The Importance of Prenatal Sound and Music

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Full Text: INTRODUCTION Music has profoundly affected human beings physically, mentally, emotionally and spiritually invirtually every culture throughout history. Yet only in this century has music begun to attract scientific attention. The research at the University of California at Irvine has provided some information about the effect of Mozart on the spatial and mathematical intelligence of children. Recently, an article in the Los Angeles Times (11/9/98) reported neurobiological research which indicates that "undeniably, there is a biology of music." Music is destined to play a more active role in the future of medicine. The following ideas illustrate how music affects our early development. The importance of prenatal music was born in my own awareness over twenty years ago when I was expecting my youngest son. The doctor thought it would be dangerous for me to participate in something very active because the baby was was due that week, and since he was a second child stastically might arrive early, if not on time. Through my communication with the baby telepathically and his subsequent delay in arrival, I was able to attend a music conference that was very important to me. My son was born the day after I attended this stimulating week of singing and gentle movement. Already at that time I observed that lullabies were relegated to the past. Young mothers no longer knew this folk song tradition. Michel Odent, M.D., believes that women have a profound need to sing to their babies but that the medicalization of birth has upset this process. In the past, women all over the world have sung lullabies to their babies. These were very important because as we now know the fetus is having first language lessons in the womb. The inflections of the mother tongue are conveyed not only through speech but most importantly through song. The singing voice has a richer frequency range than speech. In fact, studies in other disciplines such as linguistics and musicology (e.g., David Whitwell, 1993) point out that there was a time when speech was song and therefore singing is the older of the two. Babies born to deaf mothers miss these important first lessons in language development. French pioneer Dr. Alfred Tomatis mentions being intrigued by the fact that song birds hatched by silent foster mothers can't sing. What the baby learns in utero are the intonational patterns of sound and the frequencies of a language in his/her particular culture. Frequency is the level of pitch measured in Hertz (Hz.) This range varies between 16 to 20,000 Hz. There is very little distortion of the mother's voice as heard by the fetus whereas other external voices sound more muffled, especially in the higher frequencies. According to Rubel (1984), the fetus is responsive first to lower frequencies and then to higher ones. Verny and others have noted that babies have a preference for stories, rhymes, and poems first heard in the womb. When the mother reads out loud, the sound is received by her baby in part via bone conduction. Dr. Henry Truby, Emeritus Professor of Pediatrics and Linguistics at the University of Miami, points out that after the sixth month, the fetus moves in rhythm to the mother's speech and that spectrographs of the first cry of an abortus at 28 weeks could be matched with his mother's. The elements of music, namely tonal pitch, timbre, intensity and rhythm, are also elements used in speaking a language. For this reason, music prepares the ear, body and brain to listen to, integrate and produce language sounds. Music can thus be considered a pre-linguistic language which is nourishing and stimulating to the whole human being, affecting body, emotions, intellect, and developing an internal sense of beauty, sustaining and awakening the qualities in us that are wordless and otherwise inexpressible. The research of Polverini-Rey (1992) seems to indicate that prenates exposed to lullabies in utero were calmed by the stimulus. The famous British violinist Yehudi Menuhin believes that his own musical talent was partly due to the fact that his parents were always singing and playing music before he was born. THE SOUND ENVIRONMENT OF THE WOMB The sound environment of the womb is very rich. There are

