

The Effects of Mothers' Singing on Full-term and Preterm Infants and Maternal Emotional Responses

Andrea M. Cevasco, PhD, MT-BC, NICU-MT
The University of Alabama

The purpose of this research was to determine the effects of mothers' singing on their adjustment to and bonding with their new infants as well as use of music in the home environment in the first 2 weeks after their infants' birth. Preterm mothers were assessed for coping with their infants' NICU stay, and premature infants' length of hospitalization was evaluated. Fifty-four full-term infants and mothers and 20 premature infants and 16 mothers were randomly assigned to experimental or control conditions. Mothers in both experimental groups were recorded singing songs of their choice for use at home. Recordings of each preterm mother's voice were played 20 minutes per day, 3 to 5 times per week, at a time when she was not able to visit her infant in the NICU. All full-term and preterm mothers in experimental and control groups completed a posttest survey 2 weeks after infants were discharged. Comparisons revealed that experimental preterm and full-term mothers indicated less adjustment to their baby and lifestyle changes and less bonding compared to control mothers, though this difference was not significant. Preterm and full-term experimental mothers reported the greatest number of postpartum medical complications, which might explain their poor adjustment and bonding scores. There was a significant difference between mothers' value of music, with preterm experimental valuing music more. Preterm and full-term experimental mothers used music with and sang to infants more compared to preterm and full-term control mothers, but not to a significant degree. Preterm mothers reported a mean score of 4.75 (with a 5 indicating that they strongly agreed) for the following item: knowing my infant listened to

This study was conducted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Music Education and Music Therapy at The Florida State University.

my singing helped me to cope with my infant's stay in the NICU. Furthermore, preterm infants who listened to the CD recording of their mothers' singing left the hospital an average of 2 days sooner than those in the control group, though this difference was not significant.

Parents of newborn infants experience stress and anxiety over the new addition in the family, which may last 3 to 6 weeks after the birth of the infant. Mothers of full-term infants thought about the baby, cried, worried about future pregnancies, and expressed that they did not want to be left alone (Trause & Kramer, 1983). Parents of premature infants experience greater amounts of stress, depression, and anxiety while their infant is in the Neonatal Intensive Care Unit (NICU), especially since this is an unexpected and stressful event (Carter, Mulder, Bartram, & Darlow, 2005; Fowlie & McHaffie, 2004; Gennaro, 1988; Macey, Harmon, & Easterbrooks, 1987). Other emotions preterm parents experience include guilt, fear, helplessness, and grief (Backman & Lind, 1997; Carter et al., 2005; Trause & Kramer, 1983). Emotional distress, anxiety, depression, and overall impact of a preterm birth even continues for the first 4 years (Klassen et al., 2004; Singer et al., 1999; Thompson, Oehler, Catlett, & Johndrow, 1993).

Mothers of preterm infants stated that expectations for their infant's birth was quite different from the experience, especially since the NICU is a foreign environment for parents: noisy, bright, hot, overcrowded, and containing extremely high technological equipment that creates barriers between the infant and family members (Allen, 2002; Fowlie & McHaffie, 2004; Macey et al., 1987). Separation between infant and mother occurs once the infant is admitted to the NICU, and this separation may even exist over many months, thus affecting both parents' behavior and infant's behavior as well as the quality of infant-mother interactions (Fowlie & McHaffie, 2004). At times during the infant's NICU stay, parents are not allowed to hold, feed, or touch their critically ill infant. Amidst all of this, parents often experience feelings of fear and isolation (Backman & Lind, 1997; Pederson et al., 1987). Furthermore, visiting is difficult, exhausting, and financially expensive (Fowlie & McHaffie, 2004).

While some researchers reported that this experience does not affect mother-infant interactions (Greenberg & Crnic, 1988; Greene, Fox, & Lewis, 1983), others revealed quite different results. Mothers of premature infants spent less time overall with their infants (Crawford, 1982), smiled less and evinced less positive affect when interacting with infants (Crnic, Ragozin, Greenberg, Robinson, & Basham, 1983; Willie, 1991), were less sensitive if they had a very low birthweight infant (Zarling, Hirsch, & Landry, 1988), and did not hold their infant as close to their body during the infants' first 2 years of life compared to mothers of full-term infants (Leifer, Leiderman, Barnett, & Williams, 1972). Zarling et al. (1988) proposed that maternal sensitivity seemed to be due to the infant's developmental status; intensive medical complications resulted in long-term effects. Parents who had small infants with serious medical complications for extensive periods of time did not engage in many interactions, even when infants had already recovered (Minde, Whitelaw, Brown, & Fitzhardinge, 1983).

Researchers determined that specific procedures implemented by NICU staff resulted in greater social interactions between infants and parents, which also produced long-term benefits for infants in developmental areas (Als et al., 1986; Tessier et al., 2003; Zeskind & Iacino, 1984). Staff in the NICU needs to provide a holistic approach to care, accepting, responding to, and supporting the unique needs of each family (Fowlie & McHaffie, 2004). Providing advocacy and support to mothers resulted in twice as many visits with their infants in the NICU (Zeskind & Iacino, 1984). Affleck, Tennen, and Rowe (1990) proposed that the NICU staff might provide husbands and wives opportunities to engage in personal control activities, such as visiting the NICU frequently, supplying breast milk, providing social and nonsocial stimulation, completing caregiving tasks, monitoring treatment procedures, and praying.

Since parents experience stress while their infant is in the NICU, Cassidy and Standley (1995) suggested providing parents of premature infants opportunities to choose music to play for their infant; music is not contraindicated for infants in the NICU. This is especially important at times when parents are not allowed to hold, feed, or touch their fragile and critically ill infant. Providing this opportunity might be one means for parents to feel

some control over their situation when so many variables are out of their control. In one study premature infants received music, and mothers reported their babies' achievements with pride (Standley, 1991). It was possible that these babies were happier and calmer, thus resulting in a stronger bond between mother and infant. Based on these results, music in the NICU may have long-term benefits on developing relationships between mothers and infants. Furthermore, providing opportunities for personal control by playing music not only benefits parents, but it also provides positive effects for infants listening to music. Results of a meta-analysis on music for premature infants indicated statistically significant positive effects, especially for physiological measurements, weight gain, feeding, and days in hospital (Standley, 2003). Music seemed to result in an organization of behavior states, resulting in less energy loss, leading to greater homeostasis.

Mother's Voice

Newborn and 1-month-old infants preferred their mother's voice more than another female's (DeCasper & Fifer, 1980; Hepper, Scott, & Shahidullah, 1993; Mehler, Bertoncini, Barriere, & Jassik-Gerschenfeld, 1978; Standley & Madsen, 1990). Researchers indicated that the fetus learns prenatally and asserted that prenatal experiences with mothers' voices may contribute to later language development as well as attachment/bonding (Hepper et al., 1993). This preference for the mother's voice might be due to each infant's prenatal experience during the third trimester, in which maternal speech is audible, influencing auditory preferences (Decasper & Spence, 1986). The prenatal experience of hearing mother's voice prepares the infant to prefer mother's voice and provides the appropriate response the mother seeks. Even after only 12 hours of contact with their mothers, newborn infants discriminated between mothers' and other females' voices; each infant learned to produce mother's voice and evinced a preference for her voice. This preference for the mother's voice seemed to indicate the short period after birth might be essential in initiation of mother-infant bonding (DeCasper & Fifer, 1980). It is theorized that listening to the mother's voice during the first week of life may facilitate social responsiveness between infant and mother, especially since

premature infants are deprived of the social aspects of mother-infant bonding while in the NICU (Bozzette, 1997).

Rock, Trainor, and Addison (1999) indicated that singing may be used to regulate infants' states and even communicate emotion in messages. Through singing, the mother's voice conveyed positive emotion and important messages to her infant, and results seem to indicate that these emotional nuances regulated her infant's state, either arousing or soothing according to specific circumstances. Only one researcher has investigated differences between speaking and singing; Coleman, Pratt, Stoddard, Gerstmann, and Abel (1997) found that heart rate, oxygen saturation, and behavior state of premature infants were affected more by singing than speaking.

