

THE EFFECT OF SOOTHING MUSIC  
ON NEONATAL BEHAVIOURAL STATES  
IN THE HOSPITAL NEWBORN NURSERY

by

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B.Sc.N., The University of British Columbia, 1985

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF  
MASTERS OF SCIENCE IN NURSING

in

THE FACULTY OF GRADUATE STUDIES  
School of Nursing

We accept this thesis as conforming  
to the required standard

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THE UNIVERSITY OF BRITISH COLUMBIA

September 1993

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## ABSTRACT

This study was designed to test the effect of soothing music on the number of high arousal neonatal behavioural states and the frequency of behavioural state change within the hospital newborn nursery. The theoretical framework for this study was drawn from theories related to newborn behavioural states, environmental influences on newborns, psychophysiologic effects of music and music as a health intervention. This study used a quasi-experimental, one sample, pretest, posttest design in which the subjects served as their own controls. The results were then analyzed using a one-tailed, McNemar's test ( $\alpha < .05$ ) specific for related small samples when nominal scale data are gathered.

The sample consisted of twenty subjects observed in a large tertiary care hospital in Western Canada. The subjects ranged in age from 24 to 57 hours old, were 36 to 42 weeks gestational age, weighed 2860 to 4160 grams at birth, and had Apgar scores ranging from 9 to 10 at five minutes postbirth. There were 8 females and 12 males. All were Caucasian and all were born vaginally without complications. All but two were breastfed.

The subjects were observed for a total of four hours each, two hours in the normal nursery environment and

another two hours with the addition of selected soothing music. All observations took place between 2400 and 0600 hours.

There was a significant difference at the  $\alpha < .05$  level in the number of high arousal states (Nonalert Waking and Crying) between the control and experimental observations. The control group exhibited significantly more high arousal states than the experimental group did. The z score obtained from comparing the proportion of high arousal states between the two observations was 2.36,  $p < .01$ , significantly higher than the score of 1.65 needed to be significant at  $\alpha < .05$ . There was also a statistically significant difference in the number of state changes and in the z score of 2.93,  $p < .001$  for state lability. The control group demonstrated significantly more state changes than the experimental group did.

With a sample size of twenty, conclusions are tentative. The findings suggest that music may be useful to newborns adapting to extrauterine existence within a nursery setting. Interventions intended to reduce the frequency of high arousal states in newborns while in the nursery are the responsibility of nurses. Nursing and patient education should also address the possible use of music with babies exhibiting high arousal behavioural states. The results of this study suggest areas for replication and further study.

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This thesis is dedicated to my mate and my six children for giving me their support and encouragement throughout the completion of this thesis.

## ACKNOWLEDGEMENTS

I would like to thank the members of my thesis committee, Wendy Hall (chairperson) and Donelda Ellis for sharing their expertise and providing guidance and support.

I would like to thank Alison Rice for agreeing to serve as External Reader and for sharing her insights about the study.

I would like to thank Professor Evelyn Thoman and her associates for sharing their Taxonomy of Behavioural States and collection tool for use in this study.

I would like to thank my friends and colleagues for their support and encouragement throughout this endeavor.

My appreciation is extended to the nursing staff and physicians of the postpartum units of the hospital where the study was conducted.

Finally, I would like to thank the patients who participated in this study and their parents.

## CHAPTER ONE

### Introduction

#### Background to the Problem

"In the germ, where the first trace of life begins to stir, music is the nurse of the Soul; it murmurs in the ear, and the child sleeps; the tones are companions of his dreams - they are the world in which he lives." (Lingerman, 1983, p. 189).

The birth of each human being begins with a complex process of adaptation to the outside world. The neonate must make many physiological and behavioural adjustments to successfully adapt to the new environment. "The intrauterine - extrauterine adaptation of the transitional newborn is physiologically demanding and is now known to take many hours or several days. In addition, the infant is at considerable risk, more than is generally believed" (Anderson, 1989, p.197). Respiratory, cardiovascular, gastrointestinal, endocrinological and behavioural adaptation is vital for a healthy adjustment to the extrauterine environment (Pratt, 1985). The newborn exerts an enormous amount of energy establishing biological homeostasis.

Recently, professionals studying neonates have focused not only on the newborns' physiological adjustments but also on their behavioural patterns (Brazelton, 1984). They found that neonates exhibit a continuum of behavioural states of consciousness. Lewis & Zarin-Ackerman (1970) describe this state continuum as a "major adaptive mechanism" which serves as a mediator of environmental input and a mode for the infant to socially interact (p. 95). The relationship between behavioural states and the environment and its stimuli is supported in the literature (Ashton, 1971; Brazelton, 1973, 1984; Korner, 1972; Stratton, 1982; Thoman & Whitney, 1989). Thoman, Denenberg & Sievel (1981) wrote that " A neonate's state behaviors reflect both its own internal endogenous processes and exogenous influences from the environment" (p.47).

Stability of state organization over time appears to be an important characteristic of clinically healthy newborns. In their 1981 study of newborn state organization, Thoman et al. observed that "... inconsistency in state organization over the early weeks was the antecedent condition for later dysfunction or death, occurring as early as 3.5 months and as late as 2.5 years (p.53). They observed that the newborns who exhibited irregular or "poorly organized" state patterns all developed conditions ranging from delayed development, aplastic anemia, and hyperactivity to Sudden Infant Death Syndrome. Since adaptation is so crucial for the transitory neonate who is likely to spend a large percentage of the

hospital stay in the nursery, it is imperative that nurses "... create ways in which the nursery experience for infants can be designed to optimize development" (Karraker, 1986, p.362).

In the past few decades, hospitals have become the accepted environment for childbirth and postpartum adjustment (Anderson, 1989). The majority of neonates born in Western civilization spend the first one to three days of their lives in the hospital environment. Recently, "rooming -in" or accommodating the mother and her newborn in one room has become popular (Karraker, 1986). Despite this shift away from nursery - focused care, many newborns still spend a considerable portion of their hospital stay in the normal newborn nursery. Karraker (1986) explains that this occurs due to "...illness of either the mother or the infant, the mother's need for rest, avoiding infections when the mother receives visitors, and the mother's desire to be relieved of caretaking duties at times" (p. 362).

The hospital newborn nursery is designed and operated according to specific stipulations or standards (Jensen, Bobak & Zalar, 1989). These standards result in environmental conditions of bright, continuous light and a high level of noise. The American Academy of Pediatrics (1977) published guidelines which instruct that illumination should be 100 foot candles in brightness and that deluxe cool-white fluorescent bulbs be used to keep the nursery well-lit and shadow-free 24 hours per day.

In terms of noise, the nursery must contain an area to accommodate 24 - 36 infants with 20 square feet each and three feet of space between cots. Supply cupboards, wash stations, utility and examination areas plus an adjacent clerical area should all be present within the nursery setting. These requirements foster the generation of a continuous, high level of noise since all caregiving and routine activities are performed in close proximity to the newborns.

Hilton (1985) referenced Kosten and Van Os (1962) as stating that the recommended noise level in the hospital setting should be no more than 35 decibels during sleep periods and 40 decibels when the client is awake. Keefe (1987) described the nursery environment as having a noise level of over 80 decibels for an average of 146.8 minutes per four hour period of observation. Keefe warns that an 80 decibel noise level is comparable to loud traffic noise. She found that the most striking and persistent noise was the sound of other infants crying. Anderson (1989) suggested that:

"Newborn infants cared for in busy hospital nurseries on a well intended demand - feeding schedule have generally begun to cry before they are taken to their mothers. Prevention of crying and startling during the intrauterine - extrauterine adaptation may be very important to the infant's later

development" (p. 197).

Prolonged crying can complicate the newborn's adaptation since it obstructs venous return in the inferior vena cava and reestablishes fetal circulation within the heart (Anderson, 1989). "Each time the strain phase of a cry is released, poorly oxygenated blood flows through the foramen ovale and back into the systemic circulation rather than into the lungs. Thus, some degree of hypoxia must develop" (p. 197).

The multiple adjustments that the neonate makes are challenging even in a quiet, unobtrusive environment. The nursery environment presents additional challenges since "... the profound physiological adjustments the infant is required to make in the transfer from intrauterine to extrauterine existence makes him (her) particularly vulnerable to hazardous environmental conditions rarely noxious to older individuals" (Jensen et al, 1989, p.10). One way to evaluate the neonate's vulnerability is to observe behavioural state organization. "State organization improves with maturation and with well-being" (Brazelton, 1984 p.60).

One of the seven behavioural states (Thoman, 1990), Nonalert Waking, is considered a primitive state, common in premature infants but usually limited in frequency in healthy, fullterm newborns. A high frequency of this state has been linked with poor central nervous system stability in newborns and potential longterm vulnerability (Thoman,

1990). Nonalert Waking and Crying states are considered to be high arousal states (Thoman, 1990).

Obstetrical nurses assume a major responsibility for monitoring the puerperal adjustment in both the mother and her newborn (Jensen et al, 1989). Nursing interventions designed to reduce or mask the impact of noxious stimuli in the nursery environment are both desirable and ethical. Not only must the environment be conducive to physiological homeostasis but "...the pattern of infant state cycles must become harmoniously integrated with the salient recurrent features of the environment" (Keefe, 1987, p.141).

Dossey, Keegan, Guzzetta & Holkmeier, (1988) outlined ways that music therapy can be used by nurses in the clinical setting. They said that soothing music can be used for the "...reduction of psychophysiologic stress, pain, anxiety, and isolation" (p. 267). Music can produce physiological relaxation by stimulating a hypometabolic response in the autonomic, immune, endocrine, and neuropeptide systems. Music can also affect the psychological behaviours through the limbic system. This part of the brain is influenced by musical pitch and rhythm which in turn affects emotions and feelings.

Adding soothing music to the nursery environment could be an inexpensive and feasible intervention for promoting an environment more conducive for newborn homeostasis. Soothing music has been used by health care professionals to reduce stress-related behaviours and promote rest and feelings of

well-being in infants, children, and adults (Benenzon, 1981). It would appear the use of lulling music could help the newborn cope with the noxious stimuli of the nursery environment. Music researchers such as Clynes (1982) have found that music can communicate specific emotional or mood states, such as serenity or joy. The music seems to stimulate inherent emotional states via the limbic system in the brain which signals the organism to "match" the mood of the music. They theorized that this would explain why soothing music can lull a person into a state of relaxation or sleep.

The newborn child can respond to sound and music almost immediately (Deutsch & Richards, 1979). He or she is quieted by one of the earliest and constant sounds he/she hears: the mother's heartbeat. Like the fetus, the neonate will be jarred by loud and sudden sounds.

"Music will frequently quiet the child... he/she reacts calmly to the lilting melody of a lullaby. He/she exhibits a more quieting and alerting behavior to soft, high-pitched instruments and female voices than to low-pitched instruments and male voices" (Greenberg, 1979, p.48).

### Problem Statement

Neonates cared for in a hospital nursery are exposed to bright, continuous light and a high noise level. Wolke

(1987) cautioned that "...high light and noise intensity... not only lead to the disturbance of the infant's rest but also increase the time spent in rapid eye movement (REM) sleep" (p.988). This increase negatively affects the amount of deep, non - REM sleep (NREM) the neonate experiences. Since the newborn already spends approximately 52% of his/her sleep time in REM sleep, a further decrease of NREM sleep is significant for the newborn's well - being (Thoman, 1990). Intense levels of light and noise can likewise interrupt the regulation of neonatal behavioural state organization (Keefe, 1987; Wolke, 1987). Neonates tend to cry, fuss and startle more and spend more time in transitory and Nonalert Waking states. They also demonstrate an increase in state change (lability). Health care professionals, including nurses have used music within the hospital setting to promote rest and sleep and to modulate stress-related behaviours in adults, children and infants (Benenzon, 1981; Dossey et al, 1988; Fagen, 1982).

#### Purpose

The purpose of this study is to relate the effect of selected soothing music to the number of high arousal states and number of state change observed in newborns cared for in the hospital nursery.

#### Theoretical Framework

The theoretical framework best suited to this study is

borrowed from physiology, developmental psychology, and music therapy. The framework is based primarily on Lewin's (1936) general systems theory. Lewin's (1936) main postulate is important in this study: behaviour evolves as a function of the interplay between the person (system) and his/her environment (macrosystem).

The neonatal period is one of immense biological vulnerability and one in which a successful outcome depends largely on appropriate neonatal adjustments to the extrauterine environment. The neonate is dependent on a supportive environment yet, "... most Western newborns make their first adaptations to the noise, smell, and fluorescent lighting" (Stratton, 1982, p.409) of a hospital nursery.

