

The Outcome of Fetal Response and Learning to Prenatal Stimuli

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Abstract: To study the fetal response to outside stimuli and assess the capacity of fetus' memory and learning in various senses. The 120 pregnant mothers who attend prenatal enrichment unit in Hua Chiew Hospital were trained to practise the prenatal activity through out pregnancy. The activities consist of auditory, tactile and vestibular stimuli in various techniques. The clinical data and the evaluation sheet for analysis of fetal response and learning to prenatal activity were assessed in term of always, frequent, sometime, seldom and never response.

The outcome of these samples demonstrated that 87.5% of experimental infants can recognize maternal voice and 70% recognize to prenatal music. They calm down significantly when giving a prenatal music, heart beat sound, rhythmic patting and rocking pattern which they ever received during in utero. This suggests that fetus can learn variety of sensory stimuli even before birth and these previous experiences they received in utero may influence postnatal learning and perception. Experimental infants have a capacity of turning to voice only at 4.6 days in average while the general population turn to voice at 3.2 month. This means that they have a faster auditory development and learning than general population. In addition, they can be conditioned by kicking back when they were pat in 64.9%. The results confirm our belief that fetus have a capacity of conditional learning. The study also showed better performance in relation between mother and child after participated the prenatal activity. These findings suggest that prenatal activity here may be introduced to routine prenatal care and may be an effective way to enhance mother and child attachment, as well as promote infant's intelligent and emotional development.

Zusammenfassung: *Die Bedeutung von Antworten und Lernen des Ungeborenen auf pränatale Reize.* Die Studie untersucht die Antwort des Kindes vor der Geburt auf äußere Reize und bewertet die Fähigkeit des Kindes vor der Geburt, Gedächtnisinhalte zu bilden und in verschiedenen Sinnesbereichen zu lernen. Die 120 schwangeren Mütter, die an der Pränatalen Förderung am Hua Chiew Krankenhaus teilnahmen, wurden dazu angehalten, während der ganzen Schwangerschaft sich dem Kind aktiv zuzuwenden. Diese Zuwendungen bestehen in Stimulierungen des Hörsinnes, des Berührungsempfindens und Gleichgewichtssinns mit verschiedenen Techniken. Die klinischen Befunde und die Auswertungsblätter für das

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fötale Verhalten und Lernen als Reaktion auf die pränatalen Zuwendungsaktivitäten wurden nach den Bewertungskategorien immer, häufig, gelegentlich, selten und keine Reaktion eingeteilt.

Das Ergebnis dieser Untersuchungen zeigt, daß 87,5% der untersuchten Kinder die mütterliche Stimme erkennen können und 70% erkennen pränatal gehörte Musik. Sie beruhigen sich in signifikanter Weise, wenn sie pränatal gehörte Musik hören oder Herzschlaggeräusche, rhythmische Berührungen und Schaukelmuster hören, wie sie ihnen aus der Zeit im Uterus vertraut sind. Dies läßt die Vermutung zu, daß das vorgeburtliche Kind über verschiedene Sinnesreize vor der Geburt lernen kann, und daß diese Erfahrungen, die sie im Uterus machten, ihr späteres nachgeburtliches Lernen und ihre nachgeburtliche Wahrnehmung beeinflussen können. Die untersuchten Kinder haben im Mittel schon nach 4,6 Tagen die Fähigkeit, sich der Stimme zuzuwenden, während dies bei der übrigen Population erst nach 3,2 Monaten möglich ist. Das bedeutet, daß die untersuchten Kinder eine schnellere Entwicklung im Bereich des Hörens und Lernens machen als andere Kinder. Bei 64,9% war es möglich, ein Zurückstoßen bei äußerer Berührung zu konditionieren. Diese Ergebnisse bestätigen unsere Annahme, daß das Kind vor der Geburt die Fähigkeit zu konditioniertem Lernen hat. Die Untersuchung zeigte auch ein besseres Beziehungsverhalten zwischen Mutter und Kind bei den Kindern, die die vorgeburtlichen Zuwendungen erhalten hatten. Diese Ergebnisse legen die Annahme nahe, daß vorgeburtliche Zuwendungen in die normale Geburtsvorbereitung eingeführt werden sollten und ein effektives Mittel sein könnten, um die Mutter-Kind-Bindung zu fördern, wie ebenso die Entwicklung der kindlichen Intelligenz und Emotionalität.