Based on the aforementioned research findings, it seems important to provide mothers personal control activities to help with the adjustment of newborn infants and lifestyle changes. Since young infants preferred their mothers' voices and singing has positive effects on preterm infants, the purpose of this research was to determine the effects of creating a CD of each preterm mother's singing for use with her baby in the NICU on (a) preterm mothers' coping and bonding with their infants and (b) their preterm infants' length of hospitalization and weight gain. A second aspect of the study was to investigate whether mothers of full-term and preterm infants benefited from recording their singing to use at home with their infants during the first 2 weeks after discharge. Assessments for full-term and preterm mothers included adjustment to the new baby and lifestyle changes, bonding, value of music for infants, use of music in the home environment, and infants' responses to music. Additional data was collected and compiled regarding the songs mothers chose to record for their infants.

Method

Participants and Setting

Full-term mothers and infants. Participants were 72 healthy full-term infants, from the Newborn Nursery, who were born at or later than 37 weeks gestational age and weighed more than 2,500 grams at birth, and their mothers, who were randomly assigned to experimental ($n = 34$) or control ($n = 38$) conditions. Eleven

full-term mothers in the control group and 7 in the experimental group did not complete the survey conducted 2 weeks after discharge; hence, 27 of the 38 full-term mothers in the control group and 27 of the 34 full-term mothers in the experimental group completed the entire study. All data analyses were based on the 27 mothers in the experimental group and 27 mothers in the control group, except song selection, which was based on all 34 mothers in the experimental group to obtain a larger number of subjects. Full-term infants and mothers in this study resided in a NICU 1 setting in a regional medical center during their hospitalization. The NICU 1 setting provides basic care and well care for newborns. Demographic variables were analyzed using an alpha level of 0.05. See Table 1 for demographic information.

Preterm mothers and infants. Twenty-one mothers and 25 premature infants, including 4 mothers with twins, participated and were randomly assigned to experimental ($n = 11$ mothers, 13 infants) or control ($n = 10$ mothers, 11 infants) conditions. Preterm infants, born prior to 36 weeks corrected gestational age (CGA), and low birthweight infants (LBW), weighing less than 2,500 grams at birth, hospitalized in a Level II (intermediate care for premature infants to grow and gain feeding skills) and Level III NICU (high-risk care for infants needing advanced treatment to sustain life) in the same regional medical center were referred for participation in the study if they evinced the following criteria: infant born at or later than 28 and before 36 weeks CGA, infant evinced toleration of auditory stimulation between 30–32 weeks CGA, infant had no severe abnormalities which affected ability to listen to music (including significant neurological disorders such as periventricular leukomalacia or intraventricular hemorrhage) mother nor infant tested positive for illegal drugs, infant had no disease necessitating quarantine, infant not on ventilator or continuous positive airway pressure past 30 weeks CGA.

A total of 21 mothers consented to participate, with 11 mothers in the experimental and 10 in the control group. Two mothers of twins in the experimental group were dropped from the study due to early discharge and only 1 or 2 days of music intervention and one infant in the control group became extremely sick and participation in the study was discontinued. One mother in the experimental and one in the control group did not complete a phone or mail survey. Thus, 8 preterm mothers in the experi-

TABLE 1
Subject Demographics by Group for Full-term and Preterm Mothers

	Age	SD	# of children	1 st -Time mothers	SD	White	Race		Marital status	
							Black	Other	Married	Single
Full-term	27.22*	7.27	1.89	13	1.63	12	12	3	17	10
	30.33	5.22	2.11	7	0.93	17	9	1	18	9
Preterm	28.13	6.53	1.63	6	1.19	6	2	0	6**	2
	23.50	5.37	1.75	5	0.89	4	4	0	2	6

*Significant difference between groups for full-term mothers' ages, $t(52) = 1.81, p < 0.05$.

**Significant difference between preterm groups by marital status, $\chi^2(1, 16) = 4, p < 0.05$.

TABLE 2
Subject Demographics by Group for Preterm Infants

	Mean birth CGA	SD	Mean birthweight	SD	Race		Gender	
					White	Black	Boys	Girls
Experimental	31.73	1.80	1551.7	352.36	6	4	6	4
Control	32.46	1.57	1762.80	379.28	6	4	6	4

mental group and 8 preterm mothers in the control group completed the entire study, with a total of 10 infants in each group. All data were based on the 8 preterm mothers in the experimental and 8 in the control group who completed the entire study, with the exception of song selection, which was based on 11 preterm mothers. Demographic variables for mothers of premature infants were analyzed using an alpha level of 0.05. See Table 1 for subject demographics.

Analysis of demographic information for preterm infants revealed that there was no significant difference between groups and birth CGA, $t(18) = 0.960$, $p > 0.05$. The age range for infants in the experimental group was from 28 weeks to 34 weeks and 4 days CGA and 30 weeks to 34 weeks and 6 days in the control group. Also, there was no significant difference for birthweight between groups, $t(18) = 0.214$, $p > 0.05$. Birthweight ranged from 954 to 2,080 grams for the experimental group and from 1,200 to 2,535 grams for the control group. See Table 2 for subject demographics of preterm infants in the experimental and control groups.

Equipment

An Olympus WS-100 digital voice recorder and Audio-technica ATR35s omni directional microphone were used to record the singing of mothers of both term and preterm infants. DBpower-AMP Music Converter transferred the Windows Media Audio files to wave files, and Audacity was used to edit wave files. Nero burning rom software was used to compile and make CDs. Music was played for preterm infants on RadioShack Moisture Resistant Speaker System MX 1 (Cat No. 40-1400), which was connected to a RadioShack AM/FM Stereo Portable CD player (Cat. No. 42-6013). A RadioShack Sound Level Meter (Cat. No. 33-2055) was used to determine if the decibel level for each infant's isolette and

open crib was within the guidelines provided by the American Academy of Pediatrics Committee on Environmental Health.

Dependent Measures and Data Collection

Most mothers of both preterm and full-term infants in the experimental and control group completed a phone survey approximately 14–25 days post infant's discharge, answering questions from the modified Parental Perception Inventory (Trause & Kramer, 1983) as well as other questions designed by the researcher regarding mother-infant bonding and use of music with their infants. The survey included sub-categories of responses analyzed separately. Each is described below.

Parental Perception Inventory. Each mother completed an adaptation of the Parental Perception Inventory (PPI), a questionnaire rating her adjustment to her new infant and lifestyle changes. This questionnaire was modified from the original 31 items to 13 items to decrease the survey length, and several questions were rephrased for clarification and scoring purposes. The highest possible score, 26, indicated less adjustment to the new baby and lifestyle changes; a score of 0 indicated a positive adjustment to the baby and lifestyle changes.

Mother-Infant Bonding Scale. Mother-infant bonding was addressed through the use of a 5-point Likert scale for the following 4 indices: I feel that I have been helpful to my baby, I feel that I know how to nurture my baby, I feel that there is a strong mother-infant bond between me and my baby, and I feel that I know how to calm my infant. A low score of 4 indicated little mother-infant bonding and a high score of 20 indicated a positive mother-infant bond.

Value of Music Scale. Mothers rated the importance of music for their babies, which was assessed through a 5-point Likert scale for the following items: I feel that music helps my baby, I think it is very important to sing to my baby, and I think it is very important to play music for my baby. The Value of Music Scale ranged from 3 to 15, with a higher score indicating more positive feelings for using music with infants.

CD importance score. Mothers in the experimental group answered additional questions regarding the use of the CD in terms of a 5-point Likert scale for the following three items: I feel that the CD of my singing helps my baby, I think that it is very

important to play the CD of my singing for my baby, and I feel that the CD of my singing helps promote a strong mother-infant bond between me and my baby. A score of 15 indicated more positive feelings for and use of the CD. Preterm mothers in the experimental group also completed one other item, using a 5-point Likert scale for the item: Knowing my infant listened to my singing helped me cope with my infant's stay in the NICU.