Postpartum system balance in newborns is dependent on the achievement of three tasks (Lewis & Zarin-Ackerman, 1970). A newborn must establish homeostasis through self-regulation of arousal by making changes in state and sleep patterns. He/she must process, store, and organize multiple stimuli. He/she must also establish a reciprocal relationship with a primary caretaker and with the environment.

Trevisan and Nowicki (1978) described the use of music in systems theory terms. The input of soothing music can stimulate an alpha wave brain state - a state of relaxed awareness. In this state, messages of relaxation are sent by the brain via efferent neural pathways to the body organs, muscles, and glands.

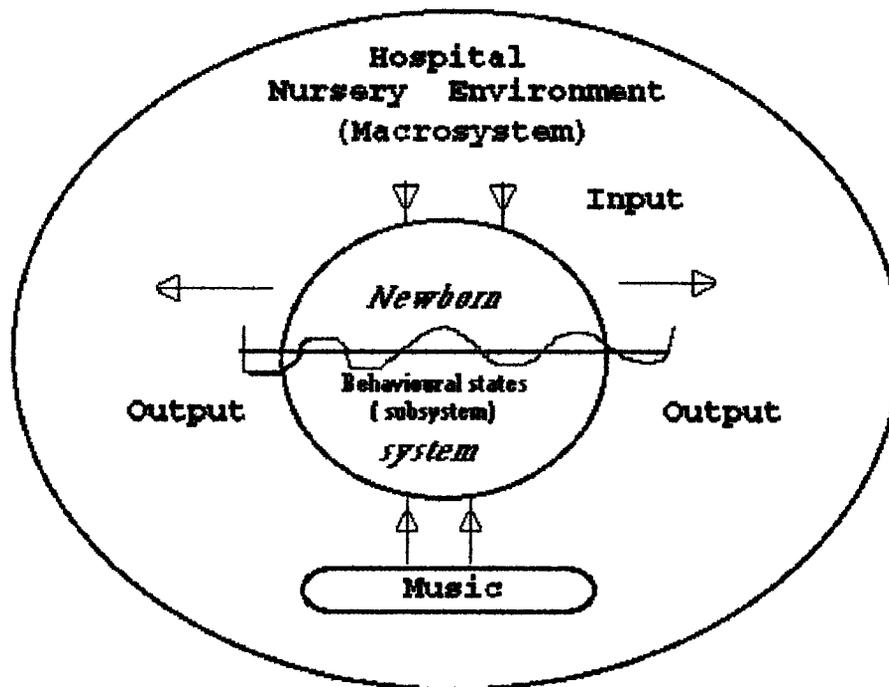
A relaxed alpha state also signals the limbic system in the brain, the centre of psychological feelings and emotions. In the presence of emotional stress or limbic tensions, the limbic cortex translates this stress to the hypothalamus resulting in high adrenalin production.

"These influences stimulate a sympathetic reaction with such physical symptoms as increased heartrate, blood pressure, blood sugar, constriction of the blood vessels of the skin and viscera and a decrease in digestion. Also there is production of cortisol which acts in the catabolism (breakdown) of protein in the system, lowering resistance and leaving the organism more susceptible to illness" (Trevisan & Nowicki, 1978, p. xi).

Slow instrumental music may initiate the "tuning system" naturally within the brain aiding the initial release of limbic emotions. The sensory stimulation of music (positive input) is received by the body and sent to the neocortex of the brain via the thalamus. This neocortical input interacts with internal limbic emotions and tension in the thalamus. The combination of sensory stimulation and an alpha wave state of relaxed awareness serve to initiate a parasympathetic relaxed response in the organism. In a relaxed state, infants are less likely to spend much time fussing, or in Crying or in Nonalert Waking states and more time in NREM (Quiet) sleep (Thoman, 1990).

Figure 1

## Model of the Theoretical Framework



### Hypotheses

1. The control group will demonstrate a significantly higher number of high arousal states than the experimental group.
2. The control group will demonstrate a significantly greater state lability or number of state changes than the experimental group.

### Definition of Terms

To clarify the variables and assumptions implicit in this study both theoretical and operational definitions of the major concepts are warranted. The theoretical definitions reflect concepts directly from the literature; the operational definitions have been refined to pertain specifically to the study. The concepts: neonate, environment, behavioural state continuum, and music have been defined both theoretically and operationally.

#### Neonate

Theoretical definition. Newborn human organism with a high level of cognitive functioning and a baseline of behaviours which predisposes the neonate to interact and to learn. The newborn constantly seeks homeostasis, and is dependent on a supportive caregiving environment (Brazelton 1973, 1984; Lewis & Zarin-Ackerman, 1970; Thoman, 1990;

Wolff, 1987).

Operational definition. Full-term (greater or equal to 36 weeks gestation), newborn (24 - 60 hours old), born vaginally with no complications during pregnancy or birth. Apgar scores over or equal to 8 after 5 minutes of age, Occidental, either male or female with no postpartum complications or anomalies.

### Environment

Theoretical definition. The hospital newborn nursery, a care area designed for routine neonatal care for normal, fullterm (36 or more weeks gestation) infants weighing more than 2000 grams. This area must meet the criteria for light and equipment established by the American Academy of Pediatrics (1977).

Operational definition. Tertiary care maternity hospital in Vancouver, B.C., Canada. Approximately 300 square feet with room for 16 regular cots, 2 bilirubin light cots, and one radiant warmer. Staffed by one LPN or RN for each 12 hour shift. Lighting and equipment similiar to specifications outlined by American Academy of Pediatrics (1977).

### Behavioural State Continuum

Theoretical definition. A recurrent, intricately organized pattern of behaviour that occurs spontaneously and is cyclic (Brazelton, 1973; Keefe, Kotzer, Reuss & Sander, 1989; Thoman, 1990). Represents a major adaptive mechanism for mediating environmental input and a mode for social interaction (Lewis & Zarin-Ackerman, 1970). The rhythmic pattern of states reflects the integrity of the newborn's central nervous system and is a sensitive measure of the neonate's response to the environment (Brazelton, 1973; Colombo, Moss & Horowitz, 1989).

Operational definition. A continuum of seven distinct states (Thoman, 1975; et al, 1981; 1985; & Whitney, 1989; 1990) that recur cyclically in response to internal and external stimuli which can be coded in 10 second epochs. The states are listed along with their characteristic behaviours:

a) Quiet Sleep: eyes closed, tonic muscle tone, no motor activity except occasional startles, mouthing or sigh-sobs.

b) Active Sleep: eyes closed, rapid eye movement (REM), phasic muscle tone, stretching, intermittent body movement, and sporadic startles.

- c) Transitional: eyes closed or may be rapidly opening and closing and there may be generalized motor activity.
- d) Drowse/Daze: Heavy - lidded eyes, eyelid flutters, small body movements (may have some larger ones).
- e) Crying: Intense, distressed vocalizations, distressed facial expression, flailing, intense body movements.
- f) Quiet Alert: Eyes open, bright, and shining, often scanning, may have small body movements.
- g) Nonalert Waking: Open, dull eyes, high motor activity, facial grimaces, startles and periods of fussing.

### Music

Theoretical definition. An auditory stimulus comprised of sound arrangements with various combinations of melody, harmony, rhythm, and tone colour (Copland, 1967; Podolsky, 1954). Reaches the body via the ear through neural pathways to the autonomic nervous system causing measureable physiological responses (Haas, Distenfeld & Axen, 1986; Lundin, 1985).

Operational definition. Soothing, dreamy arrangements with a flowing, lyrical melody; a quiet, calm tone colour; simple and consonant harmony; and an easy, slow rhythm at

approximately the same rate as a regular heartbeat (65 - 80 beats per minute) (Geden, Lower, Beattie & Beck, 1989; Haas et al., 1986; Lingerman, 1983; Lundin, 1985; Podolsky, 1954; Verdeau - Pailles, 1985). Two examples are J. Brahm's Lullaby and Waltz of the Flowers from the Nutcracker Suite by P.I. Tchaikovsky (Guthiel, 1970).

### Significance

Nursing is dedicated to holistic care of clients in all stages of development. Currently there is only a trend towards continuous "rooming-in" during the postpartum hospital stay. This is the ideal caregiving arrangement for the hospitalized healthy postpartum mother and newborn (Anderson, 1989; Keefe, 1987). Since patient advocacy is a central nursing responsibility, nurses should support and encourage new mothers to take advantage of this accommodation. As long as newborns spend a significant amount of time in the nursery, nurses must assume responsibility for protecting them from noxious stimuli. Nurses and other health care team members must recognize the physical as well as psychological vulnerability of the transitional newborn. This recognition should lead to implementation strategies to gently ease the newborn into a harmonious relationship with the external environment.

The use of music as a therapeutic agent to soothe, relax, sedate, distract, and help cope with pain and discomfort is beginning to interest nurse scholars and

researchers (Davis-Rollans & Cunningham, 1987; Duxbury, Henley, Broz, Armstrong & Wachdork, 1984; Geden et al., 1989; Jacob, 1986; Karraker, 1986; Olds, 1985). This nursing study may add to the current nursing literature on the use of music in disturbing environments. As long as nurses care for infants in the nursery setting, helping the newborn by reducing the impact of noxious environmental stimuli is a nursing responsibility. The use of soothing music in the nursery has the potential to be a viable intervention in achieving this goal.

#### Overview of the Thesis Content

This thesis is comprised of five chapters. In Chapter One, the background to the problem, problem statement, purpose, theoretical framework, hypothesis, definitions and significance of the study are described. In Chapter Two, a review of selected literature representing relevant theory about the study variables is presented. Literature on neonatal puerperal adjustment, neonatal behavioural states, environmental effects on the neonate, psychophysiologic responses to music, and the use of music as a health intervention are reviewed. In Chapter Three, the research methods including a description of the research design, sampling procedures, assumptions and limitations of the study, reliability and validity, ethical considerations and statistical procedures used in data analysis are presented.

In Chapter Four, the description of the sample, a report of the findings and a discussion of the results are given. The summary, conclusions, implications, and recommendations for future research are presented in Chapter Five.

## CHAPTER TWO

### Review of the Literature

#### Introduction

Theory from the disciplines of nursing, developmental psychology, physiology, and music therapy influenced the development of this study. Relevant theory is presented within six distinct categories: neonatal puerperal adjustment, neonatal behavioural states, environmental effects on the neonate, psychophysiologic responses to music, and the use of music as a health intervention.

#### Neonatal Puerperal Adjustment

Adjustment to extrauterine existence imposes a multitude of physiological and psychological tasks on the newborn (Anderson, 1989; Ashton, 1971; Brazelton, 1973; Gorski, Lekowitz & Huntington, 1987; Lawson, Turkewitz, Platt & McCarton, 1985; Lerner, 1984; Prechtel, 1974; Stratton, 1982; Thoman, 1990). During this time, important physiological regulators have been triggered by birth and are set in place. Many persist across the life span (Anderson, 1989). Jensen et al. (1989) list the physiological tasks as a) establishing and maintaining respirations and oxygen consumption, b) ingesting, retaining and digesting nutrients, a transition from maternal parenteral to infant enteral nutrition, c) elimination of

wastes, d) regulation of temperature and e) regulation of weight (p.586). The neonate must also regulate periods of rest with periods of wakeful activity (Keefe, 1987).

At birth, the normal human can respond to auditory, visual, tactile, gustatory and olfactory stimulation (Verney, 1981; Whaley & Wong, 1989). Horowitz (1975) describes the neonate as "...an exquisitely evolutionally adapted organism who arrives with a baseline of behaviour that predisposes the organism to interact and to learn yet is "...entirely dependent (emphasis added by author) for ultimate physical survival" (p.29).

### Neonatal Behavioural States

The concept of infant states originates in general systems theory (Lerner, 1984). The states are recurrent, intricately organized patterns of behaviours observed in the human neonate (Keefe, 1987). The cyclic pattern of the behavioural states reflects the neonate's internal status and indicates the integrity of the infant's central nervous system (Colombo et al., 1989).

Each healthy, full-term infant displays a unique yet organized series of distinct states over time. The predominant state of consciousness may be the best reflection of where the infant is during an attempt to maintain controls over his or her immature autonomic nervous

system (Brazelton, 1984). Brazelton (1984) further informs that there are several published versions of state matrices. State scales have been presented in the literature by: Brazelton (1973) and (1984), Brown (1964), Dittrichova (1962) and (1966), Korner (1972), Lewis and Zarin-Ackerman (1970), Parmalee (1974), Precht1 (1974), Thoman et al. (1981), Thoman and Whitney (1989), Wolff (1966) and (1987). All of these state taxonomies are remarkably similar, all are based on sleep - awake patterns. Most focus on one to three distinct sleep states, a few include an intermediate drowsy state as well as one to three awake states. However, according to Thoman (1990), "Our studies and those of Wolff are the only ones which have involved lengthy and longitudinal behavioural recordings of the full range of infants' sleeping and waking states in the home" (p.94).

