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THE EFFECT OF MUSIC ON BLOOD PRESSURE, HEART RATE, AND RESPIRATORY RATE IN PREMATURE INFANTS

A Thesis

Presented for the

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Colleen Angela Lorch

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ABSTRACT

This investigation compared the effects of two different kinds of music, sedative, and stimulating, on premature infants in isolettes in an intensive care nursery. The physiological responses, consisting of systolic blood pressure, heart rate, and respiratory rate, were observed and measured for increases or decreases outside the resting range of each individual infant.

Ten premature infants between 33 and 35 weeks post conceptual age who were receiving oral feedings were selected as subjects from a Level III Intensive Care Nursery regional referral center. Infants with extensive medical complications were excluded from the study.

Infants were tested in the same isolette and at the same time of day. Infants were pretested for functional hearing, and music levels were presented at 80 decibels. Data was collected during a ten minute resting period prior to a ten minute musical intervention. Music sessions were presented on two consecutive days to prevent overstimulation.

Results were presented in individual figures demonstrating physiological responses and accompanying descriptions. Respiratory rates measured during musical intervention were observed to have the most frequent number of readings outside the resting range. The variable systolic blood pressure measured during musical intervention had the least frequent number of readings outside the resting range. There were no consistent patterns of increase or decrease during either

music intervention suggesting that multiple environmental variables may have impacted on the physiological parameters of these infants.

The premature infants studied were observed to be labile in all variables during resting and during both music intervention periods. There was no effect by music observed on lability. Lability was greater during respirations than during observations of heart rate and systolic blood pressure. Respiratory lability was observed 51 times as compared to 11 observations of heart rate lability and five observations of systolic blood pressure lability. Lability was observed in respiratory rate in all ten infants as compared to five infants who had lability observed in heart rate and five infants who had lability observed in systolic blood pressure.

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CHAPTER 1

INTRODUCTION

Improved technology, coupled with advances in medicine and nursing care, are providing infants born prematurely a better chance for survival. Because preterm infants have yet to reach the developmental level of their full-term counterparts, they face multiple problems, both medically and socially. Regional referral intensive care nursery units (ICNs) are in place in most large city hospitals providing isolettes and the medical procedures necessary for life support. The ICN environment in which premature infants begin their lives is extremely stimulating, visually, auditorily, and tactility.

The premature infant is constantly bombarded by numerous stimuli. These stimuli are often therapeutically necessary as in the case of heel sticks for blood gases, frequent turning to prevent pneumonia or contractures, suctioning to clear airways, provision of feedings and medications, and frequent assessments by personnel. However, some stimuli may be present that are not necessary for routine care. For example, infants are surrounded by bright lights 24 hours a day, they experience frequent touching and handling by medical personnel, and they inhabit an environment in which there is constant background noise. Certain stimuli such as sound and light are always present and there is a current trend to measure these stimuli levels. Research is

needed on the effects of these stimuli on physiological parameters of premature infants.

Background On Sensory Stimulation

Although an ICN environment yields many types of stimuli, sound is present continually. Sounds may be soft and soothing such as soft music or a parent or caregiver's voice. Conversely these sounds may also be loud such as high-pitched voices, laughter, doors opening and shutting, loud music playing, machine sounds, and babies crying.

During the early 1970s it was hypothesized that premature infants were deprived of sensory stimulation (Scarr-Salapatek & Williams, 1973). Yet, later studies found this was not the case. Lawson, Daum, and Turkewitz (1977) found acoustical stimuli present in 95% of their observations of premature infants; infants were handled 10% of the time; and illumination levels were always elevated. These data were supported in a later study by Gottfried, Hodgman, and Brown (1984) in a Los Angeles ICN. This study demonstrated that premature infants received large amounts of ongoing stimulation. Lighting did not vary from day to night, sound levels were between 70 to 118 decibels (dB), and premature infants had human contacts, such as handling, on the average of every 18 to 30 minutes.

The pattern of stimuli received by premature infants appears to be that of inappropriate stimuli rather than an inadequate amount (Klaus, Fanaroff, & Martin, 1986; Gottfried et al., 1984; Lawson et al., 1977; Linn, Horowtiz, & Fox, 1985). Inappropriate stimuli are those stimuli

present which are not necessary for growth and development and which may have a deleterious effect. An example of inappropriate stimuli might be the continual beep of the cardiac monitor or the loud banging that accompanies the garbage can emptying. Appropriate stimuli, such as social stimulation, are needed and utilized by the infant for growth and development. Gottfried, Hodgman, and Brown (1984) found that infants received infrequent social experiences. Contacts were almost exclusively oriented toward medical-nursing activities. Social touching, rocking, or talking to the infants occurred in less than one third of the contacts.

Sounds penetrate the isolette environment in which the premature infant resides. Moreover, isolettes themselves have a high noise level. The primary source of noise from isolettes is that of motor sound, compounded in many instances by noise from life-support systems (Bess, Peek, & Chapman, 1979; Blennow, Svenningsen, & Almquist, 1974). Low-frequency sound levels in isolettes have been measured at 70-80 decibels (dB) (Bess et al., 1979; Blennow et al., 1973; Falk & Farmer, 1973). Bess, Peek, and Chapman (1979) found in a study conducted at Vanderbilt Hospital, that life support systems increased the overall noise level in isolettes by 15 to 20 dB. Striking the side of the isolette caused the noise level to reach 130 to 140 dB. Opening the storage unit door caused the amplitude to reach 92.8 dB, while closing the same door caused the level to rise to 114 dB. An unfiltered scale which measures all sounds present was used for these measurements.

Neonates have been found to prefer low-frequency sounds, probably due to their similarity to sounds heard in the intrauterine environment (Watterson & Riccillo, 1985). Noise levels in utero have been measured at about 85 dB with peaks to 95 dB. External sound levels above 85 dB increased the fetal heart rate within five seconds (Linn, Horowitz, & Fox, 1985; Livingston, 1979).

Background of Music

The sound of music has been used in a variety of ways through time. Primitive man used sound as a means of communicating with the world of the spirits. Stories link music with Satan enticing men to his kingdom. Lorelei's songs led men to drown in the Rhine; Odysseus tells of the songs of the sirens as sailors listened and wrecked their ships on the rocks; and the Pied Piper of Hamelin led the children from town with his music (Alvin, 1975).

Music as a stimulus for healing has been used through the centuries (Alvin, 1975; Standley, 1986). Even in its simplest form, music can evoke many sensations, moods, and emotions. Music can reflect the actual mood of the moment and bring it to a climax, or change the mood simply by its presence (Alvin, 1975). As early as the 18th century musicians documented how moods were affected when humans were exposed to different types of music (Ostwald, 1966).

The first research done on the relationship between music and physiologic response was by Hyde (1924), who looked at the effect of different selections of music on the cardiovascular system. Other

studies have reported effects of music on respiration, heart rate, galvanic skin response, muscle tension, and brain waves. Generally these studies have shown that slow, quiet, nonvocal music decrease physiological response and faster music increase response. Results have been varied however and have not always achieved statistical significance (Standley, 1986).

Standley (1986) in a review of 30 articles measuring the effects of music during medical and dental treatments found that most of the research in this area had been done primarily since 1980. Standley concluded that reviewed music conditions seemed to be more beneficial than nonmusic conditions regardless of whether statistical significance was achieved. The parameters being measured showed less variation in neonates than in any other age group being measured when music was introduced. This effect was attributed to the lack of experience with music by infants.

Theoretical Framework

The theoretical framework used in this study is the Roy Adaptation Model. As humans move along a continuum from health to illness, they interact with their external (world) and internal (body) environments by adapting in positive or negative ways (Castledine, 1986; Roy, 1970; Roy, 1971). In this theoretical context premature infants can be viewed as adapting to their environment either in a positive or negative manner hence enhancing or deterring growth and development.

Roy's (1980) assumption is that every human being uses both innate and acquired mechanisms to respond and adapt to environmental stimuli. These responses can be observed, measured, or subjectively reported by assessing the adaptive zone of the individual (Galbreath, 1985). The adaptive zone is the range within which stimuli will elicit a positive response. Stimuli that occur outside this zone will elicit a negative response (Roy, 1970, 1980; Tiedeman, 1983). Roy divides these adaptive mechanisms into two types--regulator and cognator. The regulator process is autonomous and carried out by the nervous, hormonal, and immune systems, and by psychomotor parts of the body. The cognator process includes conscious thought and decision making and unconscious mental mechanisms (Chadderton, 1986; Galbreath, 1985). These two processes produce responses through four modes: basic physiological needs, self-concept, role function, and interdependence (Meleis, 1985; Roy, 1971; Tiedeman, 1983). These mechanisms may contribute to the integrity of the system by being adaptive, or disrupt the integrity of the system by being ineffective (Andrews & Roy, 1986; Chaddeton, 1986). A positive response favors better adaptation to a particular environment (Castledine, 1986).

According to Roy the environment of each person is influenced by three types of stimuli. Focal stimuli are those factors immediately confronting the person; contextual stimuli are all other stimuli present in the environment that may influence the person's current situation such as temperature or noise in the environment; and residual stimuli which are factors such as attitudes, traits, and previous experiences which

can be relevant to the current situation (Andrews & Roy, 1986; Castledine, 1986; Galbreath, 1985; Roy, 1970). Premature infants are impacted by all three types of stimuli and will need to interact and adapt to them.

Nurses act by assessing the positive and negative adaptive behaviors of the individual, and manipulating the focal, contextual, or residual stimuli to better facilitate wellness. Manipulating the environment protects individuals from excessive demands and increases their tolerance to a wider range of stimuli (Castledine, 1986; Chadderton, 1986; Galbreath, 1985; Roy, 1980).

The goal of nursing is to foster an adaptive state that affects health in positive ways (Galbreath, 1985; Roy, 1970). By assessing the premature infant's ability to adapt, regulator and cognator subsystems can be adjusted to maintain positive adaptation. The ICN environment is viewed as an external focal stimulus that demands a response from the individual that may be outside the adaptive zone. Changes in this particular focal stimulus can help elicit a positive response and promote wellness (Tiedeman, 1983).

How a premature infant handles a focal stimulus, music, while being influenced by the other stimuli present in an ICN, was the particular focus of this study. The mechanism that was measured was the physiological mode changes of the regulator processes used by premature infants as they interacted with their environment during the presentation of a musical stimulus.

Nominal Definition

The following terms are defined to clarify their meaning in the context of this study:

Decibel (dB). A logarithmic ratio to measure the magnitude of sound; audible sound is between 1-140 dB (Goldstein, 1978).

Stimulating Music. A primitive driving rhythm with detached notes and the use of percussion. This music induces thoughts and images of dance and physical movement (Gaston, 1951).

Sedative Music. Melodic passages of sustained notes which lack the use of percussion or strong rhythms. This music induces thoughtful, dreamlike, contemplative, and intellectual responses (Gaston, 1951).

Problem Statement

Recognizing that in usual ICN environments premature infants are exposed to various kinds of stimuli, the purpose of this study was to evaluate the response of premature infants to two types of music. Specifically, this investigation measured the systolic blood pressure, heart rate, and respiratory rate of premature infants when exposed to sedative and stimulating music.

Research Questions

On the basis of the literature review the following conclusions have been drawn: Intensive care nurseries are noisy environments (Bess et al., 1979; Blennow et al., 1974); premature infants in ICN environments are routinely subjected to various kinds of stimuli, both positive

and negative (Gottfried et al., 1984; Lawson et al., 1977); and physiological parameters in premature infants change when presented with various stimuli (Standley, 1986). Based on the conclusions generated from the literature related to premature infants and their ICN environments and the adaptation theory of Sister Callista Roy (1970), research questions regarding this study were formulated.

Question 1. What effects will sedative music have on systolic blood pressure, heart rate, and respiratory rate of a premature infant in an isolette in an Intensive Care Nursery?

Question 2. What effects will stimulating music have on systolic blood pressure, heart rate, and respiratory rate of a premature infant in an isolette in an Intensive Care Nursery?

CHAPTER 2

REVIEW OF LITERATURE

The physiological immaturity of premature infants places them at increased risk for biological and psychological disabilities. Due to the nature of early care given these infants, environmental stimuli are often inappropriate (Cornell & Gottfried, 1976). Nurses have the responsibility to observe and describe the therapeutic setting for the care of premature infants to determine what stimuli are present and how infants respond to these stimuli. This review of literature will address the effects of selected stimuli on premature infants, noise as it impacts on humans, and the specific stimulus of music and its effective use in medicine and nursing.