After-birth complication score. Mothers were asked if they experienced any complications as a result of the birth and delivery of their infants, such as lactation complications, post-partum depression, uterine prolapse, episiotomy complications, or any other problems. A point was given for each complication reported.

Comments made by mothers at the end of the survey. Both preterm and full-term mothers in the experimental and control group were provided the opportunity to add any comments regarding mother-infant bonding and/or music at the end of the survey. Statements were recorded and rated according to the types of comments made by mothers, with higher numbers indicating a greater and more positive attitude. A rating of 0 indicated that no comment was made or that a negative comment was made and a rating of 1 indicated that the statement was general concerning the use of music or their philosophy of music. A rating of 2 indicated that the statement included only one positive term, such as good, thank you, enjoyed, help/helpful; this also included mentioning the positive benefits of using music or the personalized CD, the helpfulness of music, using the personalized CD for bonding, or any other type of comment regarding mother-infant bonding. A rating of 3 was given when the statement included at least 2 of the previously mentioned positive terms, and a 4 was used when at least 3 of the previously mentioned positive terms were utilized. Further analysis was conducted to classify types of comments mothers made. Two board-certified music therapists rated and classified the comments, maintaining a reliability level of 85%.

Premature infants' gestational age and weight. Preterm infants' gestational age and weight at birth and at discharge were collected from medical charts.

Other measures. General music use was computed based on mothers' responses of how often they used any type of music

(excluding the CD of experimental mothers' singing) with their baby in the 2 weeks following discharge (not at all = 1, a few times a week = 2, every day = 3, or several times a day = 4). Experimental mothers also indicated how often they used the CD of their singing with their baby in the 2 weeks following discharge, based on the same scale. Amount of singing was indicated by how often experimental and control mothers sang to their baby (not at all = 1, not often = 2, several times a week = 3, every day = 4, or several times a day = 5). Mothers also indicated how they used music with their infants (at a fixed time, at no specific time, to calm infant or during quiet time, to stimulate, during diaper changes, during feeding, at night or for sleeping, in the car, with a swing/bassinet/vibrating seat) as well as their infants' responses to music (sleeps, ceases crying, smiles, listens and attends, locates sounds, other, or not sure).

Procedure

Full-term mothers were approached about the study only when census listing indicated that mothers with vaginal deliveries had been in the hospital for 1 day and mothers who had Cesarean section deliveries for 1 or 2 days. Consent was obtained from mothers of preterm infants by the researcher or nurses, approximately the first week after their infant was admitted to the NICU. Mothers were told that the purpose of this research was to record a CD of their singing lullabies, children's songs, and popular tunes for their baby while the researcher provided guitar accompaniment. The mother could take the CD home with her from the hospital and choose to use the CD in any manner that was useful to her. Mothers also were informed that they might be in the control group, and mothers in both groups would complete a follow-up survey to make comparisons as to the effectiveness of this intervention. Preterm and full-term mothers in the control group signed the consent form and the preterm infants in the control group did not receive any music listening. Mothers in the experimental group signed consent forms and then the recording took place in the mother's room immediately after or at a time that was convenient for the mother and researcher. For those preterm mothers who consented after their discharge, the recording took place in nesting rooms, which provided a private and quiet atmosphere for the CD recording.

TABLE 3
Full-term and Preterm Mothers' Song Choices

Song title	Total #
You are My Sunshine	29
Twinkle, Twinkle Little Star	28
Individualized Lullaby	24
I'm a Little Teapot	15
ABC	13
Amazing Grace	11
Itsy Bitsy Spider	11
He's Got the Whole World	9
Mary had a Little Lamb	8
Rockabye Baby	7
Are You Sleeping/Frère Jacques	6
Hickory Dickory Dock	5
Swing Low, Sweet Chariot	5
The Wheels on the Bus	5
Edelweiss	3
Favorite Things	3
My Girl	3
Brahms' Lullaby	2
Goodnight Sweetheart	2
Hey Diddle Diddle	2
Home on the Range	2
Jack & Jill	2
Jesus Loves Me	2
Oh What a Beautiful Morning	2
Skidamarink	2
Somewhere Over Rainbow	2
BINGO	1
Jesus Loves the Little Children	1
Let Me Call You Sweetheart	1
Old MacDonald	1
Row, Row, Row Your Boat	1
This Little Light of Mine	1
All Night, All Day	0
All the Pretty Little Horses	0
All Through the Night	0
The Ants Go Marching	0
Baby Mine (from <i>Dumbo</i>)	0
Beautiful Dreamer	0
By 'n By	0
Down by the Bay	0
Scarborough Fair	0
Lavender's Blue	0
Moon River	0

TABLE 3
Continued

Song title	Total #
Rainbow Connection	0
Shenandoah	0
Teddy Bear	0
What a Wonderful World	0

The researcher provided experimental mothers a notebook containing a list of song titles, including lullabies, children's songs, and popular songs (see Table 3) as well as the words for each song. Mothers were informed they could sing songs not on the list. The researcher also rewrote Brahms' *Lullaby*, leaving blanks in the song for the baby's name and for personalized messages from mother to infant. Each mother had the option of filling in the blanks to Brahms' *Lullaby* and/or creating an individualized message for her infant; 17 out of 27 full-term mothers and 7 out of 9 preterm mothers chose to participate in this opportunity and sing their composed song. The researcher guided each mother through the process, assisting with word choices as requested as well as the rhythm and flow of the new words within the song. The recording process took approximately 20 minutes to an hour, depending on the number of songs the mother chose. Songs were recorded and placed on a CD for the parents to take home with them from the hospital that day. No other contact was made with full-term experimental mothers or babies until the phone survey was conducted.

The researcher kept a copy of each preterm mother's CD to play for her infant throughout the infant's hospitalization. Once premature infants reached 30 weeks CGA, daily opportunities to listen to mother's singing were implemented when the nurse caring for the infant gave permission and affirmed that stimulation would be appropriate for the infant on that day. The CD of the mother's singing was played for each infant 20 minutes per day, 3 to 5 times per week until time of discharge. Time of day for music listening was determined according to mothers' visiting schedule, infants' daily schedule, and nurses' suggestions. Music listening occurred at a time when each mother was unable to visit. During the 20 minutes of music listening

infants often were awake, sleeping, receiving NG feedings, or receiving routine medical procedures. Volume was measured via a decibel meter and set on 65 dB (Scale C), which researchers have recommended as safest for premature infants. Music speakers were cleaned with CaviWipes and then placed binaurally at least 8 inches from the infant's head; infants remained lying on their backs or sides while in the crib or incubator during music listening. Music was discontinued if infants evinced signs of distress.

Full-term and preterm mothers, control and experimental, completed the phone survey 2 weeks after their infants' discharge. One full-term mother who was Korean preferred receiving the survey via e-mail due to interpretation needs, and when the researcher could not reach two preterm mothers, one completed the survey via e-mail and another by mail. The researcher conducted the phone survey with each mother, asking the same questions in the same order for each mother. No prompting or additional comments were made to the mothers during the phone survey. Phone surveys were used rather than mail or email, especially since most mothers did not list an email address on the consent form. Researchers have found that phone surveys resulted in greater response rate than mail or email surveys and produced equivalent data (Harewood, Yacavone, Locke, & Wiersema, 2001; Hawthorne, 2003; Hertz, Zook, Chitwood, O'Carroll, & Friede, 1996). A CD of lullabies and children's songs was mailed to control mothers' home addresses as a gift.

Results

Comparisons in the results section were made between preterm and full-term experimental mothers despite the fact that there were differences in treatment provided to the infants. Both mothers made and received CDs of their singing, and they were instructed to use the CD in any manner during the two weeks following discharge. The recording of the preterm mother's voice was also played during each infant's hospitalization for 20 minutes a day, 3 to 5 times per week, at a time when the mother was not able to visit the NICU; full-term infants were not provided this treatment condition by the researcher. Data were collected from all mothers, experimental and control, 2 weeks following their infants' discharge.