Thoman (1990) described seven states including a) Quiet Alert b) Nonalert Waking c) Crying d) Transitional e) Drowse/Daze f) Active or REM Sleep and g) Quiet or NREM Sleep. Thoman (1990) deliberately chose names for the states to indicate the qualitative nature of the behavioural patterns one can observe in infants. Each state is distinct from the other six states and is distinguished by particular observable behaviours, e.g. REM eye movements in Active Sleep.

Descriptions of the cyclic frequency and duration of these behavioural states exist in the literature. Thoman (1990) summarized the average mean percent of time spent in

each state over a seven hour observation period (n = 28): Quiet Alert: 6.7%, Nonalert Waking: 2.8%, Crying: 3.4%, Drowse/ Daze: 5.4%, Transition: 1.3%, Active Sleep (REM): 52.3%, and Quiet Sleep: 28.1% (p. 98).

Since each newborn is a dynamic individual, each must learn to organize his/her behavioural states in a unique pattern. Although similarities in behavioural state organizational patterns exist, no two infants will display exactly the same sequence. The state behaviour pattern of organization is an important indicator of the newborn's general level of well-being and is a sensitive measure of the neonate's response to external events e.g. a high noise level or bright lights (Keefe, 1987).

Thoman (1975) distinguishes newborns as having either "well-organized" states or "poorly-organized" ones. She described babies as "well-organized" if they were "easy to read" or if they gave clear cues as to whether they were awake, asleep, or uncomfortable. These infants spent more time in "states of greater equilibrium", e.g. Quiet Sleep or Quiet Alert. Clear characteristics appropriate to each behavioural state were demonstrated. Relatively little time was spent in transitory states by these newborns. "Well-organized" infants demonstrated cycling of states, especially the sleep states.

"Poorly-organized" infants spent significantly less time in Quiet Sleep or Quiet Alert states. They spent more time in Transitional, Crying, Drowsy and Nonalert Waking

states. The behavioural states were demonstrated in a highly labile fashion both in duration and in changing from one state to another. Behaviours exhibited did not "match" the apparent state, e.g. eyes might be open when asleep.

### Environmental Effects On Neonatal States

To Lewis & Zarin-Ackerman (1970), state represents an infant and environmental interaction in which state is modified by the environment. The human newborn is marvelously equipped to adapt to the extrauterine environment. Still, "...the caregiving environment seems greatly responsible for enriching, stagnating, or disturbing original neonatal behaviour" (Gorski et al., 1987, p. 40).

Young infants have no verbal language besides crying, and learn through sensorimotor experiences and by making associations with stimuli. Sensorimotor experiences are exposures to tactile, kinaesthetic, auditory, visual, motor, gustatory and vestibular information (Wolke, 1987). While cared for in the newborn nursery, the neonate must synchronize his or her behavioural states and physiological adjustments with an environment where there is no clear, pronounced diurnal rhythm in noise and light intensity or in caregiving activities. This is significant since for the neonate, one of the primary biorhythmic elements is the distribution and flow of sleep-awake states over a 24 hour period (Keefe, 1987). The achievement of synchronous

interaction or coordinated exchange between the caregiving environment and the newborn represents an initial level of adaptation which is crucial to the functioning of the newborn living system (Thoman & Whitney, 1989).

High light and noise intensity not only lead to the disturbance of the infant's rest but also increase the time the baby spends in Active (REM) Sleep. Lower tissue oxygenation, increased chest wall instability and periodic breathing, with the occurrence of five to 14 times more apneic episodes during REM sleep in comparison with Quiet (NREM) sleep, have been reported (Wolke, 1987). These events have implications for brain oxygenation and intact central nervous system functioning (Anderson, 1989).

Noise pollution in the newborn nursery is mainly caused by caregiving activities (Wolke, 1987) and by other infants crying (Keefe, 1987). "Sudden loud sounds often lead to adverse physiological effects in the newborn. These include sleep disturbances, motor arousal and crying, hypoxemia, tachycardia, and increased intracranial pressure" (Wolke, 1987, p. 987). With less time spent in NREM sleep, the newborn's eyes are likely to be at least partially open, increasing the exposure to disturbing fluorescent lights.

#### Physiological and Psychological Responses to Music

Music has been a major thread in the historical literature on healing and health (Podolsky, 1954). The

ancient primitives as well as civilized societies (Greek, Roman, Oriental, Hebrew, etc.) lauded music as "... one of the greatest of all healing forces" (Podolsky, 1954, p.1). Scholars have theorized on how music affects the listener. "Deep within us, music strikes a resonance so that we respond first on a rhythmic, sensorimotor level and later in an associative, perceptual or intellectual way" (p. 256).

Other investigators have found that soothing music aids digestion (Podolsky, 1954), relaxes muscles and calms restless minds (Jacobs, 1986), decreases physiological responses to stress (Standley, 1986), regulates respiratory rates (Haas et al., 1986), and skin temperature, (McFarland, 1985) calms patients during radiation therapy (Buckingham, 1983) and helps to reduce pain perception (Geden et al., 1989; Standley, 1986). Verdeau - Pailles (1985) theorized that musical rhythms affect humans because "... they are in tune with our own internal rhythms" (p. 40) and that music can have a positive influence on both neural and hormonal function thus facilitating healthy immune and growth processes.

Music affects the actual brain-wave state via the neuro-endocrine system through electrical and chemical circuits which transmit neural messages to the brain (Trevisan & Nowicki, 1978). Music can actually affect the emotional or feeling state of the listener through direct stimulation of the limbic system. "Music seems to be recognized by our brain as the representation of integral,

holistic auditory images (the harmonic structure) whose long-term succession in time bears in itself a distinct Gestalt value" (Roederer, 1982, p.45).

Although music is obviously composed of various sounds, it "...is distinguished from most other sounds - much of the time - in that it uses steady frequencies. The amplitude of musical sound varies continuously as for natural sounds but discrete frequency steps are used to allow relationships between tones to develop" (Clynes, 1982, p.48).

Music is considered cultural in that it may serve the same function (as stimulus and in the response by the listener) for more than one person. The fact that musical responses are shared is also illustrated in people's tastes or preferences for music. For instance, " Occidental people love simple rhythms, careful tuning, fixed tonal steps and harmonies" (Lundin, 1985, p.6). Schoen (1968) pointed out that no two people will be affected exactly the same by any stimulus. He said "However, a given musical selection will arouse a certain definite reaction and will arouse the same reaction on different occasions in a large proportion of those who listen" (p.151).

Musical phenomena are felt as sonorous vibrations inside the body, as a source of energy and "release", and as semantic content (Verdeau - Pailles, 1985). Podolsky (1954) described how musical rhythm regulates inner body rhythms which help the person to feel more integrated and organized. Rhythm must be considered both as a stimulus object and as a

response of the organism. On the response side, rhythm is both motor and perceptual. Lundin (1985) explained that musical stimuli can cause a physiological rhythm to appear in the central nervous system pathways. Periodic increases and decreases in the intensity of the neural sensations become coordinated with the series of objective stimulations from the musical rhythm.

The perceptual organization of distinct rhythmic stimuli involves some discrimination of stimuli. Humans tend to perceive musical stimuli in groups or phrases: instead of hearing a series as "click - click -click", we may group them as "CLICK - click-click". This organization is labelled "subjective rhythm". The capacity for subjective rhythm is inherent in the organism and occurs without training.

Lundin (1985) also wrote "... the fundamental conditions of a rhythmic experience are to be found in the laws of periodicity of functioning in the nervous system" (p.122). Tame (1984) found that most people find music played at about the same pace as the normal heartbeat soothing ( 65 - 80 beats per minute). This is similiar to Salk's findings (1981) that infants seemed to find rhythms of about 72 beats per minute (similiar to the mother's heartbeat heard in utero) soothing as they slept longer when exposed to this stimulus.

Although music is mostly an auditory stimulus, the effects of the sound vibrations are processed through and responded to by much of the human body (Harvey, 1985). The

sound vibrations are channeled through the ear, the skin, and through bone conduction, then processed in the brain stem (the reticular activating system), the limbic system (thalamus) and the cerebral cortex, particularly the temporal lobes. Neural impulses then trigger autonomic nervous system reactions affecting the listener's respirations, pulse rate, blood pressure, muscle tone, brain wave frequency, galvanic skin response, pilomotor reflexes, pupillary reflexes and gastric motility (Harvey, 1985).

Goldstein (1985) found music can evoke "natural highs" through inducing the release of endorphins, the brain's own endogenous neurotransmitter opiates. Pleasing music increases the production of the neurochemical phenylthylamine, the "chemical of love" which produces an euphoric "falling in love" type of feeling in the listener (Harvey, 1985; Rosenbaum, 1984). Harvey (1985) also noted that music can cause a decrease in the blood levels of adrenocorticotrophic hormone, (ACTH), one of the major stress hormones found in the human body.

Although, as Tame (1984) stressed, "... there is scarcely a single function of the body which cannot be affected by musical tones" (p. 136) due to its seeming intangibility, "... music is not considered by a materialistic age to be capable of producing significant healing effects" (p. 157).

### Music as a Health Intervention

Music used for healing is both an ancient art and a current form of scientific therapy. Research on the effects and usefulness of music as an intervention is still in its infancy. Studies focusing on the use of music in therapy are becoming more frequent in the literature: all support the ancient postulate that music is a viable intervention in healing (Lundin, 1985; Trevisan & Nowicki, 1978).

The most common use of music in healing is as an audioanalgesic (MacClelland, 1979). As early as 1914, Kane used music to calm surgery patients prior to applying anesthesia (Podolsky, 1954). Several studies in dental surgery and practice have documented the use of music for pain control (Bonny, 1983; Clifton, 1983; Clynes, 1982; Foutz, 1970; Hanser, 1987). Standley (1986) pointed out that "... auditory stimuli may directly suppress pain neurologically and may mask the sound of the dental drill, removing a source of conditioned anxiety" (p. 59). Geden et al. (1989), Livingston (1979) and Sammons (1984) asserted that music can be successfully used as an audioanalgesic during childbirth. They found music reduced the mother's perception of pain, shortened the length of labour time, and increased feelings of euphoria during the birth. Standley (1986) described how the audioanalgesic properties of music helped terminally ill cancer patients reduce anxiety and discomfort during radiotherapy regimes.

Music has also been lauded as an anxiolytic agent. Reder, Floyd & Kirkpatrick (1985) tested music for this property with orthopedic, gynecologic, and urologic surgery patients. The patients who listened to selected meditative, soothing music showed decreased serum stress hormone (i.e. cortisol levels) postoperatively.

Music can serve as a focus of attention or as a distractor from uncomfortable or invasive stimuli. Lingerman (1983) described how Romantic "tonic-like" music was used with severely burned patients. Music distracted the clients from the pain associated with dressing changes and treatments, elicited movement for maintenance of joint mobility, augmented respiratory exercises and helped alleviate the psychological trauma of permanent disability and scarring. Livinggood, Kesic & Paige (1984) found that music distracted and reduced anxiety in family members waiting for relatives to undergo emergency surgery. A study carried out at St. Joseph Hospital in New York described how Classical and soothing Popular music was used in a six bed Intensive Care Unit. The incidence of myocardial infarction dropped and the mortality rate decreased by 8 - 12% below the "national average" on this ward when music was played continuously (Verdeau - Pailles, 1985).

Melodic music has been used quite extensively in psychiatric settings as a means of gaining contact with the patient, especially schizophrenics and in occupational therapy (Lundin, 1985). Bright, stimulating music has been

used to treat depressive disorders and to evoke group participation (Standley, 1986).

Another intervention has been the use of Baroque music to reinforce or structure learning. Standley (1986) described how severely handicapped, nonresponsive infants showed physiologic responses such as overt sucking movements when exposed to lullaby-like music.

The sedative effects of music have been aptly described in the literature. Olds (1985) studied the fetal response to music and found that dreamy, lyrical music seemed to calm the fetus, while loud, complex music stimulated hyperactive fetal movement. Schoen (1968) found that music with a slow tempo, less decided accent, and an easy, flowing melody resulted in slower physiologic responses in his adult subjects. Chetta (1981), Fagen (1982), Marley (1984) and Owens (1979) credited soothing music for decreasing fear, distress and anxiety in hospitalized infants, toddlers, and their families. Fagen (1982) described music as an intervention ideally suited to "...promote creative wellness attributes in the very ill child" (p.61). Verdeau-Pailles (1985) postulated that lullabies used in a newborn Intensive Care Unit setting resulted in 16% less time needed for premature infants to reach the weight criterion for discharge. She also described the soothing effects of music on neonates:

"Newborn children have been calmed by: a) the mother's heartbeat recorded through a liquid environment, b) the rhythm of a lullaby that recalls the pendular motion of the pregnant mother's heavy gait or c) a particular musical work or works of the same composer that were listened to frequently by the pregnant mother" (p. 48).