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Introduction

Newborns have been shown to respond to their environment from the first day of postnatal life. They can see, feel, hear and even recognize their mother's voice. How and when does a baby learn these things? Several researches indicate that the learning may begin before birth.

Hooker observed responses to tactile stimulation in human fetuses at the end of the 7th week gestational age, his stroking the lip of fetus with a light hair caused a reflex response. Elliott and Elliott report that the labyrinths acquire adult morphology and size during the 5th month gestational age. By 6 month the auditory apparatus is structurally mature, and fetus would be expected to respond to auditory stimuli. Also, some studies indicated that human fetus can be conditioned experimentally during the last two or three months of pregnancy.

However, Most of the reports about prenatal learning focus on the fetal capacity of auditory learning more than the ability of other senses, while the basic scientific knowledge shows that the fetus develops in all sense during in utero. So, our purpose is to investigate that:

1. Can the unborn child really learn during in utero, can they learn and respond to tactile stimuli, vestibular stimuli as well as auditory stimuli?
2. Can human fetus recognize the previous experience during pregnancy and may the previous experience exert potent effect on postnatal learning and perception?
3. Does the human fetus have a capacity of conditional learning?

Material and Method

Subject

The sample consisted of 120 infants whose mothers were applied the prenatal activity through out the pregnancy period. The maternal characteristics are shown in Table 1.

Table 1. Sample characteristics

Maternal age		Gravid	
Range	Percentage	Range	Percentage
21–25 year	13.9	1	64.5
26–30 year	37.6	2	19.4
31–35 year	38.7	3	6.4
36–40 year	6.5	4	1.1
40 up	3.2	Unknown	8.6

Income		Educability	
Bath per month	Percentage	Grade	Percentage
10,000	6.5	Undergraduate	29.8
10,000–20,000	24.7	Graduate	70.2
20,000–30,000	16.1		
30,000 up	31.2		
Unknown	21.5		

120 pregnant women were trained to practise the prenatal activity through out pregnancy. Type of prenatal activity and duration of practice are shown in Table 2.

Table 2. Prenatal activity

Type of activity	Duration
1. Prenatal communication between mother and child by talking though infant phone	10 minute aday, start from 20 week gestational age till birth
2. Prenatal music	10 minute aday, start from 20 week gestational age till birth
3. Prenatal rhythmic patting on fetus’ bottom	10 minute aday, start from 24 week gestational age till birth
4. Prenatal rocking using rocking chair	15 minute aday start from first trimester till birth
5. Prenatal patting on abdomen when fetus moves	Occasionally, start from 28 week gestational age till birth

Table 3. The frequency of practice

Frequency	Type of prenatal activity		
	Auditory	Tactile	Vestibular
Everyday	15.1%	27.3%	22.7%
5–6 / week	31.8%	36.4%	12.1%
3–4 / week	36.4%	27.3%	27.3%
1–2 / week	16.6%	9.1%	21.3%
No practice	–	–	16.7%
3–4 Up / week	83.3%	90.9%	62.1%

Also, the frequency of practice the prenatal activity were recorded in term of practice everyday, 5–6 day in a week, 3–4 day in a week, 1–2 day in a week or no practice.

Measurement

When the fetus moves arms, bends the eye brow, blinks eye or eye moves toward the stimuli, these indicate that fetus shows positive response to the stimuli. The fetus feels sleepy or calms down when received the previous stimuli indicates fetus' capacity of memory and learning. The evaluation sheet for analysis of fetal response and learning to prenatal activity were collected in term of always, frequent, sometime, seldom and never response (only always and frequent response indicate that fetal can really response).

The evaluation sheets are corresponding to our purpose:

1. Can fetus learn variety of senses in utero? Fetuses will be evaluated that whether they can recognize the maternal voice, prenatal music, rocking and patting pattern.
2. May the prenatal experience influence the postnatal learning and perception?
The clinical data was recorded that:
How many days that infant can turn head to maternal voice.
While the baby is crying, we will apply the prenatal music, heart beat sound, rhythmic patting pattern and rocking pattern and test whether each activity will calm down the infant or not.
3. Does fetus have a capacity of conditional learning?
The experimental pregnant woman will pat her abdomens everytime when fetus moves for a period of eight weeks, start from 28 week gestational age till 36 week. After that, during fetus awakes. Pat back to abdomen in order to see whether fetus will move in response or not. We recorded the number of response in term of percentage.