TABLE 4

Comparison of Mean Scores for Full-term and Preterm Mothers in Experimental and Control Groups

	Full-term		Preterm	
	Experimental	Control	Experimental	Control
PPI	4.56	4.30	5.25	3.88
Mother-Infant Bonding Scale	19.11	19.22	19.38	19.63
Medical complications	0.56	0.41	0.88	0.38
End of survey comments	1.56	0.41	2.5	0.50
Value of Music Scale	13.44	13.07	14.75	13.13
CD importance score	12.61	NA	13.86	NA
General music use	2.85	2.59	2.88	2.63
Personalized CD use	2.48	NA	1.75	NA
Time spent singing	4.1	3.5	3.63	2.83

Parental Perception Inventory

The Parental Perception Inventory (PPI), which was administered posttest only, indicated experimental preterm mothers scored the highest on the PPI, indicating less adjustment to their baby and lifestyle changes compared to control preterm mothers as well as experimental and control full-term mothers. Control preterm mothers scored the lowest on the PPI. See Table 4 for scores. Several interesting trends occurred for correlations between the PPI and other variables for full-term and preterm mothers (see Table 5). There was a relationship between first-time mothers in the experimental group, who did not easily adjust to the new baby and lifestyle changes; there was no relationship evident between these two variables for preterm mothers in the control group. There was a greater relationship between marital status and scores on the PPI for preterm mothers than full-term mothers, indicating married preterm mothers reported less adjustment to the new baby and lifestyle changes.

Preterm mothers in the experimental group reported the greatest number of medical complications, followed by experimental full-term mothers; preterm mothers in the control group reported the least medical complications. Six of the 8 preterm experimental mothers reported medical complications compared to 3 out of 8 control mothers; 7 of 27 full-term experimental mothers and 9 out of 27 full-term control mothers reported medical complications. The relationship for medical complica-

TABLE 5

Comparisons of Correlations for Full-term and Preterm Mothers in Experimental and Control Group

	Full-term		Preterm	
	Experimental	Control	Experimental	Control
<u>PPI &:</u>				
First-time Mothers vs. Several Children	-0.38*	-0.25	-0.18	0
Marital Status	0.11	-0.01	0.25	0.20
Medical Complications	0.55**	0.15 ^t	0.22	0.49
<u>Mother-Infant Bonding Scale &:</u>				
First-time Mothers vs. Several Children	0.28	0.21	0.36	-0.26
Marital Status (1 = single, 2 = married)	0.11	-0.01	-0.36	-0.75**
Medical Complications	-0.29	0	-0.34	0.07
PPI	-0.53**	-0.23	-0.11	-0.35
Value of Music Score & Amt of Music Used	0.47	0.41	-0.05	0.31
CD Importance Score & Amt of CD Used	0.59**	NA	0.35	NA
CD Importance Score & PPI	0.14	NA	0.28	NA
CD Promoted Bonding & Mother-Infant Bonding Scale	0.57	NA	0.38	NA
<u>Comments at End of Survey &:</u>				
PPI	0.49**	-0.12	0.24	0.35
Medical Complications	-0.08	0.12	0.94**	0.82*
Mother-Infant Bonding Scale	-0.23	0.30	-0.11	0.18
Music Importance Scale	0.16	0.24	0.11	0.45
CD Importance Score	0.17	NA	0.32	NA

Note. For the PPI, higher scores indicate less adjustment to infant and lifestyle change. Higher scores for Medical Complications also indicate more complications from birth and delivery. To analyze data, the following coding system was used: 1 = first-time mothers and 2 = mother of several children as well as 1 = single mothers and 2 = married mothers.

* $p < 0.05$. ** $p < 0.01$.

^t $p < 0.05$, difference between correlations of full-term experimental and control group.

tions and adjustment to the new baby and lifestyle changes indicated more medical complications were associated with less adjustment, which was greatest for full-term mothers in the experimental group, followed by preterm mothers in the control group, and then preterm mothers in the experimental group; full-term mothers in the control group had the least relationship. The Fisher r -to- z transformation was used to determine the significance of the difference between two correlation coefficients, which indicated that the full-term experimental group was

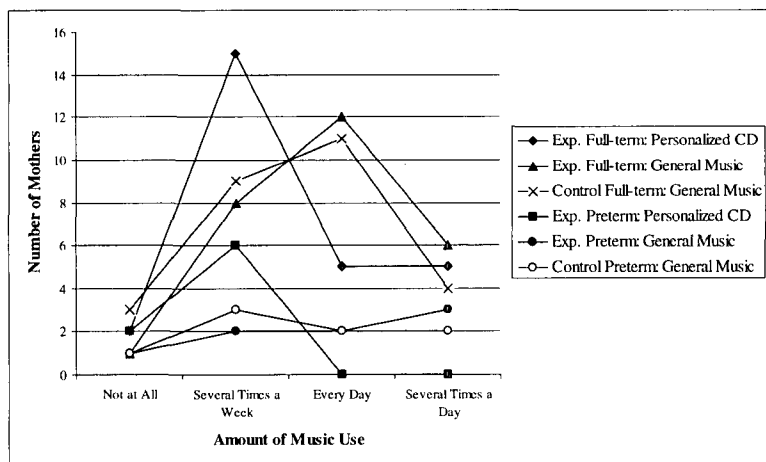


FIGURE 1.

Amount of time full-term and preterm mothers used music with their infants.

significantly different from the full-term control group regarding the correlations for medical complications and the PPI, $z = 1.62$, $p < 0.05$. One preterm mother in the experimental group who did not have medical complications scored high on the PPI, possibly skewing data results for the correlation, considering that these mothers had the highest mean PPI score and medical complications score.

Mother-Infant Bonding Scale

Results from the questions on the Mother-Infant Bonding Scale indicated that preterm mothers in the control group reported the greatest mother-infant bonding, followed by experimental preterm mothers, control full-term mothers, and then experimental full-term mothers (see Table 4). Several variables were interrelated to the Mother-Infant Bonding Scale (see Table 5). Mother-infant bonding scores for first-time mothers versus mothers of several children indicated that mothers with several children had better bonds with their infants, especially experimental preterm mothers; interestingly, there was an inverse relationship for preterm control mothers and mother-infant bonding scores. Experimental full-term and preterm mothers experienced greater medical complications; furthermore, the relationship between

medical complications and mother-infant bonding also indicated that as preterm and full-term mothers in the experimental group reported increased medical complications, they also reported less mother-infant bonding.

Music Indices

Value of Music Scale. Individual and total scores for the Value of Music Scale indicated that full-term and preterm mothers in the experimental group rated music as more important for their infants compared to full-term and preterm mothers in the control group. Mothers in the experimental groups indicated greater belief in the importance of music, as evidenced through their belief that music was helpful for their infants, it was important to sing to their babies, and it was important to play music for their babies (see Table 4 for mean scores for mothers in the experimental and control groups). A Mann Whitney Test indicated that the Value of Music score for experimental preterm mothers was significantly higher than preterm mothers in the control group, $U(9, 9) = -2.12, p < 0.05$. Preterm mothers in the experimental groups all agreed that singing was important for their infants, giving the highest positive rating possible, 5 out of 5 points. Furthermore, preterm mothers in the experimental group had the highest average score for believing that music helps their infants while preterm mothers in the control had the lowest average score of the 4 groups.

