The effects of vocal music on young infants: mother tongue versus foreign language

by
Jolán Kovács-Mazza

Submitted in partial fulfillment of the requirements for the degree of Master of Arts in Music Education in the Faculty of Graduate Studies and Research of McGill University, Montreal
July, 1996

ISBN 0-612-19901-0

ABSTRACT

The purpose of this study was to investigate whether young infants would differentiate sedative vocal music in their mother tongue versus sedative vocal music in a foreign language. It was hypothesized that if infants did discriminate between the two languages, they would demonstrate a preference for their mother tongue. The responses of ten one- to four-day-old full-term infants were recorded by measuring their sucking rate while presenting lullabies. The infants were randomly and evenly divided into two groups. The first group heard four presentations of the mother tongue version followed by four presentations of the foreign language version. The second group heard the foreign language version of a lullaby followed by the same lullaby sung in the infant's mother tongue. A 5-second interval of silence was spaced between lullabies. The lullaby chosen was *Twinkle Twinkle Little Star.* It was performed by a classically trained soprano, in English, French, Italian, and Russian. Russian was chosen as the foreign language and English, French, and Italian covered the mother tongues for all infants in the study.

Results revealed that infants were not able to detect a difference between the mother tongue version of the lullaby as opposed to the foreign language version. However, the results of the present study may be attributed to an insufficient sample size and to the ineffectiveness of the methodology employed.

SOMMAIRE

Le but de cette étude était d'investiguer si de très jeunes nouveau-nés pouvaient distinguer une berceuse chantée dans leur langue maternelle à l'opposé d'une berceuse chantée dans une langue étrangère. Si les nouveau-nés réussissaient à faire cette distinction, l'hypothèse était qu' ils démontreraient une préférence pour leur langue maternelle. Les réponses de dix nouveau-nés, âgés entre un et quatre jours, furent examinées en mesurant la rapidité du niveau de succion lorsqu'une berceuse leur était présentée. Les dix nouveau-nés ont été divisés au hasard et en deux groupes égaux. Le premier groupe avait entendu en premier, quatre présentations de la berceuse chantée dans la langue maternelle, suivi de quatre présentations de la berceuse chantée dans une langue étrangère. Le deuxième groupe avait entendu la berceuse chantée dans la langue étrangère suivi de la même berceuse chantée dans les langues maternelles de chaque nouveau-né. Un intervalle de 5 secondes de silence etait espacé entre chaque berceuse. La berceuse choisie était *"Ah! vous dirais-je maman"*. Elle était interpretée par une chanteuse de formation classique, en anglais, francais, italien, et russe. Le russe était choisi comme langue étrangère, tandis que l'anglais, le francais et l'italien servaient comme langue maternelle pour tous nouveau-nés dans la présente étude.

Les résultats ont démontré que les nouveau-nés ne pouvaient pas significativement détecter une différence entre la version de la berceuse en langue maternelle et la version en langue étrangère. Cependant, les résultats de la présente étude peuvent être attribués à l'insuffisance du nombre de sujets ainsi qu'à l'inéfficacité de la méthodologie utilisée.

TABLE OF CONTENTS

ABSTRACT	I
SOMMAIRE	II
LIST OF TABLES	IV
ACKNOWLEDGEMENTS	V
INTRODUCTION	1
METHOD	10
RESULTS	14
DISCUSSION	16
REFERENCES	21
APPENDICES	26

LIST OF TABLES

Table 1 Group A and B subjects' average scores

Table 2 Two-way mixed design analysis of variance for infants' sucking responses

Table 3 Table of means for the treatment main effect

ACKNOWLEDGMENTS

I wish to express my gratitude to Professor Joel Wapnick for his critical suggestions and guidance throughout this project. I would also like to thank my brother, Dr. Lajos Kovács, for his time, incredible support, and invaluable advice concerning this research. I extend my deepest appreciation to Lise Pouliot and the entire nursing staff of the Newborn nursery at the Sir Mortimer B. Davis Jewish General Hospital. A special thank-you to singer Deborah Kraus for her participation in this study. Thanks are due to Professor Jan Simons for coaching Deborah on all the languages. I would also like to extend my gratitude to Professor Eugenia Costa-Giomi for translating the original lullaby into Spanish. A special note of thanks to Professor Eleanor Stubley for her invaluable suggestions and constant encouragement. I am also indebted to Professor Patera of the Russian department at McGill University for her work on the Russian translation. My deepest appreciation to my mother for her work on the french version of the lullaby and the correction of the french version of the abstract. All my love and thanks to my father for his wise advice and great encouragement.

Finally, I wish to give special thanks to my husband, Aldo Mazza, not only for his time and effort in composing the Italian version of the lullaby but most of all, for his incredible patience, love, and tremendous understanding. This research could not have been possible without his unending encouragement and inspiration.