various interpretations as to the noise level, ranging between 30 to 96 dB. I (decibel being a measure of sound intensity or loudness). A whisper can register 30 dB., a normal conversation is about 60 dB. and rush hour traffic can average about 70 dB. On the other hand, shouted conversations and motorcycles reach about 100 dB. Rock music has been measured as 115 dB. and the pain threshold begins at 125 dB. Yet, recent research with hydrophones have revealed that the womb is a "relatively quiet place" (Deliege and Sloboda, 1996), something comparable to what we experience in our environment between 50 and 60 dB. Uterine sounds form a "sound carpet" over which the mother's voice in particular appears very distinct and which the prenate gives special attention because it is so different from its own amniotic environment. These sounds are of major importance because they establishes the first patterns of communication and bonding. Some researchers have discovered that newborns become calmer and more self-regulated when exposed to intrauterine sound (Murooka, et al., 1976; DeCasper, 1983; Rossner, 1979). The soothing sounds of the ocean and water are probably reminiscent of the fluid environment in which we began life. Tomatis suggests that the maternal heart beat, respiration and intestinal gurgling, all form the source for our collective attraction to the sound of surf and may have to do with our inborn sense of rhythm. Prenatal sounds form an important developmental component in prenatal life because they provide a foundation for later learning and behavior. With fetal sound stimulation the brain functions at a higher level of organization. The ear first appears in the third week of gestation and it becomes functional by the 16th week. The fetus begins active listening by the 24th week. We know from ultrasound observations that the fetus hears and responds to a sound pulse starting about 16 weeks of age (Shahidullah &Hepper, 1992), even before the ear construction is complete. The cochlear structures of the ear appear to function by the 20th week and mature synapses have been found between the 24th and 28th weeks (Pujol, et al., 1991). For this reason most formal programs of prenatal stimulation are usually designed to begin during the third trimester. The sense of hearing is probably the most developed of all the senses before birth. Four-month-old fetuses can respond in very specific ways to sound; if exposed to loud music their heart beat will accelerate. A Japanese study of pregnant women living near the Osaka airport had smaller babies and an inflated incidence of prematurity-arguably related to the environment of incessant loud noise. Chronic noise can also be associated with birth defects (Szmeja, et al., 1979). I recently received a report from a mother who was in her seventh month of pregnancy when she visited the zoo. In the lion's enclosure, the animals were in process of being fed. The roar of one lion would set off another lion and the sound was so intense she had to leave the scene as the fetus reacted with a strong kick and left her feeling ill. Many years later, when the child was seven years of age, it was found that he had a hearing deficiency in the lower-middle range. This child also reacts with fear when viewing TV programs of lions and related animals. There are numerous reports about mothers having to leave war movies and concerts because the auditory stimulus caused the fetus to become hyperactive. Alfred Tomatis notes that the ear is "the Rome of the body" because almost all cranial nerves lead to it and therefore it is considered our most primary sense organ. Embryonically, according to him, the skin is differentiated ear, and we listen with our whole body. In order to better understand the role of music in its elements of rhythm and melody, we must briefly clarify the two parts of the inner ear. These are the vestibular system and the cochlea. The vestibular system controls balance and body movements, including the integration of movements which make up the rhythm of music-making the vestibular system the more archaic. And according to Paul Madaule (1984) "it is in fact because of the vestibular system that music seems to have an impact on the body." At around four to six weeks gestational age the vestibular and the cochlear systems become differentiated, at seven the auditory ossicles start to grow, and at four months the ear of the fetus is already adult-like in shape and size. The cochlear system enables the transformation of acoustic vibrations into nervous influx, thus allowing the perception of melodies which carry higher frequencies. Knowing this, one can have a better understanding of the intimate relationship and unity of rhythm and melody. George Gershwin expressed this nicely: "Music sets up a certain vibration which unquestionably results in a physical reaction." With this in mind, we should choose for early music stimulation melodies and rhythms that are simple. Tomatis

