



# The Effects of Contingent Lullaby Music on Parent-Infant Interaction and Amount of Infant Crying in the First Six Weeks of Life

Amy M. Robertson, Ph.D., MT-BC<sup>a,\*</sup>,<sup>1</sup> Michael R. Detmer, MME, MT-BC<sup>b</sup>

<sup>a</sup> Florida State University, College of Music, Tallahassee, FL, United States of America

<sup>b</sup> Norton Women's and Children's Hospital, University of Louisville, Louisville, KY, United States of America

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## ABSTRACT

**Purpose:** The purpose of this study was to examine the effect of a live music intervention provided by the mother on full term infants' amount of crying and parent-infant interaction in the first six weeks of life.

**Design and methods:** A randomized posttest-only experimental/no-contact control group design was used for this study. A sample of 66 mothers with healthy, newborn infants were recruited. The researcher wrote an original lullaby with each mother in the experimental group and gave instructions as to how to use the lullaby as reinforcement for infant quiet, non-crying behavior. Mother-infant dyads were assessed over a six-week period for infant crying amounts and parent-infant interaction behaviors. Demographic variables, postpartum depression, and value of music were assessed as well to detect associations between variables and groups.

**Results:** Results indicated that there were significant differences between groups for mean crying time per week and mother-infant interaction behaviors. Analysis by demographic variables such as mother parity, socioeconomic status, and marital status showed no significant group differences on infant crying or interaction scores. Mothers who used the contingent music intervention were more motivated to sing and valued the use of music with their infants more than mothers in the control group.

**Conclusions:** The outcomes of this study demonstrate importance of parental singing for mother-infant bonding.

**Practice implications:** Implementing early intervention services, such as music therapy in the postpartum unit, can provide new mothers useful music applications that can enhance mother-infant interaction, especially mothers living in high stress or negative environments.

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## Introduction

At birth, infants are equipped with different cries to signal their non-distressed and distressed states to the caregiver (Del Vecchio, Walter, & O'Leary, 2009). The various cries can represent hunger, pain, thirst, boredom, fatigue, fussiness, injury, and indigestion that parents learn to distinguish in the first two weeks after birth (Ludington-Hoe, Cong, & Hashemi, 2002). The frequency and duration of crying/fussing behaviors can be impacted by infant and maternal variables. Factors that have been known to influence crying/fussing behaviors include infant temperament, pediatric conditions, birth weight and other physical factors related to birth, maternal sensitivity, care giving techniques, feeding practices, demographics, and lifestyles (Wurmser et al., 2006). Negative lifestyle changes, such as divorce, and infant characteristics have been

found to have an adverse impact on the duration and frequency of crying behaviors. Mothers who experienced negative lifestyle changes and reported high stress levels had infants who exhibited more crying behaviors during the first six months postpartum than infants of mothers with low stress scores and lifestyle changes (Wurmser et al., 2006). In a study by Barr, Kramer, Pless, Boisjoly, and Leduc (1989), parents of newborns were given a questionnaire at two and six weeks postpartum assessing their infants' temperament, feeding choice and socioeconomic status. Results indicated that infant temperament was the most stable predictor of crying/fussing behaviors. Infants who were assessed as having a "difficult temperament", or the inability to adapt to new situations, display negative moods, and intense reactions, cried and fussed more than infants with low temperament scores.

Infant crying behavior is indicative of biological behavioral shifts during the first year of life and is often referred to as the crying curve (Barr, 1990). This curve is reflected in the first six weeks of life when the newborn is experiencing physiological maturational changes affecting the duration and frequency of crying behaviors. Most infants exhibit increased crying/fussing behaviors, especially in the late afternoon and evening hours until three months of age (Wurmser et al., 2006). Within the initial hours after birth, crying spells can last up to 40 s and as the

\* Corresponding author at: University of Missouri Kansas City, Kansas City, MO, United States of America.

E-mail addresses: [robertsonam@umkc.edu](mailto:robertsonam@umkc.edu) (A.M. Robertson), [michaelrdetmer@gmail.com](mailto:michaelrdetmer@gmail.com) (M.R. Detmer).

