

Prenatal Auditory Learning, Technique of Enrichment and Outcome

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Abstract: The auditory enrichment program was instructed to 24 Thai pregnant women. The designed program consisted of applying the prenatal auditory music and communication with the unborn child by giving parent voice, singing or telling the story, 20-minute periods per day from 20 week gestational age until birth.

The enriched infants can recognize, response and memory, to the previous prenatal music and maternal voice, they can vocalize, turn to voice, call mama, imitate sound very earlier when compare to sample norms of Bangkok children. They also showed early parent-infant interaction and a good emotional growth. They smile spontaneously very earlier, calm down and be sleepy when previous prenatal music were played back.

These data suggest that the designed auditory enrichment program not only can significantly promote the auditory potential, development and faster learning process, but also enhance the better emotional growth and bonding.

Zusammenfassung: *Förderung vorgeburtlichen Hörens.* Ein akustisches Förderungsprogramm wurde bei 24 thailändischen schwangeren Frauen durchgeführt. Das Programm bestand in der Vermittlung von Musik und Stimme an das ungeborene Kind, indem die Eltern mit dem Kind sprachen, sangen oder eine Geschichte erzählten, und zwar täglich über 20 Minuten von der 20. Schwangerschaftswoche bis zur Geburt.

Die in dieser Weise geförderten Kinder konnten die vorgeburtlich vermittelte Musik und die mütterliche Stimme nach der Geburt erkennen, beantworten und erinnern. Im Vergleich zu anderen Kindern waren sie in ihrer lautlichen Entwicklung weiter, konnten sich früher Stimmen zuwenden, früher Mama sagen und ebenso früher Laute nachahmen. Ebenso zeigten sie eine intensivere Eltern-Kind-Interaktion und ein gutes emotionales Wachstum. Sie lächeln früher, beruhigen sich rascher und wurden schläfrig, wenn sie die vor der Geburt gehörte Musik vorgespielt bekamen.

Diese Ergebnisse lassen vermuten, daß dieses akustische Förderungsprogramm nicht nur in signifikanter Weise das Potential, die Entwicklung und die Lernprozesse beim Hören fördert, sondern ebenso das emotionale Wachstum und die Bindungsfähigkeit.

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Introduction

It has been accepted that fetus can perceive and react to the sound stimuli. Many researchs showed that fetus has the auditory ability of memory, discrimination or even learning. Genetic and nutrition are the key factors that create fetal auditory anatomical system, but another important factor that stimulate the auditory system to function is the intrauterine acoustic environment which consist of maternal cardiovascular sound, sound from body movement, digestive sound and maternal voice. These intrauterine auditory environment will enhance the auditory system until it work and response.

Naturally, the fetal auditory nerve pathway are formed and increase percentage of response by increasing gestational age. 7% response between 20–22 week gestational age, 22% response at 24–26, week gestational age, 89% response at 26–28 week gestational age, and 100% response at 30–32 week gestational age (Gagnon et al., 1987). They response to the acoustic outside stimuli by rising heart rate, changing in fetal EEG brain, startle response or moving response to the stimuli.

Many studies demonstrate that fetus has an ability in auditory memory and discrimination, the fetus can recognize maternal voice by turning toward his maternal sound immediately after birth (Panthuraamphorn, 1990). De Casper (1980) determined that the neonate can discriminate between a story which had been repeatedly read during the pregnancy and another which had not been previously presented. Murooka et al. (1976), Rosner and Doherty (1979), Lind (1980) reported that fetus can response and have a calming effect when fetus heard maternal heart beat sound. This suggest that fetus not only can percept but also can memory to the prenatal auditory experience.

Moreover, the study from spelt indicated that human fetus can be conditioned experimentally during the last two or three months of pregnancy. Conditioning of response to acoustic sound has even been determined in the fetus. Fetal movement response to the loud noise and lack of response to a vibration were determined. Thereafter, the noise and vibration were presented simultaneously, following this, the activation of the vibrator alone elicited movement response.