INTRODUCTION

Speculation about the fetus' sensitivity to sound and movement is as old as Western civilization (Sundberg, 1979). In Plato's *Laws* for example, the importance of movement is advocated for pregnant women. In fact, one specific law required expectant mothers to "walk about and fashion the embryo within as we fashion wax before it hardens" (Jowett, 1920).

The Bible also speaks of the experience of the child before birth. In the following passage, St. Luke tells of Mary's meeting with Elizabeth, the wife of Zachariah, and explains how the unborn child reacted to the sound of her voice:

> And when Elizabeth heard the greeting of Mary, the babe leaped in her womb; and Elizabeth was filled with the Holy Spirit and she exclaimed with a loud cry, "Blessed are you among women, and blessed is the fruit of your womb! And why is this granted me, that the mother of my Lord should come to me? For behold, when the voice of your greeting came to me ears, the babe in my womb leaped for joy.
>
> (Luke 1:41-44)

Clearly, the relationship of the unborn child to both sound and movement has a rich background both in universal human experience and in historical documents of great cultural importance. Since the advent of ultrasound, representations of the womb in medical literature have also shifted from being viewed as " an impermeable barrier between the fetus and the outside world" to images of the womb as "a penetrable 'window' onto the fetus" (Adams, 1994).

Russian physicians were among the first to do research in physical movements of expectant mothers (Bjorkvold, 1989). In the late 1950's, Klosovskij showed how

movements of both mother and fetus produce changes in the fetus' nervous system that stimulate chemical processes which in turn directly affect the brain's maturation and capacity to function (Klosovskij, 1963). He concluded that "exterior influences play a major role in the development of the child before birth."

The auditory abilities of the developing fetus also have been the object of investigations of both physicians and psychologists alike. In fact, as early as the late 1920's, Peiper (in Forbes & Forbes, 1927) reported that a hand held on the abdomen of a pregnant woman could detect fetal movement in response to the sudden honk of a nearby automobile horn. No less crude methodologically, Forbes and Forbes (1927) also observed that a metal funnel struck on the side of a bathtub provoked a briefly visible rise of the abdominal wall of the pregnant woman as well as her report of sensations of fetal movement. In another study, Sonntag and Wallace (1935) repeatedly applied a 120 cycles per second stimulus to the abdominal wall of seven women in the final 12 weeks of pregnancy and recorded their sensations of fetal movement. They found that fetuses respond to sound beginning in the tenth prenatal week and this response increases as a function of fetal age. This finding was medically explained by Arey (1965) who demonstrated in his investigations that by the later fetal months, anatomical development in the auditory system is largely complete, with middle and inner ear as well as relevant brain stem structures having attained adult dimensions. In fact, recent medical studies have shown that it is even possible to detect minor hearing problems from the thirty-fifth week of gestation (Jensen, 1985). From the sixth month on, fetuses typically respond to sound with increased heart rates (Verny, 1982; Eisenberg, 1976). Moreover, it is not just aurally that sound reaches the fetus; it is also transmitted in the form of vibrations from

the mother's body via the water in the amniotic sac, thus affecting the fetus's entire body (Bjorkvold, 1989). In this way, sound becomes a total body experience for the developing fetus.

A few researchers have studied not only the fetus' reaction to sounds but also their potential for remembering them. There is, in fact, evidence to suggest that the newborn may remember at least the last six months in the womb (Yakovlev, 1962; Axline, 1964; Towbin, 1971; Janov, 1983). Janov, for example, reported that the fetus is a being that responds, reacts to, and remembers its experience. He described these early memories as "birth imprints" and believed that even the birth experience itself can be remembered. In one study for example, a patient of Dr. Janov relived under hypnosis his traumatic birth experience:

> One cannot image what it is like to be squeezed for hours by massive contractions; to be blocked in an unyielding canal or pushed back up the canal by a nurse's hands; to be suffocated by an overdose of anesthetic; to be drowned in viscous fluid; to be fighting for air; to be squeezed by a doctor's metal forceps around the head and yanked out unceremoniously - and then held upside down in a cold room, spanked sharply by a stranger and removed from the only person I really knew.
>
> (Janov, p.14)

This patient went to see Dr. Janov because of a severe, lifelong asthmatic history. After his session, the patient was reportedly relieved to discover that there was in fact a connection between his trauma at birth and his asthma:

> I couldn't breathe at birth and during my life I've had asthma which reproduces the same sensation of not being able to breathe: it kept alive the feeling that I couldn't breathe and reminded me of the trauma I had been through.
>
> (Janov, p.83)

None of us can remember what our births felt like Janov explained because there are chemicals in the brain triggered by pain to eradicate the memory of the trauma However, the chemicals do not rid us of the trauma itself Janov hypothesized that such experiences are instead engraved as imprints in the developing nervous system of the fetus, and he believed that these birth imprints may determine a person's physiological and neurological response tendencies and personality Regardless of Janov's claims which apply to adult recall, the possibility that newborns may remember emotions and physical sensations from their birth experience suggests that they also are capable of recalling sounds heard while in the womb