<sup>1</sup> Present address: University of Missouri Kansas City, 5228 Charlotte St., Kansas City, MO 64110, United States of America.

infant matures, increase to 42.7 min a day in the first couple of weeks of life and peak at 120 min at six weeks when the infant is experiencing dramatic shifts in states of wakefulness distinguished by a rapid decrease in alert inactivity and increase in alert activity (Barr, 1990; Ludington-Hoe et al., 2002). This peak is common across many cultures and has been explained by common maturational and neurodevelopmental processes (Ijzendoorn & Hubbard, 2000; Wurmser et al., 2006).

Maternal response has been shown to have significant effects on infant crying behaviors and is one of the earliest and most frequent infant-mother interactions (Del Vecchio et al., 2009). It has been found that the maternal voice, proximity, and interactive behavior have an organizing effect on the developing brain and help to regulate neurobiological, sensory, perceptual, emotional, physical and relational systems (Feldman, 2007; Winberg, 2005). Some of the most effective maternal response behaviors that have elicited positive behavior responses from young infants are exaggerated facial expressions and movements, vestibular stimulation (bouncing, changing baby's position) and auditory stimulation (singing, talking) (Kaye & Fogel, 1980; Osofsky & Danzger, 1974). Goldberg (1977) found that when maternal behaviors are provided on a consistent basis in response to infant behavior, there was an increase in desirable infant behavior such as attention, smiling and vocalizing, and effective manipulation of states of arousal. When there is a lack of consistent, close behavior with the infant, long-term implications such as weakened social competence and peer interaction can occur (Forslund, Kenward, Granqvist, Gredebäck, & Brocki, 2017).

Other factors such as spousal support, mother parity, and socioeconomic status have shown to effect mother-infant interaction and crying behaviors. Spousal support has been reported as the most common type of postpartum support and can have a significant effect during the prenatal and postpartum periods on maternal behaviors and mother-infant interactions with married mothers experiencing more positive relationships with their infants than those who are single or in a cohabiting relationship (Rosenkrantz-Aronson & Huston, 2004). Even though research on mother parity and socioeconomic status is inconsistent, there is evidence of lasting adverse effects on mother-infant attachment and interaction resulting in a need for early intervention (Abbas et al., 2018; Ferber, 2004; Schiffman & Omar, 2003). Postnatal depression is another element that is considered to significantly effect infant attachment and crying and is diagnosed in 20%–40% of mothers (Field, 2010). Depressed mothers spend more time in negative behavior states and less time providing positive interactions with their infant leading to long-term negative outcomes such as poorer motor, cognitive, and social-emotional development (Feldman, 2007; Feldman, Greenbaum, & Yirmiya, 1999).

The use of music to improve maternal interaction and crying behaviors is very limited and has mainly addressed the effects of music on mother-infant interactions within a group setting. Studies have shown that music groups increase communication (gestures) and social interaction within parent-infant dyads (Gerry, Unrau, & Trainor, 2012), as well as improve parenting behaviors and the mental health of parents (Nicholson, Berthelsen, Abad, Williams, & Bradley, 2008). Within the field of music therapy, the effects of joint music making have been assessed among mother-infant dyads in which there was an interruption in the maternal attachment process caused by issues such as postpartum depression or stress. Study results indicated a significant increase in parent-infant interaction and engagement in mother-infant dyads participating in the experimental music groups (Edwards, 2011; Walworth, 2009).

While research is limited, positive outcomes have been demonstrated when mothers and caregivers were taught how to use music with their infants during the first weeks of life. Whipple (2000) trained new mothers on how to use music-based developmental techniques with their infants who were in the neonatal intensive care unit. Results showed parents were more appropriate in parental responses to their

infants and had lower levels of stress. Additionally, other mothers who were trained to sing to their infants within the first weeks of life realized how important the use of live music was for their infants and used it more during care than mothers who were not instructed to use music (Cevasco, 2008). In a study by Velismas and Bowes (1999), first time mothers were trained to use music and movement to soothe their newborns in group music therapy classes. The mothers in this study reported being more relaxed and used live lullaby singing more to soothe or stimulate their infants than parents who were not trained.