With the basic concept that external sound environment either negative or positiv stimuli may effect fetus' physical, emotional and intelligent development, we practise our designed auditory enrichment program for the unborn child in order to investigate that

1. Whether the fetus can response or react to the outside sound stimuli.
2. Does the fetus really have the ability in auditory learning and memory.
3. May the auditory enrichment program effect on physical growth.
4. May the auditory enrichment program effect on fetus' auditory potential and development both expressive and receptive capacity.
5. Does the program influence on fetal emotion.
6. Could the program promote the parent-infant and parent-parent interaction.

Material and Method

Subject

The auditory enrichment program was provided to 24 Thai pregnant women. They were trained to practise the program started from 20 week gestational age until birth. The maternal characteristics and obstetrics factors are shown in Table 1.

Table 1. Sample characteristics

	Enriched group (N = 24) Mean ± S.D.	Control group (N = 24) Mean ± S.D.	T	P
Maternal age	32.1 ± 3.4	28.6 ± 3.4	2.9	0.006 (S)
Gravid	1.4 ± 0.7	1.4 ± 0.6	0.0	1 (NS)
Educability*	1.3 ± 0.5	1.5 ± 0.5	0.9	0.37 (NS)
Economic status**	1.6 ± 0.5	1.4 ± 0.5	1.2	0.23 (NS)
Amniotic fluid***	1.1 ± 0.3	1.3 ± 0.5	0.9	0.37 (NS)
Term/Preterm****	1.1 ± 0.3	1.1 ± 0.3	0.4	0.72 (NS)

* 1 = graduate 2 = under graduate

** 1 = > 2.5000 B 2 = < 2.5000 B

*** 1 = clear 2 = meconium

**** 1 = term 2 = preterm

Procedure

Enriched infants received auditory enrichment program in the evening for 20-minute periods each day from 20 week gestational age until birth. The 20-minute environmental session consisted of

1. Stimulation from prenatal tape which recorded parental voice, baby's name, a loving phrase and the light music. The prenatal tape was played back through maternal abdominal wall to the fetus. The optimal time for starting auditory stimulation is 20 week gestational age which the auditory nerve pathway has formed and response. We recommend to play this tape in the evening which the baby is more alert and response, or play it one hour after meal which baby more alert and active as the glucose are already sent to the fetus' brain, or whenever the fetus move, it mean that the fetus is ready to begin the activity. The sound level is adjusted at 90 dB in order that fetus can hear at 70 dB sound level which similar to the intrauterine sound level that they have heard everyday in the womb.

2. The infant phone or rolling newspaper is also used to communicate with their unborn children by talking, singing lullaby or telling the story.

Measure

Clinical data recorded from the evaluation charts included maternal age, gravid, educability, economic status, colour of amniotic fluid, date of birth, obstetric and postnatal complication. The questionnaire for evaluation of fetal response to sound was collected. When the fetus move arms, bend the eye brows, blink eye or eye move toward the sound origin, these indicate that fetal show response to the sound

stimuli. The fetus feels sleepy or calm down when heard the previous music or sound indicate their capacity of sound memory. We also describe their response in the term of never, seldom, sometime, frequent and always response. Never, seldom, indicate no response, sometime, frequent, always indicate response.

Physical growth especially the head circumference was measured by pediatrician who does not know whose fetus was participated the program. Auditory potential and development in expressive and receptive capacity were detected by using Denver developmental test in the area of vocalization, turning to voice, calling mama and imitation speech sound. The date of ability to smile spontaneously were recorded by their mothers. The effect of prenatal music on fetal emotion and the parent-infant, parent-parent interaction were also evaluated.

Result

From the Table 1, the characteristics and obstetric factors of enriched group. Are no significant difference from the control group except maternal age. This is to show that 24 enriched pregnant women are the general population found in Bangkok.

As shown in Table 2, the fetus can response to music 87.5% and maternal voice 91.7%. They also have an ability of auditory memory in prenatal music in the percentage of 91.7%, in maternal voice 100% and in heart sound 95.9%.

The head circumference of enriched group are no significant difference when compare to the head circumference of sample norms of Bangkok children as shown in Table 3.