#### Summary

In summary, newborns enter the world equipped with a sophisticated repertoire of adaptive physiological and psychological behaviours. They demonstrate a cyclic pattern of organized behavioural states. These behavioural states are distinctly affected by the surrounding environment and may be "well" or "poorly" organized.

Music has distinct effects on the human organism. Soothing music can be used to achieve an alpha wave brain state which initiates a state of relaxed awareness. This state of relaxation may facilitate the newborn's ability to regulate his/her behavioural state organization despite the noxious environmental stimuli in the hospital nursery.

## CHAPTER THREE

### Methods

#### Introduction

This chapter includes an outline of the methods used to compare newborns' behavioural state patterns exhibited during exposure to selected music with those displayed when the newborns had no music exposure. Content includes a discussion of the research design, sample selection and inclusion criteria, the data collection instrument and procedures, the assumptions and limitations inherent in the study, data analysis, reliability, validity and procedures used for protection of human rights.

#### Study Design

A pre-experimental, one group, pretest, posttest design was used. This is a "... quasi-experimental design in which the investigator pretests the sample, introduces the experimental manipulation to everyone in the study and then obtains posttest measures" (Woods & Catanzaro, 1988, p.179). This design enabled the determination of the influence of the treatment variable (soothing music) on the independent variable (behavioural state) by using ipsative controls: each participant served as his or her own control.

Each subject (n = 20) was directly observed on two separate occasions for two hours for each observation period. During the control observation the newborn's

behavioural state organization was documented without any music present. The experimental observation included exposure to continuous selected music.

All observations and coding were done in 10 second epochs. The same observer documented the subjects' behaviours during both the control and experimental observations.

Figure 2:

One Group, Pretest, Posttest Design

01      X      02

Sample Inclusion Criteria

The sample subjects (n = 20) were selected by convenience sampling from a population of neonates in a tertiary hospital who met the following criteria:

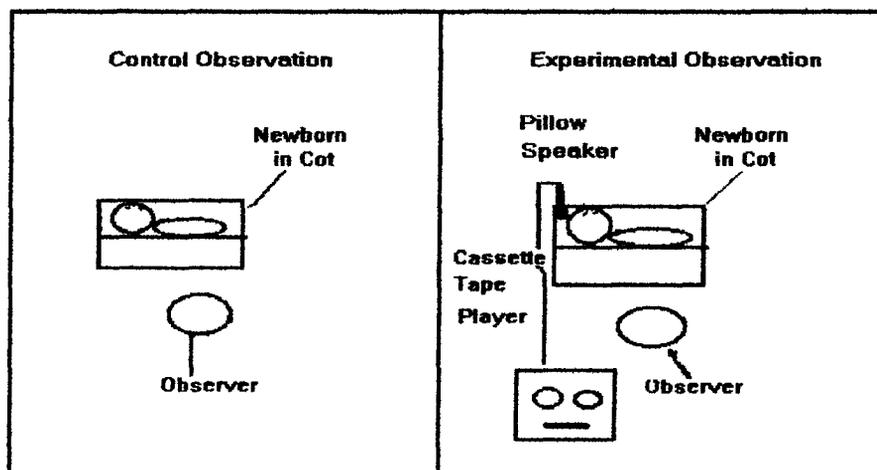
- 1) Greater than 24 hours but less than 60 hours of age.
- 2) Equal to or greater than 36 weeks gestational age.
- 3) Apgar scores greater or equal to 8 after 5 minutes of age.
- 4) No gestational complications.

- 5) Normal spontaneous delivery.
- 6) No postpartum complications or anomalies.
- 7) Occidental descent.
- 8) Equal as possible numbers of males and females.

### Data Collection

Figure 3:

#### Data Collection Model



The investigator visited the two postpartum units of the agency where the study was conducted to explain the study to the nursing staff and to answer questions regarding the study. The investigator requested that the charge nurse on the postpartum unit(s) of the selected agency identify patients that met the inclusion criteria. The investigator then consulted with the assigned registered nurse on

occasions when the potential participant's mother had voiced an intent to use the nursery for newborn care and when she was interested in hearing about the study.

The investigator then talked to potential participants' mothers, and sometimes fathers about the study, reviewed the patient informed consent form (Appendix A) and requested the parent(s)' signature on the form. When the subject's parent(s) gave written consent, the investigator arranged a preferred time for observations (all mothers preferred late night hours, after bedtime and between infant feedings).

Twenty newborn subjects who met the sample selection criteria were individually observed for a total of four hours. During the first two hour observation (control) each subject was observed without exposure to continuous selected music. During the second observation (experimental) the selected music (see Appendix B) was played via a three inch circular "Pillow" speaker placed in the cot, connected to a dual cassette tape playing system, (Model: Samsung PD-790C) set at 50 decibels of sound. The tape system was set on continuous play mode. Music was played during the experimental observation to provide data for comparison of behavioural states exhibited and number of state changes when the subjects were exposed to the music in the nursery and when they were not. Observations were made in one of two nurseries in a tertiary hospital in Vancouver, B.C.

Each subject was breast or bottle fed within a half hour before both the control and experimental observations

began. Each subject also had his/her diaper changed by the mother or nursery nurse prior to both the control and experimental observations. The subjects were all positioned in a lateral position and bundled uniformly.

All subjects were dressed in a diaper, a hospital infant gown (extended to baby's hips) and wrapped loosely in a flannel blanket with hands and forearms free. The newborns were bundled by the nursery nurse with the blanket wrapped more loosely than usual to allow easier viewing of foot and knee movement for the investigator. The cot was situated amongst the other infants in the nursery. The observer sat within a five foot radius of the cot in direct line of vision to the infant. All subjects were continuously observed for frequency of the dependent variable, behavioural state and for behavioural state changes (lability) in 10 second epochs. The control observation was done first for two hours unless the subject became distressed and required caregiving. Once the infant was calm, he/she was repositioned in the cot by the nursery nurse and the observation continued for a total of two hours. The investigator began the experimental observation after the subject had been fed, the diaper had been changed and the newborn was repositioned in the cot as described above. If possible, the experimental observation was done continuously for two hours. Some subjects did require caregiving during this second observation. If so, the

experimental observation was resumed once the newborn was returned to the nursery in his/her cot.

The average amount of time from the beginning of the control observation and the ending of the experimental observation was approximately six hours. The longest timespan for one subject was ten and a half hours from start to finish.

The observer recorded the observed state behaviours and lability using a collection tool designed by E. Thoman (1990) (see Appendix C). "A frequency coding system allows the investigator to determine ... how the observation time is divided into specific, mutually exclusive states" (Woods & Catanzaro, 1988, p. 280). The observer initially designated the first four subjects' data as pilot study data to discover potential problems while learning to use the data collection tool. The observation of the behaviours included in the tool and the recognition of the behavioural states described by Thoman (1990) was not a problem for any of the four initial subjects. The investigator chose to include the data for the four initial subjects with the study data. The direct observation approach was chosen because "... hypotheses require data that can best be produced during observation" especially with groups or individuals "... who are not able to answer questionnaires or interviews... such as infants or young children" (Woods & Catanzaro, 1988, p.278).

The data were coded in time-samples of 10 second

epochs: the newborns' state behaviours were observed and recorded every 10 seconds. Behaviours typifying each state were observed (Thoman, 1990). The frequency of each subject's state occurrence was tallied for both two hour observation periods. The frequencies of selected newborn behaviours (see Appendix D) were tallied from the coding tool sheets (see Appendix C) for each subject. All subjects (n = 20) were observed for two distinct periods: once with no music exposure (control observation) and once with exposure to the independent variable, the selected music (experimental observation).

#### Assumptions

There are several assumptions evident in this study.

- 1) The potential problems of subject reactivity, novelty, and response selection were not significant in this study since the neonate is unlikely to be aware of the observations or become interactive with the observer.
- 2) Maturation was not an issue because all subjects were 24-60 hours old and both observations were done within 12 hours of each other.

- 3) Caregiving received by the subjects in the nursery was uniform across the subjects and did not interfere with the study observations.
- 4) The neonatal behaviours observed reflected the categories of states outlined by Thoman (1990). The unique individual characteristics of each neonate would not significantly alter the flow of behaviours or the specificity of states.
- 5) The method of feeding (breast or bottle) would not affect the neonate's behavioural state patterns.
- 6) The effects of the music would be observed immediately following the introduction of the stimulus.

### Limitations

Some limitations evident in the study included:

- 1) The data collected can only tentatively be considered for healthy, full-term infants in the immediate puerperal period because behavioural states are dynamic and patterns change as the neonate matures.

- 2) The study did not control for variance in caregiver effects. The quality of care given by the assigned nursery nurse may have a significant difference in the rhythmical change of each neonate's behavioural states.
- 3) Direct observation limited the data available to the behaviours that are visible. No data on innate physiological or biochemical responses were gathered.
- 4) The data gathered were limited by the observational perception of the observer and the presence of infant's clothing.
- 5) The study did not control for variance in maternal-infant interaction, maternal quality of care, or reciprocity of behaviours.
- 6) There was no interrater reliability established because only one investigator conducted the study.
- 7) Data gathered during pilot testing were included in the data analysis and may have affected the findings.
- 8) The sample was not randomly selected but a sample of convenience which limits generalizability.

- 9) The small sample size may have affected the robustness of the statistical testing.
- 10) The investigator was aware of the timing of the control and the experimental conditions and that may have biased the investigator's observations.
- 11) The presence of the investigator may have affected the nurses' usual behaviours in the nursery setting.

#### Data Analysis

The nominal data collected from the frequencies of behavioural states were tabulated as molar units (behavioural state categories) and as molecular units (actual observed behaviours). The data for this study meet the conditions for a nominal scale of measurement. Nominal data are categorical data that do not have an implied order (Roberts & Ogden-Burke, 1989). Nominal data are separated into clear categories. In this study, the behavioural states were categorized into high arousal states (Nonalert Waking and Crying) or low arousal states (Quiet Sleep, Active Sleep, Drowse/Daze, Transitional, and Quiet Alert). Combinations of the observed behaviours were clustered according to Thoman's descriptions (see Appendix D) to accurately describe the seven categories of behavioural states. The tallied frequency score for each subject was

compared for differences in demonstration of the behavioural states between the control and the experimental observations. The demographic data of the sample were summarized using descriptive statistics (mean, standard deviation and range) to indicate the homogeneity of the sample.

The number of high arousal states observed during the control and experimental periods was compared using the McNemar's test as directed by Roberts and Ogden-Burke (1989). This test is suitable to test differences when the data are nominal and two variables are studied. The McNemar's test "... tests the significance of the difference between two proportions based on the same sample of individuals. The data consists of pairs of observations" (Ferguson, 1981, p.187).

A normal deviate z score was obtained by dividing the difference between the two proportions of high arousal states and low arousal states for both the control and experimental observations. A z score was also calculated for the proportions of state changes between the two observations. Related group design tests are preferred when groups are identical because they are more sensitive to the effects of the independent variable (Miller, 1974). A one-tailed z score was obtained since it was predicted that the control group would have a higher number of high arousal states than the experimental group.

## Reliability

Reliability refers to the consistency and accuracy of a measurement instrument (Miller, 1974), it gives a similar result no matter who is doing the measuring (Woods & Catanzaro, 1988). If the measurement is used more than once to measure the same object or behaviour under similar circumstances it will yield virtually the same value.

The measurement tool used in this study was developed by Evelyn Thoman and colleagues at the University of Connecticut. Thoman has presented reliability values in relation to stability and consistency of measurement including test-retest reliability and interrater reliability.

### Instrument Reliability

In their 1975 study Thoman, Korner & Kraemer used a test-retest correlation coefficient to test the individual consistency of infants in the seven behavioural state categories over time. They achieved a reliability coefficient of  $r = .75$ , a high level of reliability. This statistic suggests consistency of behavioural states over time in each subject. States were exhibited in similar patterns of occurrence and change (lability) for most of the subjects over time.

Thoman et al., (1981) observed infants on three occasions in the hospital, at home for seven hours during weeks one, two, three, four, and five and again at three

months, six months and one year of age for a total of ten observations per subject. Thoman et al., (1981) used a lower-bounds reliability coefficient for twenty molecular behaviours for the observations done on weeks one through five. They achieved a reliability coefficient of  $r = .70$  or more (median  $r = .785$ ) for the twenty behaviours, reflecting stability in measurement across the repeated observations.