Studies on the aural memory capacity of the fetus have demonstrated that between the twenty-eight and the thirty-second weeks of gestation, the fetus' nervous system reaches a stage of development virtually identical to that of a newborn child The brain stem also matures rapidly during this time. Neurologically, therefore, everything is in place for the fetus to store sounds in its long-term memory. In fact, both Verny (1982) and De Casper (1980) have shown that the fetus is able to remember sounds from the eighth month, if not earlier. For example, De Casper (1980) carried out several experiments which showed that "within the first three days of postnatal development, newborns prefer the human voice, discriminate between speakers, and demonstrate a preference for their mothers' voice with only limited maternal exposure." These findings led him to suggest that sound preferences after birth are influenced by what is heard prenatally. To test this hypothesis, De Casper and Spence (1982) asked sixteen pregnant women to read a poem to their respective fetuses from a well-known children's book by Dr. Seuss, *The Cat in the*

Hat (Seuss, 1957):

> The sun did not shine,
> It was too wet to play.
>
> So we sat in the house
> All the cold, cold, wet day.

The women were instructed to read the whole poem aloud twice a day during the last six and a half weeks of their pregnancies. De Casper and Spence estimated that by the time of their birth, each of these fetuses were exposed to the poem for about five hours.

After the children were born, the researchers employed an established sucking test known as the *High Amplitude Sucking Technique* (HAS). The HAS technique was believed by De Casper and Spence to be the most reliable operant measure available for testing infants under four months of age. Newborns wore headphones, and nipples were placed in their mouths. If the baby sucked in one rhythm, it would hear a tape of its mother reading *The Cat in the Hat*; if it sucked in another, it would hear its mother reading Nancy and Eric Gurney's, *The King, the Mice, and the Cheese* (1965). The rhythm of this poem was altogether different and there were no rhymes:

> Once upon a time,
> In a faraway country,
> There lived a king ...

Results revealed that the newborns rarely chose to hear the latter poem. They preferred the poem from their prenatal environment. It might be argued however, that perhaps the first poem was simply more attractive to these infants because of the hypnotic regularity in rhyme and rhythm of the poem itself. De Casper and Spence

(1986) therefore altered the phonetic character, rhymes, and rhythms of the poems, and were able to confirm that newborns were still able to pick out the poem their mothers had read to them in the womb. They were even able to do this whether or not the poem was read by the mother or another person reciting the story.

Another question that has been studied is whether the fetus is able to "understand" differing emotional meanings in its mother's voice (Verny, 1982; Kuhl, 1985). Changes in the mother's emotional state have been shown to produce changes in her biochemistry, her movements, and her tone of voice. Thurman, Chase, and Langness (1987), for example, indicated that the fetus receives various types of biochemical imprints such as endorphins (hormones present when the mother is in the state of well-being) and that these biochemical imprints can be triggered by a variety of events, including song.

Mehler et al. (1988) demonstrated how familiarity played an important role in the capacity of young infants to distinguished utterances from two different languages. They designed and conducted an extensive series of studies with four-day-old French infants to see if the infants could distinguish between their mother tongue and a foreign language. In one such experiment, a fluent French-Russian speaker recorded an oral account of some events in her life, once in French and once in Russian. Fifteen different sound samples with durations from 13 to 22 seconds were selected for each language. A test sequence was then prepared by randomly ordering the utterances and interspersing a 5-second silent interval between successive samples. Ten infants of French speaking mothers were assigned randomly to each of four test conditions. Two of these were no language change control conditions: one consisted exclusively of Russian samples and

the other of French samples. For the other two groups, infants heard French samples during the first phase of the test period, followed by Russian samples in the second phase, or they heard Russian samples first, followed by the French samples. As in the De Casper and Spence (1986) study, the HAS technique was employed to measure sucking rate. Results revealed that four-day-old infants discriminated between the two languages by sucking at significantly higher rates for French than for Russian samples.

Although these results suggest that newborns can in fact discriminate between their mother tongue and a foreign language, Mehler and his research team wondered if newborns could discriminate between utterances from two foreign languages. In a subsequent study (1989), a speaker who spoke Italian and American English fluently was recorded. Ten infants were assigned randomly to each of two experimental groups, English-Italian and Italian-English. Eight subjects were randomly assigned to one of two control groups, English-English and Italian-Italian. Results revealed that French infants gave no evidence of discriminating English from Italian utterances. Hence in light of the previous experiment, the ability to discriminate utterances from two languages appeared to depend upon greater familiarity with one of the two languages.