There is little research on the effect of contingent music in the first weeks of life on infant crying behaviors and parent-infant interaction. However, many studies incorporated the use of contingent background music with premature infants or infants that have been diagnosed with colic to decrease crying and parental stress. Contingent music is a common strategy used in music therapy; it is a behaviorism technique in which music either starts or stops when a behavior is exhibited. For example, if the desired infant behavior is a calm state, music may be provided until the infant becomes fussy or is crying, at which point the music stops until the infant returns to a calm state. Keith, Russell, and Weaver (2009) examined the effects of recorded lullaby music used as a contingency for premature infants in the NICU who were deemed inconsolable by nursing staff. Results showed that when contingent music was played, inconsolable crying periods decreased from seven to four times a day and lasted an average of 5 min versus 23 min when contingent music was not used. Similarly, when parents were taught how to use recorded lullaby music as a contingency for their infants with colic, results indicated that the contingent lullaby music significantly reduced crying by 75% as well as decreased parental distress (Larson & Ayllon, 1990).

It has been demonstrated that infants as well as parents benefit from the use of music in the early stages of development. To date, there is no such study that analyzes the effects of live, parental contingent singing on attachment and crying behaviors in healthy newborn infants. The purpose of this study was to determine the following: 1) the effects of creating an original lullaby to be used as a reinforcement tool by the mother on infant crying behaviors when the infant is in a quiet, alert state; 2) the effects of creating an original lullaby to be used by the mother and mother-infant interaction; 3) whether primiparous and multiparous status of mothers in the contingent music group and control group will have an effect on crying behaviors; 4) how marital status will affect crying behaviors; 5) whether socioeconomic status will have an impact on crying behaviors; 6) risk of postnatal depression in experimental and control groups; and 7) whether parents using the contingent music intervention will find the use of music beneficial for infants.

## Method

### Participants

This study took place at two regional medical centers and a birthing center in Florida as well as a regional medical center in Kentucky from October 2016 to May 2017. Mothers were referred by nurses for the study 24 h after giving birth and then randomly assigned to experimental or control condition groups with randomization order generated by a computerized random number generator. Mothers were informed of the study by the researcher respective to each participating site and written consent was obtained from the mothers. Inclusion criteria stated that mothers must be 18 years of age or older and had given birth vaginally to a healthy, newborn infant at or greater than 37 weeks post menstrual age. The study was approved by the participating institutional review boards and human subject committees.

### Study design and procedures

This study utilized a posttest-only experimental/no-contact control group design with random assignment to measure mother-infant

interactions, and infant crying behaviors. Nursing staff were blind to mother-infant condition groups. Mothers in the control group used standard care practices to care for their infant during the first six weeks of life and were not provided education on how to use contingent lullaby music. They were told they would be contacted once a week for the following five weeks to obtain daily infant crying amounts as well as participate in a video recording interacting with their infant the sixth week. For those assigned to the experimental group, the researcher helped mothers write an original lullaby that would be used during the contingent lullaby intervention by rewriting lyrics to a lullaby or play song that the mother was familiar with – e.g. “Twinkle, Twinkle, Little Star.” The mothers were encouraged to write lyrics that reflected how they felt about their infant and what they would be doing during play – e.g. “time to smile and time to play.” After the song was composed and recorded as a reference, if needed later, the researcher taught the mothers how to sing the lullaby as a reinforcement tool when the baby was quiet and alert. The researcher explained to only sing the written lullaby to their baby when he or she was in a quiet state and, during periods of crying, music should not be used until the infant pauses or stops to take a breath, at which point singing should resume and only continue if the infant remains quiet. The experimental group was also informed that they would be contacted once a week for the following five weeks to obtain daily infant crying amounts, number of times that they used the contingent lullaby singing as well as participate in a video recording interacting with their infant the sixth week.