Thoman et al. (1981) also incorporated a F ratio by using an analysis of variance (ANOVA) test to indicate the relative degree of profile consistency across time. Her intent was to describe in a single number how parallel the profile curves were for each infant. Babies who demonstrated a low profile consistency statistic (F), e.g.  $F = 3.09$  later developed health or behavioural problems such as aplastic anemia and sudden infant death syndrome (SIDS). Those who showed a high F value, e.g.  $F = 304.86$  developed without any major problems.

In their 1989 study, Thoman & Whitney calculated test-retest correlation coefficients which ranged from  $r = .70$  to  $.87$  for all seven states, again suggesting measurement reliability. Thoman also demonstrated measurement reliability in her 1990 study in the seven behavioural state categories. She again tested using an ANOVA format to obtain an F value for individual differences. She obtained a measure of reliability once more indicating stability over time in the state measures for individual infants. Developmental changes in states were also manifested in a

reliable pattern for most subjects. Thoman found the infants showed a significant linear increase in waking during the daytime as they matured ( $r = .97, p < .01$ ), while waking during the night remained stable across the early weeks.

#### Interrater Reliability

Thoman and her colleagues have consistently maintained a high level of interrater reliability over fifteen years of study. Thoman (1975) quotes a mean interrater agreement of 91.9% in behavioural state category identification equating with an interobserver reliability coefficient of  $r = .82$ .

In their 1989 study, Thoman & Whitney compared the data from direct observations with data gathered through computer-aided scoring. They calculated a mean agreement of 86% (range was 76 - 98% agreement) on behavioural state identification between the two data collection methods.

Again in her 1990 study Thoman cites > 90% exact agreement between observers on each 10 second epoch coding of behavioural state observed.

#### Study Reliability

The investigator attempted to ensure internal reliability by following Thoman's specific guidelines for using her instrument. Since Thoman (1975) recorded observational data in ten second epochs, this study also used this ten second unit of measurement. Thoman's codes, coding tool and behavioural state categories and behaviours were all used as she directed. Considerable time was taken

(six months) by the observer to memorize the codes and behavioural parameters of each state. Practice identifying molecular behaviours was afforded while teaching in a similiar obstetrical clinical area prior to the study.

A pilot study was carried out with four newborns within the selected nursery environment, adhering to the exact protocol of the intended study. No apparent problems arose during the data collection during the pilot study period. The investigator chose to include these four initial subjects in the final sample. The investigator concedes that this choice may have affected the reliability of the data.

An attempt to closely mirror the demographic characteristics of the infants studied by Thoman during the puerperal observations was made. Like the 41 subjects in Thoman et al.'s (1975) study, the subjects were all Caucasian, included males and females (Thoman et al. did not quantify gender) and none showed signs of any complications. All infants' diapers had been changed and they had been fed within one hour of the beginning of an observation.

The infants in this study were placed in their cots on their right side like the infants in Thoman et al.'s (1975) study. However, Thoman et al. placed the cots under a radiant warmer in a separate room adjacent to the nursery. They were dressed in only a diaper and were observed once in the morning and once in the afternoon. A radiant warmer was not used in this study. The infants in this study were dressed in a diaper and nightshirt and loosely bundled in a

cotton blanket to prevent hypothermia. Their cots were situated in the main nursery amidst the cots of other newborns. All observations were done after midnight in this study.

### Validity

Validity "... describes the degree to which a test or instrument measures what it purports to measure" (Woods & Catanzaro, 1988, p. 251). It suggests that an instrument actually measures the constructs or concept it is supposed to measure. The instrument used to code the behavioural states was developed by Professor E. Thoman (University of Connecticut) in 1975. Thoman has replicated her studies using this particular instrument several times between 1975 and 1990.

### Instrument Validity

Thoman's behavioural state taxonomy instrument appears to meet the criteria for construct validity, content validity, predictive validity, and ecological validity.

Construct validity is the judgement of the validity of a measurement instrument on the basis of many interrelated experimental findings (Miller, 1974). It represents a cyclic process that requires extensive psychometric studies combined with theory development (Woods & Catanzaro, 1988). Thoman (1990) asserts that her taxonomy of behavioural states has been assessed psychometrically more than any other state classification scheme. Thoman and her colleagues

(1975, 1981, 1990) have used an intensive, mini-longitudinal approach to achieve repeated results in studies to observe the occurrence of the seven behavioural states and how they are organized over the first five weeks of life and beyond.

Content validity is concerned with whether the measurement tool and the items contained in it really are representative of the domain being studied (Woods & Catanzaro, 1988). Five steps are common to achieving content validity:

- a) Literature review- Thoman has embellished the background theory throughout her published work over the past fifteen years culminating in an extensive review of current behavioural state theory in 1990. She has applied concepts from theory to qualitatively describe behavioural states, assign molecular behaviour identifiers and design the measurement tool.
- b) Personal reflection- This seems evident in Thoman's 1990 publication. She painstakingly explores the validity of her cumulative work, identifying every possible interpretation of her longitudinal study findings.
- c) Identification of components of a concept- is the third step toward content validity. Thoman and her colleagues have given clear descriptions of seven categories of behavioural states (1975, 1981, 1989, 1990). The behavioural states have been labeled according to their qualitative components, e.g. Nonalert Waking, Quiet Alert, Drowse/Daze, Transitional, Quiet Sleep, Active REM Sleep.

d) Identification of items- the fourth step has also been demonstrated both in Thoman's published work and in her coding tool guidelines. Specific behaviours, e.g. eyes open/closed, Rapid eye movement (REM), large and small body movements, startles, mouthings, and so on have been identified as the molecular behaviours that combine to produce the seven molar behavioural states.

e) Empirical analysis of items- the fifth step toward content validity is demonstrated through Thoman's substantitive study results from observing infants repeatedly from twelve hours old up to 30 months old. Care has been taken by Thoman (1990) to interrelate the repeated findings to provide a consistency profile of states over time for each subject.

Thoman claims that she has achieved predictive validity in her work. Predictive validity refers to the amount of correlation between a measurement of a concept and a future measure of the same concept. It demonstrates the extent that an instrument's predictions of future behaviours are judged to be accurate (Treece & Treece, 1986).

Thoman described in her 1975, et al., 1981, & Whitney, 1989, and 1990 publications how predictive validity was achieved in her studies. In one longitudinal study (1975) of 22 infants observed between two to five weeks of age, she outlined how she used a Friedman analysis of variance (ANOVA) calculation to yield a single state stability score from the four weekly state profiles accumulated over the

observation period. Thoman (1990) calculated state stability scores ranging from  $F = 3.09$  to  $304.86$  ( $p < .001$ ).

The infants with the four lowest profile consistency indices were judged by the observers to be "poorly organized" and had major developmental delays or problems between 3.5 to 30 months of age. One infant developed aplastic anemia, one had seizures and hyparrhythmia with severe retardation, another died of sudden infant death syndrome (SIDS), and the fourth became hyperactive. None of the babies at the upper end of the consistency continuum showed any evidence of developmental delay or disability by thirty months of age.

#### Study Validity

There are two important criteria for evaluating the credibility and dependability of a study's results: internal and external validity (LoBiondo-Wood & Haber, 1986).

Internal validity. Internal validity "...asks if the independent variable really made the difference" (LoBiondo-Wood & Haber, 1986, p.108) in the study findings. Six threats to internal validity have been identified. These are history, maturation, testing, instrumentation, mortality and selection bias. The investigator has attempted to control the effects of these six threats in this particular study.

a) History- refers to prior exposure to the independent variable. This threat does not appear to be a problem in this study since the subjects are only 24 to 67 hours old. They are unlikely to have acquired a history of exposure to

music postnatally, although they may have had exposure to music while in utero (Olds, 1985). It is unlikely though that the subjects were exposed to the exact eighteen pieces of music selected as the independent variable (see Appendix B).

b) Maturation- was not an issue in this study. Both observations (group and experimental) occurred within a few hours of each other.

c) Testing- was not a concern. All infants were observed initially as the control group thus there was not a pretest to sensitize the subjects to the independent variable.

d) Instrumentation- was a viable threat to the internal validity of this study. The investigator attempted control of this threat by utilizing the instrument exactly the same during each observation of the twenty subjects. However, the same investigator performed both observations with prior knowledge of whether it was a control or experimental observation. This could threaten the internal validity of the study findings.

e) Mortality- could have also been a significant threat to this study's internal validity. Fortunately, none of the subjects was lost. All twenty participated in both two hour observations.

f) Selection bias- was a potential threat to this study. The sample was one of convenience, chosen according to the selection criteria. Lack of randomization may have affected the degree of internal validity attained in the study.

External validity. External validity deals with possible problems of generalizability of the investigator's findings to additional populations and to other environmental conditions (LoBiondo-Wood & Haber, 1986). External validity is subclassified into population validity and ecological validity.

Population validity refers to the generalization of results to other populations. The measurement instrument has been used by Thoman and her colleagues (1975, 1981, 1989, 1990) to observe infants with a variety of characteristics, e.g. premature infants, and infants of various racial and socioeconomic status. The subjects in this study, however, were selected according to specific selection criteria e.g. gender, racial origin, and mode of delivery. This may have diminished the generalizability of the findings to other newborn populations.

Ecological validity refers to the generalization of results to other settings or environmental conditions. The author has attempted to ensure ecological validity by describing the method and procedures used in the study to facilitate potential replication of the findings.

### Ethical Issues

The study proposal was reviewed by the University of British Columbia Behavioural Sciences Screening Committee for Research and other Studies involving Human Subjects as well as by the Research Coordinating Committee at the selected Lower Mainland hospital.

Written consent was solicited (see Appendix A) from the parent(s) of the neonatal subject by the investigator with permission by the unit managers and the approval of the Research Coordinating Committee of the agency.

A letter of information was distributed to each potential subject's parent(s) outlining the study. The purpose and procedures for the study were explained to each parent. Reassurance that participation or refusal would in no way interfere with the usual care of the infant was given. A consent form was used to petition the parent(s)' written informed consent. Written and/or verbal consent was sought from at least one parent. Under no circumstances did the parents receive the impression that participation was anything but voluntary. Parents had the uncontested right to refuse to participate or terminate participation at any time during the study. A letter of information for the attending Physician(s) was also placed on the subject's chart (see Appendix E).

The investigator served as observer only - caregiving of the subjects continued to be the responsibility of the assigned nursery nurse. The observer applied only the

independent variable, the selected music to the group during the experimental observations. Care to limit the effect of the observer on the routine operation of the hospital nursery was diligently taken. Confidentiality was assured: codes were used - no recording of the infant's identity was used.

### Summary

This chapter outlined the methods used to compare the differences in behavioural state frequencies between the control observations (no music exposure) and the experimental observations (exposure to selected music) of twenty newborns. The research design used to study the proposed hypothesis was "One group, pretest, posttest". The sample consisted of twenty newborns who met the inclusion criteria. The newborns were observed for two hours on two occasions (one a control observation, the other an experimental observation). The behavioural states exhibited were recorded in ten second epochs for both observations. All subjects were exposed to exactly the same music during the experimental observation. One observer collected the data for all observations.

A pilot study was conducted which identified no difficulties regarding procedures, musical equipment or the data collection sheet. The hypotheses were summarized using descriptive statistics and analyzed using a one-tailed,

McNemar's test. The significance level was set at alpha =.05. The reliability and validity of the measurement instrument developed by Thoman & colleagues was described (1975, 1990). In addition, study validity and reliability were discussed.

The proposal was approved by the University of British Columbia's Behavioural Science Screening Committee for Research and Other Studies involving Human Subjects and by the Research Coordinating Committee of the agency where the study was conducted. Written consent was obtained by a parent of each of the twenty newborns that participated in the study. Procedures for protection of subject privacy were implemented.

## CHAPTER FOUR

### Presentation and Discussion of Results

#### Introduction

This chapter is divided into three sections. The first section describes the demographic and health - related characteristics of the subjects in the sample. The second section presents the results for the investigated study hypotheses. The third section discusses the findings of the study.

#### Characteristics of the Sample

During the period from November 1992 through January 1993, twenty newborns who met the inclusion criteria of the study were recruited. Each participated in both a control and experimental observation in one of two newborn nurseries within a tertiary hospital in Vancouver, B.C. The sample will be described in terms of demographic and health related characteristics.

#### Demographic and Health related Characteristics of the Sample

Demographic and health related data collected about the subjects concerned gestational age, Apgar score at five minutes postbirth, age, in hours at the beginning of the first observation, birth weight, maternal age, number of siblings, gender, method of feeding, race, and mode of

delivery. The subjects varied in gestational age, Apgar scores, age at time of the observations and birth weight. Maternal age also varied as did the number of newborns' siblings (see Table 1).

Eight (40%) of the infants were female, twelve (60%) were male. According to 1992 population statistics, out of 46,300 live births in British Columbia, 22,600 or 49% were female, 23,700 or 51% were male (Statistics Canada, Ministry of Industry, Science and Technology, 1992). This fact lowers the gender representativeness of the study subjects compared to the target population.