Effects of Stimuli On Infants

It has been established that premature infants in intensive care nurseries (ICNs) are bombarded by extensive environmental stimuli (Anderson, 1986; Blackburn, 1982; Cole, 1985; Cole & Frappier, 1985; Gottfried, 1985; Gottfried et al., 1984; Gottfried, Wallace-Lande, Sherman-Brown, King, & Coen, 1981; Lawson, Daum, & Turkewitz, 1977; Mann, Haddow, Strokes, Goodley, & Rutter, 1986; Newman, 1981, Oehler, 1985; Schaefer, Hatcher, & Barglow, 1980). However, sensory stimuli per se, are not completely detrimental to these infants. Studies have shown that sensory stimulation plays a crucial role in the infant's

neurological and physical maturation process (Katz, 1971; Klaus et al., 1986; Norris, Campbell, & Brenkert, 1982; Segall, 1972). Literature reviewed on effects of stimulation of low birth-weight infants demonstrated that stimulation can be good for premature infants, but the sensory input presented must be appropriate to the level of maturity of the infant's neurological system. After birth, the infant must organize his/her physiological functions and behaviors to respond appropriately to the extrauterine environment. Caregiving that these infants receive during this period influences how these behaviors are organized and how the infants will adapt. A low level of stimulation will allow the infant to become unresponsive, while a higher degree of stimulation promotes neural structure growth and maturation (Blackburn & Barnard, 1985; Segall, 1972). If premature infants are exposed to a stimulus before appropriate levels of development have been reached, effects of the stimulus will not be noticed as much because the infant will be unable to process the stimulus (Brazelton, 1981).

Embryologic and behavioral data suggest that fetuses perceive sounds in utero by the beginning of the third trimester (Linn et al., 1985). Several studies on infants born before term show the effects of auditory stimulation. For example, Berkson, Wasserman, and Behrman (1975) investigated heart rate response to an auditory stimulus of 86 decibels (dB) in 20 infants, 36-37 weeks post conceptual age. Infants were tested in isolettes. The auditory stimulus was a door buzzer which was presented for three seconds, at 30 second intervals, for ten trials. These tests were repeated weekly during the infant's entire

hospitalization. Results demonstrated a heart rate acceleration to auditory stimulation prior to 40 weeks post conceptual age. Other studies (Allen & Capute, 1986; Hack, 1983; Schulman, 1969) have shown the ability of premature infants, at various post conceptual ages, to respond to auditory stimuli by acceleration of heart rates and/or respiratory rates during sleep and wakefulness, even if there is documented neurological damage.

Brackbill, Adams, Crowell, and Gray (1966) replicated a 1960 Salk study to test for arousal levels in neonates using three auditory stimuli: heartbeats, metronome beats, and lullabies, and a control group with no auditory stimulation. Twenty-four normal neonates were presented these four conditions for fifteen minute periods. Results demonstrated decreased levels of arousal following continuous stimulation. This effect has been demonstrated by other researchers as well (Field, Dempsey, Hatch, Ting, & Clifton, 1979; Katz, 1971; Morrongiello & Clifton, 1984; Watterson & Ricillo, 1985).

There appears to be increasing evidence that auditory stimulation can be beneficial to premature infants. Benefits include weight gain, earlier hospital discharge (Chapman, 1983), enhanced auditory and visual responsiveness (Katz, 1971), advanced social and neurological development (Scarr-Salapatek & Williams, 1973), and decreased irritability and wakefulness (Segall, 1972). Following the review of the literature from 1965 to 1988, the immediate effects of sensory stimulation on physiological parameters was found to have not been systematically researched and reported.

Premature infants need to be assessed for overstimulation. Due to a lack of maturity, premature infants become easily overwhelmed by routine stimulation (Brazelton, 1981; Linn et al., 1985). For instance, a simple heel stick may force premature infants into coping models not conducive to recovery. Brazelton (1981) suggests evaluating how an infant handles stimulation by using the Neonatal Behavioral Assessment Scale. By increasing the degree of the stimulus, an infant can be assessed for individual thresholds. Cole (1985) took into account the increased fragility of the premature infant in refining Brazelton's scale for use with the premature infant, i.e., the Assessment of Preterm Infants' Behavior (APIB). This scale considers among other things, how a preterm infant's behavior can reflect approach or avoidance behaviors to a stimulus (Als, Lester, Tronick, & Brazelton, 1982).

Avoidance behaviors represent maneuvers from the infant that are directed away from the stimulus. Avoidance behaviors include spit-ups, gags, hiccups, bowel movements, grunting and straining, grimaces, trunkal arching, and finger splaying. Bodily movements such as, an airplane with arms extended out at the shoulder, saluting with arms fully extended into midair, and sitting on air with legs extended into midair, sneezing, yawning, sighing, coughing, averting eyes, and frowning are all described as avoidance measures (Als et al., 1982).

Approach behaviors represent maneuvers from the infant that are directed toward the stimulus. Approach behaviors include tongue extension, hand on face, sounds, hand clasp, foot clasp, finger fold, trunk tuck, body movement to a more flexed position, hand to mouth,

grasping, leg/foot brace, mouthing, such search, sucking, hand holding, "ooh" face, locking visually and/or auditorially, and emitting cooing sounds (Als et al., 1982). The preterm infant will regulate his/her behavior pattern by using avoidance and approach maneuvers. Maneuvers are viewed as being on a developmental continuum from the physiological system to the motor system to the attentional system. As each behavior is mastered, the infant can progress to another level of development.

Noise and Its Impact On Humans

Noise is inherent in environments and is impossible to eliminate. One of the first physiological responses to noise observed in both animals and humans is a reduction in blood flow at the arteriole level. This alteration occurs at sound levels of 85 to 90 dB. Vasoconstriction does not adapt over time; it occurs again with each exposure and persists after cessation of the stimulus, even during sleep (Ramsey, 1982).

An expected result of this vasoconstriction is an elevated systolic blood pressure. Rats subjected to intermittent but chronic auditory stimulation of 100 dB show an increase in systolic blood pressure within eight weeks. This phenomenon has also been demonstrated in monkeys and hypertensive patients exposed to 30 minutes of noise at 90 dB (Ramsey, 1982). Other effects of noise exposure on humans are increased gastrointestinal motility, decreased immune system response with an increase in susceptibility to viruses, and an increase in action

of epinephrine, catecholamines, glucocorticoids, and metabolic rate (Alvin, 1975; Ramsey, 1982).

As early as 1970 the Occupational Safety and Health Administration (OSHA) set standards for protection of humans from noise exposure. Any exposure above 90 dB for eight hours a day is considered unsafe in industrial situations, and protection needs to be provided (Federal Occupation Noise Regulations, 1975; Jauhiainen, Kohenen, & Jauhiainen, 1972). At sound levels above 80 dB for eight hours a day, a high percentage of humans will begin to show hearing impairment, usually due to hair cell damage in the cochlea of the ear (Jauhiainen et al., 1972; Ramsey, 1982).

Fortunately for premature infants, there are some mechanisms at work to provide protection against intense noise exposure. The ear anatomy itself may alter hearing function. The development of cochlear microscopic structure and some nerve myelinization continues postnatally in term infants as well as preterm infants (Linn et al., 1985). The eighth cranial nerve is immature and lacks nerve fiber diameter, dendrite branching and mature innervation patterns. The sensory receptor hair cells in the cochlea of a premature infant are not equal in maturity to those of an adult or even a term newborn. This maturation usually occurs by one year of age (Hecox, 1975; Salamy & McKean, 1976). A high incidence of middle ear effusion among premature and high-risk neonates creates a conductive hearing loss which also protects against harmful noises (Bess et al., 1979; Richmond, Kinkle, & Potsic, 1986; Salamy & McKean, 1976).

Music and Medicine

Any sound may evoke pleasant or unpleasant associations and subsequent responses. Sensation may occur in response to pitch, tone color, intensity, or duration (Alvin, 1978). It is not always possible to measure an emotional response to music, but one can assess the physiological response to vibrations. Physiological response depends upon many different variables--age, sex, environment, maturational level, circumstances, etc. (Alvin, 1975; Kopp, 1987).

Music has been used as an adjunct to medicine since 800 A.D. (Alvin, 1975). The invention of the phonograph and records increased music's availability, and use. Dr. Gatewood (1921) offered an explanation for the "neurological" basis for the beneficial effect of music. He stated that when two sensory stimuli enter the nervous system simultaneously they tend to neutralize each other with the strongest stimulus entering into a person's consciousness. Therefore, if an individual has his/her attention focused on music, this stimulus may exclude others.

A number of studies have been reported relating the effects of different kinds of music on mood and state anxiety in college students (Fisher & Greenberg, 1972; Gibbons & Tricker, 1987; Howard, 1985; Rohner & Miller, 1988; Shatin, 1970; Smith & Morris, 1976; Smith & Morris, 1977). Only Rohner and Miller (1988) reported that overall, music did not significantly reduce state anxiety. The other reports demonstrated an increase in anxiety, worry, aggression, and heart rate during playing of stimulating music as opposed to a decrease in these

variables during periods when calming music was played or periods without music. Stimulating and sedative music were defined in all these studies by using the classical definitions proposed by Gaston (1951). Stimulating music is a primitive driving rhythm with detached notes and the use of percussion. Sedative music is defined as melodic passages of sustained notes which lack the use of percussion or strong rhythms. All the studies involved the playing of music during test taking except Rohner and Miller (1988), who played their music between the taking of two separate tests, which might explain their different results.

Studies have also investigated the effectiveness of music in reducing stress related acting-out or disruptive behaviors in hospitalized children, such as crying, throwing objects, decreased verbalization, and increased body tension (Froehlich, 1984; Marley, 1984). Use of music was associated with an increase in the child's verbalization about stressful events as well as a decrease in other disturbing behaviors.

Music has been used in a variety of hospital settings in recent years. Brain injured children in a pediatric intensive care unit served as their own controls as they experienced two intervention: either the playing of sedative music via earphones or the application of earphones only with no music played. Heart rate, blood pressure, intracranial pressure, and finger temperature were measured during both interventions and were found to decrease with the music intervention (Wincek, 1986). Music has been used in childbirth education classes during exercises to promote relaxation, as well as in labor and delivery

as a diversion from discomfort (Clark, McCorkle, & Williams, 1981; Hanser, Larson, & O'Connell, 1983; Livingston, 1979).

Music has been used extensively to decrease anxiety during pre-operative teaching sessions as well as to decrease pain post-operatively (Chetta, 1981; Kopp, 1987; Rozzano & Locsin, 1981). Researchers working with burn patients (Christenberry, 1979), oncology patients (Cook, 1986), hospitalized adolescents (Henderson, 1983), autistic children (Alvin, 1978), and retarded boys (Reardon & Bell, 1970) have found music to be beneficial to treatment.

Most of the research on auditory stimulation in the fetus has been in countries other than the United States. Studies in Norway (Jensen, 1984a; 1984b; Jensen & Flottorp, 1982) and in Brazil (Luz, Lima, Luz, & Feldens, 1980) showed that fetal heart rates increased by as much as 10 to 40 beats per minute in response to sound stimulus of at least 80 dB as gestational age increased.

Olds (1985) studied twins in England and showed that the fetus hears music and can respond to it as early as 30 weeks gestational age. When piano music by Chopin was played by way of headphones placed on the mother's abdomen, twin B was still and had no heart rate change, while twin A moved away from the stimulus. When Faust by Gounod was then played, twin A moved back toward the stimulus with an increase in heart rate, while twin B moved away. How much of the heart rate pattern change was due to the maternal response or to the vibration of the stimulus is not really known. Mills (1978) and Olds

(1985) demonstrated some variability of the heart rate pattern in the fetus with sound stimulation by at least 26 weeks gestational age.

Chapman (1983) studied preterm infants in New York to assess the effect of auditory stimuli on gross limb activity. This study demonstrated that auditory stimulation was more effective in decreasing activity in these infants as opposed to only environmental sounds. All the infants (153) were tested in isolettes and were between 26 to 33 weeks post conceptual age. The experimental group (101) were presented auditory stimulation for five minutes six times a day from five days after birth until a minimum weight of 1800 grams was reached. One surprising result emerged from this study. Infants who had the musical auditory stimulation of Brahms Lullaby not only decreased limb activity, but reached a discharge weight of at least 2040 grams one week sooner than those infants who had as auditory stimulation their mother's voice on tape. It was hypothesized that music helped conserve the infants' energy and assisted in efficient caloric use resulting in a faster weight gain.

Music can also be considered beneficial to newborns by increasing weight gain, decreasing crying, conserving energy, and decreasing stress (Livingston, 1979; Segall, 1972; Smith & Steinschneider, 1975; Standley, 1986). Owen (1979) observed two groups of full-term newborns during their first three days of life to assess how music stimulation and routine environmental auditory stimulation affected them. There was no significant effect on daily weight loss, crying, or bodily movements of the arms, legs, or head. This study is problematic in

that there was some question as to whether the recorded weights were indeed accurate and the fact that the music played for the infants was at the 70 dB level, a level probably too low to be significant in its impact.

Summary

Noise is an auditory stimulus that is ever present in our society. Research has shown that some sensory stimulation is needed to assist in growth and development. Preterm infants, while needing this sensory stimulation, have mechanisms that protect against intense noise exposure. They also require constant observation to determine their tolerance and susceptibility level to sensory stimuli.

Studies demonstrate that infants in utero hear and respond to sensory stimuli. Documentation of various physiological parameters have demonstrated effects of different types of stimuli in utero. Even in the premature infant with protective mechanisms to block intense noise, changes in physiological parameters have been observed in response to auditory stimulation. These parameters have often been studied separately so that overall effects were not documented.