However, the data in Fig. 1 showed the comparison of infant auditory potential and development between the enriched infants and 1000 sample norms of Bangkok children which collected by faculty of medicine, Mahidol University. Enriched infants can vocalize at 0.6 month of age, turn to voice at 0.26 month of age, call mama, non specific at 5 month of age and imitate speech sounds at 5 month of age in average while the Bangkok children can vocalize, turn to voice, call mama, no specific and imitate speech sound at 0.8, 3.2, 9.8 and 9.3 of age in average.

These suggest that the enriched infants have a very significantly in auditory potential and development than the sample norms of Bangkok children.

The enriched infants showed a good emotional development. They can smile spontaneously at 0.3 month of age in average while the Bangkok children smile at 1.8 month of age. This suggest that enriched infants can smile spontaneously very earlier and calm down, be sleepy when the previous prenatal music was played back after birth (Fig. 2a,b)

The data in Fig. 3 suggested that maternal relationship to her child and husband were increased significantly after participated the auditory enrichment program.

Discussion

These data from Table 2 suggest that the human fetus can hear, react and learn the outside sound stimuli during in utero, they showed the response to music and maternal voice significantly by blinking eyes, bending eye brows, move arms and

Table 2. Percentage of fetal response and memory to auditory stimuli.

	Percentage of response and memory (N = 24)					Total response
	No Response and Memory		Response / Memory			
	never	seldom	sometimes	frequent	always	
Response to music	0	12.5	29.1	33.3	25	87.5
Music memory	0	8.3	29.1	25	37.5	91.7
Response to voice	0	8.3	25	41.6	25	91.7
Voice memory	0	0	4.1	41.6	54.1	100
Heart sound memory	0	4.1	29.1	41.6	29.1	95.9

Table 3. Head circumference of enriched group compare to sample norms of Bangkok children

	Enriched group Mean \pm S.D.	Sample norms Mean \pm S.D.
Male		
Birth	33.6 \pm 1.4	33.7 \pm 1.3
1 Month	36.2 \pm 1.0	37.9 \pm 2.7
2 Month	38.4 \pm 0.8	39.0 \pm 1.8
4 Month	41.6 \pm 0.7	41.3 \pm 1.4
6 Month	43.6 \pm 1.0	43 \pm 1.6
Female		
Birth	33.7 \pm 1.1	33.4 \pm 1.3
1 Month	36.2 \pm 1.6	37.2 \pm 1.4
2 Month	38.5 \pm 1.1	38.5 \pm 1.3
4 Month	40.7 \pm 1.3	40.9 \pm 2.0
6 Month	42.7 \pm 1.2	42.3 \pm 1.8

some can even turn to voice. Moreover, enriched infants will calm down and feel sleepy when heard their maternal heart sound or previous prenatal music. This is to demonstrate that fetus has an ability in auditory memory and learning. Furthermore, the prenatal auditory experience can influence postnatal perception and behaviour.

Although we believe that prenatal auditory enrichment may stimulate auditory brain cell and increase density of dendrite, but in the enriched group showed no greater head circumference than the sample norms of Bangkok children. This could be due to the only one type of stimulation may not enough to effect the brain size as well as the multimodal stimulation of our previous report. However, the auditory potential and development of these enriched infants showed significantly in better capacity than sample norms of Bangkok children. The enriched group demonstrated early expressive capacity in vocalization, calling mama, imitation speech sound and also showed highly significant in receptive capacity in turning