### Measures

Mothers in both the experimental and control groups were contacted once a week after discharge from the hospital and asked to report how many minutes/h total their infant cried the day prior until the infant was six weeks of age. Average infant crying amounts were reported in minutes and calculated by adding the weekly crying amounts for each group and dividing by the number of subjects for each week. Average daily use of the contingent lullaby intervention was calculated by adding the frequency used each week divided by the number of subjects. The Looking, Touching, Talking, Smiling (LoTTS) Parent-Infant Interaction Coding Scale (Beatty et al., 2011), which has an overall inter-rater reliability rating greater than 80%, was used during the sixth week of the study to record the frequency of interaction behaviors during a four-minute video recording in which the mothers were instructed to play with their infants. Interaction behaviors were recorded every 20 s and included touch, look, talk, smile and infant response. The principle investigator added “singing” to the coding scale for the purposes of this study. The coding scale also consisted of two global ratings: mother responsiveness and warmth, which were rated on a scale of one to five, with five being the most positive. Three board-certified music therapists were trained in using the LoTTS coding scale and yielded an overall inter-rater reliability rating of 83%. All three coders were blind to experimental or control dyads when coding. A Value of Music scale was given to every mother during the sixth week visit and consisted of three questions regarding how important they perceive music to be for their infants and was assessed through a 5-point Likert scale with 1 representing strong disagreement and 5 representing strong agreement. The average value of music score was calculated for each subject by adding all three scores together and dividing by three. The Edinburg Postnatal Depression Scale (EDPS) (Cox, Holden, & Sagovsky, 1987) was also administered to all mothers during the sixth week and included ten questions in which each mother underlined the response that she felt most often over the previous seven days. The EDPS score was calculated by adding up the corresponding scores for all ten responses. Of note, if mothers received a score of seven or above, indicating a possible risk for depression, they were provided with local resources and encouraged to seek assistance. For this scale, validity data indicate overall agreement of 84% accuracy.

### Statistical analysis

The primary outcome measures for this study were infant crying time and frequency of parent-infant bonding behaviors. Secondary outcome measurements were incidence of postnatal depression and mothers' value of music. Means, standard deviations, and checks for normality were calculated for all variables. A chi-square and *t*-test was used for demographic data to determine if differences between groups existed before the intervention was administered. A Mann-Whitney *U* was used to assess comparisons of overall differences in infant crying time, parent-infant bonding behaviors, postnatal depression and value of music between groups. The significance level was set at 0.05 for all statistical tests for this study.

### Results

A total of 66 mother-infant dyads meeting inclusion criteria were enrolled for this study. Over the course of the study, 21 dyads failed to complete the study due to the following reasons: (1) participants moved out of the area; (2) participants' phones were turned off; (3) participants stated that they were too busy to continue participating in the study; or (4) participants stopped responding. For the remaining 45 mother-infant dyads ( $n = 21$  experimental,  $n = 24$  control), demographic and characteristics for infants and mothers are listed in Tables 1 and 2. Of those who chose not to enroll, mothers stated that they felt they would not have time or were just not interested. These mothers did not differ in demographics from the mothers who decided to enroll.

When comparing groups by conditions, a significant difference was found for mean crying time per week over six weeks,  $U(n_1 = 6, n_2 = 6) = 34, z = 2.48, p < .01, r = 0.7$ . No significant differences were found in mean crying time by marital status, mother parity, and socioeconomic level. Infants in the experimental group experienced a shorter mean crying duration each week than those in the control group (Table 3). In regards to parent-infant bonding, there was a significant difference between groups for responsiveness  $U(n_1 = 24, n_2 = 21) = 340, z = 1.99, p < .05, r = 0.2$ , and warmth,  $U(n_1 = 24, n_2 = 21) = 372, z = 2.72, p < .01, r = 0.4$ , demonstrating mothers in the experimental condition were found to be more responsive and warm during the four-minute video recorded interaction at six weeks. There were also significant differences for mother-infant eye contact,  $U(n_1 = 24, n_2 = 21) = 360.5, z = 2.46, p < .01, r = 0.3$ , talking,  $U(n_1 = 24, n_2 = 21) = 348.5, z = 2.18, p < .02, r = 0.3$ , singing,  $U(n_1 = 24, n_2 = 21) = 336, z = 1.9, p < .05, r = 0.2$ , and infant response,  $U(n_1 = 24, n_2 = 21) = 375.5, z = 2.8, p < .01, r = 0.4$ . No significant differences were found for smiling. Touch was eliminated from the data analysis since all mothers were continuously holding or touching their infants throughout the observation period. Mothers and