Amount of music used with infants. Mothers approximated how often they used music with their infants. See Figure 1 for the amount of time mothers in the full-term and preterm control and experimental mothers reported using music with their infants, including experimental mothers' CD of their singing. Compared to mothers in the control group, full-term mothers in the experimental group indicated somewhat greater use of music with their infants, especially regarding the use of music every day and several times a day. Experimental mothers scored 2.48 for the personalized CD and 2.85 for general music use. Combined average scores for both the CD and general music use was 2.67, whereas the control group averaged 2.59 for general music use. A Friedman Analysis indicated that there were no significant differences for the amount of music used with infants by full-term mothers who had the personalized CDs, these same

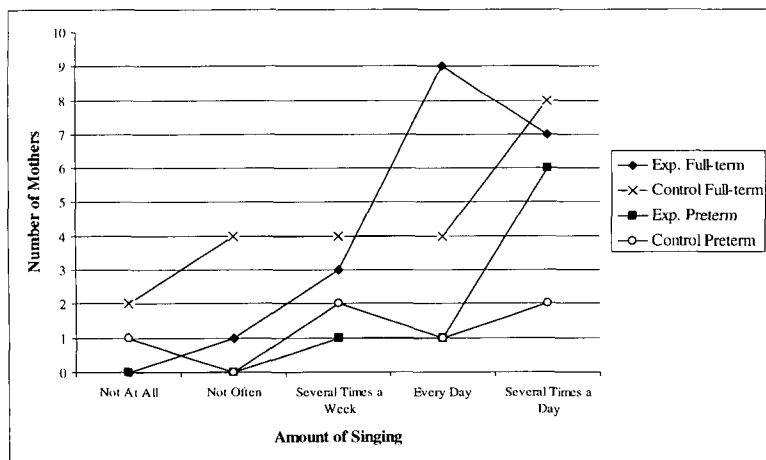


FIGURE 2.

Amount of time full-term and preterm mothers sang to their infants.

experimental mothers when using general music, and control mothers using general music, $\chi_r^2(3, 4) = 1, p > 0.05$. Other than the 2 mothers who did not use their CD at all, mothers in the experimental group indicated that they used the CD of their singing at least several times a week; one of the mothers who did not use the CD also did not use any type of music with her infant. Four mothers in the experimental group indicated that they used the CD of their singing more than other types of music, and 9 of the mothers conveyed that they used the CD the same amount of time per week as other music. See Figure 1 for further information.

Preterm mothers reported how often they used music with their infants. Mean averages indicated that experimental mothers scored 2.88 for general music use and 1.75 for the CD; control mothers rated 2.63 for general music use (see Figure 1). A Friedman Analysis indicated that there were no significant differences for the preterm experimental mothers use of the personalized CDs, preterm experimental mothers use of general music, and preterm control mothers use of general music, $\chi_r^2(3, 4) = 5.08, p = 0.08$.

There was a strong relationship between the Value of Music Score and the amount of general music played, especially by full-term experimental mothers but not for preterm experimental mothers. While the correlation for preterm experimental mothers

is negative and extremely low, one mother did not use general music with her infant, resulting in skewed results. A Pearson Correlation revealed a positive relationship between full-term experimental mothers' Value of Music Score and the amount of music they used with their infants as well as control mothers' Value of Music Score and amount of music they used with their infants (see Table 5 for more information on Value of Music Score and other variables).

CD importance score. Mothers in the experimental groups also rated their feelings concerning three additional statements regarding the importance of the CD of their singing. For the statement "I feel that the CD of my singing helps my infant," full-term mothers had a mean score of 4.22 and preterm mothers had a score of 4.71. Full-term mothers mean score was 4.19 and preterm mothers score was 4.75 for "I think it is very important to play the CD of my singing for my baby." Full-term mothers scored 4.38 and preterm mothers scored a 4.88 for the statement "I feel that the CD of my singing helps promote a strong mother-infant bond between me and my baby". See Table 4 for compiled scores. Preterm mothers also completed an additional statement regarding the personalized CD: Knowing my infant listened to my singing helped me to cope with my infant's stay in the NICU. Mothers reported a mean score of 4.75. For all of these statements a score of 5 indicated that mothers strongly agreed with the comment.

For full-term experimental mothers, there was a strong relationship between the CD Importance Score and the amount of music used. There was a strong relationship for the question regarding whether the CD promoted bonding and the Mother-Infant Bonding Scale, especially for the full-term experimental mothers. Further analysis indicated a strong relationship existed between scores on the CD Importance Score and preterm mothers' report that the CD helped them to cope with their infants' stay in the NICU, $r = 0.94$, $p < 0.01$. Also, there was a relationship between the CD helping mothers cope and Mother-Infant Bonding Scale, $r = 0.51$ (see Table 5 for further information).

Time spent singing to infants. Full-term mothers reported how often they sang to their infants on a scale from 1 to 5, with 5 indicating greatest amount of time spent singing (see Figure 2). Mothers in the experimental group averaged a score of 4.1;

mothers in the control group averaged 3.5. Two mothers in the control group indicated that they never sang to their infant and four indicated that they did not sing often. One hundred percent of experimental moms reported that they engaged in singing to their infants, and only one mother reported not often singing. Information was based on data collected from 20 experimental and 22 control mothers. A Mann-Whitney Test indicated that there was no significant difference for the amount of time full-term mothers spent singing to their infant, $Z(20, 22) = 10.05, p > 0.05$.

Some of the preterm mothers reported how often they sang to their infants, with information based on all 8 mothers in the experimental group and 6 out of 8 mothers in the control group (see Figure 2). Six mothers in the experimental group reported singing to their infant several times a day, 1 indicated at least every day, and 1 indicated several times a week. Mean score for time spent singing for preterm mothers in the experimental group was 3.63. Only 2 mothers in the control group reported that they sang several times a day, 1 indicated every day, 2 reported a several times a week, and 1 stated not at all. Mean score for time spent singing for preterm mothers in the control group was 2.83.

Comments Made by Mothers at the End of the Survey

Mothers were provided the opportunity to make comments about mother-infant bonding and/or music at the end of the survey. Twenty full-term mothers in the experimental group and 7 full-term mothers in the control group made comments at the end of the survey. Fourteen out of 20 full-term experimental mothers made comments regarding the personalized CD, including comments about using the CD, comments about using the CD for bonding, and also appreciation and thanks for the opportunity and experience. Mothers in both groups made general comments about their infants as well as philosophical comments about music. Mean score for positive comments made by mothers in the experimental group was 1.56, and mothers in the control group scored 0.41 (see Table 4). A Mann-Whitney U indicated a significant difference between experimental and control mothers' positive comments, $Z(27, 27) = -3.34, p = 0.001$.

Six preterm mothers in the experimental group and 3 in the control group made comments at the end of the survey. Four of

TABLE 6
Full-term and Preterm Mothers' Uses of Music with Their Infants

	Fixed time	No specific time	Fussy/calm/quiet time	Stimulate	Diaper change	Feeding	Sleep/night	Car	Swing/bassinet/vibrating seat	Other
Experimental										
Full-term										
Personal CD	3	4	11	3	2	5	5	0	0	2
General music	5	7	6	4	2	2	6	2	0	0
Preterm										
Personal CD	0	3	2	2	0	0	0	0	1	0
General music	0	3	2	2	1	1	1	1	2	1
Control										
Full-term										
General music	1	7	8	4	4	1	7	2	7	2
Preterm										
General music	2	3	2	1	1	1	2	1	0	0
TOTAL:	11	27	31	16	10	10	21	6	10	5

TABLE 7

Full-term and Preterm Mothers' Reports of Infants' Responses to Music

	Sleeps	Ceases crying	Smiles	Listens & attends	Locates sounds	Not sure
Experimental						
Full-term						
Personal CD	6	9	6	10	1	4
General Music	7	8	0	15	1	3
Preterm						
Personal CD	2	2	2	6	1	0
General Music	3	3	3	5	0	0
Control						
Full-term						
General Music	9	14	9	12	1	1
Preterm						
General Music	3	3	3	1	0	1
TOTAL:	30	39	23	49	4	9

the experimental mothers stated that they felt better knowing that their infant was listening to their voices when they were not able to be there; all of the experimental mothers expressed thanks and appreciation. Mean score for comments made by mothers in the experimental group was 2.5, and mothers in the control group scored 0.50. A Mann-Whitney U indicated a significant difference between experimental and control mothers' comments, $U(8, 8) = -2.25, p = 0.03$. Three mothers in the control group made comments at the end of the survey, and only 2 of these mothers mentioned music. Preterm mothers who reported increased medical complications also reported more positive comments at the end of the survey, with a slightly greater relationship occurring for mothers in the experimental group than mothers in the control group; the correlations for the full-term mothers were not as strong (see Table 5 for further information).