All but two were breastfed. All twenty subjects were born by spontaneous vaginal delivery without any apparent intrapartum complications. There was no record of major antenatal or postpartum problems or any congenital anomalies. All subjects were of Caucasian race.

Gender distribution, a non-random sample, and single racial origin of the subjects obviously limit the representativeness of this sample in relation to the target population in the Lower Mainland of British Columbia. There was no representation from the large Oriental or Indo-Canadian population or other minority cultural groups common to Vancouver. Caucasians were selected due to the evidence in the literature that cultural music preferences and conditioning vary (Lundin, 1985). Lundin (1985) asserts that the "...Occidental love for simple rhythms, careful tuning, fixed tonal steps, harmonies, the tonic effect, and the

diatonic scale is not shared the world over" (p. 179).

Common musical instruments used in soothing Western music include the piano, violin, flute, harp and oboe.

Roederer (1982) points out that musical familiarity is psycho-physiological, imprinted in the neural circuitry of the auditory system. Benenzon (1981) elaborates by attributing cultural preference of certain forms of music to the "...mnemonic engram of the being in gestation" (p.19). This mnemonic engram contains an inherited genetic pattern comprised of experiences of the developing child's folkloric legacy, corresponding to the life of his or her ancestors, race, and cultural milieu.

Oriental, particularly Chinese music is written using a pentatonic, five-note scale in contrast to the Western diatonic major/minor scales (Geoffrey, 1971). Oriental music is composed primarily of melody and timbre with no harmony and a nature that seems "mistuned" to Occidental listeners. Common Oriental instruments include stone chimes (pian ch'ing), silk-stringed zithers, panpipes, sheng mouth organs, and simple clay flutes. These instruments produce a much different sound compared to Western instruments.

East Indian music is written using 22 shrutis or notes. The traditional Indian music has no sense of key as we know it in Western music (e.g. C major) and also has no harmony. Indian rhythm is much more complex than the rhythms used in traditional Western music (Geoffry, 1971). Common Indian instruments include the vina and sitar, both enormous

stringed instruments and the vansha or transverse flute. These instruments produce a distinct sound compared to Western or Oriental instruments.

It seemed prudent to select subjects who were most likely to be favorably disposed to the decidedly Western music selections (listed in Appendix B) thus racial origin was limited to Caucasian infants for this study.

Table 1

Demographic Characteristics of the Newborn Sample compared with Thoman, Korner & Kraemer's 1975 Study Subjects

	<u>1975 Study</u>		<u>Current Study</u>		
	n = 41		n = 20		
Total Time:	2 hours		4 hours		
Variable	Range	Mean	SD	Range	
Gest. Age:wks	38-42	39.3	1.5	36-42	
Apgar (5 min.)	9-10	9.1	0.3	9-10	
Hours old	12-67	37.8	12.5	24-57	
Birth wt:gms	2500 -4000	3527.0	383.6	2860 -4160	
Maternal Age	18-29	27.7	5.9	20-38	
Siblings	0-2	0.4	0.7	0-2	

NOTE: Sample consisted of 8 female and 12 male Caucasian infants. All but 2 were breastfed. All born vaginally, without complications.

### Findings

The findings of the study will be presented in relation to the two study hypotheses. A description of the data related to the dependent variable, the number of high arousal states (Nonalert Waking and Crying) will be presented first. Data describing the lability or frequency of state changes over time will follow.

Hypothesis 1: The control group will demonstrate a significantly higher number of high arousal states than the experimental group.

The comparison of the high arousal behavioural states (Nonalert Waking and Crying) between the two groups begins with an analysis of the number of times these two states were manifested during the control and experimental observations. This is followed by a calculation of the differences in proportions between each subjects' two scores (control and experimental) for high arousal states using a one-tailed, McNemar's test ( $\alpha < .05$ ). The difference in proportion of lability or frequency of state changes was also analyzed using the one-tailed, McNemar's test ( $\alpha < .05$ ).

Table 2

Number of High and Low Arousal Behavioural States and Number of State Changes (Lability) during the Control and the Experimental Observations (in 10 second epochs).

Observation	High Arousal States	Low Arousal States	Lability: State Changes
<u>CONTROL</u>			
Number of epochs	2404	11996	596
<u>EXPERIMENTAL</u>			
Number of epochs	872	13528	463

Statistical analysis of the difference in frequency of the high arousal behavioural states between the two groups. A one-tailed, McNemar's test was calculated for the data for the high arousal behavioural states (Nonalert Waking and Crying). This statistic tested the differences in proportion of the number of high arousal behavioural states demonstrated within the two hour control and experimental observations. The significance level was set at  $\alpha < .05$  indicating that the z scores would be different from a standard z score of 1.65 due to chance only one out of

twenty times (Ferguson, 1981). Because the first hypothesis suggested a directional difference (control group would score higher in high arousal states) the one-tailed z score (Miller, 1974) was used.

The subjects demonstrated a score of 2404 epochs high arousal states during the two hour control observation compared to 872 epochs of high arousal states during the experimental period. The one-tailed, z score for the high arousal behavioural states (Nonalert Waking and Crying combined) was 2.32 ( $p < .01$ ) which is considerably higher than the z score of 1.65 needed to be significant at alpha  $< .05$  level. The newborns demonstrated significantly more high arousal states during the control condition.

#### State Lability (Frequency of State Changes) during the Control and Experimental Observations

Hypothesis 2: The control group will demonstrate significantly greater state lability or number of state changes than the experimental group.

State lability or frequency of state changes was measured to test the second hypothesis. A measure of state lability (Colombo, 1989 and Thoman, 1990) was derived by counting the number of state changes that occurred during the two observation periods. The newborns exhibited a combined frequency score of 596 state changes during the two

hour control observation. They demonstrated a combined frequency score of 463 state changes during the two hour experimental observation.

Statistical analysis of state lability. A one - tailed, McNemar's test to test the second hypothesis was calculated to measure the differences in proportions between the control and experimental scores for state lability. The one-directional z score used for comparison was 1.65 ( $\alpha < .05$ ). A directional difference (control group would demonstrate more state changes) was hypothesized making a one-tailed test suitable.

The z score obtained for state lability was 2.93 which is considerably higher than the z score of 1.65 needed to be significant at the  $\alpha < .05$  level. This suggests that there was a significant difference in the number of state change in the newborns between the control and experimental observations.

### Discussion of the Findings

The findings presented in the first half of this chapter will be discussed in two parts. The discussion begins with an interpretation of the differences in high arousal behavioural states exhibited by the twenty newborns during the two observations. The lability or number of state changes will be further defined with a discussion of the

differences in lability or fluctuations of the seven behavioural states over time in both observations.

### High Arousal State Frequencies in the Control and Experimental Observations

The high arousal behavioural state frequencies exhibited by the twenty newborn subjects within the control observation provided an interesting contrast to the frequencies displayed during the experimental period. The frequencies can be viewed in terms of supporting/rejecting the first hypothesis of this study. This hypothesis theorized that during the control observation the newborns would exhibit a higher number of high arousal state (Nonalert Waking and Crying) behaviours.

To adequately discuss the significance of the findings, an examination of the high arousal behavioural states is appropriate. The first part of the discussion will include theory from the literature to support the study results for these high arousal behavioural states.

High arousal behavioural states. Two of the seven behavioural states described by Thoman (1990) are considered high arousal states, Nonalert Waking and Crying (Anderson, 1989; Brazelton, 1984; Keefe, 1987; Thoman, 1990). Both states occur while the infant is awake and exhibiting

responsive behaviours to some form of disturbing internal or external stimulus.

Brazelton (1984) described signs of stress and fatigue in newborns. He correlated specific behaviours and behavioural states with a newborn's common reaction to stressful stimuli. These behaviours included:

- a) Signs of autonomic nervous system stress such as acrocyanosis, rapid respirations, and tachycardia, correlated with the crying state.
- b) A movement to a higher arousal state to attempt self-regulation and to shut out disturbing environmental stimuli. This change of state is most likely to become Crying or fussing states (e.g. Nonalert Waking).
- c) Behavioural changes, e.g. unfocused eyes (common in Nonalert Waking state); uncoordinated, active arm and leg movement (typical in Crying state); hiccoughs; sneezes; yawns and crying.

The two states, Nonalert Waking and Crying (Thoman, 1990) reflect several of the behaviours described by Brazelton (1984). It seems likely that these two states represent an infant's attempts to cope with perceived stressors. Although both states share a similar function, distinct behaviours differentiate them.

Nonalert waking state. The Nonalert Waking state (called the Active Alert state by Brazelton, 1984 and by Thoman in her early work e.g. 1975) is a "primitive" waking state which occurs frequently in premature infants but

usually diminishes quickly in the postterm period. Thoman & Whitney (1989, 1990) observed that fullterm infants who demonstrated persistently high levels of the Nonalert Waking state during the first week or two of life also showed erratic, unstable state patterns over successive weeks of age. Thoman (1990) stated that high levels of Nonalert Waking indicated a baby was at risk for future health or developmental problems as this was "...indicative of poorer overall state-integrity" (p.100). She claimed that no other waking state was inversely related to state stability and that high frequencies of Nonalert Waking reflected a malfunctioning in the developing central nervous system that could affect later developmental status.

Behaviours exhibited by newborns when in the Nonalert Waking state include (Brazelton, 1984; Thoman, 1990):

- a) open, but dull, inattentive, unfocused eyes.
- b) motor activity that varies but is typically high.
- c) isolated fussy vocalizations.
- d) periodic distressed facial expressions.
- e) irregular, increased respirations.
- f) increasing sensitivity to disturbing stimuli (e.g. hunger, fatigue, noise, excessive handling). If the stimuli becomes intolerable newborn is most likely to change to the Crying state.

Newborns in this study, exposed to soothing music, spent significantly less time in the Nonalert Waking state.

Perhaps the music played a role in facilitating adaptation

in the listening subjects to the nursery environmental stimuli. The music may have also stimulated the limbic system and temporal lobes of the cerebral cortex to assist the newborns to generally maintain lower arousal states in the presence of any environmental stimuli (Harvey, 1985).

Crying state. Crying behaviour represents the infant's most effective means of expressing needs. Crying is a reflexive vocalization in response to a given disturbing stimulus (e.g. hunger, pain, loud noise). Infants use crying to indicate a need for a decrease or increase of a stimulus, for instance, a decrease in pain, an increase in tactile stimulation (Shaw-Schuster & Smith-Ashburn, 1986).

Needs expressed through crying may reflect hunger, thirst, discomfort, feelings of insecurity, loneliness, boredom, fear, overstimulation, fatigue, and disturbing emotional tension. The pattern, tone, and rhythm of crying becomes uniquely distinguishable in response to each of these sensations, e.g. a hunger cry will come to sound different from a painful cry (Thoman, 1990).

When infants experience mild anxiety, the sensation acts as an incentive or powerful motive for action (Brazelton, 1984). They begin to fuss and cry softly to elicit caregiving behaviours. If the feeling of need is not responded to, infants will likely begin to cry excessively, signaling a more acute state of anxiety which will only stop if the infants' need are satiated. If their needs are met,

e.g. feeding given or they are cuddled, they usually stop crying as tension is decreased.

Although crying is a necessary and very adaptive behavioural state, it can be detrimental if prolonged or frequent. Intense crying in the infant resembles the adult Valsalva maneuver which can obstruct venous return in the inferior vena cava. This can potentially reestablish fetal circulation in the heart in sporadic bursts during the crying episode (Anderson, 1989).

With every strain phase of a cry, poorly oxygenated blood flows through the foramen ovale (which connects the right and left atrium in the fetus), returning to the systemic circulation rather than to the pulmonary vessels connected to the lungs. This circulating blood does not become oxygenated while the infant is crying putting the infant at risk for hypoxemia. The shunted blood moves as a large bolus through the foramen ovale increasing the potential for emboli to form and for insufficient oxygenation of the brain (Anderson, 1989; Shaw-Schuster & Smith-Ashburn, 1986).

The venous return is also obstructed in the superior vena cava which promotes increased cerebral blood volume but decreased cerebral oxygenation. This predisposes newborns to intracranial hemorrhage which can lead to future learning disabilities and has even been linked to cerebral palsy (Anderson, 1989). Anderson (1989) described a lifespan perspective by warning that a patent foramen ovale has been

found in apparently healthy adults. Lechat, Mas, Lascault, Loron, Theard, Kilimczac, Drobinski, Thomas, & Grosogeat (1988) found that patent foramen ovales were present in 40% of "ischemic stroke" patients less than 55 years old who suffered paradoxical emboli through what appeared to be a normal adult heart. Anderson speculated that this finding could be related to neonatal episodes of distress years before.