It may be that the child's language training starts long before the moment of birth. Moreover, it is in the most literal sense a *mother tongue* that the fetus begins to learn, for it is above all the mother's voice that reaches the unborn child. However, there are many ways in which languages differ with respect to their sound structure. For example, language may differ in their phonetic segments (Garnica, 1973). They also may differ in their prosodic characteristics such as their rhythms or stress patterns (Waterson,

1971). Did the infants then simply respond on the basis of certain characteristics such as the intonational contours and the rhythm of a specific language? Furthermore, the mother tongue that the child begins to acquire in the womb can be considered at root a musical mother tongue as well, for it is the musical qualities of the mother's voice - the tone, the rhythm, the tempo, the dynamics - that acquire meaning for the fetus, not the meanings of the words that she happens to be using. It is, in fact, the mother's voice - in speech, song and laughter - with which the fetus became familiar during the months in the womb. This familiarity gives continuity in the transition from fetus to newborn. Therefore, if the stimuli were to be manipulated in such a way as to replace the intonational contours and accents of speech into musical pitch contours and accents, would the sound and rhythm of an infant's familiar native language still be distinguishable? As already mentioned, there is sufficient evidence to suggest that the fetus hears sounds long before birth. Research on the fetus' response to musical sounds however, is scant. Butterfield and Siperstein (1972) for example, found that neonates of 1-2 days of age exhibited a strong preference for vocal music over instrumental music. Furthermore, other studies have shown that both neonates and older infants (2 months of age) respond better to sedative music than to stimulative music (Tims, 1978; Lepage and Dufresne, in press). However, only the barest beginnings have been made in research studies relating prenatal to postnatal musical experience.

Purpose of the study:

The present study attempted to extend the findings of Mehler et al. (1988) by investigating whether infants could differentiate between their native language and a foreign language if the languages were sung instead of spoken. It was also hypothesized that young infants would demonstrate a preference for sedative, vocal music in their mother tongue versus such music in a foreign language. This hypothesis was inferred from past research of the Affective Domain Taxonomy Continuum (Krathwohl, Bloom, and Masia,1964), in which the first three abilities - receiving, responding, and valuing - have been shown to occur in early infancy (Tim, 1978; Michel, 1973; Simons, 1986).

METHOD

Subjects:

Subjects were ten one- to four-day-old full-term infants, between 37-41 weeks of gestation, born at the Sir Mortimer B.Davis Jewish General Hospital in Montreal. Only those infants that were exclusively formula fed, weighed at least 2500g, and had no obvious hearing deficits were selected. Two infants were excluded from the study for persistent crying and for falling asleep while feeding. Infants suffering from jaundice requiring phototherapy also were excluded.

Preparation of Experimental Tapes:

A SONY digital audiotape master was prepared from repeated performances of a lullaby, *"Twinkle, Twinkle Little Star"*. The recording was engineered by a graduate student enrolled in the Sound Recording Program at McGill University. An AKG C12 BR microphone, a Sony MXP 3000 mixer, and a Panasonic RDAT 3700 Dat recorder was used to record the performances.

Two copies from the master tape were made on a KABA Realtime Professional Duplicating System, using high-quality Maxell XLII audiotapes. On these audiotapes, a test sequence was created by ordering two versions of the same lullaby. One version was the lullaby sung in the mother tongue of the infant, and the other version was the lullaby sung in a foreign language. Each version was repeated four times, with 5-second intervals of silence-spaced between successive examples. The same sequence of versions

was then recorded twice to produce the final test tapes for each language. Side "A" of each test tape consisted of the recorded lullaby sung first in the mother tongue four times followed by four repetitions of the lullaby sung in the foreign language. Side "B" of each test tape consisted of the recorded lullaby sung first in the foreign language followed by the mother tongue. The lullaby was performed in English, French, Italian, and Russian by a classically trained soprano. The mother tongues for all infants in the study were either English, French or Italian. Russian was chosen as the foreign language. Each version of the lullaby was sung at the same tempo, and in the same tonality.

The High Amplitude Sucking Technique:

The methodology used in this study employed a modification of the High Amplitude Sucking Technique (HAS). The usual HAS procedure is an operant non-nutritive methodology. Non-nutritive sucking occurs in the first hours of postnatal life, even before the first feeding (Kessen, Leutzendorff, & Stoutsenberger, 1967). The HAS has been shown to be a reliable measure of the frequency of an infant's suck (Kaye, 1967; Kessen, 1967). With this procedure, infants learn that sucking strongly on a plastic nipple will result in the presentation of sound. At first, the rate of high amplitude sucking increases as the infant learns the contingency. It then decreases over time as the novelty of the stimulus declines. Changing the auditory stimulus usually results in an increased rate of sucking, provided that the baby notices the change. However, a few studies have reported methodological weaknesses with this procedure. For example, Ferland (1987) reported that non-nutritive sucking generated insufficient interest on the part of the

infants even when a novel auditory stimulus was used as reinforcement. Therefore, he suggested developing an alternative technique in which the reinforcing and discriminative stimuli would be independent from each other. Thus unlike previous studies involving non-nutritive HAS, (Butterfield and Siperstein, 1972; Eimas et al., 1971; Morse, 1972b; Siperstein, 1973; Trehub and Rabinovitch, 1972; Trehub, 1973; De Casper & Spence, 1986; Mehler et al., 1988), infants' sucking was recorded in the present study *as* they were being bottle fed. In this way, the reinforcement employed (feeding) was independent of the discriminative stimuli (musical excerpts).