Correlations provided further information regarding the comments mothers made at the end of the survey and how they related to other variables. The amount of CD use was also related to the greater appreciation and positive comments from full-term experimental mothers, to a significant degree, $r = 0.39$. See Table 5 for further information regarding correlations

between mothers' comments at the end of the survey and other variables.

Mothers' Use of Music with Their Infants

While completing the survey, mothers indicated how they used music with their infants. Full-term mothers in both groups reported that they mostly used music with their infants during quiet time or to calm their fussy infants; mothers in the experimental group reported that they used the CD of their singing for this reason more than any other reason. The second highest overall use of music by control and experimental mothers was when putting their infants to sleep, and the third highest use of music was at no specific time. Experimental mothers were more likely to use music for quiet time or to calm their fussy infants than control mothers, while control mothers reported using automated swings, bassinets, or vibrating swings that came with automated music. The greatest response from preterm mothers in both groups was that they used music with their infants at no specific time (see Table 6 for additional information).

Infants' Responses to Music

Mothers were asked to describe how their infants responded to music. The behavior that mothers of full-term infants reported the most was that their infants listened and attended to music, and the second highest response was ceased crying. Full-term mothers in the experimental group also reported that their infants responded by smiling when the CD of their singing was played; they did not report that their infant responded by smiling to other types of music. Preterm mothers reported that their infant listened and attended to music the most (see Table 7 for further information regarding how infants responded to music).

Song Selections

Responses for the song selections are based on all 34 full-term and 11 preterm mothers from the experimental group. Most mothers chose traditional children's songs to sing and record on their CD; *You are My Sunshine* and *Twinkle, Twinkle, Little Star* were the two most popular song selections. Seventeen full-term mothers chose to sing the individualized song to the tune of Brahms' *Lullaby*, which was the third most frequently performed

song for both preterm and full-term mothers combined; 7 of the 11 mothers of premature infants composed messages about their infants growing and coming home soon, which was the second most frequently recorded song of preterm mothers. Interestingly, one mother sang *Frère Jacques*, *Twinkle, Twinkle, Little Star*, and the ABC song in French; one mother sang *Itsy Bitsy Spider* in Spanish; and another sang a Korean lullaby (see Table 3 for additional information).

Preterm Infants

Average number of days infants listened to the CD of their mothers' singing was 13.3, with total number of listening opportunities ranging from 3 to 28, $SD = 8.26$; mean number of days of music listening per week was 4.2. An experimental infant, who was born at 28 weeks gestational age, weighing the least at 954 grams, received the greatest number of music listening opportunities, at a total of 28 days. Overall, the music listening experience started on an average of 8.7 days of life, with ranges from 4 to 17. One infant was not started until the 17th day of life, at the mother's request to do the CD recording after the Christmas holidays. Twins were started on the 15th day of life due to possible infectious disease.

Mean weight gained per day was 17.70 grams for infants in the experimental group and 16.95 for infants in the control group. A t test indicated that there was no difference between groups for weight gained, $t(18) = -0.214$, $p > 0.05$, and number of days in hospital, $t(18) = 0.53$, $p > 0.05$. Infants in the experimental group left the hospital 2 days sooner than those in the control group, at an average of 15.6 days compared to 17.8 days.

Discussion

Several factors emerged as possible influences on mothers' PPI responses. There were more first-time full-term mothers in the experimental group, and these mothers indicated less adjustment to their infant and lifestyle changes than did first-time mothers in the control group. A possible confounding variable was the fact that more experimental mothers experienced medical complications than control mothers. Within this study it seemed that medical complications might have possibly resulted in less

adjustment to the new baby and lifestyle changes as well as lower mother-infant bonding scores for experimental mothers.

Experimental preterm and full-term mothers valued and used music more than mothers in the control groups. The personalized CD was used more by full-term mothers in the experimental group than by preterm mothers. This might have been due to the fact that preterm mothers might have viewed it primarily as an intervention for the NICU, especially since these mothers sang to their infants, played music more for their babies, and rated music as more important compared to other groups. While preterm mothers did not use the personalized CD at home as often as other types of music, these mothers commented on the importance of their infants hearing their singing in the NICU. They indicated that knowing their infant listened to the CD of their singing helped them to cope with their infants' stay in the NICU, especially when medical complications as well as returning to work hindered their ability to visit their infants. This was evident when examining the relationship between the CD Importance Score and mothers' reports that the CD helped them to cope with their infants' stay. Furthermore, there was a significant difference between comments made by mothers in the open-ended section at the end of the survey, with more positive comments regarding music and mother-infant bonding from mothers in the experimental groups.

Overall, more mothers in the control group reported not using music with and not singing to their infant compared to those in the experimental group. Results of this study coincide with other research findings regarding use of music with infants (Custodero & Johnson-Green, 2003). While Campbell (2000) found that low-income and primarily minority caregivers reported little use of a classical CD sent home with their babies from the hospital and greater use of other music, the results of the present study indicated that creating a personalized CD of each mother's singing seem to result in positive uses of music in the home environment.

More mothers in this experimental group sang daily compared to mothers in the control group or in the Custodero and Johnson-Green (2003) study. The process of making the CD recording might have provided parents the opportunity to realize that they knew many songs that would be appropriate to utilize with their

infants. Another explanation for this high frequency of singing in the experimental group compared to the control group might be attributed to the fact that mothers in the experimental group realized, via the research study, the importance of singing to their infant. Some mothers even commented that this was important for the baby, despite the fact that they felt self-conscious singing. Also, encouragement and positive feedback given to mothers during the recording process might have given them confidence about their singing and thus have positively empowered them to sing at home.

Many mothers stated they found the personalized CD of their singing beneficial for calming their infants and promoting mother-infant bonding. One mother stated that she used the CD when she was too tired to even think at the end of the day. She often played the CD while holding her infant, prior to putting her infant down to sleep; she found this time period of music listening relaxing for her and her infant. Another mother found the CD beneficial at times when her infant was crying and waiting for a bottle. She played the CD for her infant while she was preparing bottles. These mothers as well as others reported creative ways of using their CDs.

Most mothers utilized music for its calming effect. Some experimental and control mothers reported using music during transitional times; however, only 11 mothers from both groups reported using music to stimulate their infant. The minimal use of music for stimulation provides many implications for music therapists and educators concerning the importance of promoting and teaching mothers appropriate methods of using music to stimulate their infants.

Many mothers seemed to enjoy picking out songs for the CD recording as well as writing individualized lyrics to Brahms' *Lullaby*. These mothers often incorporated very personal messages to their infants. Nevertheless, several mothers stated that they did not know this lullaby, even after hearing the melody; some recognized the melody but did not feel comfortable singing it. Future clinicians might create another individualized song to the tune of a familiar melody so that all mothers could participate in this aspect of the study if they desired.

One consideration for music therapy clinicians working with this population is to be sensitive to the mothers' self-confidence when singing. Many mothers vocalized concern about the quality

of their singing and seemed very insecure of their voices. Many mothers preferred lower keys and did not use their upper vocal register. Practice trials before recording each song seemed to help mothers.

Based on this information, it is possible that mothers of premature infants might not sing during NICU visits; singing is a very personal interaction between mothers and infants, and nurses and other hospital personnel are often moving in and out of infants' rooms. Two to 3 infants resided in most rooms, and sometimes parents' visits overlapped. Thus, the infant might have heard her singing in NICU only when the researcher played the CD. Future research questions might include asking mothers how often they sang to their infant in the NICU.