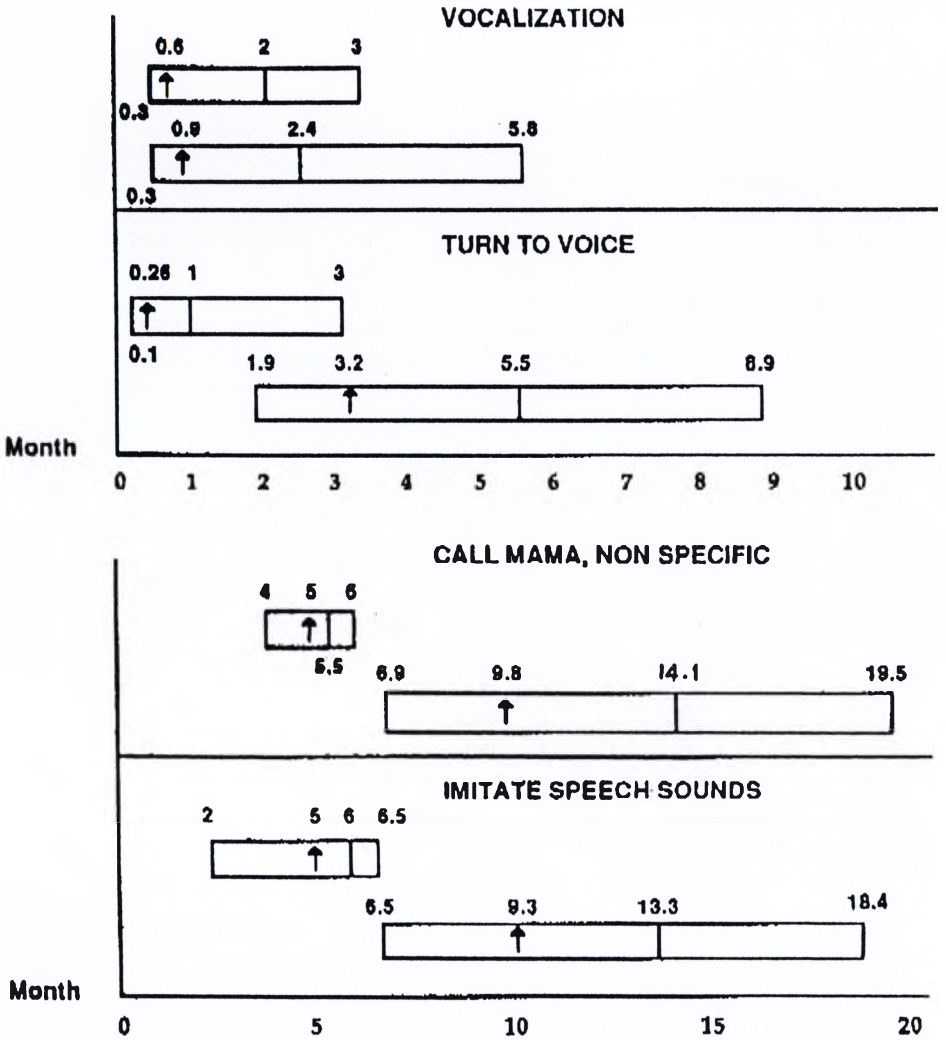


Fig. 1. Auditory potential and development compare to sample norms of Bangkok children.

to voice very earlier than the sample norms. These could possibly be a result of prenatal stimulation music and maternal voice that can stimulate auditory system to give more function and also aid language development. These significant data suggest that we can maximize the human auditory potential, and learning ability even in utero and enriched infants will get faster learning process and higher development as shown in Fig. 1.

In addition, the enriched infants appear smile spontaneously very earlier than sample norms of Bangkok children as well as appear the calming down effect when heard the previous prenatal music. This suggest that fetus can learn and memory to the music and maternal voice. Also, the sound enrichment effect can actually enhance fetus to have a good emotional development.