The clinical use of music in medicine has been heavily researched and documented over the past 20 years. Music can be an effective therapeutic agent even when the specific aspect that promotes healing is not known. Music has been shown to affect fetuses, neonates, and infants, but studies need to be implemented to determine exactly how basic physiological parameters are influenced.

CHAPTER 3

DESIGN AND METHODOLOGY

This study was designed to document alterations in premature infants' physiological functioning in response to two different types of music. A description of the design and methodology utilized in this study is presented in the following sections of this chapter: (a) research design, (b) operational definitions, (c) sample, and (d) procedure.

Research Design

The research design utilized in this study was an experimental, single-subject, repeated measures design. Each subject served as his/her own control, receiving the one independent variable, music. Music was either stimulating or sedative. Dependent variables were heart rate, systolic blood pressure, and respiratory rate.

Operational Definitions

Decibel (dB). A level of 80 dB was used as the top level of sound allowed in the isolette for this study. This falls below the range considered harmful to humans by OSHA. The sound levels were measured before and during the study with a General Radio type 1551-C sound level meter, calibrated to standards with a General Radio type 1562 sound level calibrator before use.

Sedative music. A pilot study by Howard (1985) using Gaston's (1951) definitions was the framework for music selection. Howard presented excerpts from 34 classical music selections to female college students who ranked the selections on a Likert type scale of 1 (sedative) to 9 (stimulative) based on rhythm, percussion, and detachment of notes. The selection rated most sedative, Beethoven's Piano Sonata #14 in C sharp minor, Op. 27, No. 2, was used as the sedative music in the present study. The Adagio Postenuto of movement I, Moonlight Sonata, was recorded on a six inch Sony tape from a compact disc from Decca records (1983).

Stimulating music. Howard's (1985) pilot study was also used in selecting this music. The selection rated as most stimulating, Khachaturian's Gayaneh Suite, Movement I, Sabre Dance, was used as the stimulating music in the present study. This selection was recorded on a six inch Sony tape from a compact disc from Chandos Records (1987).

Mean baseline. Mean baseline is defined in this study as the mean of the specified physiological parameter for a ten minute resting period immediately prior to the beginning of musical intervention for each baby.

Range. Range is defined in this study as the highest and lowest values observed during two ten minute resting periods preceding music intervention.

Lability. A range between two readings in either direction of more than 15 breaths during assessment of respiratory rate, 30 beats during

assessment of heart rate, and 22 mm/Hg during assessment of systolic blood pressure. These are arbitrary numbers calculated by figuring 75% of the range of normal values.

Normal values are:

Respirations--30-50 times per minute

Heart rate--120-160 beats per minute

Systolic blood pressure--40-70 mm/Hg

(Goldsmith & Karotkin, 1988).

Sample

The subjects for this study consisted of ten premature infants, six females and four males. Post conceptual age ranged from 33-35 weeks with a mean of 34.3 weeks. These subjects were selected from the infants in a 20 bed intermediate care unit of a level III ICN regional referral center in East Tennessee.

This study utilized nonprobability sampling. Criteria for selection as subjects in this study included post conceptual age of 32 to 36 weeks and receiving oral feedings. Infants with the following medical conditions were excluded from the study: infections, congenital malformations, intracranial hemorrhages, respiratory disease caused by prematurity, seizure activity, or hearing deficits. Infants who were having assisted ventilation via a respirator or receiving ototoxic drugs were also excluded.

Once it was determined that an infant met the above criteria, the parents were contacted and given a full explanation of the study and

were informed that participation in the investigation was voluntary. Parents were told that identities of infants would not be released. Primary care givers retained responsibility for care of the infants during the study. After parental questions were answered, a written consent form was signed (see Appendix A).

Procedures

Before an infant was included in the study, a certified audiologist pretested the infant to make sure auditory development was consistent with normal hearing. The auditory brain stem response (ABR), a non-invasive clinical procedure routinely done on every infant in the ICN, was used to test for normal hearing. All ten infants passed the ABR test. If an infant had failed the ABR test, he/she would have been excluded from the study.

Subjects were orally fed one and one half to two hours before any intervention was started. Some of the infants were receiving care in isolettes at the time of the study, and some were in bassinettes. In order to keep the conditions constant infants were placed in the same isolette for testing. An Airshield single-wall isolette model C-86, was used for each testing procedure. Infants were placed in the isolette dressed in a gown and diaper and wrapped in a blanket to prevent heat loss.

Immediately before each intervention, the sound level in the isolette was tested and each time was 58 dB. This level was used to determine the volume level necessary for the musical stimulation. The music level was to be calibrated at approximately 20 dB above this

initial level. The music presented to the infants was calibrated and presented at 80 dB.

Two types of music were presented to each subject: sedative and stimulating. The order of music played was counterbalanced across subjects, and presented in two ten minute sessions on two consecutive days to prevent overstimulation of subjects.

A General Electric mini cassette was placed six inches from the sound level meter microphone and the subject's head. The one inch sound level meter microphone was placed three and one half inches into the isolette. A neonatal blood pressure cuff was placed on the subject's left arm and connected to a Dinamap Neonatal Vital Sign Monitor No. 1846 (Critikon). Any clothing around the chest wall was removed so the researcher could have a full view of the infant's chest to count respirations. No other medical or nursing interventions were performed during the testing period.

A ten minute baseline measurement of the variables, heart rate, blood pressure, and respiratory rate was obtained before music intervention was instituted. Heart rate, and systolic blood pressure were recorded every one minute by the Dinamap monitor. Respiratory rates were counted every minute by the researcher (15 seconds X 4). There was no attempt made to control overall noise levels in the nursery during the test period. All of the subjects were tested between three and five o'clock in the afternoon.

Certain guidelines were established to reduce any risk to the infant. Intervention was to be immediately discontinued and the infant

withdrawn from the study if any of the following occurred: heart rate of 200 beats per minute (normal--120-160 bpm); respiratory rate of 100 breaths per minute (normal--30-50 breaths per minute); systolic blood pressure of 100 mm/Hg (normal--40-70 mm/Hg) (Goldsmith & Karotkin, 1988). Sound levels in the isolette were continuously monitored to keep exposure at or under 80 dB. Decibel levels for each piece of music are presented in Figure 1.

Data from each individual subject will be presented in figures in Chapter 4. Alterations in each variable will be described as well as variations observed during the two music interventions for each subject.

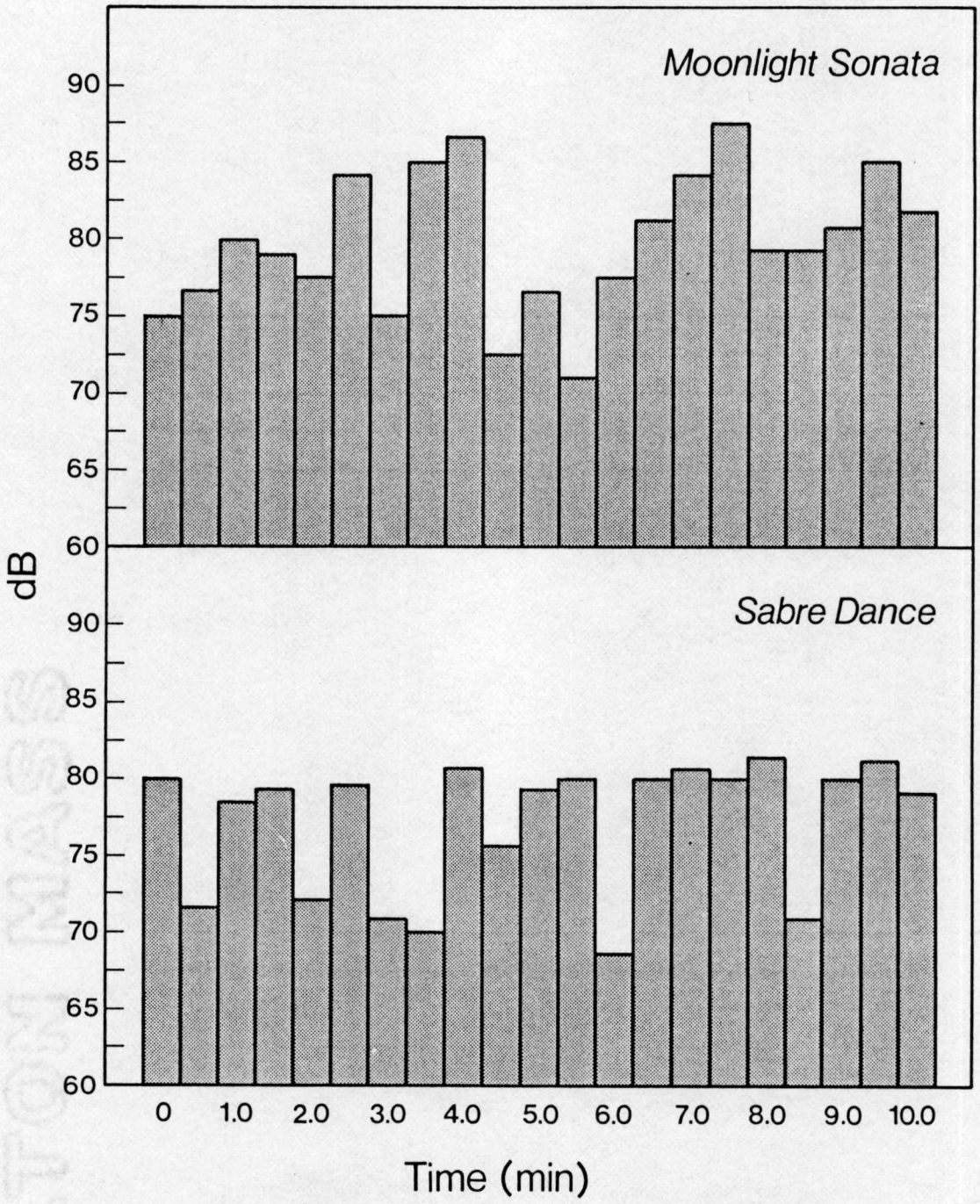

Figure 1. Decibel levels of music.

CHAPTER 4

RESULTS

Because of the small sample size and the nature of the research design, inferential statistical procedures were not employed to analyze data. The research questions were addressed by comparing respiratory rate, heart rate, and systolic blood pressure, of each infant during music intervention to the resting range of each infant. Readings falling outside this range were compared to the mean baseline of the music during which it occurred. The lability of the infants during resting and music intervention was also described. Figures are used to present data. Both sedative and stimulating music intervention observations are presented on the same graph to allow for comparisons.

Baby 1

Baby 1's response is presented in Figure 2. During sedative music intervention, five respiratory rate readings were observed above the upper limit of the resting range. These readings varied from 12 to 28 respirations per minute above the baseline mean for sedative music. There were no respiratory rate readings during stimulating music intervention that were observed outside the resting range. Lability was observed during four resting readings with a range of 16 to 32 respirations. Lability was observed during four stimulating music

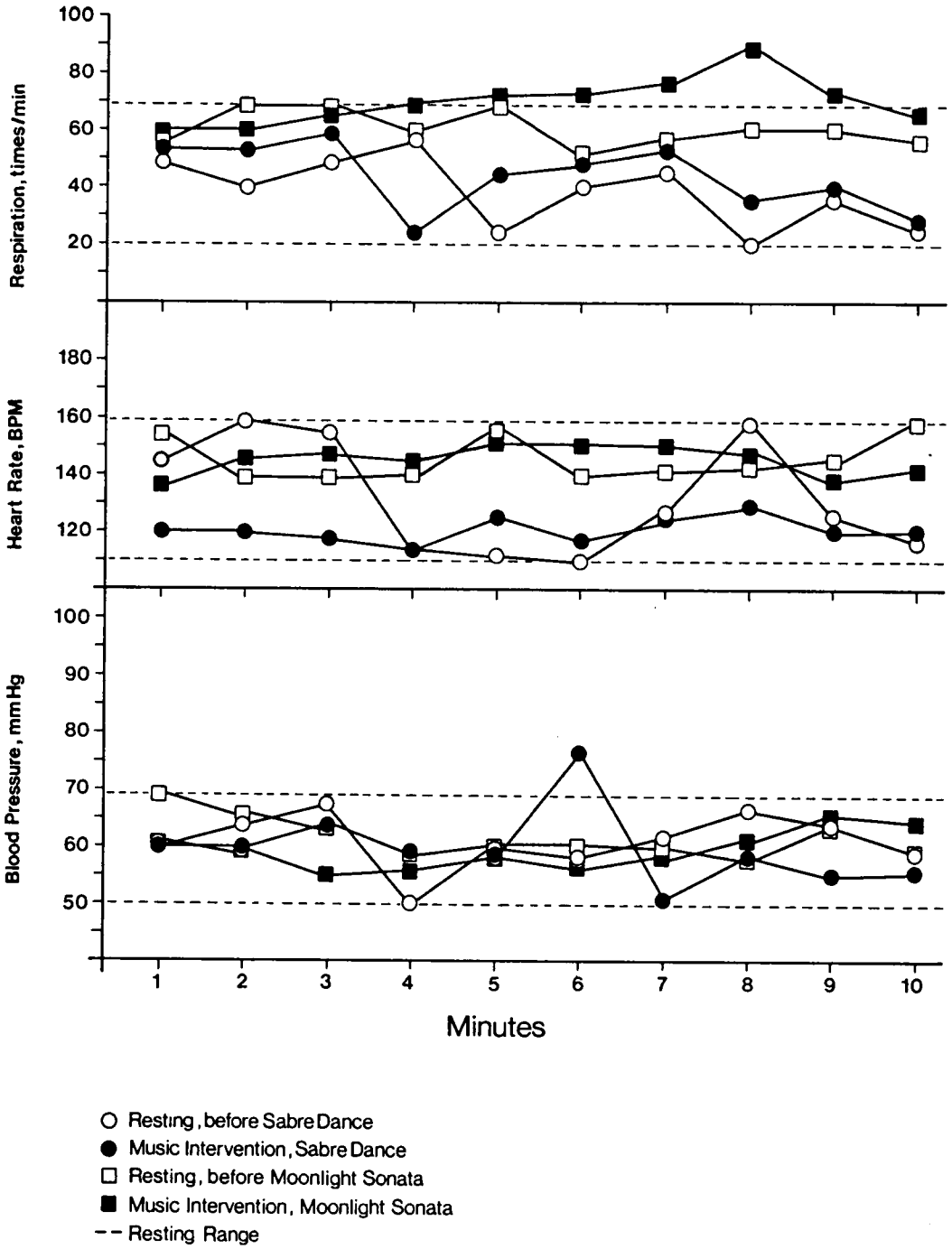

Figure 2. Baby 1.

intervention readings with a range of 16 to 34 respirations, but was not observed during sedative music interventions.