While in the Crying state, newborns exhibit a very high level of arousal (Thoman, 1975). This can magnify the energy expenditure of an infant by as much as 200% (Owens, 1979). This may stimulate an infant's delicate basal metabolic rate, increasing the need for energy to maintain their life processes and normal development.

In a newborn, the Crying state demonstrates the closest obvious behaviours common to a general stress response (Brazelton, 1984). The normal newborn has a heart rate of 120 to 150 beats per minute. When crying the neonate's pulse can increase to 170 to 180 beats per minute (Shaw-Schuster & Smith-Ashburn, 1986). During a stress response, respirations increase, blood pressure rises and gastrointestinal function is disrupted, often demonstrated by emesis or "spitting up". A "flight or fight" endocrine response is initiated, stimulating secretion of catecholamines (epinephrine, norepinephrine), cortisol and adrenocorticotrophic hormone (ACTH) which all function to ready the body to challenge or escape from the perceived stressor. Cardiac output

increases, and blood vessels constrict to concentrate the blood flow toward the heart, brain, and skeletal muscles. In the newborn this is complicated by the shunting of deoxygenated blood to the systemic circulation instead of richly oxygenated blood being pumped to the major organs during the stress response (Anderson, 1989).

During stress, increased cortisol secretion stimulates catabolism of tissue proteins to facilitate glyconeogenesis, stimulating blood glucose levels which can potentially lead to hyperglycemia (Shaw-Schuster & Smith-Ashburn, 1986). Catabolism of fats and carbohydrates is also stimulated in the liver which increases the risk of stored brown fat being used in the newborn to elevate the blood glucose level.

During the perception of stress, the limbic system in the brain is also stimulated increasing the emotional sensation of tension and anxiety. If crying is prolonged, all of these effects can seriously impede the newborn's delicate adaptation to the extrauterine environment. If one infant is upset, the potential for others to be upset is high since infectious crying may also be observed in babies. When one baby starts crying, others often follow suit (Shaw-Schuster & Smith-Ashburn, 1986).

The newborns exposed to soothing music in this study demonstrated significantly less crying behaviour than they did when in the hospital newborn nursery without music exposure. The relaxation response represents the opposite of the stress response demonstrated by newborns when in the

high arousal states (Nonalert Waking and Crying). The relaxation response is triggered by the parasympathetic nervous system contrasted with the sympathetic predominance in the stress response (Shaw-Shuster & Smith-Ashburn, 1986).

The relaxation response is manifested by decreased heart rate and blood pressure, slower and deeper respirations, blood flow is redistributed to include the peripheral body, digestion and peristalsis resume, oxygen consumption decreases, the immune system is reactivated and emotional tensions drain leaving a sense of wellbeing (Ader, 1981).

Soothing music with a lyrical melody, simple harmony, soft tone colour, and easy rhythm (About 60 to 80 beats per minute) can help to stimulate the relaxation response (Benenzon, 1981). Music can stimulate the release of endorphins from the brain, reduce blood levels of ACTH and increase phenylethylamine secretion. Neural impulses triggered by soothing music can trigger autonomic nervous system reactions to produce relaxation in muscle tone, brain wave frequency, galvanic skin response, pilomotor reflexes and pupillary reflexes (Verdeau-Pailles, 1985) Music also facilitates emotional homeostasis (Livingston, 1979).

It is possible that the exposure to the selected soothing music in this study somehow helped facilitate the relaxation response in the subjects, decreasing the amount of time spent in high arousal states during the experimental observation.

### Lability of the Behaviourial States during the Control and Experimental Observations

The findings suggest a significant difference in the mean number of state changes or lability within the control and experimental observations. The infants changed state an average of 29.8 times during the control period and 23.1 times during the experimental one. The one-tailed z score of 2.93 ( $\alpha < .05$ ,  $p < .001$ ) indicates that the difference in lability between the control and experimental periods is significant.

Lability or changes in state can be observed over time to reveal patterns of infant organization and state regulation (Keefe, 1987). This variability of state is an early indicator of an infant's capacity for self-organization. It is also an indicator of an infant's ability and effort to adapt to perceived disturbing internal or external stimuli (Brazelton, 1984).

Erratic or frequent state changes may imply that an infant is having difficulty achieving a rhythmic flow to the states. Keefe (1987) explains that the infant's ability to rhythmically organize state behaviour is indicative of central nervous system maturation and can be predictive of later development. Thoman (1990) described newborns who exhibited frequent state changes, labelling them as "poorly organized". Over time these apparently clinically normal newborns developed serious conditions, e.g. aplastic anemia,

hyperactivity, mental retardation, and one died of Sudden Infant Death Syndrome. Other babies observed by Thoman (1990) who did demonstrate regular patterns of state changes in the newborn period exhibited no major developmental problems by the age of 30 months.

During the control period, the infants studied demonstrated a higher frequency of state changes, often to a state of high arousal (Nonalert or Crying). These same infants demonstrated fewer state changes coupled with less time spent in high arousal states when exposed to soothing music. These findings suggest that music may have served in some capacity to help the newborns regulate their behavioural state changes, so that they were not moving so frequently to high arousal states.

Lability of states is regulated by the infant's central nervous system in response to internal and external stimuli (Keefe, 1987). State is a behavioural mode which functions as a filter, both for internal and environmental input and for modulating behavioural response (Thoman, 1990). States function as a process for maintaining equilibrium. Infants attempt to regulate stimulation impinging on them by changing state. The inability of an infant to change state appropriately is potentially maladaptive (Thoman, 1990).

Soothing music may be of benefit to newborns attempting to regulate their behavioural state through the innate qualities of gentle rhythm, tone colour, melody and harmony. A steady rhythm of 60 to 80 beats per minute is in tempo

with the average maternal heartbeat. This particular rhythm and sound has been used in studies showing significant results in relaxing infants and children while in hospital settings (Salk, 1981).

Rhythm is the sequence and proportion of durations of notes in music, representing musical "movement" (Verdeau-Pailles, 1985). The human body operates through an ensemble of rhythmical functions, e.g. circulation of blood, respiration patterns, and walking gait. Soothing musical rhythm and its organization stimulates a similar relaxed rhythm within the physical systems. Through the limbic system it also stimulates a more relaxed emotional affect (Lundin, 1985) and promotes an alpha brain wave pattern.

Melody, harmony, and tone colour enrich the effect of musical rhythm. When all four musical characteristics are purposefully subdued, lyrical and "dreamy" they can prompt a parasympathetic relaxation response in the listener (Benenzon, 1981). The behavioural states and their frequency of change are strongly involved in maintaining the homeostatic rhythm of the newborn's physical and psychological being. The use of soothing music seems to be a potential way to help facilitate an organized rhythm of behavioural state manifestation with less movement between states.

### Summary of the Findings

In this chapter a description of the sample in terms of the subjects' ages (hours postbirth), gestational age, birth weight, 5 minute Apgar scores, gender, method of feeding, number of siblings, maternal age, mode of delivery and race was presented. All subjects were Caucasian which did not give a true representation of the racial demography of the target population (which included a fairly large number of Oriental and Indo - Canadian newborns). The sample consisted of 8 females and 12 males with an average age of 37.8 hours postbirth.

The findings and a discussion of the findings in relation to the research hypotheses were presented. A discussion of the number of high arousal behavioural states and the number of lability or state changes was included.

There was a significant difference between the control and the experimental conditions in the number of high arousal states (Nonalert Waking and Crying) exhibited. The control group exhibited significantly more high arousal states than the experimental group did. Descriptive statistics of the results were presented along with the one-tailed, McNemar's test values ( $\alpha < .05$ ,  $p < .01$ ). A lower number of Nonalert Waking and Crying states occurred during the experimental observation. It

would appear that the newborns exhibited fewer high arousal behavioural states when exposed to soothing music.

There was a significant difference between the control and experimental conditions in the lability or fluctuation between states. This finding supports the second hypothesis since the newborns demonstrated fewer changes in state during the experimental observation. It appears that soothing music could benefit newborns attempting to adapt to extrauterine life while cared for in the hospital newborn nursery. This adaptation would include a demonstration of few high arousal states and fewer behavioural state changes (lability) (Brazelton, 1984; Colombo et al., 1989; Thoman, 1990).

## CHAPTER FIVE

### Summary, Conclusion, Implications and Recommendations

#### Introduction

This study was designed to determine the difference in the number of high arousal behavioural states and of state changes when the subjects were exposed to soothing music in the normal newborn nursery. This chapter presents an overview of the study, followed by conclusions, implications for nursing practice and education and recommendations for nursing research.

#### Summary

Staff at various Lower Mainland hospitals shared with the author a concern that newborns cared for in the normal newborn nursery did not seem to sleep well and exhibited behaviours associated with stress. The author had read several studies describing how infants, children, and adults had slept longer, exhibited less pain and stress related behaviours while in the hospital when soothing music was played. This study was designed to compare the number of high arousal behavioural states and the number of state change in newborns cared for in the nursery under normal circumstances and when exposed to selected soothing music.

The theoretical framework for this study was drawn from

theories on behavioural state patterns, puerperal newborn adjustment, environmental effects on newborns, psychophysiological responses to music, and the use of music as a health intervention. Review of the literature on these five theoretical topics provided information about the factors to consider when observing newborns and using music as a stimulus. This literature provided various behavioural state taxonomies to choose from, environmental qualities of newborn nurseries to consider, and gave examples of soothing music that have been used in hospital settings.

The literature suggested that the nursery environment could be a disturbing milieu for the newborn adapting to the extrauterine transition (Anders & Chalemian, 1974; Anderson, 1986; Anderson, 1989; Chard & Richards, 1977; Karraker, 1986; Keefe, 1987). Theorists postulated that noxious environmental stimuli could stimulate an increase in high arousal states, e.g. Nonalert Waking and Crying in newborns (Anderson, 1986; Anderson, 1989; Brackbill, 1971; Brazelton, 1984; Moreau, Birch & Turkewitz, 1970; Parmalee & Stern, 1974; Thoman, 1990). They also suggested that prolonged time spent in these states could be detrimental to their immediate and longterm health.

As well, the literature indicated that infants may demonstrate erratic and frequent behavioural state changes when exposed to disturbing stimuli (Colombo et al., 1989; Dement, 1972; Harper, Leake, Miyahara, Mason, Hoppenbrouwers, Sterman & Hodgman, 1981; Thoman, 1990) e.g.

hearing other babies crying, sudden loud noises, and bright fluorescent lights (Anderson, 1989; Karraker, 1986; Keefe, 1987; Shaw-Shuster & Smith-Ashburn, 1986). Reference to the calming results observed in patients when soft, lyrical, flowing music was used in hospital wards, operating rooms, intensive care units, and special care nurseries supported the hypothesis that music could be of benefit to newborns cared for in the normal nursery (Bonny, 1983; Buckingham, 1983; Chetta, 1981; Clynes, 1982; Cohen, Thorpe & Trehab, 1987; Davis-Rollans & Cunningham, 1987; Dossey et al., 1988; Fagen, 1982; Hammer, 1984; Hanser, 1987; Hanslick, 1986; Jacob, 1986; Lingerman, 1983; Livingston, 1979; MacClelland, 1979; McFarland, 1985; Marley, 1984; Owens, 1979; Podolsky, 1954; Pratt, 1985; Roederer, 1982; Sammons, 1984; Schoen, 1968, Standley, 1986; Verdeau-Pailles, 1985). The literature also suggested that behavioural states were the best index to use when assessing newborn behaviours and stability. Therefore, this study was designed to determine if there was a difference in the number of high arousal behavioural states exhibited by newborns in the nursery when the infants were exposed to selected soothing music. The study was also designed to see if there was a difference in the number of state changes (lability) in newborns when soothing music was played.

The study used a quasi-experimental, one group, pretest, posttest design in which the subjects served as their own controls. The study was conducted in a large

tertiary care hospital in Western Canada. The author observed each infant for a total of four hours within one of two normal newborn nurseries. The infants were observed for behavioural state changes and categories for two hours in the usual nursery environment, and again for two hours with selected music exposure isolated to the subject being observed. Only the subject was exposed to the music via a three inch diameter, circular "Pillow Speaker" placed in the infant's cot.

The sample was composed of twenty newborns. They were between 36 and 42 weeks gestational age, 24 to 57 hours old, weighed 2860 to 4160 grams at birth, had 5 minute Apgar scores of 9 to 10, had 0 to 2 siblings, and their mothers' ages ranged from 20 to 38 years. There were 8 females and 12 males in the study. All subjects were born by spontaneous vaginal delivery without complications. All were Caucasian, all but two were breastfed.