Apparatus:

Sterile gloves and scissors were used to make a small hole in the nipple of a 4-oz baby bottle. A feeding tube was then inserted through this hole and into a prepared bottle of infant formula. The end of the feeding tube was connected to a Statham physiological pressure transducer machine (Model P23AA). The transducer fed into a direct current preamplifier of a Grass polygraph (Model 79) which provided a graphic record of the frequency of the infants' sucking. An RP-7824 SONY tape recorder, a Scott 417A stereo amplifier and a Braun L 620 loudspeaker were used to provide the auditory output.

Procedure:

A protocol of the study was approved by the Sir Mortimer B. Davis Jewish General Hospital's Ethics Committee (see Appendix A) and by the Quebec Minister of

Health (see Appendix B). Thereafter, a list of new births was obtained on a daily basis from the records of the hospital. From this list, medical information on each subject was solicited by speaking with the subject's nurse and by verifying mothers' medical charts. Mothers of the infants who met the established criteria for inclusion in the experiment were approached by the investigator for their consent (See Appendix C for the consent form). If either the mother or father read and signed the consent form, this form was then placed in the baby's medical chart and testing began.

Subjects were randomly and evenly assigned to one of two test groups. One group heard the mother tongue version of the lullaby four times, followed by the same lullaby sung four times in a foreign language. For subjects in the other group, the foreign language version of the lullaby were played first, followed by the mother tongue examples. Each subject thus listened to eight examples altogether. There was a 5-second interval of silence between examples.

During testing, infants were held with their heads in the crook of their mothers' or fathers' right arms, in a semi-reclining position and facing a loudspeaker. All testing took place inside the Newborn Laboratory of the Sir Mortimer B. Davis Jewish General Hospital.

RESULTS

The dependent measure consisted of the average number of recorded sucks per second. The means for mother tongue, foreign language, and silence between lullabies were examined for Group A (the lullaby sung in the infant's mother tongue followed by the foreign language version) and Group B (the lullaby sung in the foreign language followed by the mother tongue version).

Group A and B results:

Descriptive data for both groups are shown in Table 1. A two-way mixed design analysis of variance was performed in order to compare each of the subjects' scores with each of the three treatments.

Table 1

Descriptive data for Groups A and B

Group	**Mother Tongue**	**Silence**	**Foreign Language**
A	1.1	1.06	1.01
A	1.13	0.97	1.01
A	1.14	1.03	1.31
A	1.17	1.02	1.19
A	1.03	0.82	0.96
B	0.99	0.98	1.11
B	1.73	1.26	1.32
B	1.33	1.26	0.99
B	0.67	1.11	1.02
B	0.92	0.89	1.16

Results revealed a P value greater than 0.05 for both the order main effect (Group A versus Group B) and the order by treatment interaction (see Table 2). Since no significant results were found, post tests were therefore not calculated.

No differences were found between mother tongue, silence, and foreign language treatments ($F = .946$, $p > 0.05$). Although infants exhibited a greater frequency in sucking when the lullaby was sung in their mother tongue as opposed to silence or to the foreign language version (see Table 3), the treatment main effect was not significant. Once again, post tests were not calculated.

Table 2

A two-way mixed design analysis of variance of infants' sucking responses

Source of Variation	df	Sum of Squares	Mean Square	F	P	Epsilon Correction
o	1	.017	.017	.233	.6425	
Error	8	.578	.072			
t	2	.046	.023	.946	.4089	
ot	2	.012	.006	.249	.7825	
Error	16	.391	.024			.79

Table 3

Table of means for treatment main effect

t 1 (Mother tongue)	1.1210
t 2 (Silence)	1.0320
t 3 (Foreign Language)	1.1080

DISCUSSION

This study investigated whether one- to four-day-old full-term infants could discriminate between a lullaby sung in their mother tongue and a lullaby sung in a foreign language. Half of the infants listened to *Twinkle, Twinkle Little Star* sung first in their native language four times (either English, French, or Italian) followed by another version of the same lullaby sung in a foreign language four times (Russian). The other half heard the foreign language version followed by the mother tongue version. A five-second interval of silence was spaced between excerpts. The frequency of each infant's suck was recorded and measured as they were being fed infant formula.

Limitations of the experiment:

Before discussing the present results, two main limitations of the experiment - the insufficient sample size obtained and the ineffectiveness of the methodology employed - should first be taken into consideration.