Baby 1 did not have any heart rate readings observed outside the resting range during either music intervention. Lability was observed during three resting readings with a range of 32 to 43 beats, but was not observed during either music intervention.

Baby 1 had one systolic blood pressure reading during stimulating music intervention above the upper limit of the resting range. This reading was 15 mm/Hg above the baseline mean for stimulating music. There were no systolic blood pressure readings outside the resting range during sedative music intervention. Lability was not observed during resting or sedative music intervention, but was observed once during stimulating music intervention with a 25 mm/Hg variation.

Baby 2

Baby 2's response is presented in Figure 3. Baby 2 had eight respiratory rate readings above the upper limits of the resting range during sedative music intervention. These responses were between nine and 17 respirations per minute above the baseline mean for sedative music, but six of these readings were only four respirations above the upper limit of the range. There were no respiratory rate readings outside the resting range for stimulating music. Lability was observed during six resting readings with a range of 16 to 20 respirations. Lability was not observed during sedative music but was observed twice

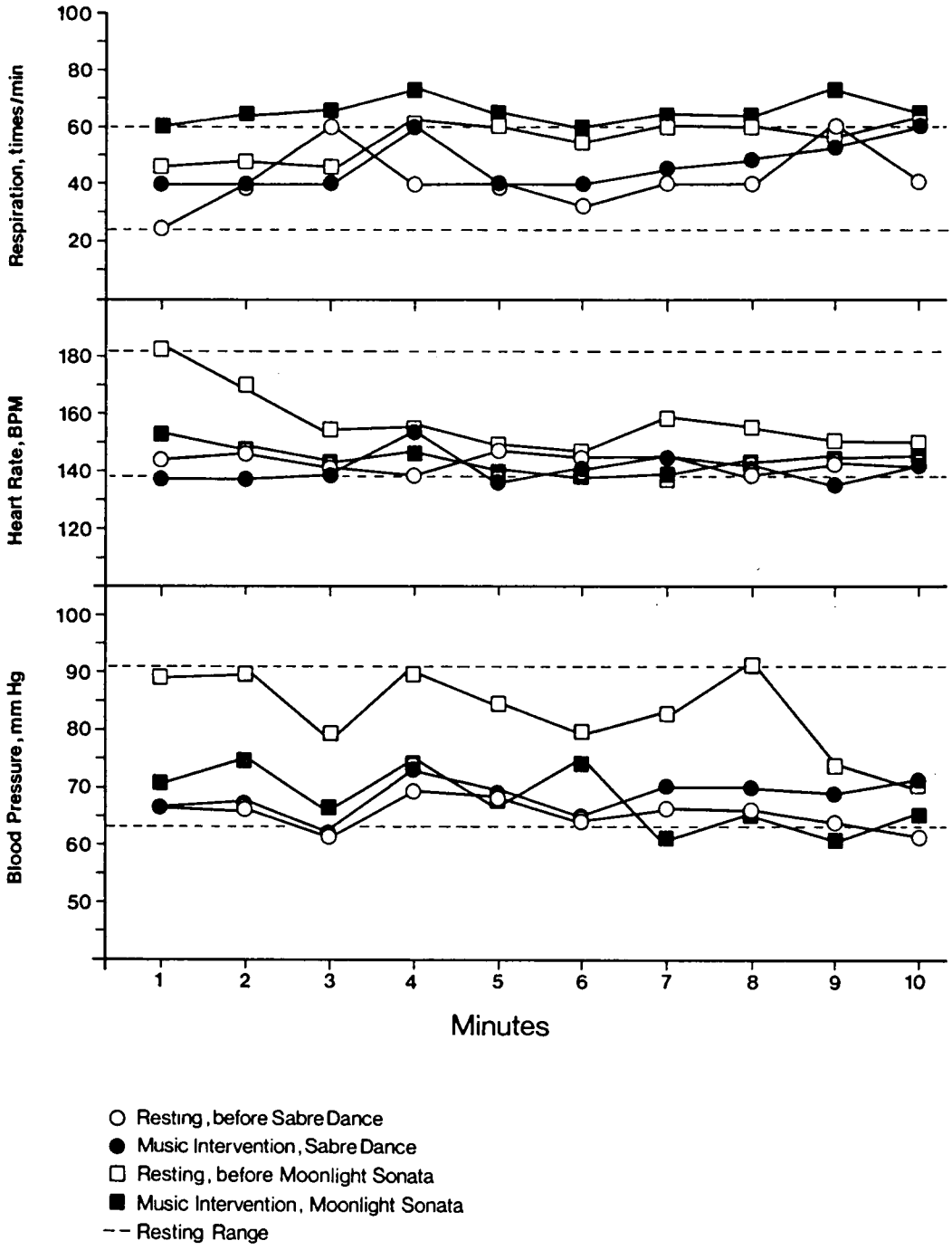

Figure 3. Baby 2.

during stimulating music intervention, both times with a variation of 20 respirations.

Baby 2 had two heart rate readings below the lower limit of the resting range during stimulating music intervention. These readings were both six beats per minute below the baseline mean for stimulating music, but were only two beats per minute below the range. There were no heart rate readings observed outside the resting range during sedative music. Lability was not observed during resting or either music intervention.

Baby 2 had two systolic blood pressure readings below the lower limit of the resting range during sedative music intervention. These readings were between 21 and 22 mm/Hg below the baseline mean for sedative music, but were only 1 and 2 mm/Hg below the lower limit of the range. There were also two systolic blood pressure readings below the lower limit of the resting range during stimulating music intervention. These readings were both 6 mm/Hg below the baseline mean for stimulating music, but were only 1 mm/Hg below the lower limit of the range. Lability was not observed during resting or either music intervention.

Baby 3

Baby 3's response is presented in Figure 4. Baby 3 had ten respiratory rate readings above the upper limits of the resting range during sedative music intervention. These readings were between 20 and 40 respirations per minute above the baseline mean for sedative

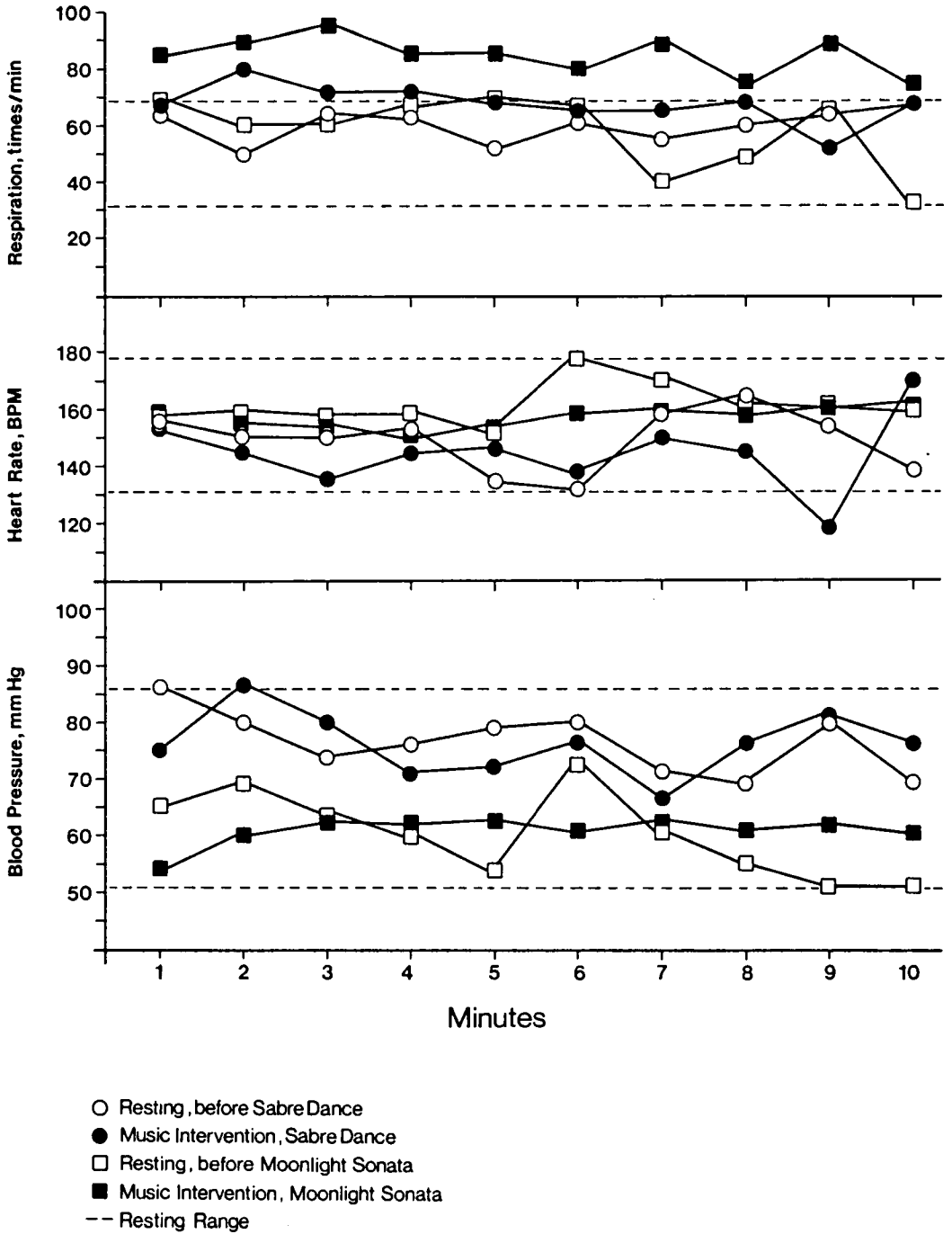

Figure 4. Baby 3.

music. Baby 3 had three respiratory rate readings above the upper limits of the resting range during stimulating music intervention. These readings were between 12 and 20 respirations per minute above the baseline mean for stimulating music. Two of these readings were four respirations per minute above the upper limit of the range. Lability was observed during three resting readings with a range of 16 to 32 respirations. Lability was observed during two stimulating music intervention readings, both times with a variation of 16 respirations.

Baby 3 had one heart rate reading below the lower limits of the resting range during stimulating music intervention. This reading was 29 beats per minute below the baseline mean for stimulating music. There were no heart rate readings observed outside the resting range during sedative music intervention. Lability was not observed during resting or sedative music intervention. Lability was observed in one reading during stimulating music intervention with a variation of 51 beats per minute.

Baby 3 did not have any systolic blood pressure readings outside the resting range during either music intervention. Lability was not observed during resting or either music intervention.

Baby 4

Baby 4's response is presented in Figure 5. Baby 4 had two respiratory rate readings below the lower limits of the resting range during sedative music intervention. These readings were 14 to 30 respirations per minute below the baseline mean for sedative music.