has a unique view of the function of the human ear going beyond what is traditionally assumed. He regards it as neither an instrument solely for hearing and listening, nor an organ for the maintenance of equilibrium and verticality. For him the ear is primarily a generator of energy for the brain, intended to give a cortical charge which is then distributed throughout the body "with the view to toning up the whole system and imparting greater dynamism to the human being" (Gilmor and Madaule, 1984, p. 6). Hence the importance of right sound stimulation which will lead to vocal expression, listening, and thinking. Sound, music and human development are intricately interwoven. Clearly, the vestibular system progresses rapidly as seen by the active movement of the fetus in utero. As early as the first trimester, regular exercise patterns have been observed with ultra-sound: rolling, flexing, turning, etc. (Van Dongen &Goudie, 1980). The movements appear as graceful somersaults, flexing of the back and neck, turning the head, waving arms, kicking legs-all self initiated and expressive in nature. When the baby moves in utero, the heartbeat accelerates. DeMause (1982) summarizes reactions of the second trimester as follows: "The fetus now floats peacefully, kicks, turns, sighs, grabs its umbilicus, gets excited at sudden noises, calms down when the mother talks quietly, and gets rocked back to sleep as she walks I about." The fetal heart is fully developed by the second trimester and its pulse rate oscillates between 120 to 160 beats per minute. Some think the distinctive rhythm of the mother's heart beat in utero is the basis and our attraction to drumming, rock rhythms, and the African tribal beat. Salk (1960), Murooka (1976), and De Casper (1983) provided evidence that newborns learned and remembered their mother's heart beat in utero. Ashley Montagu (1962) suggested that the universal appeal of music and the soothing effect of rhythmical sounds may be related to the feeling of well being assumed to exist in utero in relation to the mother's heartbeat. Salk (1960) showed that newborns in hospitals listening to heartbeat sounds gained weight at a faster rate. Likewise, breathing was deeper and more regular among these babies. According to W. Ernest Freud "rhythm itself provides a most reassuring 'cradle' because of its promise of repetition and continuity." SOUND AND LEARNING IN UTERO The powerful connection between sound/music and prenatal memory/learning have been revealed in formal experiments, parental observations, clinical records, and first person reports. Chamberlain (1998) using Howard Gardner's concept of multiple intelligences, has presented evidence for musical intelligence before birth. Peter Hepper (1991) discovered that prenates exposed to TV soap opera music during pregnancy responded with focused and rapt attention to this music after birth-evidence of long-term memory. On hearing the music after birth, these newborns had a significant decrease in heart rate and movements, and shifted into a more alert state. Likewise, Shetler (1989) reported that 33% of fetal subjects in his study demonstrated contrasting reactions to tempo variations between faster and slower selections of music. This may be the earliest and most primitive musical response in utero. The pioneering New Zealand fetologist, William Liley, found that from at least 25 weeks on, the unborn child would jump in rhythm with the timpanist's contribution to an orchestral performance. The research of Michele Clements (1977) in a London maternity hospital found that four to five month fetuses were soothed by Vivaldi and Mozart but disturbed by loud passages of Beethoven, Brahms and Rock. Newborns have shown a preference for a melody their mother sang in utero rather than a new song sung by their mother (Satt, 1987). Babies during the third trimester in utero respond to vibroacoustic as well as air-coupled acoustic sounds, indicative of functional hearing. A study by Gelman, et al. (1982) determined that a 2000 Hz. stimulus elicited a significant increase in fetal movements, a finding which supported the earlier study by Johnsson, et al. (1964). From 26 weeks to term, fetuses have shown fetal heart accelerations in response to vibroacoustic stimuli. Consistent startle responses to vibroacoustic stimuli were also recorded during this period of development. Behavioral reactions included arm movements, leg extensions, and head aversions (Birnholz and Benacerraf, 1983). Yawning activity was observed after the conclusion of stimuli. Research by Luz, et al. (1980 and 1985) has found that the normal fetus responds to external acoustic stimulation during labor in childbirth. These included startle responses to the onset of a brief stimulus. New evidence of cognitive development in the prenatal era is presented by William Sallenbach (1998) who made in-depth and systematic observations of his own daughter's behavior from weeks