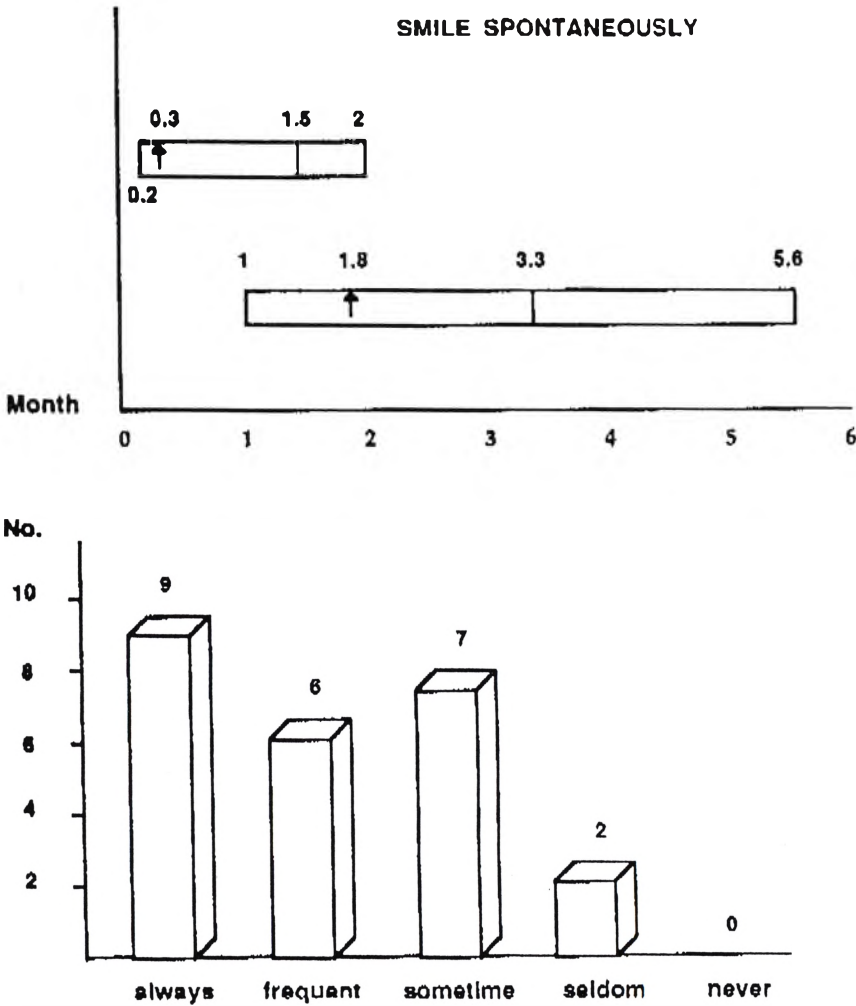


Fig. 2a,b. (a) The influence of auditory enrichment on fetal emotion. (b) Fetal emotional response to prenatal music.

The data from Fig. 3 suggest our believe that the communication with unborn child during pregnancy may improve mother-child bonding and attachment. The data showed better performance in relation between mother and child after participated the program and this interaction and bonding may effect the later development both in physical and emotional grownt. The better relationship to her husband also showed in Fig. 3.

In conclusion, from our study we can demonstrate that fetus can really learn, response and memory to the outside sound stimuli and a positive stimuli as our prenatal auditory enrichment program not only can significantly promote the auditory potential, development and faster learning process, but also enhance the better emotional growth and bonding.

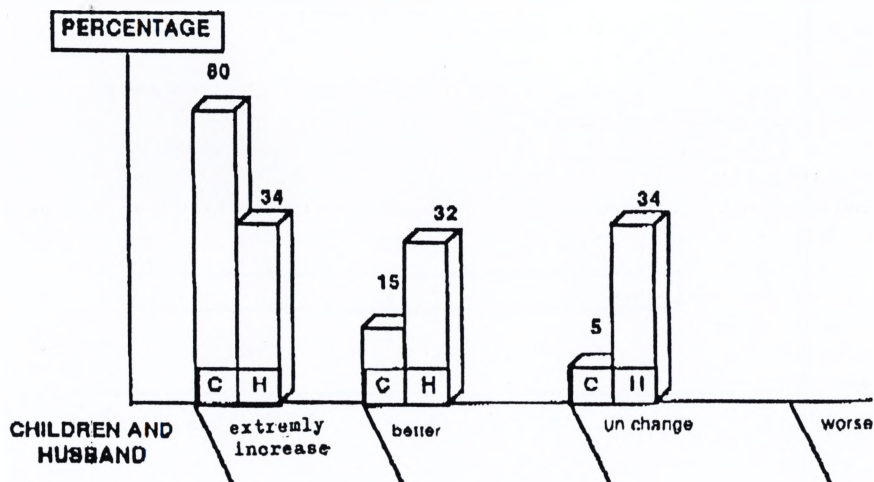


Fig. 3. The relationship to their children and husband after participated the program.

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