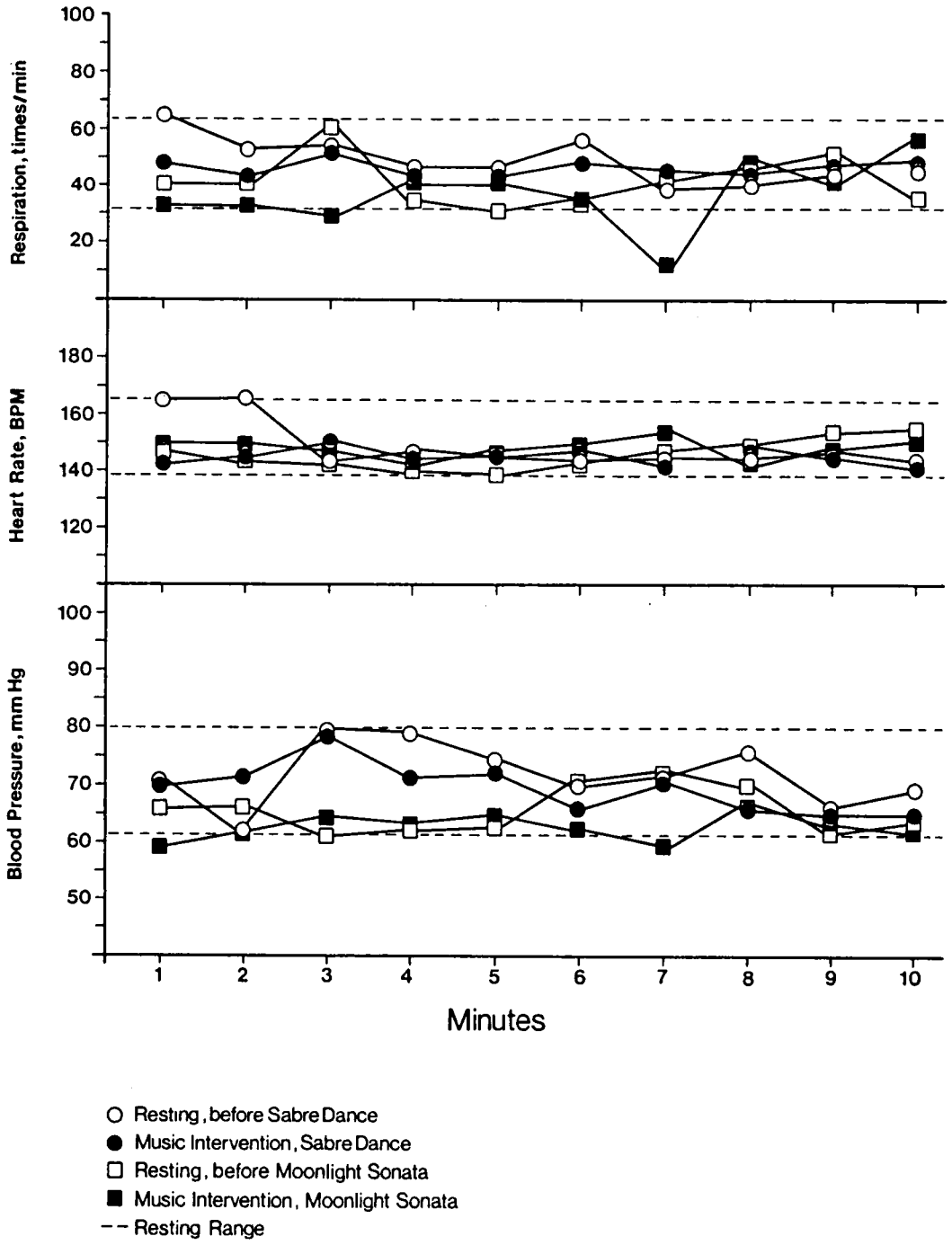

Figure 5. Baby 4.

One reading was four respirations per minute below the lower limit of the range. There were no respiratory rate readings outside the resting range during stimulating music intervention. Lability was observed during four resting readings with a range of 16 to 24 respirations. Lability was observed during three sedative music intervention readings with a range of 16 to 36 respirations, but was not observed during stimulating music intervention.

Baby 4 did not have any heart rate readings observed outside the resting range during either music intervention. Lability was not observed during resting or either music intervention.

Baby 4 had two systolic blood pressure readings observed below the lower limits of the resting range during sedative music intervention. These readings were 7 and 8 mm/Hg below the baseline mean for sedative music, but only 3 and 4 mm/Hg below the lower limit of the range. Lability was not observed during resting or either music intervention.

Baby 5

Baby 5's response is presented in Figure 6. Baby 5 had six respiratory rate readings below the lower limits of the resting range during sedative music intervention. These readings were 12 to 16 respirations per minute below the baseline mean for sedative music. Five of these readings were four respirations per minute below the lower limit of the range. There was also one respiratory rate reading below the lower limits of the resting range during stimulating music

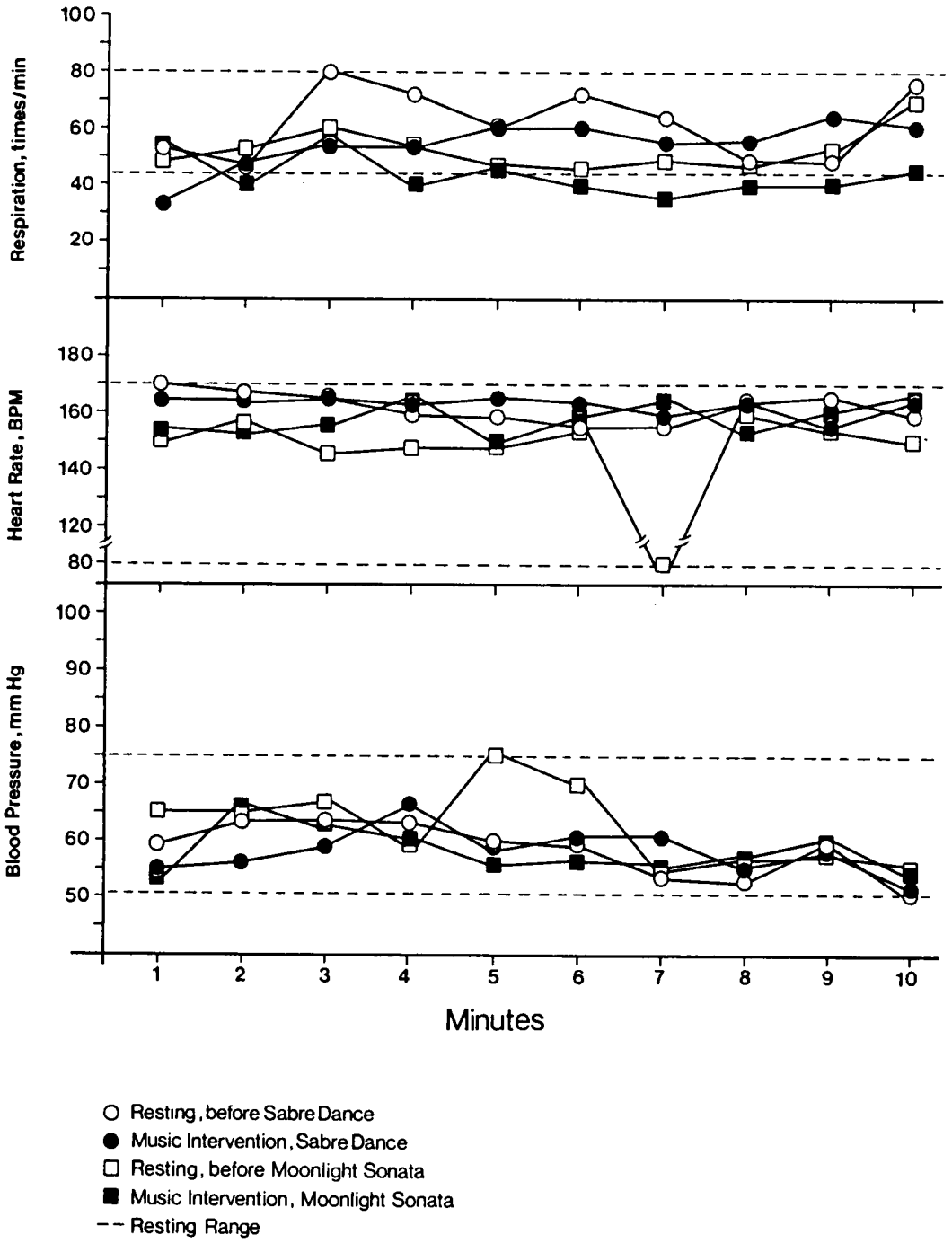

Figure 6. Baby 5.

intervention. This reading was 30 respirations per minute below the baseline mean for stimulating music. Lability was observed in four resting readings with a range of 16 to 32 respirations. Lability was observed once during stimulating music intervention with a variation of 16 respirations but was not observed during sedative music intervention.

Baby 5 did not have any heart rate readings outside the resting range during either music intervention. Lability was observed during two resting readings with a range of 76 to 79 beats per minute, when the heart rate dropped to 80 beats per minute. Lability was not observed during either music intervention.

Baby 5 did not have any systolic blood pressure readings outside the resting range during either music intervention. Lability was not observed during resting or either music intervention.

Baby 6

Baby 6's response is presented in Figure 7. Baby 6 had two respiratory rate readings below the lower limits of the resting range during stimulating music intervention. These readings were 13 respirations per minute below the baseline mean for stimulating music, but were only four respirations per minute below the lower limit of the range. There were no respiratory rate readings outside the resting range during sedative music intervention. Lability was observed during three resting readings with a range of 16 to 20 respirations. Lability was observed during two stimulating music intervention readings with a

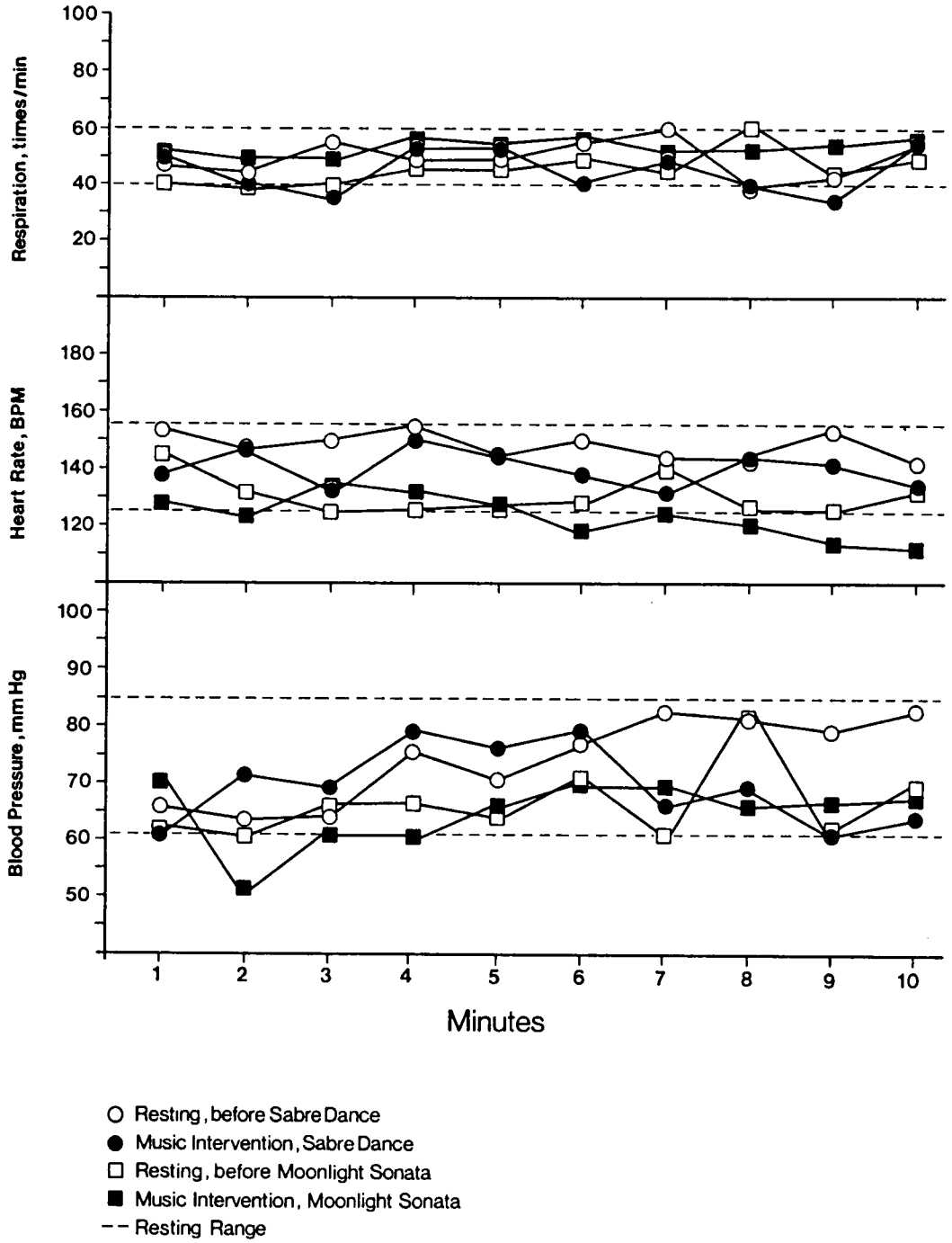

Figure 7. Baby 6.

range of 16 to 18 respirations, but was not observed during sedative music intervention.

Baby 6 had five heart rate readings below the lower limits of the resting range during sedative music intervention. These readings were eight to 19 beats per minute below the baseline mean for sedative music. Lability was not observed during resting or either music intervention.

