
Time recorded:	Vital Sign

Information from electronic fetal monitoring:

Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
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Time recorded:	Heart rate:	Contraction:
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Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:
Time recorded:	Heart rate:	Contraction:

APPENDIX D:

Post-Partum Questionnaire

Participant:

Date:

Delivery Date:

Number of days post-partum:

Interview Questions:

1. Do you feel the hospital staff were receptive to your use of music and movement?

YES NO

2. Did you use the music and movement technique at the hospital throughout labor?

YES NO

3. Did you wear the pedometer throughout labor at the hospital?

YES NO

4. Do you feel music and movement were beneficial at home?

YES NO

5. Do you feel music and movement were beneficial at the hospital?

YES NO

6. Do you feel music and movement were more beneficial in one setting or the other?

YES NO

7. Do you believe the support of the music therapist was beneficial?

YES NO

8. Do you feel the amount of time home labor support was provided by the music therapist was sufficient?

YES NO

9. What do you feel were the benefits of music and movement when used at home?

10. What do you feel were the benefits of music and movement when used at home?