**Table 1**  
Mother characteristics and demographics by group.

Characteristics	Experimental mothers		Control mothers	
	(n = 21)		(n = 24)	
Age, M, SD	28.88	5.55	25.95	4.19
Number of children, M	0.8	0.87	0.91	1.13
Race, n				
Caucasian	13		7	
African American	7		9	
Other	1		0	
Marital status, n				
Married	15		6	
Single	6		7	
Socioeconomic level, n				
Upper	2		2	
Middle	11		12	
Lower	8		10	

**Table 2**  
Infant characteristics and demographics.

Characteristics	Experimental infants (n = 21)		Control infants (n = 24)	
Postmenstrual age In weeks, M, SD	39.29	1.22	39.30	1.18
Gender, n				
Male	11		15	
Female	10		9	
Race, n				
Caucasian	13		15	
African American	7		9	
Other	1		0	

infants in the experimental condition exhibited a higher frequency of parent-infant interaction behaviors (Table 4).

A significant difference was found between groups for perceived value of music,  $U(n_1 = 24, n_2 = 21) = 378.5, z = 2.87, p < .01, r = 0.4$ , indicating mothers in the experimental group valued the use of music with their infants more than mothers in the control group. The mean was calculated for number of times mothers in the experimental group used the contingent music intervention and it was found the intervention was used an average of 4.7 times a day for six weeks. There were not any significant differences between groups for postnatal depression scores, however a trend was found in which there were twice as many mothers in the control group with scores of 7 or above than in the experimental group. There were no significant differences for group by marital status, race, income, or first-time mothers vs. those with other children. There were also no significant differences for group by age, or number of children indicating that groups were similar when enrolled in the study. Analysis of demographics for infants showed that there was not a significant difference between groups and birth age indicating no group differences for how old infants were when beginning study.

## Discussion

Mothers in the contingent music group reported significantly shorter infant crying periods than mothers in the control group, but interestingly, mean crying time per day decreased after the fourth week for both groups, which contradicts existing literature. The standard crying curve for newborns consists of an average crying time of 42.7 min for the first couple of weeks of life and peaks at 120 min at six week of age, however, in this study, mean crying time decreased for both groups after week four which is inconsistent with results in the literature (Barr, 1990; Ijzendoorn & Hubbard, 2000; Ludington-Hoe et al., 2002; Wurmser et al., 2006). Infants in the experimental group were consistently below the crying curve average, by week four were crying one-third less than the control group, and by week six, were crying half of the time experienced by infants in the control group. Further, standard deviation scores for crying duration for the experimental group decreased after the third week indicating mothers may have been using the contingent music technique on a more consistent basis

**Table 3**  
Means and standard deviations for crying time in minutes by group.

	Experimental		Control	
	M	SD	M	SD
Week 1	23.47	24.83	31.25	36.35
Week 2	24.14	32.28	35	32.06
Week 3	31.28	31.20	41.87	40.56
Week 4	34.76	28.26	52.91	51.13
Week 5	26.76	27.92	43.75	51.54
Week 6	22.52	22.83	43.12	50.29

**Table 4**  
Means for parent-infant interaction behaviors by group.

	Experimental		Control	
	M (SD)		M (SD)	
Look	3.66 (2.07)		2.25 (2.75)	
Talk	10.57 (1.91)*		8 (3.75)*	
Smile	6.90 (3.71)		6.37 (3.66)	
Sing	0.9 (0.89)*		0 (0)*	
Infant Response	3.95 (2.12)		2.29 (2.66)	

Note: underline indicates significance at 0.01.

\* Indicates significance at 0.05.

to decrease crying duration. Additionally, standard deviation scores for crying time within the control group showed a gradual increase perhaps indicating greater inconsistency across time among mothers who were not trained to use contingent music decrease crying in their infants. These findings validate previous research results indicating consistency of maternal response is an important factor for crying duration and frequency (Del Vecchio et al., 2009).

The use of contingent music in this study was successful at decreasing crying in healthy, newborn infants across the first six weeks of life. Other studies have found similar results, but used recorded music as a tool for reinforcement and only included premature infants or those diagnosed with colic (Etscheidt, 1989; Keith et al., 2009; Larson & Ayllon, 1990). In the current study, mothers were taught to sing a personalized lullaby or playsong that they helped create specifically for their infant as a reinforcement tool for quiet, alert behavior. Results indicated that experimental mothers used the music intervention an average of four to five times a day per week to reinforce calm behavior. These data are consistent with prior research that parents might be more motivated to use music with their infants if they are educated as to how to use the music, why the music is important and can understand the effects of the music in a timely manner (Cevasco, 2008; Velismas & Bowes, 1999).