Baby 6 had one systolic blood pressure reading below the lower limits of the resting range during sedative music intervention. This reading was 15 mm/Hg below the baseline mean for sedative music. Lability was not observed during resting or either music intervention.

Baby 7

Baby 7's response is presented in Figure 8. Baby 7 had four respiratory rate readings below the lower limits of the resting range during sedative music intervention. These readings were 16 to 20 respirations per minute below the baseline mean for sedative music. Two of these reading were four respirations per minute below the lower limit of the range. There were no respiratory rate readings observed outside the resting range during stimulating music intervention. Lability was observed during four resting readings with a range of 16 to 24 respirations. Lability was observed during three sedative music intervention readings all with a variation of 16 respirations, but was not observed during stimulating music intervention.

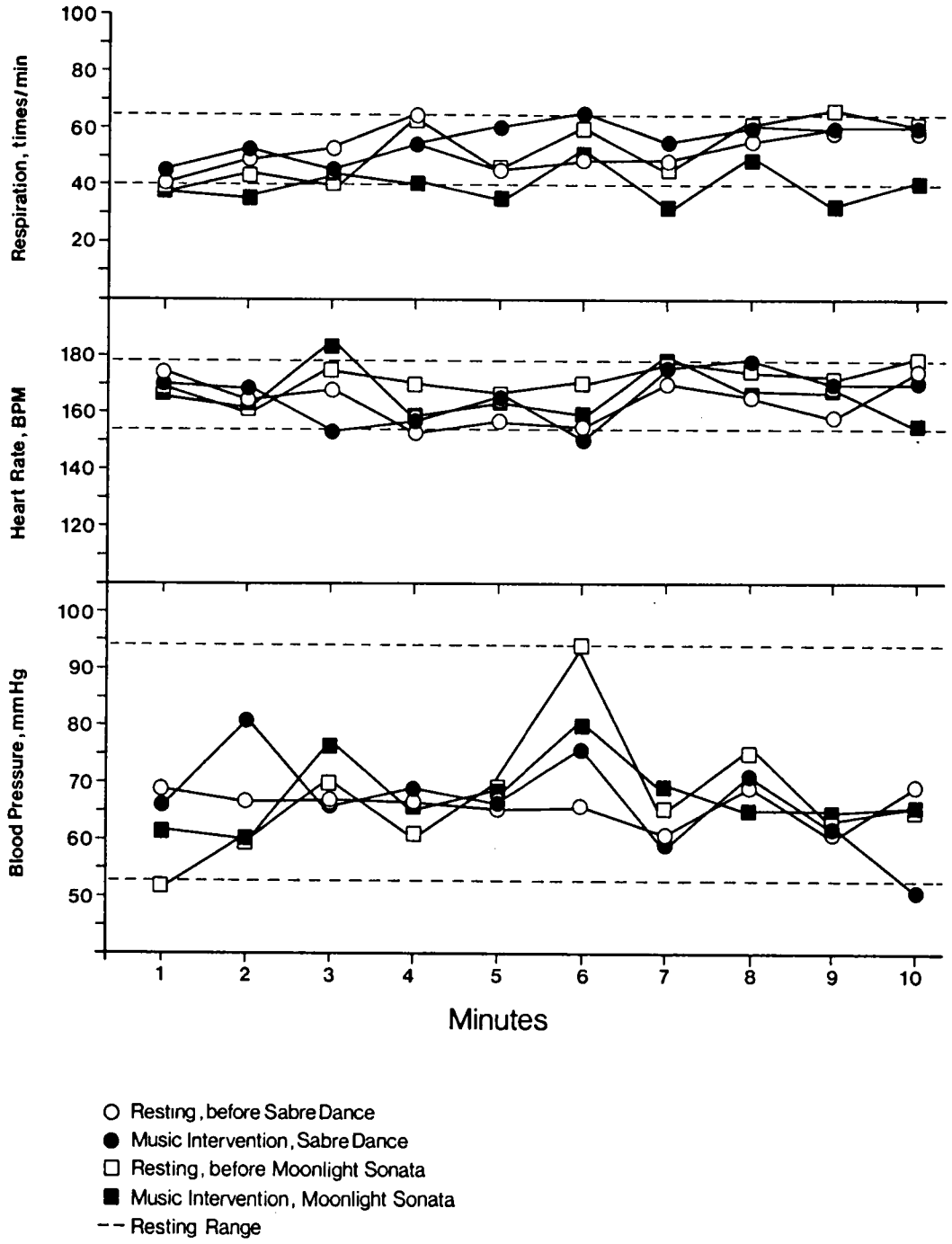

Figure 8. Baby 7.

Baby 7 had one heart rate reading above the upper limits of the resting range during sedative music intervention. This reading was 12 beats per minute above the baseline mean for sedative music, but was only four beats per minute above the upper limit of the range. Baby 7 also had one heart rate reading below the lower limits of the resting range during stimulating music intervention. This reading was 14 beats per minute below the baseline mean for stimulating music, but was only three beats per minute below the lower limit of the range. Lability was not observed during resting or either music intervention.

Baby 7 had one systolic blood pressure reading below the lower limits of the resting range during stimulating music intervention. This reading was 15 mm/Hg below the baseline mean for stimulating music, but only 2 mm/Hg below the lower limit of the range. Lability was observed during two resting readings with a range of 28 to 29 mm/Hg, but was not observed during either music intervention.

Baby 8

Baby 8's response is presented in Figure 9. Baby 8 had six respiratory rate readings above the upper limits of the resting range during stimulating music intervention. These reading were 11 to 23 respirations per minute above the baseline mean for stimulating music. Two of these reading were four respirations per minute above the upper limit of the range. Baby 8 also had one respiratory rate reading below the lower limits of the resting range during sedative music intervention. This reading was 11 respirations per minute below the baseline mean for

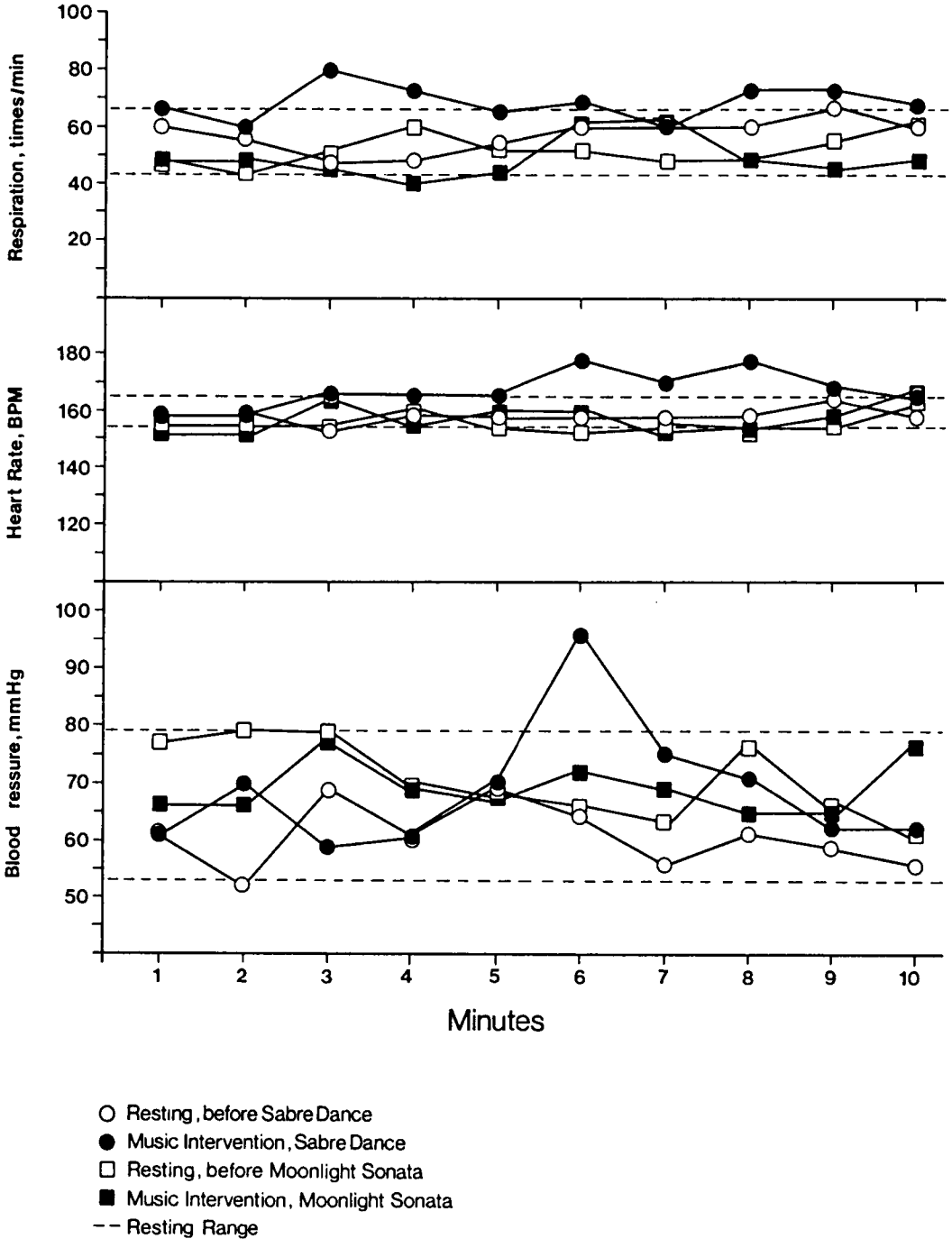

Figure 9. Baby 8.

sedative music, but only four respirations per minute below the lower limit of the range. Lability was observed during two stimulating music intervention readings, both times with a variation of 16 respirations, and one reading during sedative music intervention with a variation of 20 respirations. Lability was not observed during resting.

Baby 8 had five heart rate readings above the upper limits of the resting range during stimulating music intervention. These readings were seven to 19 beats per minute above the baseline mean for stimulating music. Two of these readings were three beats per minute above the upper limit of the range. There was also one heart rate reading above the upper limits of the resting range during sedative music intervention. This reading was 11 beats per minute above the baseline mean for sedative music, but only three beats per minute above the upper limit of the range. Lability was not observed during resting or either music intervention.

Baby 8 had one systolic blood pressure reading above the upper limits of the resting range during stimulating music intervention. This reading was 35 mm/Hg above the baseline mean for stimulating music. There were no systolic blood pressure readings outside the resting range during sedative music intervention. Lability was observed once during stimulating music intervention with a variation of 26 mm/Hg. Lability was not observed during resting or sedative music intervention.

Baby 9

Baby 9's response is presented in Figure 10. Baby 9 had one respiratory rate reading below the lower limits of the resting range during sedative music intervention. This reading was 11 respirations per minute below the baseline mean for sedative music, but was only four respirations per minute below the lower limit of the range. There were no respiratory rate readings outside the resting range during stimulating music intervention reading with a variation of 16 respirations. Lability was not observed during resting or sedative music intervention.

Baby 9 had one heart rate reading above the upper limits of the resting range during sedative music intervention. This reading was 30 beats per minute above the baseline mean for sedative music. There were no heart rate readings outside the resting range during stimulating music intervention. Lability was not observed during resting or stimulating music intervention. Lability was observed in two sedative music intervention readings with a range of 38 to 47 beats.

Baby 9 had one systolic blood pressure reading below the lower limits of the resting range during sedative music intervention. This reading was 30 mm/Hg below the baseline mean for sedative music, but was only 5 mm/Hg below the lower limit of the range. There were no systolic blood pressure readings outside the resting range during stimulating music intervention. Lability was observed during one sedative music intervention reading with a variation of 24 mm/Hg. Lability was not observed during resting or stimulating music intervention.