Firstly, to meet the established criteria of selection for the present study, infants were required to be exclusively formula fed, weigh at least 2500g, have a gestational age of 37 weeks or more, have no obvious hearing deficits, and have no traces of jaundice requiring phototherapy treatment. Given that at the Jewish General Hospital 4000 term newborns are delivered per year, and that about 30% of these infants are exclusively bottle-fed, it

was thus estimated by the investigator and the members of the ethics committee that even if only 20% of these infants successfully met the established criteria, the estimated duration of recruitment and testing would be not more than two months. Unfortunately in the two month period allotted by the ethics committee for the running of the present study, only ten full-term infants met the established criteria. Consequently, this study should be considered as a pilot study, and its findings suggestive for attempts at future research.

Secondly, although the HAS technique had been previously found to be highly reliable in the testing of infants under four months of age (Jusczyk, 1985; Polka, Jusczyk, and Rvachew, in press), the modification of the HAS as a nutritional sucking technique, instead of the original non-nutritional technique, was found to be completely ineffective. In fact, infants in the present study were observed to fall asleep shortly after taking in the required amount of infant formula (this would occur after approximately the sixth example of the study). Once their hunger was satisfied, they no longer showed any signs of interest for the presented stimuli and did not suck at all. It is thus reasonable to conclude that the modification of the HAS as a nutritional technique was not any more successful in generating sufficient interest on the part of the infants than the non-nutritional technique.

Discrimination hypothesis and suggested explanations of the present findings:

Although infants sucked more frequently when they heard music sung in their mother

tongue as opposed to the silence or the foreign language treatments, the P value obtained for the treatment main effect was greater than 0.05 and therefore was considered not significant. Furthermore, no significant results were found for either the order main effect (Group A versus Group B) or the order by treatment interaction

The present results unfortunately failed to replicate the findings of recent medical studies. Burk et al. (1995) and Kaminiski and Hall (1996) both reported, for example, that infants demonstrated a significant preference for an environment stimulated by sound rather than one of silence. Playing music to newborns also had a very soothing effect. Furthermore, music was suspected to be responsible for therapeutic benefits such as weight gain in premature infants. However, due to the difficulty in recruiting subjects in the present experiment, it is possible that a larger sample size would yield the present findings significant.

Since the findings in Mehler et al.'s (1988) study indicated that the ability of newborns to distinguish utterances from two different languages occurred only when they were familiar with one of the languages, it would seem logical to wonder if the foreign language and silence conditions were not recognized in the present study because neither conditions were familiar prenatal experiences to the infants. This possible explanation does not explain, however, why infants failed to discriminate between their native language and the foreign one, and why this study failed to replicate the findings of previous studies. For example, Gould and Marler (1987) concluded from their experiment that infants of only a few days of age possess "an innately guided learning process which enables them to detect characteristic features of their native language."

Furthermore, they explained that this innate ability was similar to the well-known abilities of many bird species that fixate on certain physical characteristics in identifying members of their own species (Marler and Peters, 1977). Perhaps the infants in this study were not able to discriminate between the characteristic features of their familiar native tongue and those of a foreign language because both languages were set in an identical musical context, thus creating too much information to absorb and therefore making the task far too complex. However, other studies contradict such a possibility. For example, evidence of gestalt processing of auditory information has been reported in young infants (Chang and Trehub, 1977; Cohen, Thorpe and Trehub, 1987). In these studies, infants were shown to have the ability to encode subtle differences in intonational changes, while still retaining the knowledge of the basic structure of the music presented. Clearly, these contradictory findings merit further investigation.

Conclusion and suggestions for further research:

In conclusion, the present experiment suggested that one- to four-day-old infants are not capable of discriminating music sung in their mother tongue versus silence and versus a foreign language.

As noted earlier, the primary difficulty with the nutritional HAS technique was that infants would fall asleep shortly after the fifth musical example. Therefore the analysis of the present data was difficult to interpret because by the sixth example, interspersed periods of inactivity (the investigator noted that infants were asleep and no longer

sucking) were recorded on the polygraph tracings. Perhaps investigators of subsequent studies using the nutritional HAS technique should consider the amount or time it took for the infants in the present study to fall asleep (approximately two minutes and 30 seconds, or after they had taken in one and a half ounces of infant formula), and make sure that the stimuli presented to infants never exceed this amount. Furthermore, it is important to note that the stimuli presented to infants in the present study consisted of sedative vocal music in the form of a lullaby. It is possible that this kind of music may have contributed to the infants increasingly drowsy state.

Finally, as mentioned earlier, previous studies in speech pathology (Mehler et al., 1988) have demonstrated that infants have the ability to distinguish between their mother tongue and a foreign language. Mehler et al. attributed this ability to the influence of the infants' prenatal experiences. Further investigation could disclose whether more infants would demonstrate this ability if during their prenatal experience their mothers would sing regularly to them.

REFERENCES

Adams, A.E. (1994). **Reproducing the Womb: Images of Childbirth in Science, Feminist Theory, and Literature.** London: Cornell University Press.