Result

From Table 3, we found that the prenatal auditory activity was practised more than 3–4 / week in 83.3%, rhythmic patting 90.9% and 62.1% for vestibular activity.

Number and percentage of response

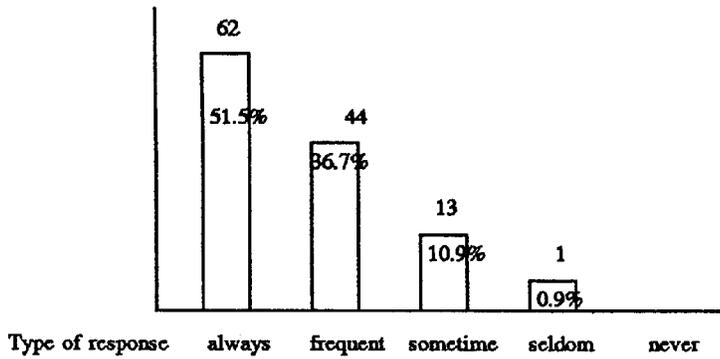


Fig. 1. Recognition to maternal voice.

Number and percentage of response

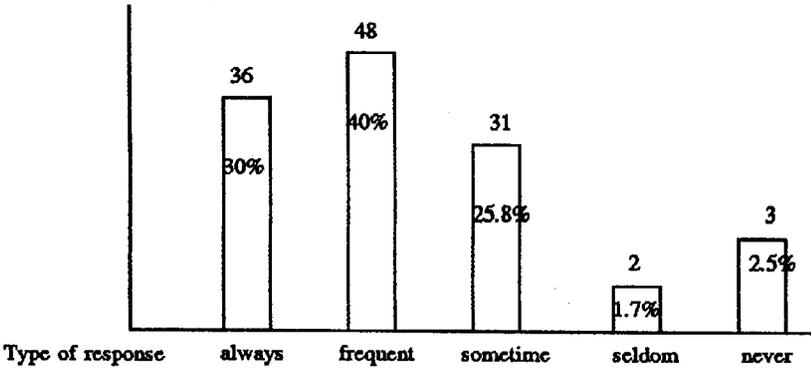


Fig. 2. Recognition to prenatal music.

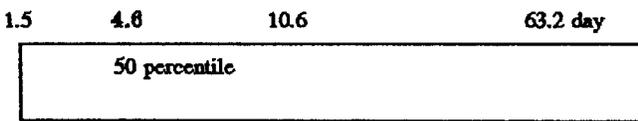


Fig. 3. The ability of turning to maternal voice.

The fetus' recognition in Fig. 1 showed that 51.5% of the infants always recognize thier maternal voice and 36.7% recognize frequently. 30% of the infants always recognize thier prenatal music and 40% recognize frequently (Fig. 2).

In Fig. 3, the experimental infants can recognize and turn to voice at 4.6 day of age in average while the Bangkok children can turn to voice at 3.2 month of age.

In order to test the ability of learning previous experience during in utero, we found in Figs. 4-7 that:

1. 27.5% of the infants always feel sleepy or calm down when they heard the pre-natal music, 42.5% calm down frequently. (Fig. 4 – total response 27.5 + 42.5 = 70%)

Number and percentage of response

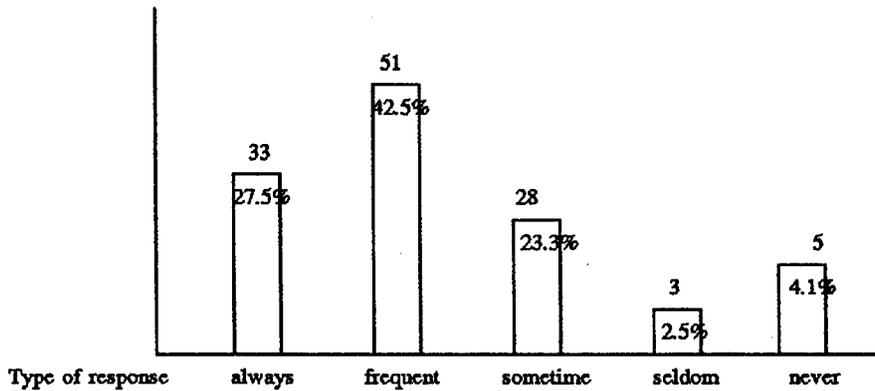


Fig. 4. Calming effect on previous prenatal music.