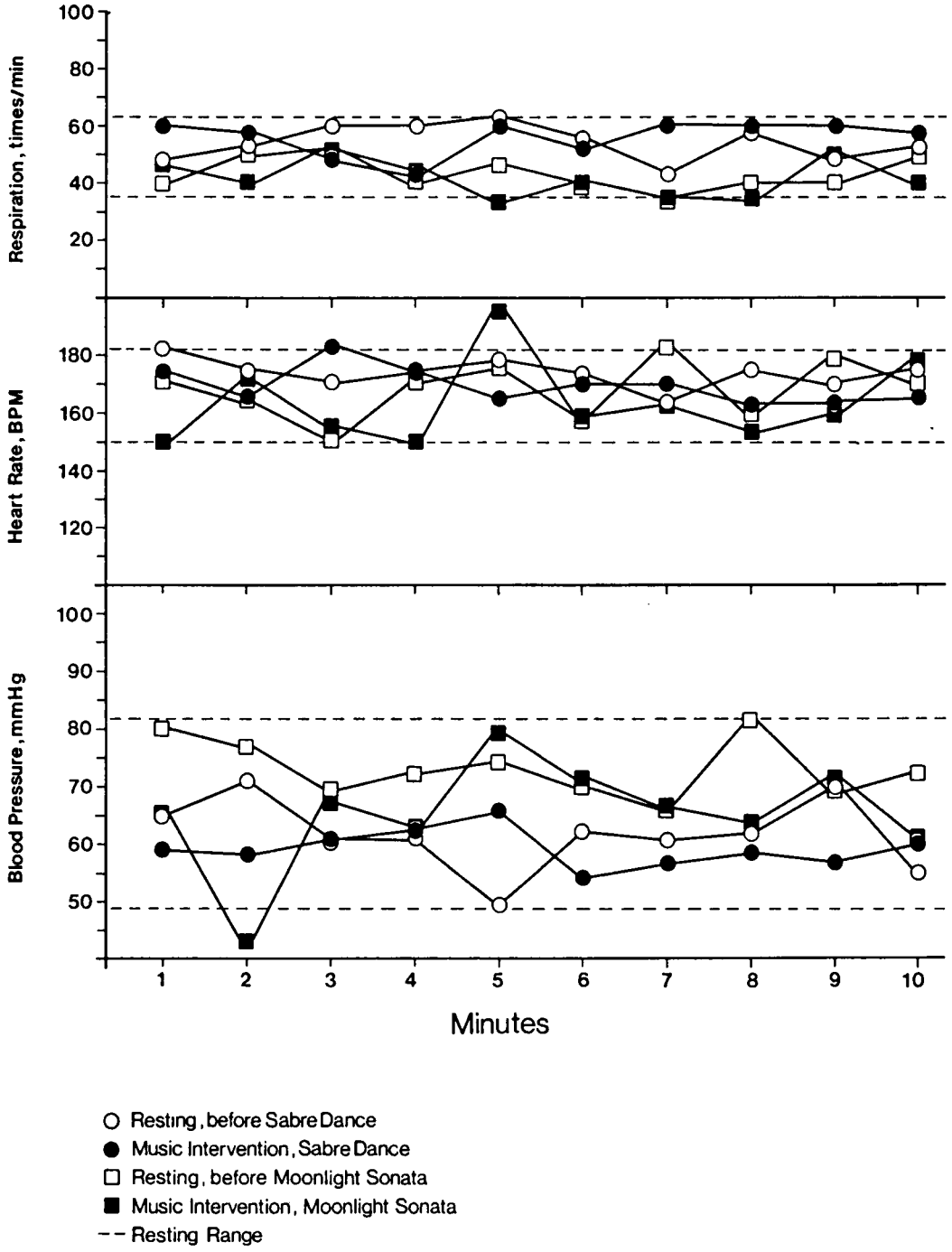

Figure 10. Baby 9.

Baby 10

Baby 10's response is presented in Figure 11. Baby 10 had no observed respiratory rate readings outside the resting range during either music intervention. Lability was observed during two resting readings, both times with a variation of 16 respirations. Lability was not observed during either music intervention.

Baby 10 had four heart rate readings above the upper limits of the resting range during sedative music intervention. These reading were between eight and 23 beats per minute above the baseline mean for sedative music. There were no observed heart rate readings outside the resting range during stimulating music intervention. Lability was observed during three sedative music intervention readings with a range of 31 to 37 beats. Lability was not observed during resting or stimulating music intervention.

Baby 10 had one systolic blood pressure reading above the upper limits of the resting range during sedative music intervention. This reading was 16 mm/Hg above the baseline mean for sedative music, but was only 1 mm/Hg above the upper limit of the range. There were no observed systolic blood pressure readings outside the resting range during stimulating music intervention. Lability was not observed during resting or either music intervention.

Summary

The findings are discussed in relation to the original research questions:

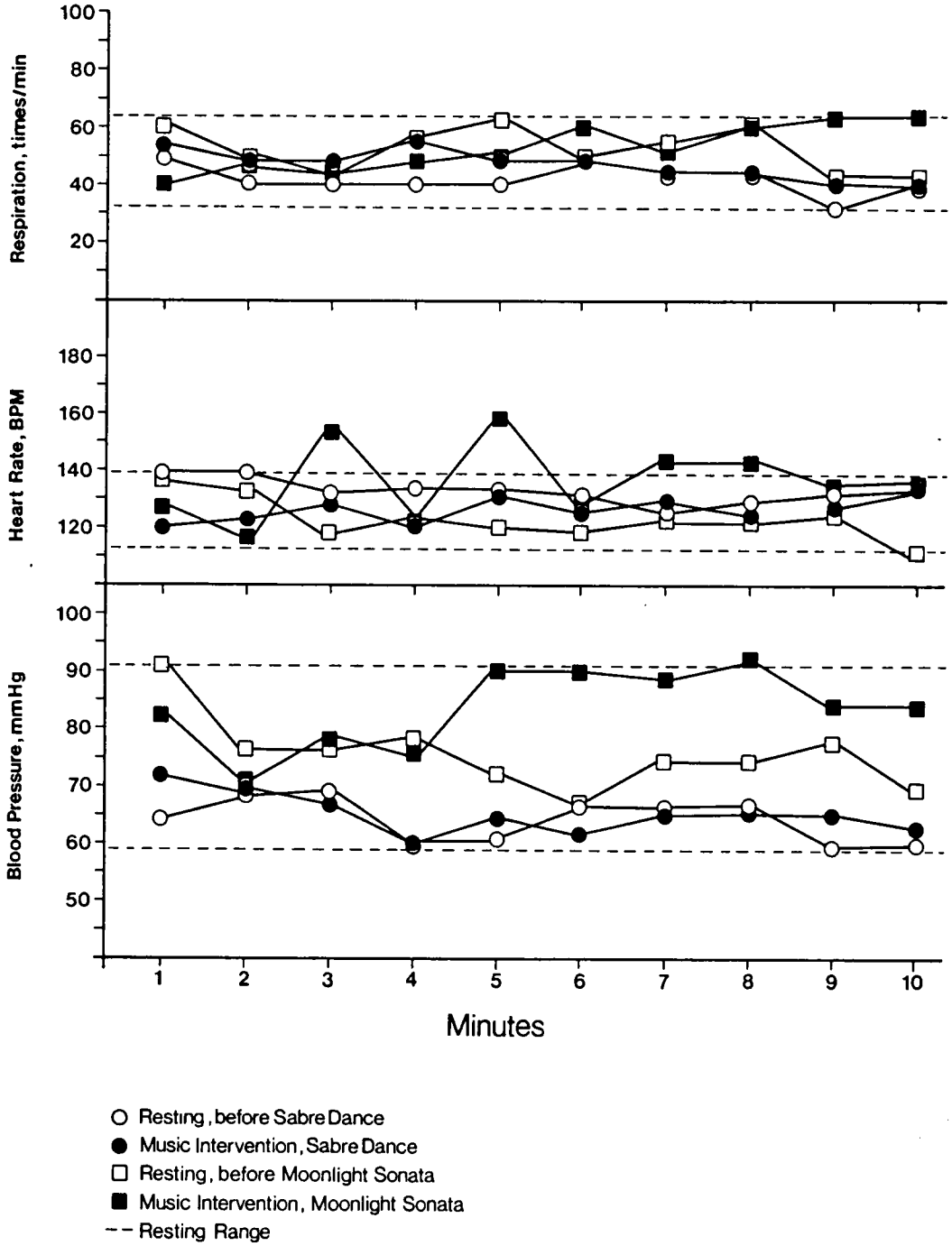

Figure 11. Baby 10.

Question 1. What effects will sedative music have on systolic blood pressure, heart rate, and respiratory rate of a premature infant in an isolette in an Intensive Care Nursery?

Question 2. What effects will stimulating music have on systolic blood pressure, heart rate, and respiratory rate of a premature infant in an isolette in an Intensive Care Nursery?

During sedative music, respirations were observed to be below the lower limit of the range in four infants and above the upper limit of the range in three infants. During stimulating music, respirations were observed to be above the upper limit of the range in two infants and below the lower limit of the range in three infants. There were 33 respiratory rate readings observed outside the resting range during sedative music intervention, with 23 readings above the upper limit of the range and ten readings below the lower limit of the range. There were 16 respiratory rate readings observed outside the range during stimulating music intervention, with nine readings above the upper limit of the range and seven readings below the lower limit of the range.

During sedative music, heart rate was observed below the lower limit of the range in one infant and above the upper limit of the range in four infants. During stimulating music, heart rate was observed above the upper limit of the range in one infant and below the lower limit of the range in three infants. There were also three infants who did not demonstrate readings outside the resting range with either music intervention.

During sedative music, the systolic blood pressure was observed below the lower limit of the range in four infants and above the upper limit of the range in one infant. During stimulating music systolic blood pressure was observed above the upper limit of the range in two infants and below the lower limit of the range in two infants. Two infants did not demonstrate readings outside the resting range during either music intervention. Systolic blood pressure had the fewest readings outside the resting range, with only seven readings observed outside the range during sedative music, with six readings below the lower limit of the range and one reading above the upper limit of the range. There were five readings observed outside the range during stimulating music, with three readings below the lower limit of the range and two reading above the upper limit of the range.

As defined for this study lability was observed in all infants even when variable readings were within resting ranges. Music was not observed to affect lability. Appendices C, D, and E present tables on the mean, range and standard deviations of all variables during resting and music intervention. A discussion of the conclusions, limitations, and recommendations emanating from this study are delineated in Chapter 5.

CHAPTER 5

DISCUSSION

This chapter describes the observations made during this study and includes the limitations of the study. Clinical implications focus on some recommendations for nurses who work in ICNs. Research implications are described by adapting the present methodology as well as further directions for study.

Respiratory Rate

During the playing of sedative music, respiratory rate was observed above the upper limits of the resting range in three infants and below the lower limits of the resting range in four infants. During stimulating music the respiratory rate was observed above the upper limits of the resting range in two infants and below the lower limits of the resting range in three infants. Allen and Capute (1986) also document respiratory changes in response to auditory stimulation. They observed that two of the five premature infants (40%) they studied who had post conceptual ages of 25 to 26 weeks, increased respirations when they were presented with the sound of a bell. A 10% change in respiratory rate was calculated as a response. At 32 to 36 weeks post conceptual age (the ages of infants in the present study) increases were not observed in response to the bell. Data from the current study was not consistent with that of Allen and Capute (1986).

There was no consistent pattern of response evident. The present study was also different from Allen and Capute's findings in that the type of auditory stimulation used was music intervention rather than an intervention with a bell which may have influenced infant responses.

Heart Rate

During the playing of sedative music, heart rate was observed above the upper limits of the resting range in four infants and below the lower limits of the range in one infant. The heart rate during stimulating music was observed above the upper limits of the resting range in one infant and below the lower limits of the range in three infants. There were three infants who were not observed to have any heart rate readings outside the range during either music intervention. A few studies have documented an acceleration of heart rate when auditory stimulation was introduced to infants who were not yet 40 weeks post conceptual age (Allen & Capute, 1986; Berkson et al., 1974; Segall, 1972). The auditory stimuli used in these studies were a bell, a door buzzer, and the mother's voice, respectively. There was no discussion about lability and apparently no consideration of it as a factor in these studies. Data collected in this study was not consistent with the current literature review. There were some increases in heart rate and also some decreases observed and some had essentially no change in heart rate. The literature review provides no reasons for these differing findings. Lability of preterm infants should be taken into consideration when making observations about them.

Systolic Blood Pressure

Sedative music was observed to affect systolic blood pressure with increases above the upper limits of the resting range in one infant and below the lower limits of the resting range in four infants. During the playing of stimulating music, systolic blood pressure was observed above the upper limits of the resting range in two infants and below the lower limits of the resting range in two infants. Two infants were not observed to have any systolic blood pressure readings outside the range during either music intervention.

Lability was observed in all variables measured during resting as well as music intervention. Lability was greater during respirations than during observations of heart rate and systolic blood pressure. Respiratory lability was observed 51 times as compared to 11 observations of heart rate lability and five observations of systolic blood pressure lability. Lability was observed in respiratory rate in all ten infants as compared to five infants who had lability observed in heart rate and five infants who had lability observed in systolic blood pressure.

Observations made in the present study during music intervention could suggest that the infants were trying to habituate to the auditory stimulus, but were not able to maintain this response. For example, infants were awake when presented with the music intervention and they seemed to begin to shut down and subsequently went to sleep after a few minutes of the music. Researchers have documented that infants can selectively habituate to stimuli, but preterm infants are not

always able to maintain these responses (Bartoschuk, 1962; Birns, Blank, Bridger, & Escalona, 1965; Field et al., 1979; Fogel, 1984; Schulman, 1970). A stable, consistent response was not observed in any infant or during any variable being measured. Respiratory rates were observed to change the most with music intervention and systolic blood pressure the least. Many readings were observed above and below the baseline mean for the particular type of music but were within five readings of the upper and lower limits of the resting range suggesting again the lability of these infants.

As stated previously infants in this study were all awake during the resting period, but fell asleep during the playing of both types of music. This suggests that the infant might have been trying to control input by changing his/her state of consciousness. Nugent (1985) states that changing states is how an infant handles the environment.

Limitations of Study

The conclusions and interpretations of this study should be considered with caution. This study generated findings that are not congruent with previously collected data. Limitations are apparent in the research methodology.

Small sample size was one major limitation. Infants were selected for the study from those residing in the ICN at the time the study was initiated. The results can not be generalized to all premature infants. The data can only be applied to infants 33 to 35 weeks post conceptual

age, receiving oral feedings, and meeting the stated criteria of this study.