Due to less infant crying, mothers in the experimental group may have experienced lower levels of stress than is typical for most parents of newborns. After educating parents on how to appropriately bond with their infants in the neonatal intensive care unit using music, Whipple (2000) found that the parents reported significantly lower levels of stress. Cevasco (2008) had similar results when parents were instructed to use music with their newborns. Mothers could have also experienced longer rest periods if their infants were crying less leading to more positive interaction time when they were using the contingent music tool and improved self-care. Velismas and Bowes (1999) found that parents were more relaxed in the music group, motivating them to soothe or stimulate their infants with music more than the parents who did not participate in the music treatment group.

Research shows that demographic variables can have a remarkable effect on mother-infant interaction and crying behaviors. A lack of spousal support can lead to a decrease in maternal response due to high levels of stress in single parents (Crnic, Greenberg, Rogozin, Robinson, & Basham, 1983). In the current study, there were no differences found in crying time between mothers who were married or living with a partner versus single mothers, indicating the music intervention may have helped to decrease single mothers' stress levels.

Another demographic variable that can have an impact on maternal response is mother parity. Research has shown that multiparous mothers had a stronger maternal response, were more competent and reported lower levels of stress when caring for their infant (Hung, Yu, Chang, & Stocker, 2011; Stallings, Fleming, Corter, Worthman, & Steiner, 2000). In the current study, there was no difference between multiparous and primiparous mothers in regards to reported crying time of their newborn. Primiparous mothers in the experimental group reported a lower mean crying time than did the multiparous mothers, which may be a further indication of reduced stress in the music-trained mothers.

The last demographic variable that was analyzed was the effect of socioeconomic status on crying duration. The training provided by the researcher in how to use music contingently affected all socioeconomic groups similarly in report of crying time of their infants and results indicated that there was no difference in crying time between treatment groups and socioeconomic status. However, the group that reported the lowest mean crying time was low-income mothers in the experimental group. This is an interesting finding due to the fact that a majority of the data from previous studies show that mothers living in low-income settings often have lower maternal attachment and competence when caring for their infants (Bradley & Corwyn, 2002; Petterson & Albers, 2001).

Overall, experimental mothers displayed a higher frequency of interaction behaviors with their infants than did mothers in the control group during the observational period. Look, talk, singing and infant response were all significantly different between groups corroborating Ainsworth's (Ainsworth & Bell, 1972) findings on maternal sensitivity that mothers who consistently respond to their infants' cues in the first weeks of life exhibit richer mother-infant relationships and shorter infant crying times. By responding consistently with the contingent music intervention mothers engaged in more face-to-face interaction and infants exhibited more responses such as eye contact, smiling, and vocalizing validating the earlier findings of Ainsworth (1979) and Blehar, Lieberman, and Ainsworth (1977). A reduction in crying time as well as a consistent, positive maternal response helped to increase infant responses and the quality of maternal interaction.

For the four-minute observation period, mothers were instructed to freely interact with their infants as they normally do. Observational data analysis revealed that none of the mothers in the control group sang to their infants during the four-minute observation period, but seven of the 21 music mothers sang during their observation period using the original lullaby used for the study. This was an interesting finding considering many of the mothers in the experimental group originally told the researcher that they "do not sing" or asked if they could use a musical toy or use a recording instead of live singing for the contingent music intervention. The researcher educated the mothers on the benefits of music and the mother's interactive voice with infants, and helped the mothers write an original lullaby or play song that was easy to remember and sing. The researcher used the previous techniques to not only motivate mothers to sing, but to make the intervention user-friendly by embedding it within normal care time. The aforementioned result is consistent with previous research in which parents or mothers were hesitant to sing, but were motivated to use the music once they were exposed to the benefits and taught how to use the intervention (Cevasco, 2008; Whipple, 2000).