Number and percentage of response

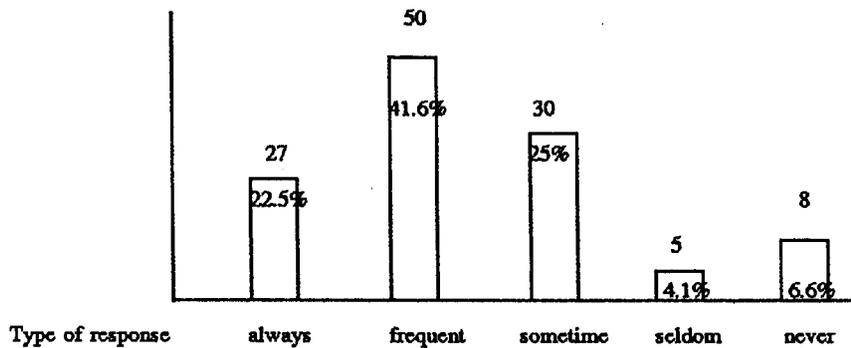


Fig. 5. Calming effect on heart beat sound.

- 22.5% of the infants always feel sleepy or calm down when they heard the heart beat sound, 41.6% calm down frequently. (Fig. 5 – total response 22.5 + 41.6 = 64.1%)
- When the experimental infants was crying, the rhythmic patting pattern will be performed and we found that infants take 2.1 minute in average to stop crying, while the 100 control infants stopped crying with the same patting pattern in 4.6 minutes. (Fig. 6)
- 32.5% of experimental infants always calm down after giving the previous rocking pattern. 29.1% response frequently. (Fig. 7 – total response 32.5 + 29.1 = 61.6%)

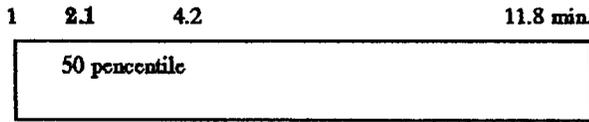


Fig. 6. Duration in response to rhythmic patting.

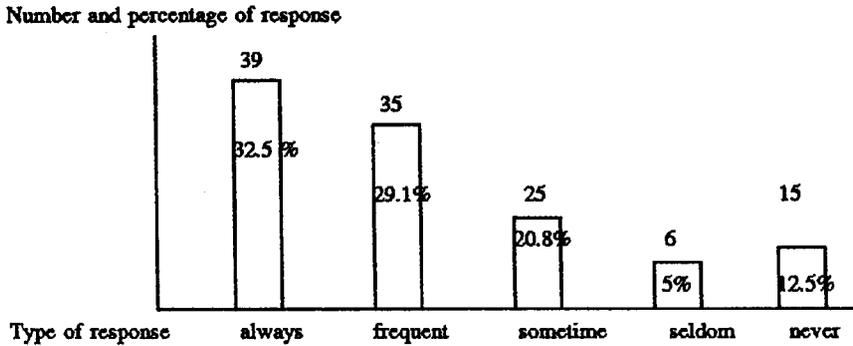


Fig. 7. Calming effect on rocking chair.

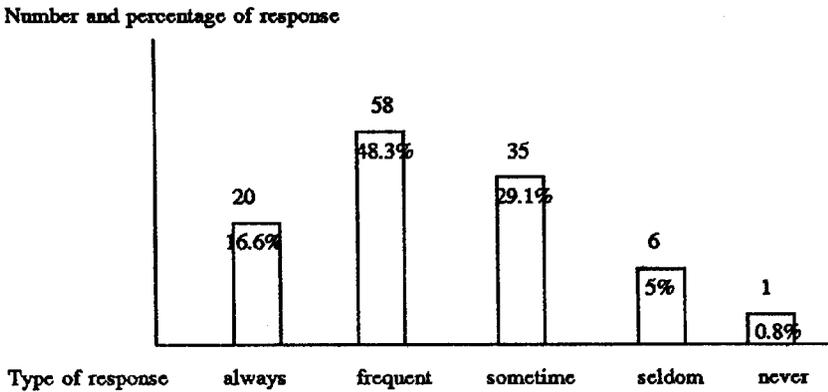


Fig. 8. Kick back response. (Conditional learning)