The extreme lability of these infants during resting, points to the need to interpret data with caution. Respiratory rate had the most lability observed compared to the other variables, but the environment was not controlled.

Conclusions

Although ability to generalize to the larger population of premature infants is limited, the findings from this study have some medical as well as nursing implications for ICN personnel. The following conclusions are based on data from this investigation:

1. Premature infants are labile. This lability is not limited to any one measure and is apparent during resting periods as well as periods of stimulation.

2. Auditory stimulation may affect premature infants' heart rate, respiratory rate, and systolic blood pressure, but the direction of change is unpredictable.

3. More infants had labile readings during respiratory rate than during heart rate and systolic blood pressure readings.

The following nursing implications can be generated from observations made during this study:

1. Nurses need to assess all physiological measures of premature infants frequently. Sleeping infants as well as those who are awake may have adverse responses to stimuli in the environment.

2. Nurses and other caregivers in ICNs need to individualize nursing interventions of premature infants. Each premature infant handles input differently. Tests such as the APIB could enable caregivers to determine each infant's stimulation threshold leading to individualization of care.

Suggestions for Further Study

Based on data obtained in this study, the following implications for additional research were formulated:

1. There is a need to carefully research lability of premature infants to document what changes can be observed during periods of rest as well as stimulation.

2. There is a need to replicate this study to see if similar results would be obtained.

3. There is a need to expand this study to include more seriously ill infants; for example, infants with a diagnosis of intraventricular hemorrhage, to see if sedative music might play a role in preventing further complications by decreasing lability.

4. There is a need to replicate this study via a pilot study, using rock and easy listening music to see if results would differ from this study which used classical music.

5. There is a need to collect demographic information on mothers of premature infants; for example, the age of the mother, what music the mother listened to while pregnant, the educational level of the

mother, and the birth order of this infant, in order to determine what influences this information might have on the infants after birth.

6. There is a need to investigate how playing different types of music in the ICN affects the nurses and other infant caregivers.

7. There is a need to replicate this study in a normal newborn nursery to document any differences between the response of full-term and premature infants to music.

8. There is a need to enlarge the present study and use inferential statistical analysis to evaluate the amount of random error present in the data.

Summary

This study and those recommended for future research pose critical issues for nursing. If it is the task of nursing to assist the patient to wellness, then everything possible should be done to facilitate this process. Nurses have the responsibility to assess the environment, as well as the patient, to provide stimulation that is beneficial, rather than harmful.

In conclusion, the research questions from this study have supplied observations on data not previously documented. Lability was observed in these infants during all periods of observation. Sedative and stimulating music were not observed to affect any one parameter more than another or more than any other environmental stimulus. It is hoped that awareness of music and its effects has been greatly increased. It is also hoped that further research ideas will be

stimulated from this study as well as an increase in clinical nursing practices that benefit premature infants.

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APPENDICES

APPENDIX A

CONSENT FORMS

THE UNIVERSITY OF TENNESSEE
MEDICAL CENTER AT KNOXVILLE

Department of Pediatrics
1924 Alcoa Highway
Knoxville, Tennessee 37920-6999
(615) 544-9320

March 8, 1988

Office of Research Compliances
404 Andy Holt Tower
University of Tennessee, Knoxville
Knoxville, Tennessee 37916

Re: Colleen A. Lorch
Candidate for Master of Science in Nursing

To Whom It May Concern:

The above named student has permission to use patients and equipment in the Intensive Care Nursery at The University of Tennessee Medical Center at Knoxville for the research project titled, "The effect of music on blood pressure, heart rate, and respiratory rate in premature infants".

Sincerely,

Mark Anderson, M.D.
Assistant Professor
Director of Neonatal Research

CONSENT FORM

Your signature below indicates your willingness to allow your baby to participate in a study being conducted at The University of Tennessee Medical Center at Knoxville, in the Intensive Care Nursery (ICN) by Colleen Lorch, R.N. The purpose of this study is to see how your baby responds to music when it is played in the isolette at a comfortable level. Valuable information obtained from this study may benefit future babies who spend time in ICN's.

Measures on blood pressure, heart rate, and respiratory rate will be obtained while two different types of music are played for your baby. All sound levels will be measured and controlled within safe limits. The entire procedure will only take 40 minutes during two separate days and participating in the study will not expose your baby to any known risks. Your baby's blood pressure, heart rate, and respiratory rate may increase during the playing of stimulating music and decrease during the playing of soothing music.

All data collected in this study will be treated in such a way as to assure confidentiality of individuals. Data will be kept in a locked cabinet in the home of the project director, Colleen Lorch. Your decision to have your baby participate in this study is voluntary and will not alter any care given your baby in the ICN. You can withdraw from the study at any time by notifying the ICN staff and the care of your baby will not be affected. Negative effects are not expected to result to your baby from this study.

You understand that you are not waiving any legal rights or releasing the hospital or its agents from liability for negligence. You understand that in the event of physical injury resulting from the research procedures, the University of Tennessee does not have funds budgeted for medical treatment. Therefore, the University does not provide for treatment or reimbursements for such injuries.

I am available to answer questions about the study at any time. Please feel free to contact me at my home (690-9299).

Thank you,

Colleen Lorch, R.N.
690-9299

Signature of Mother_____Date_____
Age_____Radio Station listened to most_____
Investigator_____

Signature of Father_____Date_____
Age_____Radio Station listened to most_____
Investigator_____

APPENDIX B

TABLES

Table B-1

Mean, Range, and Standard Deviations of Respiratory Rate During Resting and Music Intervention

		Mean(Range)	Standard Deviation	Mean(Range)	Standard Deviation
1.	stimulating music	41.4(24-56)	±13.46	40.0(20-58)	±10.15
	sedative music	60.4(52-68)	±8.47	69.6(60-88)	±5.79
2.	stimulating music	41.6(22-60)	±11.02	46.4(40-60)	±8.26
	sedative music	54.8(44-60)	±6.81	64.8(60-72)	±4.13
3.	stimulating music	60.2(50-68)	±5.84	67.6(52-80)	±7.16
	sedative music	56.4(32-68)	±12.13	84.4(76-96)	±6.09
4.	stimulating music	49.5(39-64)	±7.73	46.0(44-62)	±2.82
	sedative music	41.6(32-60)	±8.47	36.4(12-56)	±11.84
5.	stimulating music	62.0(48-80)	±12.54	54.8(32-64)	±9.05
	sedative music	51.6(44-60)	±7.41	42.8(36-52)	±5.34
6.	stimulating music	49.0(42-60)	±6.34	44.6(36-54)	±6.93
	sedative music	45.2(40-60)	±5.97	52.4(48-56)	±3.50
7.	stimulating music	52.0(40-60)	±7.77	55.6(44-60)	±6.91
	sedative music	52.2(40-64)	±10.17	39.6(32-48)	±5.79
8.	stimulating music	57.2(48-64)	±5.34	68.0(60-80)	±6.25
	sedative music	50.8(44-60)	±4.63	50.0(44-60)	±7.36
9.	stimulating music	54.2(44-64)	±6.42	55.6(44-60)	±5.79
	sedative music	42.8(36-52)	±5.0	41.2(32-52)	±6.26
10.	stimulating music	41.6(32-48)	±4.69	46.8(40-56)	±5.0
	sedative music	52.4(44-64)	±7.64	52.6(40-64)	±8.84

Table B-2

Mean, Range, and Standard Deviations of Heart Rate During Resting and Music Intervention

		Mean(Range)	Standard Deviation	Mean(Range)	Standard Deviation
1.	stimulating music	132.3(110-159)	±20.38	120.8(113-129)	±4.51
	sedative music	144.6(138-159)	±8.22	144.7(136-150)	±5.05
2.	stimulating music	142.5(138-147)	±3.24	141.2(136-153)	±5.05
	sedative music	157.0(147-182)	±10.94	143.1(138-153)	±4.70
3.	stimulating music	147.8(131-166)	±11.73	145.9(119-170)	±12.74
	sedative music	161.7(156-178)	±6.81	156.9(150-159)	±3.17
4.	stimulating music	148.7(144-166)	±9.16	144.3(141-150)	±2.98
	sedative music	145.2(138-153)	±5.32	148.2(147-153)	±2.89
5.	stimulating music	162.0(156-170)	±4.85	162.5(159-166)	±2.99
	sedative music	145.1(80-159)	±23.25	157.5(150-163)	±4.67
6.	stimulating music	147.9(141-156)	±5.30	139.7(131-150)	±6.66
	sedative music	130.4(125-144)	±6.05	122.6(111-131)	±7.24
7.	stimulating music	163.7(153-174)	±7.58	165.3(150-178)	±9.28
	sedative music	169.8(163-178)	±5.18	165.6(156-182)	±8.55
8.	stimulating music	158.8(153-163)	±2.39	166.5(159-178)	±6.88
	sedative music	155.5(153-163)	±3.34	156.8(153-166)	±4.56
9.	stimulating music	173.6(166-182)	±4.40	169.1(163-182)	±6.20
	sedative music	167.5(150-178)	±9.73	162.8(150-197)	±14.75
10.	stimulating music	131.1(122-138)	±5.02	124.6(120-131)	±3.56
	sedative music	123.5(115-136)	±6.58	136.1(117-159)	±13.54

Table B-3

Mean, Range, and Standard Deviations of Blood Pressure During Resting and Music Intervention

		Mean(Range)	Standard Deviation	Mean(Range)	Standard Deviation
1.	stimulating music	60.8(50-67)	±4.91	59.6(51-76)	±6.61
	sedative music	61.6(58-69)	±3.77	59.4(55-66)	±3.77
2.	stimulating music	67.9(63-71)	±2.46	66.2(62-73)	±3.32
	sedative music	82.6(72-91)	±6.85	66.3(61-74)	±3.91
3.	stimulating music	76.1(68-86)	±5.82	76.3(67-86)	±5.35
	sedative music	60.4(52-73)	±7.39	60.9(54-63)	±2.60
4.	stimulating music	72.0(63-80)	±5.33	69.8(65-79)	±4.44
	sedative music	65.8(62-73)	±3.58	62.9(58-65)	±5.00
5.	stimulating music	58.2(51-63)	±4.46	58.0(52-66)	±3.94
	sedative music	61.6(55-75)	±7.15	57.7(54-66)	±4.05
6.	stimulating music	74.5(63-85)	±8.03	69.6(61-79)	±6.83
	sedative music	66.9(61-82)	±6.36	65.0(52-71)	±5.57
7.	stimulating music	65.9(61-69)	±2.80	66.6(59-81)	±8.51
	sedative music	67.0(53-94)	±11.15	67.7(60-80)	±6.07
8.	stimulating music	60.9(53-69)	±5.23	69.1(58-96)	±10.90
	sedative music	70.7(62-79)	±6.65	69.6(65-78)	±4.81
9.	stimulating music	61.7(48-70)	±6.68	58.8(54-62)	±2.57
	sedative music	73.3(67-82)	±5.05	64.9(43-78)	±9.36
10.	stimulating music	64.0(58-68)	±3.88	65.1(60-72)	±3.34
	sedative music	75.6(67-91)	±6.60	83.5(71-92)	±6.96

APPENDIX C

DATA COLLECTION SHEET

DATA COLLECTION SHEET

TIME_____

BABY ID #_____

P.C. AGE_____ SEX M F

WEIGHT_____

TYPE OF MUSIC MS SD

dB A (in isolette before intervention)_____

B/P (Systolic not ↑100 mm Hg)

	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"
B										
MI										

T→B_____

H/R (not ↑200 BPM)

	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"
B										
MI										

T→B_____

R/R (NOT↑ 80 TPM)

	1"	2"	3"	4"	5"	6"	7"	8"	9"	10"
B										
MI										

T→B_____

B=Baseline MI=Music Intervention
T→B=Amount of time needed to return to baseline

VITA

Colleen Angela Pace Lorch was born in Louisville, Kentucky, on February 17, 1946. She received her elementary and secondary education in Louisville, Kentucky, graduating from Butler High School in 1964. In the fall of 1964, she entered Graceland College, Lamoni, Iowa, where she completed one year of prenursing studies. She next attended The Independence Sanitarium and Hospital, Independence, Missouri, where she graduated with honors in 1968 with a diploma in nursing.

After graduation, while pursuing her Bachelor of Science degree in Nursing, she held the position of staff nurse on the obstetric floor and pediatric floor at Cincinnati General Hospital, Cincinnati, Ohio. During the summer of 1969, while working as a staff nurse at Children's Hospital, Louisville, Kentucky, she met her future husband, who she married in 1970. After marrying, she finished her degree at Spalding University, Louisville, Kentucky, graduating in 1972. During 1974-75, she was staff nurse at Variety Children's Hospital, Miami, Florida.

In March, 1986, she began work on her Master of Science in Nursing degree. In December, 1988, requirements for this degree were completed for The University of Tennessee, Knoxville.

Currently she is a member of the following professional and scholarly organizations: ANA, TNA, NAACOG, and Sigma Theta Tau.