Maternal responsiveness and warmth were assessed as global ratings within the four-minute observation period. Responsiveness was defined as how quickly the mother responded to the infant's cues and warmth was defined as how often the mother displayed verbal and non-verbal signs of affection. The results indicated that there were significant differences in responsiveness and warmth between the experimental group and control group negating the possible argument that behavioral interventions with infants and children could decrease the quality of a mother's responsiveness to her infant. Experimental mothers produced higher global ratings than the control group indicating that the contingent music interaction might have improved maternal responsiveness and sensitivity.

Postnatal depression is a factor common among mothers of all ages and backgrounds and can severely impact mother-infant interactions and crying behaviors. In this study, there were no significant differences found between experimental and control mothers' depression assessment scores. Nine mothers in the control group and three in the experimental group received a score of seven or above indicating a possible risk for depression. Adhering to the contingent music interaction as trained did not increase the possible risk of depression among music mothers. Mothers in the control group might have experienced less

rest, more stress and infant crying leading to higher depression scores, but this difference was not significant.

A Value of Music survey was given to all of the mothers assessing their response to statements focusing on the importance of use of music with their infants. Experimental mothers' scores were significantly higher than the control group validating their belief that music was helpful for their baby, the importance of singing to their baby, and the importance of music for bonding. This finding is consistent with other research that parents value music more when they are educated on its use and experience the benefits with their infants.

In summary, mothers in the experimental group experienced significantly less infant crying time by using the contingent music interaction which helped to produce more enriching mother-infant interactions. Providing this type of training for mothers of newborns might have a remarkable impact on mother-infant bonding and interactions, leading to stronger mother-infant attachment patterns. Long-term research on attachment would indicate that this could impact infants' overall cognitive, social and neurological growth. Three of the mothers in the experimental music group contacted the researcher months after participating in the study to explain that she was still using the music intervention because her daughter had always responded so well to it. It was also suggested to the researcher that this type of intervention should be provided to all mothers with newborns because the information was so helpful. There were mothers in both treatment groups that asked the researcher "what do you mean by interact with my infant?" or made statements such as "we really don't interact that much." Many mothers commented on how the music helped to remind them of what they should be doing with their infant at that moment, such as smiling and playing. Other mothers commented not only on how the music helped them bond with their baby, but it also helped other family members bond with the infant as well. Mothers in the experimental music group were able to easily implement the music intervention within their infants' normal standard of care. Since the mothers created the lyrics to familiar lullabies, the music used for the intervention was easy to remember.

One limitation that could have affected the results of this study was the length of enrollment in regards to data reporting. Since mothers in both groups did not have a consistent log that they were keeping, it could be assumed that some of them were giving estimates of total crying time and if in the experimental group, frequency of contingent music use. Another limitation was subjects' previous music experience and/or knowledge of benefits of singing with infants. This characteristic could mean that mothers with previous experience or knowledge used music more frequently, therefore, possibly influencing all variables that were assessed. Finally, since study enrollment took place on the postpartum unit 24 h after giving birth, a time when mother-infant interaction levels were low due to maternal and infant fatigue, it was not possible to assess the true baseline of each dyad's mother-infant interaction behaviors.

Little time was needed to teach mothers the contingent music intervention. The researcher spent a total of 10–15 min writing the original lullaby with each mother and providing training on how to use the music contingently to decrease crying. The music-trained mothers were able to easily implement the intervention due to the fact that their original lullabies were short and easy to remember and the intervention was embedded within their infants' playtime. This type of positive intervention would be a low-cost, effective way to provide music therapy services that would improve the quality of life for all newborns and new mothers on postpartum units.

## Conclusion

Mothers in this study who were trained to use contingent lullaby singing with their newborn experienced significantly less infant crying and improved interaction behaviors with their baby. This is a simple, but effective intervention, corroborating existing research on contingent music

with newborns, that can easily be implanted into the standard of care for music therapists working with the newborn population. Due to the strong results of this study, it seems important to investigate further impact of this positive intervention during the early weeks of life. For future research, it is theorized that infant sleeping duration might be increased as crying time lessens which may also indicate a need to assess parental stress.

### Declarations of interest

None.

### CRedit authorship contribution statement

**Amy M. Robertson:** Conceptualization, Methodology, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration.  
**Michael R. Detmer:** Investigation, Writing - review & editing.

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