Arey, L. B.(1965). **Developmental Anatomy.** Philadelphia: Saunders.

Axline, V. (1964). **Dibs: In Search of Self.** New York: Ballantine Books.

Bjorkvold, J. (1992). **The Muse Within: Creativity and Communication, Song and Play from Childhood through Maturity.** New York: Harper Collins.

Burke, M., Walsh, J., Oehler, J., Gingras, J. (1995). Music therapy following suctioning: four case studies. **Neonatal Network, 14.**

Butterfield, E.C., and Siperstein, G.N. (1972). Influence of contingent auditory stimulation upon nonnutritional suckle. In J. Bosma (Ed.), **Oral Sensation and Perception: The Mouth of the Infant,** Springfield, IL: Charles C.Thomas, 313-333.

Chang, H., and Trehub, S.E. (1977). Auditory processing of relational information by young infants. **Journal of Experimental Child Psychology, 24 ,** 324-333.

Cohen, A.J., Thorpe, L.A., and Trehub, S.E. (1987). Infants' perception of musical relations in short transposed tone sequences. **Canadian Journal of Psychology, 41,** 33-47.

De Casper, A. J. (1980). Of human bonding: newborns prefer their mothers' voices. **Science, 208.**

De Casper, A.J., and Spence, M.J. (1986). Prenatal maternal speech influences: newborns' perception of speech sounds. **Infant Behaviour and Development, 9,** Norwood, New Jersey.

Eimas, P.D., Siqueland, E.R., Jusczyk, K.P., & Vigorito, J. (1971). Speech perception in infants. **Science, 171**, 303-306.

Eisenberg, R.B. (1976). **Auditory Competence in Early Life: The Roots of Communicative Behaviour.** Baltimore, MD: University Park Press.

Ferland, M.B. (1987). Infants' categorization of melodic contour. Unpublished doctoral dissertation. Montreal, Quebec: McGill University.

Forbes, H.S., and Forbes, H.B. (1927). Fetal sense reaction: hearing. **Journal of Comparative Psychology, 7,** 353-355.

Garnica, O. (1973). The development of phonemic speech perception. In Moore T. (ed.), **Cognitive Development and the Acquisition of Language.** New York: Academic Press, 215-222.

Gould, J.L., and Marler, P. (1987). Learning by instinct. **Scientific American, 256.**

Gurney, N., and E. (1965). **The King, the Mice, and the Cheese.** New York: Dover.

Janov, A. (1983). **Imprints: The Lifelong Effects of the Birth Experience.** New York: Coward-McCann, Inc.

Jensen, O. H., and Flottorp, G. (1985). **The Effect of Controlled Sound Stimuli on the Heart Rate of Human Fetuses.** Unpublished research paper, University of Oslo.

Jowett, B. (1920). **Plato: Laws.** London: Butterworths.

Jusczyk, P.W. (1985). On characterizing the development of speech perception. In J. Mehler and R. Fox (Eds.) **Neonate cognition: Beyond the blooming buzzing confusion** (pp. 199-229). Hillsdale, N.J: Erlbaum.

Kaminski, J., Hall, W. (1996). The effect of soothing music on neonatal behavioral states in the hospital newborn nursery. **Neonatal Network, 15.**

Kaye, H. (1967). Infant sucking behaviour and its modification. In L.P. Lipsitt and C.L. Spiker (Eds.), **Advances in Child Development and Behaviour, Vol.3.** New York: Academic Press, 1-52.

Kessen, W. (1967). Sucking and looking: Two organized congenital patterns of behaviour in the human newborn. In H.W. Stevenson, E.H. Hess, and H.L. Rheingold (Eds.), **Early Behaviour: Comparative and Developmental Approaches.** New York: John Wiley and Sons, 147-179.

Kessen, W., Leutzendorff, A.M., & Stoutsenberger, K. (1967). Age, food deprivation, non-nutritive sucking, and movement in the human newborn. **Journal of Comparative and Physiological Psychology, 63**, 82-86.

Klosovskij, B.N. (1963). **The Development of the Brain and Its Disturbance by Harmful Factors.** New York: New York University Press.

Krathwohl, D., Bloom, B., and Masia, B. (1964). **Taxonomy of Educational Objectives.** New York: David Mackay Co.

Kuhl, P.K. (1985). Categorization of speech by infants. In J. Mehler & R. Fox (Eds.), **Infant cognition: Beyond the Blooming, Buzzing Confusion.** Hillsdale, N.J:

Erlbaum.

Lepage, L., and Dufresne, J. (in press.) **Les effets apaisants de la musique chez les prematures et les petits poids.**

Marler, P., and Peters, S. (1977). Selective vocal learning in a sparrow. **Science, 198.**

Mehler, J., Jusczyk, P., Lambertz, G., Halsted, N., Bertonicini, J., & Amiel-Tison, C. (1988). A precursor of language acquisition in young infants. **Cognition, 29,** 143-178.