The two research hypotheses were tested using an one-tailed, McNemar's test ( $\alpha < .05$ ) statistic. There was a significant difference between the control and the experimental conditions at the  $\alpha < .05$  level, in the frequency of high arousal behavioural states, (Nonalert Waking and Crying). There was also a significant difference at the  $\alpha < .05$  level for the number of state changes or state lability.

The findings reflected support for the two hypotheses since the mean differences between the number of high

arousal states and number of state changes demonstrated during the control and experimental observations were significant. The infants demonstrated significantly fewer high arousal states and fewer behavioural state changes during the experimental observation. These findings suggest that the dependent variable, the selected music, was related to the exhibition of fewer high arousal states and the fewer changes of behavioural state.

### Conclusions

Although the sample size was small ( $n = 20$ ) it was large enough to provide worthwhile data for a preliminary research study. This study was exploratory in nature and covered a wide range of subject behaviours.

The trends identified in this study contribute toward the refinement of the concepts related to the effects of soothing music on neonatal behavioural states and behavioural state lability within the normal newborn nursery. Based on the findings the following tentative conclusions or trends are suggested:

1. That soothing music may be a beneficial stimulus to use with newborns being cared for in a hospital nursery setting.
2. That soothing music may be useful to newborns learning to regulate their behavioural state changes within the hospital nursery environment.

### Implications for Nursing Practice

The incidence of high arousal states and frequency of state change in newborns cared for in the hospital nursery have been examined. The results of this study have implications for nurses. Implications are identified in relation to practice and to nursing education. Nurses are responsible for providing care for neonates within the normal newborn nursery. The findings suggest that interventions may facilitate fewer high arousal states (Nonalert Waking and Crying). The findings also suggest that exposing the newborns to soothing music would be a cost-effective, feasible intervention for nurses to provide.

However, in order to utilize music as an intervention nurses would need to:

- a) learn to recognize behavioural states (Brazelton, 1984; Keefe, 1987; Thoman, 1990).
- b) understand the physiological implications for a newborn when frequent high arousal behavioural states are exhibited (Anderson, 1989).
- c) know an alternative to using music in the nursery environment could be to encourage "rooming-in" as much as possible. There is, however limited data available to demonstrate that the mother's hospital room is less noxious than the nursery environment. Anderson (1989), Karraker (1986) and Keefe (1987) present study results

which suggest that lighting and noise is significantly lower at nighttime in the mother's postpartum room.

d) recognize the potential of noxious stimuli (such as loud noises, bright lights) to disrupt normal state patterns within the nursery setting.

The implications of this study have relevance also to education. There are implications for staff inservice, patient education, specialized education of professionals and in the general education of nursing students. Nurses should become aware of the usefulness of music as a health intervention to provide more holistic care for their clients. Nurses should also become proficient in assessing behavioural states in newborns and providing appropriate stimulation to correlate with the apparent state of consciousness.

Nurses are the primary educators of patients, which in this case would be the newborns' parents. Many parents do not understand that newborns demonstrate behavioural states nor how best to care for them when in a particular state. Many do not understand a baby's need for stimulation or the effects of noxious stimuli, e.g. intense light, noise or temperature fluctuations. Teaching parents the necessity of stimulation and how to use music as a way to stimulate or soothe can facilitate newborn wellbeing.

Implications for nursing students also arise from this study. The curriculum content of nursing programs should include theory, promotion of valuing and practice for

students in a few areas. First, in order to appreciate the effects of music on neonates, nursing students need to learn to recognize behavioural states, to understand their significance in the newborn and learn the potential physiological and psychological harm associated with frequent exhibition of high arousal states in newborns (Anderson, 1989, Keefe, 1987, Thoman. 1990). Nursing students must also learn the significance of frequent behavioural state changes and need to learn to value and teach parents to adopt the practice of "rooming-in" (Anders & Chalemian, 1979; Anderson, 1989; Keefe, 1987). To consider music as an intervention, they could learn about and value the positive effects of creating a relaxation response in newborns to facilitate adaptation to the extrauterine environment. Nursing students should develop a repertoire of "alternative" therapeutic techniques including the use of music in the clinical setting. This would relate to nursing students' understanding of the value and practice of interventions to create a nursery environment more conducive to adaptation.

#### Recommendations for Further Nursing Research

Findings from this study suggest avenues for further nursing research. Replications of this particular study could validate the representability of the findings. Variations in study demography, e.g. attempts to match the

target population more closely, especially for gender and race could also support (or negate) this study's representability. Other studies, using various cultural types of music could also be done to examine the variable of ethnic predisposition in relation to musical familiarity and preference. Perhaps studies with subjects of a particular cultural heritage, e.g. Oriental or Indian could be conducted using Western music or music from their particular native culture.

The usefulness of music for newborns in alternate environments could also be tested, for example, in the mother's hospital room when "rooming - in" or at home.

More research needs to be done on the patterns of behavioural states exhibited within the nursery environment. (Anders & Chalemian, 1974; Ashton, 1971; Brazelton, 1984; Lawson, Turkowitz, Platt & McCarton, 1985; Lerner, 1984). Research is needed to determine if there are significant differences in state patterns between different demographic groups based on gender, length and mode of labour and delivery, method of feeding and pattern of caregiving in the hospital. Further research in special care nurseries could also be valuable to examine the relationship of high arousal states and music in premature and high risk newborns (Duxbury et al, 1984; Marley, 1984; Owens, 1979; Scanlon, Nelson, Grvlackl & Smith, 1979).

In summary, the findings of this study suggest that high arousal states and state lability in newborns may be

influenced by exposure to soothing music. Further testing could support the hypotheses that soothing music helps reduce the frequency of high arousal states and frequency of state change when newborns are in the nursery. The methods and findings of this study offer some direction for further testing of the potential usefulness of music for neonates experiencing extrauterine adjustment within the hospital setting. Further testing of the study hypotheses is suggested.

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## APPENDIX A

## CONSENT FORM

I agree / do not agree (please circle correct statement) to allow my newborn to participate in the study "The effect of soothing music on behavioural state organization in the hospital newborn nursery", designed by June Kaminski (telephone #: 984 - 0813) a graduate student from the University of British Columbia's School of Nursing.

I understand that the purpose of the study is to observe the way infants organize their newborn behaviours while cared for in the hospital nursery. I know that two observations will be necessary for the study, one without music exposure, and one with exposure to selected soothing music. I understand that both observations will be two hours long, therefore, the total time required will be four hours.

I understand that confidentiality will be strictly respected and that the written reports will contain no personally identifiable information. I understand that the data collection and analysis forms will be destroyed after completion of the study. Only the graduate student conducting the observations will be aware of the identity of the participants. I understand that the investigator will respond to any questions I may have about the study.

I understand that my baby's participation in this study is purely voluntary. I may withdraw my infant at any time without jeopardy to the conduct of my care (or my baby's care) by health professionals. I acknowledge that I have received a copy of this consent form.

My faculty advisor is Wendy Hall, Assistant Professor, UBC School of Nursing. She can be reached at 822-7447.

I consent to my child's participation in this study.

\_\_\_\_\_

\_\_\_\_\_

( Parent(s) Signature(s)).

I do not consent to my child's participation in this study.

\_\_\_\_\_

\_\_\_\_\_

( Parent(s) Signature(s)).

Date: \_\_\_\_\_

Investigator's Signature: \_\_\_\_\_

## Appendix B: Music Selections

1. Beethoven: Piano Sonata, Opus 27, No. 2, 1st movement  
(Moonlight)
2. Beethoven: Symphony No. 6, Opus 68, 2nd movement (By the  
Brook)
3. Brahms: Three Intermezzi, Opus 117
4. Brahms: Symphony Number 2, 2nd movement
5. Brahms: Lullaby
6. Debussy: Claire de lune
7. Debussy: L'apres midi d'une faune
8. Dvorak: Silent Woods; Cello Concerto
9. Grieg: Peer Gynt, Suite 1: Morning  
: Ase's Death
10. Mendelssohn: A Midsummer Night's Dream: Incidental Music
11. Mendelssohn: Violin Concerto in E minor, Opus 64, 2nd  
movement
12. Mozart: Piano Concerto Number 21 (slow movement)
13. Ravel: Pavane pour une enfante defunte
14. Respighi: Pines of Rome
15. Saint Saens: Carnival of the Animals: The Swan  
The Aquarium
16. Schubert: Quintet in A for Piano & Strings, Opus 114,  
3rd & 4th movements
17. Tchaikovsky: Waltz of the Flowers (Nutcracker Suite)
18. Vaughan Williams: Fantasia on "Greensleeves"  
(Cass-Beggs, 1978, p. 132; Lundin, 1985, p.159;  
Guthiel, 1970, p. 74 - 81; McFarland, 1985, p. 257).

# DATA COLLECTION TOOL: TOTAL 15 MINUTES

S# \_\_\_\_\_ CODE NAME: \_\_\_\_\_ DATE: \_\_\_\_\_ TIME: \_\_\_\_\_

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Appendix C

		1.	2.	3.	4.	5.
	NEWBORN MOVEMENT					
	BEHAVIOURAL STATE					
	NEWBORN BEHAVIOURS					
	NEWBORN MOVEMENT	6.	7.	8.	9.	10.
	BEHAVIOURAL STATE					
NB. BEH.	NEWBORN BEHAVIOURS					
NB.	NEWBORN MOVEMENT	11	12	13	14	15.
	BEHAVIOURAL STATE					
	NEWBORN BEHAVIOURS					

APPENDIX D  
Behavioural State Codes and Descriptions

<u>Code Symbol</u>	<u>State</u>	<u>State Description</u>
Q	Quiet Sleep	<p><u>Eyes:</u> Closed, no REM.</p> <p><u>Muscle Tone:</u> tonic.</p> <p><u>Motor Activity:</u> Virtually none, with the exception of occasional startles, twitches, sighsobs, or rhythmic mouthing.</p>
A	Active REM Sleep	<p><u>Eyes:</u> usually closed, may open and close during REM.</p> <p><u>Muscle Tone:</u> Phasic.</p> <p><u>Motor Activity:</u> May range from minor twitches to writhing and stretching.</p> <p><u>Vocalization:</u> Brief high pitched cry episodes may occur.</p> <p><u>Colour:</u> Variable or flushed.</p>
C	Crying	<p><u>Eyes:</u> May be open or tightly squeezed shut.</p> <p><u>Muscle Tone:</u> Rigid.</p> <p><u>Motor Activity:</u> Flailing of limbs, may arch back, intense facial tightening</p> <p><u>Vocalization:</u> Intense, distressed wailing.</p>

/	Drowse/Daze	<p><u>Eyes:</u> either half closed or opening and closing slowly. Eyelids heavy.</p> <p><u>Muscle Tone:</u> semi- phasic</p> <p><u>Motor Activity:</u> May have small and large body movements.</p>
T	Transitional	<p><u>Eyes:</u> May be closed, or closing and opening.</p> <p><u>Muscle Tone:</u> phasic</p> <p><u>Motor Activity:</u> may have generalized motor movements, may be large.</p>
e	Quiet Alert	<p><u>Eyes:</u> Open, bright and shining, often scanning.</p> <p><u>Muscle Tone:</u> Relaxed</p> <p><u>Motor Activity:</u> Small movements only.</p>
ee	Nonalert Waking	<p><u>Eyes:</u> Open but does not seek out visual stimuli. Vague, glassy.</p> <p><u>Muscle Tone:</u> Phasic.</p> <p><u>Motor Activity:</u> alert with large movements. Periods of fussing, grimaces and jerks.</p>

## Appendix E

Information Letter for Physicians of Recruited Subjects  
for Proposed Nursing Research Study:

" The effects of soothing music on Neonatal Behavioural  
States  
in the Hospital Newborn Nursery"

Dear Dr. \_\_\_\_\_,

Your patient, Newborn \_\_\_\_\_ has been given parental consent to participate in this study. This project is being done as a partial requirement for the co - investigator's Master's degree in Nursing Education at the University of British Columbia's School of Nursing.

The study requires that Baby \_\_\_\_\_ be observed for a total of four hours while being care for in the hospital nursery. This observation will be done in two two - hour periods. During the "control" observation the child will have no music exposure. During the "experimental" period the child will receive exposure to selected, continuous soothing music. Normal caregiving activities by the nursery staff will not be interrupted during these two observation periods.

Participation in this study is purely voluntary. If at any time the parents wish to withdraw the newborn from the study, they are certainly free to do so. If you have any reservations about your patient participating in this study, your wishes about the newborn's continued participation will be promptly adhered to. If you have questions or wish to discuss the study please phone us at the following numbers.

Sincerely,

Wendy Hall, Assistant Professor, UBC School of Nursing  
Phone: 822 - 7447

June Kaminski, MSN Candidate, UBC School of Nursing  
Phone: 984 - 0813 Home. 599-2266 Work.