32 to 34 in utero. Until recently, most research on early learning processes has been in the area of habituation (Querleu, et al., 1981), conditioning (Van de Carr, 1988) or imprinting sequences (Salk, 1962). However, Sallenbach observed that in the last trimester of pregnancy, the prenate's learning state shows movement from abstraction and generalization to one of increased specificity and differentiation. During a bonding session using music, the prenate was observed moving her hands gently. In a special musical arrangement, where dissonance was included, the subject's reactions were more rhythmic with rolling movements. Similarly, in prenatal music classes, Sister Lorna Zemke has found that the fetus will respond rhythmically to rhythms tapped on the mother's belly. From what research is telling us, we may presume that prenates would prefer to hear lullabies sung by their mothers, or selected slow passages of Baroque music such as Vivaldi, Telemann, and Handel which have a tempo resembling our own heart beat at rest. Recent research has shown that four month old infants demonstrate an innate preference for music that is consonant rather than dissonant (Zentner and Kagan, 1998). However, this allows great latitude in the selection of music which babies and their mothers might like to hear. Our ultimate objective, of course is to help create not a musical genius but a person well integrated in his physical, emotional, intellectual and spiritual self. References REFERENCES Campbell, Don. (1997). The Mozart Effect, New York: Avon Books. Chamberlain, David B. (1994). The sentient prenate: What every parent should know. Pre- and Perinatal Psychology Journal, 9(1), 9-31. Chamberlain, David B. (1998). Prenatal receptivity and intelligence. Journal of Prenatal and Perinatal Psychology and Health, 12(3 and 4), 95-117. Clements, Michele (1977). Observations on certain aspects of neonatal behavior in response to auditory stimuli. Paper presented to the 5th Internat. Congress of Psychosomatic Obstetrics and Gynecology, Rome. DeCasper, A. and Sigafoos. (1983). The intrauterine heartbeat: A potent reinforcer for newborns. Infant Behavior and Development, 6, 19-25. DeCasper, A. and Spence. (1986). Prenatal maternal speech influences newborns' perception of speech sounds. Infant Behavior and Development, 9, 133-150. Deliege, Irene and Sloboda, John (Eds.). (1996). Musical Beginnings, Oxford University Press. Gilmor, Timothy M. and Madaule, Paul P. (1984). The Tomatis Anthology. Toronto: The Listening Centre. Odent, Michel. (1984). Birth Reborn. New York: Pantheon Books. Shahidullah, Sara and Hepper, Peter. (1992). Hearing in the fetus: Prenatal detection of deafness. Int. J. Prenatal and Perinatal Studies, 4(3 and 4), 235-240. Shetler, Donald J. (1989). The inquiry into prenatal musical experience: A report of the Eastman Project 1980-1987. Pre- and Peri-Natal Psychology Journal, 3(3), 171-189. Whitwell, David. (1993). Music As A Language: A New Philosophy Of Music Education. Northridge, CA: Winds. Woodward, Sheila C. (1992). The Transmission Of Music Into The Human Uterus And The Response To Music Of The Human Fetus And Neonate (Doctoral Thesis, Dept. of Music Education, University of Cape Town, South Africa. Zentner, Marcel R. and Kagan, Jerome. (1998). Infant's perception of consonance and dissonance in music. Infant Behavior and Development, 21(3), 483-492. FOR STUDY IN GREATER DEPTH Birnholz, J. C. and Benacerraf, B. B. (1983). The development of the human fetal hearing. Science, 222, 516-18. DeCasper, A. J. and Sigafoos, A. D. (1983). The intrauterine heartbeat: A potent reinforcer for newborns. Infant Behavior and Development, 6, 19-25. deMause, L. (1982). Foundations of psychohistory. New York: Creative Roots. Gelman, S. R., Wood, S., Spellacy, W. N. and Abrams, R. M. (1982). Fetal movements ; in response to sound stimulation. American J. of Obstetrics and Gynecology, 143, 484-485. Hepper, P. G. (1991). An examination of fetal learning before and after birth. The Irish Journal of Psychology, 12(2), 95-107. Johansson, B., Wedenberg, E., and Westin, B. (1964). Measurement of tone response by : the human fetus. A preliminary report. Acta Otolaryngologica, 57, 188-192. Luz, N. P., Lima, C. P., Luz, D. H., &Feldens, V. L. (1980). Auditory evoked responses of the human fetus. I. Behavior during progress of labor. Acta Obstetrica Gynecologica Scandinavica, 59, 395-404. Luz, N. P. (1985). Auditory evoked responses in the human fetus. II. Modifications i observed during labor. Acta Obstetrica Gynecologica Scandinavica, 64, 213-22. Montagu, A. (1962). Prenatal influences. Springfield, IL: Charles Thomas. Murooka H., Koie Y., &Suda N. (1976). Analyse des sons intra-uterins et leurs effets tranquil-lisants sur le nouveau. Journal of Gynecology and Obstetrics: Biologie de la Reproduction, 5, 367-376. Polverini-Rey, R. A. (1992). Intrauterine musical learning:

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