In this study several mothers reported varying degrees of postpartum depression. Researchers have determined that postpartum depression is apparent across marital status, all age groups, and varying socioeconomic backgrounds (Josefsson et al., 2002; Yonkers et al., 2001). Recently, researchers pinpointed that high depression rates occurred during late pregnancy and at the maternity ward rather than later (Josefsson, Berg, Nordin, & Sydsjo, 2001). Future researchers and clinicians might want to investigate the possibility of music therapy interventions prior to birth to assist with any onset of depressive symptoms. Music therapy interventions might also counteract the negative effects of postpartum depression on infants, especially since researchers have found differences in interactions and even brain activation in infants of depressed mothers versus infants of mothers who were not depressed (Field et al., 1988). Other interventions might involve teaching depressed mothers how to engage with their infants through highly structured interactive musical activities, providing mothers and infants success.

Several limitations of this study might be addressed in future research. Future researchers might counterbalance the number of first-time mothers in control and experimental groups to decrease differences in groups. Controlling for medical complications is also warranted and might take greater efforts and coordination with medical treatment teams. Also, scales for the PPI might be rated on a 1–5 scale rather than the 3-point scale used, as some mothers indicated that the answers were not appropriately weighted to indicate how they felt. Furthermore, established

measurements tools with consistent reliability and validity might be used to determine bonding and value/importance of music.

Future researchers might think of using a different design from the posttest only design to a pre and posttest design. With several mothers the timing of the survey would have influenced their responses, as previous researchers have reported many emotional needs of mothers with infants in the NICU (Brooten et al., 1988; Pederson et al., 1987; Singer et al., 1996). Some of the preterm mothers indicated that they were happy and calm once their infants were discharged, but their answers would have been different during the time their infants were in the NICU. Based on the finding from the current study, 2 weeks after discharge preterm mothers were already reporting decreased stress and anxiety.

Another factor that might have affected responses involved rapport that was developed with mothers while recording the CD; many confided in the researcher their concerns about their infants. The relationship with these mothers might have resulted in genuine and honest answers during phone surveys versus those in the control group. Future researchers might incorporate music versus nonmusic interventions so rapport would be established with all mothers.

Rapport that was established between experimental full-term and preterm mothers might have resulted in honest answers, but it is also possible that the relationship resulted in greater awareness of complications or even produced more insecurity regarding the baby and new motherhood responsibilities. Zeskind and Iacino (1984) found that mothers who frequently visited the NICU had more negative perceptions of their infants at discharge and even 6 weeks later compared to mothers who did not visit as often; they theorized that mothers became familiar with their infants, and their perceptions indicated a more realistic view of their infants.

Researchers have found that some parents experienced significant distress while infants were in the NICU and when preparing to bring infants home; thus, intervention may be beneficial for parents (Carter et al., 2005; Pederson et al., 1987). Offering mothers opportunities to create a CD of their singing might be one intervention to provide locus of control of the situation. Many mothers in this study stated that knowing their

infant listened to the CD recording of their voice helped them to cope with their infants' stay in the NICU, and they also felt like it helped with mother-infant bonding. Furthermore, providing them opportunities to create an individualized lullaby, providing a specific message to their infant, might further alleviate the turmoil of premature birth. One mother told her preterm infant, "Please, go to sleep, 'cause you really need your rest. We hope you can come home, sooner than later." Many preterm mothers sang that they hoped their infant was resting and gaining weight and others sang that they were thinking and praying for them daily.

Preterm Infants

While there were no significant differences in weight gained and number of days in the hospital between infants in the experimental and control groups, infants in the experimental group went home 2 days sooner. Possible differences in this study parallel another study, in which infants with respiratory disorders who received 20 minutes of recorded sedative music for 4 days evinced no significant differences for heart rate, respiration rate, oxygen saturation rate, and infant behavior (Calabro, Wolfe, & Shoemark, 2003). These authors thought that music did not establish an effect on infants due to not enough exposure. Infants in the Caine (1991) study received 1.5 hours of music every day until time of discharge, and infants in the experimental group went home 5 days sooner.

Recently, researchers have provided 4 hours of music listening to premature infants who were between 25 to 30 weeks gestational age, and results indicated a significant difference in length of hospital stay, with infants leaving 7 days earlier than those receiving standard care and 12 days earlier than those receiving ear muffs for 4 hours a day (Baily, Kantak, Jarjoura, Reuman, & Knatak, 2005). In a follow-up study Bailey and Kantak (2005) indicated that 8 hours a day resulted in negative effects, including longer length of hospital stay. Consequently, listening to mothers' singing for longer periods, such as an hour and a half but no longer than 4 hours a day, might provide increased benefits.

Data were not collected on oxygen saturation rate, heart rate, or respiratory rate. Future researchers might want to investigate these variables, especially since several infants evinced positive physiological signs while listening to the CD. Future researchers

might also investigate the use of mothers' voices to attenuate stress of preterm infants following medical procedures.

Conclusions

While the experimental full-term mothers expressed great appreciation for the opportunity to create the CD, it might not be cost-effective for music therapists to work with all mothers and newborn infants. Thus, future music therapists in the medical field might want to investigate the effects of creating a CD with full-term mothers who are experiencing postpartum depression. Based on the genuine responses from experimental preterm mothers, it seems important to continue to provide preterm mothers with positive interventions to help them cope with their infants' NICU stay.

References

- Affleck, G., Tennen, H., & Rowe, J. (1990). Mothers, fathers, and the crisis of newborn intensive care. *Infant Mental Health Journal*, 11(1), 12–25.
- Allen, M. C. (2002). Overview: Prematurity. *Mental Retardation and Developmental Disabilities Research Review*, 8, 213–214.
- Als, H., Lawhon, G., Brown, E., Gibes, R., Duffy, F. H., McAnulty, G., & Blickman, J. G. (1986). Individualized behavioral and environmental care for the very low birth weight preterm infant at high risk for Bronchopulmonary Dysplasia: Neonatal intensive care unit and developmental outcome. *Pediatrics*, 78, 1123–1132.
- Backman, D. H., & Lind, R. F. (1997). Perinatal social work and the family of the newborn intensive care infant. *Social Work in Health Care*, 24, 21–37.
- Baily, K. A., & Kantak, A. (2005). *Music therapy in the neonatal intensive care unit: A multi site study*. Music therapy and sound reduction in the Neonatal Intensive Care Unit. Music Therapy in the NICU: A Symposium of Music Therapy in the Neonatal Intensive Care Unit. Conducted in Cleveland, OH.
- Baily, K. A., Kantak, A., Jarjoura, D., Reuman, P., & Knatak, S. (2005). *Music therapy and sound reduction in the Neonatal Intensive Care Unit*. Music Therapy in the NICU: A Symposium of Music Therapy in the Neonatal Intensive Care Unit. Conducted in Cleveland, OH.
- Bozzette, M. (1997). *Premature infants responses to taped maternal voice*. (UMI No. 9736245).
- Brooten, D., Gennaro, S., Brown, L. P., Butts, P., Gibbons, A. L., Blakewell-Sachs, S., & Kumar, S. P. (1988). Anxiety, depression, and hostility in mothers of preterm infants. *Nursing Research*, 37, 213–216.
- Caine, J. (1991). The effects of music on the selected stress behaviors, weight, caloric and formula intake, and length of hospital stay of premature and low birth weight neonates in a newborn intensive care unit. *Journal of Music Therapy*, 28, 180–192.
- Calabro, J., Wolfe, R., & Shoemark, H. (2003). The effects of recorded sedative music on the physiology and behaviour of premature infants with a respiratory disorder. *The Australian Journal of Music Therapy*, 14, 3–19.