The finding in Fig. 8 suggested that the experimental infants have a capacity of conditional learning. 16.6% of them always kick back in response, 48.3% kick back frequently. (Total response 16.6 + 48.3 = 64.9%)

Discussion

Our previous study in 1994 on recognition to maternal voice and prenatal music of 24 experimental infants showed that 91.7% recognize to maternal voice and 87.5% recognize to prenatal music. But the findings on Figs. 1 and 2 in this paper indicate that 88.2% recognize maternal voice and 70% recognize to prenatal music. Because of the large amount of samples in this paper convince our belief that fetus can really perceive and learn during in utero. These result are also consistent with the studies of De Casper and Fifer (1980) that 16 newborns prefer there

mother's voice and Woodward (1992) investigated that 10 experimental infants can recognize previous prenatal music.

Another point to be considered is that our both studies suggest that infants can significantly recognize maternal voice than prenatal music, this mean that maternal voice is one of the most effective stimuli that can influence infant's perception and learning. It also means that infants prefer human's voice than any other.

The result on Fig. 3 suggest that the experimental infants can turn to voice 4.6 day while the Bangkok children turn to voice 3.2 month of age in average. This striking findings are consistent with our previous study on 24 infants which have a capacity of turning to voice 7 day in average. These results reconfirm our belief that maternal voice is a very powerful stimuli that infants can perceive and recognize earlier. The earlier of turning to voice also suggests that experimental infants have a faster auditory development than general population.

In a series of papers, Salk (1960, 1961, 1962, 1965, 1973) reported that human infants exposed to the sound of an adult's heart beat will cry less than infants not so exposed. A heart beat sound can produces long-term pacification in newborn. To check all of these possibilities, we investigate on a large number of 120 infants in Fig. 5 and found that 64.1% of experimental infants will response to heart beat sound by calming down and being sleepy. While 70% response to prenatal music with calming effect (Fig. 4). The capacity of prenatal memory on heart beat sound and prenatal music is now absolutely proven in this paper. And the prenatal experience can really influence postnatal learning and perception. Therefore, the important point to be stressed here is that the prenatal activity in this paper may be applied to routine prenatal care in order to promote the good emotional development after birth as well as create calming down effect to new born in clinical practice.

The data from Figs. 6 and 7 showed us that after giving the rhythmic patting on experimental infants bottom, they will stop crying in 2.1 minute when compare to 4.6 minute in general population. 61.6% of experimental infants stop crying when rock them on the rocking chair. There findings confirm us that previous experience may influence postnatal perception and learning. This also suggest that fetus not only can perceive and learn auditory stimuli, but also learn tactile and vestibular stimuli as well. Therefore, rhythmic patting and rocking may be another consideration for routine practice of pregnant women in order to enhance the infants emotional development and make them easy to take care after birth.

In Fig. 7 showed that the infants respond to rocking in the lower percentage than tactile and auditory activity. This due to the small amount of practice rocking shown in Table 3. However, the effective outcome from rocking will be found when practice more than 3-4 day in a week.

Some studies suggested that fetus have a capacity of conditional learning at 28 week gestational age. The result of this paper reconfirm the finding of previous study that experimental infants can be conditioned by kicking back when patting in 64.9%. This prenatal tactile activity not only promote mother and child bonding, but also let the fetus learn to respond to outside stimuli.

In conclusion, the effective outcome on 120 experimental infants here convinces our belief that fetus can learn not only auditory stimuli, but also tactile and vestibular stimuli. The previous experience that fetus received in utero may in-

fluence postnatal learning and perception. Fetus also have a conditional learning even in utero. In addition, the prenatal activity mentioned in this paper should be introduced to routine prenatal care and could be an effective way to enhance mother and child attachment, as well as promote intelligent and growth to all children in this near future.

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