Michel, P. (1973). The optimum development of musical abilities in the infant years of life. **Psychology of Music, 1, (2),** 14-20.

Morse, P.A. (1972 b). The discrimination of speech and nonspeech stimuli in early infancy. **Journal of Experimental Child Psychology, 14,** 477-492.

Polka, L., Jusczyk, P., and Rvachew, S. (in press). Methods for studying speech perception in infants and children.

Seuss, Dr. (1957). **The Cat in the Hat.** Boston: Houghton Mifflin.

Simons, G. (1986). Early childhood musical development: A survey of selected research. **Council for Research in Music Education, 86,** 36-52.

Siperstein, G.N. (1973). Differential modification of neonatal behaviour. Paper presented at meetings of the Society for Research in Child Development, Philadelphia.

Sontag, L.W., and Wallace, R.F. (1935). The movement response of the human fetus to sound stimuli. **Child Development, 6,** 253-258.

Sundberg, O.K. (1979). Musiske perspektiver i Platons dialog Lovene. **Studia**

Musicologica Noregica, 5, 187-192.

Thurman, L., Chase, M., and Langness, A.P. (1987). Reaching the young child through music: Is pre-natal and infant music education possible? In Jack Dobbs, ed., **International Music Education, ISME Yearbook, 14,** 433-463.

Tims, F.C. (1978). Contrasting music conditions, visual attending behaviour, and state in eight-week-old infants. Doctoral Dissertation, The University of Kansas. Critiqued by A. Gabrielson (1981) in **Bulletin of the Council for Research in Music Education, 66,** 164-168.

Towbin, A. (1971). Organic causes of minimal brain dysfunction. **Journal of the American Medical Association, 217,** 1213.

Trehub, S. (1973). Auditory linguistic sensitivity in infants. Unpublished doctoral dissertation, Montreal: Quebec, McGill University.

Trehub, S., and Rabinovitch, M.S. (1972). Auditory-linguistic sensitivity in early infancy. **Developmental Psychology, 6,** 74-77.

Verny, T. (1982). **The Secret Life of the Unborn Child,** London: Oxford University Press.

Waterson, N. (1971). Child phonology: A prosodic view. **Journal of Linguistics, 7,** 179-211.

Yakovlev, P.I. (1962). Morphological criteria of growth and maturation of the nervous system in Man. **Journal of Mental Retardation, 39,** 1567.

*APPENDIX A * Letter of Approval from the Ethics Committee**

*APPENDIX B * Letter of Approval from the Quebec Minister of Health**

*APPENDIX C * Consent Form **

Department of Neonatology, The SMBD-Jewish General Hospital

CONSENT FOR THE LULLABY STUDY

Principal investigators: Ms. Jolán Kovács, McGill University
Dr. Lajos Kovács, Jewish General Hospital

Music has been shown to have soothing effects and even therapeutic benefits in an infant's life. The hospital environment may be noisy, unfamiliar and even stressful for your new baby. We are now studying the possibly calming and soothing effects of music during feeding time at the hospital.

The feeding will consist of milk in a standard baby bottle administered by you, the mother, to your child. Your baby will be in the comfort of your arms, and as you are feeding your baby, both you and your child will listen to the music of a lullaby sung in two different languages. The music will be played at a reasonable sound level (no louder than how you would be singing to your own child) which will be transmitted over a set of speakers. The two different languages will be the mother tongue of your baby or the language in which you speak to your child, and a foreign language which will be unfamiliar to your child. We will examine if your child reacts differently when listening to the language he/she is familiar with, as opposed to the unfamiliar language. We are specifically looking at the possible changes in the way your baby sucks as he/she listens to the music. For this purpose, a small machine that measures how fast your baby is sucking will be attached to the bottle you are feeding your child. Please be assured that this machine will not come into contact with your baby.

Only the investigators will be present with you during your feeding time as it is important to keep the setting of our study as calm, relaxed, and natural as possible. The lullaby music will be very short and your child will take in no more than 2 ounces of milk during the course of the study. The experiment will be stopped at your request and/or if Dr. Kovacs or any qualified hospital staff member should feel it is necessary.

Should you have any further questions about the study, please feel free to contact the investigators at any time, by calling Dr. Kovács at 340-8232, or Ms. Jolán Kovács at 646-7216. Any further concerns may be addressed to the patient representative, Mrs. Roslyn Davidson, at 340-8222 local 5833.

I, the undersigned, give informed consent to the enrollment of my baby in this study. I understand that I have the right at any time to withdraw my child's participation in the study, and that my decision would not affect the quality of his/her care. I also understand that all information obtained about my baby will be kept strictly confidential, and that any published results will guarantee his/her anonymity.

Date: _____

Signature:_____ Relation to patient: _____

Witness:_____

Mother Tongue:_____

Other Languages Spoken at Home:_____