- Campbell, C. L. (2000). *Classical music compact discs and books for Georgia's infants: Use and relationship to infant development one year later as reported by low-income caregivers*. Doctoral dissertation. Georgia State University, Atlanta, GA.
- Carter, J. D., Mulder, R. T., Bartram, A. F., & Darlow, B. A. (2005). Infants in a neonatal intensive care unit: Parental response. *Archives of Disease in Childhood. Fetal and Neonatal Edition*, 90, 109–113.
- Cassidy, J. W., & Standley, J. M. (1995). The effect of music listening on physiological responses of premature infants in the NICU. *The Journal of Music Therapy*, 32, 208–227.
- Coleman, J. M., Pratt, R. R., Stoddard, R. A., Gerstmann, D. R., & Abel, H. (1997). The effects of the male and female singing and speaking voices on selected physiological and behavioral measures of premature infants in the intensive care unit. *International Journal of Arts Medicine*, 5(2), 4–11.
- Crawford, J. W. (1982). Mother-infant interaction in premature and full-term infants. *Child Development*, 53, 957–962.
- Crnic, K. A., Ragozin, A. S., Greenberg, M. T., Robinson, N. M., & Basham, R. B. (1983). Social interaction and developmental competence of preterm and full-term infants during the first year of life. *Child Development*, 54(5), 1199–1210.
- Custodero, L. A., & Johnson-Green, E. A. (2003). Passing the cultural torch: Musical experience and musical parenting of infants. *Journal of Research in Music Education*, 51, 102–114.
- DeCasper, A. J., & Fifer, W. P. (1980). Of human bonding: Newborns prefer their mothers' voices. *Science*, 208, 1174–1176.
- DeCasper, A. J., & Spence, M. J. (1986). Prenatal maternal speech influences newborns' perception of speech sounds. *Infant Behavior and Development*, 9, 133–150.
- Field, T., Healy, B., Golstein, S., Perry, S., Brendell, D., Schanberg, S., Zimmerman, E. A., & Kuhn, C. (1988). Infants of depressed mothers show "depressed" behavior even with nondepressed adults. *Child Development*, 59(6), 1569–1579.
- Fowle, P. W., & McHaffie, H. (2004). Supporting parents in the neonatal unit. ABC of preterm birth. Supporting parents in the neonatal unit. *British Medical Journal*, 329, 1336–1338.
- Gennaro, S. (1988). Postpartal anxiety and depression in mothers of term and preterm infants. *Nursing Research*, 37, 82–85.
- Greenberg, M. T., & Crnic, K. A. (1988). Longitudinal predictors of developmental status and social interaction in premature and full-term infants at age two. *Child Development*, 59(3), 554–570.
- Greene, J. G., Fox, N. A., & Lewis, M. (1983). The relationship between neonatal characteristics and three-month mother-infant interaction in high-risk infants. *Child Development*, 54(5), 1286–1296.
- Harewood, G. C., Yacavone, R. F., Locke, G. R., & Wiersema, M. J. (2001). Prospective comparison of endoscopy patient satisfaction surveys: E-mail versus standard mail versus telephone. *The American Journal of Gastroenterology*, 96(12), 3312–3317.
- Hawthorne, G. (2003). The effect of different methods of collecting data: Mail, telephone and filter data collection issues in utility measurement. *Quality of Life Research*, 12, 1081–1088.

- Hertz, K., Zook, E., Chitwood, K. S., O'Carroll, P. W., & Friede, A. (1996). "E-mail versus phone: Experiences from the field, <http://ai.mit.edu/projects/iip/conferences/survey96/hertz/wonder.html>
- Hepper, P. G., Scott, D., & Shahidullah, S. (1993). Newborn and fetal response to maternal voice. *Journal of Reproductive and Infant Psychology*, 11, 147-153.
- Josefsson, A., Angelsioo, L., Berg, G., Ekstrom, C., Gunnervik, C., Nordin, C., & Sydsjo, G. (2002). Obstetric, somatic, and demographic risk factors for postpartum depression. *Obstetrics & Gynecology*, 99(2), 223-228.
- Josefsson, A., Berg, G., Nordin, C., & Sydsjo, G. (2001). Prevalence of depressive symptoms in late pregnancy and postpartum. *Acta Obstetrica Et Gynecologica Scandinavica*, 80, 251-255.
- Klassen, A. F., Lee, S. K., Raina, P., Chan, H. W. P., Matthew, D., & Brabyn, D. (2004). Health status and health-related quality of life in a population-based sample of neonatal intensive care unit graduates. *Pediatrics*, 113, 594-600.
- Leifer, A. D., Leiderman, P. H., Barnett, C. R., & Williams, J. A. (1972). Effects of mother-infant separation on maternal attachment behavior. *Child Development*, 43(4), 1203-1218.
- Macey, T. J., Harmon, R. J., & Easterbrooks, M. A. (1987). Impact of premature birth on the development of the infant in the family. *Journal of Consulting and Clinical Psychology*, 55(6), 846-852.
- Mehler, J., Bertoncini, J., Barriere, M., & Jassik-Gerschenfeld, D. (1978). Infant recognition of mother's voice. *Perception*, 7, 491-497.
- Minde, K., Whitelaw, A., Brown, J., & Fitzhardinge, P. (1983). Effects of neonatal complications in premature infants on early parent-infant interactions. *Developmental Medicine and Child Neurology*, 25, 763-777.
- Pederson, D. R., Bento, S., Graham, W., Chance, G. W., Evans, B., & Fox, A. M. (1987). Maternal emotional responses to preterm birth. *American Journal of Orthopsychiatry*, 57, 15-21.
- Rock, A. M. L., Trainor, L. J., & Addison, T. L. (1999). Distinctive messages in infant-directed lullabies and play songs. *Developmental Psychology*, 35, 527-534.
- Singer, L. T., Salvator, A., Guo, S., Collin, M., Lilien, L., & Baley, J. (1999). Maternal psychological distress and parenting stress after the birth of a very low-birth-weight infant. *The Journal of the American Medical Association*, 281, 799-805.
- Standley, J. M. (1991). Longterm benefits of music intervention in the newborn intensive care unit: A pilot study. *Journal of the International Association of Music for the Handicapped*, 6(1), 12-22.
- Standley, J. M. (2003). A meta-analysis of the efficacy of music therapy for premature infants. *Journal of Pediatric Nursing*, 26, 493-499.
- Standley, J. M., & Madsen, C. K. (1990). Comparison of infant preferences and responses to auditory stimuli: Music, mother, and other female voice. *Journal of Music Therapy*, 27, 54-97.
- Tessier, R., Cristo, M. B., Velez, S., Giron, M., Nadeau, L., & de Calume, Z. F., et al. (2003). Kangaroo mother care: A method for protecting high-risk low-birthweight and premature infants against developmental delay. *Infant Behavior and Development*, 26, 384-397.

- Thompson, R. J., Oehler, J. M., Catlett, A. T., & Johndrow, D. A. (1993). Maternal psychological adjustment to the birth of an infant weighing 1,500 grams or less. *Infant Behavior and Development, 16*, 471-485.
- Trause, M. A., & Kramer, L. I. (1983). The effects of premature birth on parents and their relationships. *Developmental Medicine and Child Neurology, 25*, 459-465.
- Willie, D. E. (1991). Relation of preterm birth with quality of infant-mother attachment at one year. *Infant Behavior and Development, 14*, 227-240.
- Yonkers, K. A., Ramin, S. M., Rush, A. J., Navarrete, C. A., Carmody, T., March, D., Heartwell, S. F., & Leveno, K. J. (2001). Onset and persistence of postpartum depression in an inner-city maternal health clinic system. *American Journal of Psychiatry, 158*, 1856-1863.
- Zarling, C. L., Hirsch, B. J., & Landry, S. (1988). Maternal social networks and mother-infant interaction in full-term and very low birthweight, preterm infants. *Child Development, 59*(1), 178-185.
- Zeskind, P. S., & Iacino, R. (1984). Effects of maternal visitation to preterm infants in the neonatal intensive care unit. *Child Development, 55*(5), 1887-1893.



COPYRIGHT INFORMATION

TITLE: The Effects of Mothers' Singing on Full-term and
Preterm Infants and Maternal Emotional Responses

SOURCE: J Music Ther 45 no3 Fall 2008

The magazine publisher is the copyright holder of this article and it is reproduced with permission. Further reproduction of this article in violation of the copyright is prohibited. To contact the publisher:
<http://www.yale.edu/jmt/>