

CASE STUDY ON STANDARD CHINESE DISYLLABLE OF A HEARING-IMPAIRED CHILD WITH COCHLEAR IMPLANT

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ABSTRACT

This paper focuses on Standard Chinese disyllable tones acquisition of a hearing-impaired child with cochlear implant. The fundamental frequency is disorder, which indicates that the child fails to acquire the rules of Chinese disyllable tones because the command of monosyllables has a great effect on the acquisition of disyllable tones. Based on the assessment results, a treatment program was designed to treat the child. The results indicated that the combined therapy is effective for the improvement of disyllable tones.

Keywords: child with hearing-impaired, standard Chinese, disyllable, tone, tone disorder

1. INTRODUCTION

The tone is known to be a phoneme that can distinguish the significant of the syllable by different pitch voice [7]. The tone in Chinese is indispensable because it can not only distinguish meanings but also play a very important part as consonants and vowels do. Accordingly, one cannot truly master Chinese without acquiring Chinese lexical tones.

The main acoustic representation of super sound paragraph structure includes fundamental frequency curve of the voice, tone, pitch stress, intonation and so on [6]. Therefore, most of Chinese tone's studies are inseparable from the fundamental frequency curve.

Every Chinese character is a syllable except rhotic accent ones. Except few modal particles, most Chinese syllables have their lexical tones and can be singly read [1]. When two syllables form a word or phrase, only a monosyllable tone is not enough, so the acquisition of Chinese single character tone doesn't mean that one has mastered the disyllable variety regulation [7]. [5] indicated that both monosyllable and disyllable are the basic

units of intonation in Standard Chinese. Through different experiments of hundreds groups of two-character words, Wu summarized fifteen tonal types (the combined regulation of T2T3 and T3T3 is the same). Wu also mentioned that every two Chinese characters will create tone sandhi whenever they are read together, whether they are a word or a meaning group. [4] focused on disyllable sentences and made major concentration on the affection of focus-accent towards disyllable combinations, and how the mood of narration and question behaved in disyllable sentences, which proof that there is stable "disyllable basic unit" in Chinese. The acquisition of Chinese disyllable tones will lay a solid foundation of acquiring triple syllables, or even the whole sentence intonation. Hence, it is the indispensable link in language learning and should be paid great attention to.

When hearing-impaired children get cochlear implantation, the longer rehabilitation training time is and the younger the child is, the better hearing ability develops. Hearing ability could not relatively be stable until experiencing at least 12 months listening training [3]. Vocal organs cannot perform coordinated movements well enough, which cause phenomena such as higher or lower tones, oversize change of tones [2]. These are the speech pathological phenomena, which will affect not only the children's daily communication and emotional expression but also the children's study and work life, interfere with their entry to the mainstream society, and cause physical and emotional damage.

What's the character of cochlear implanted children's disyllable tones? How to carry out the speech correction?

By analyzing and discussing the obstacles of disyllable tones of a cochlear implanted child, we are aiming to help this child achieve speech rehabilitation, and also explore effective rehabilitation program.

2. MATERIALS AND METHODS

2.1. Subject

Liu, male, 6 years old, born in March 2004, wore a hearing aid from April 2005 to September 2009. His right ear implanted Austral-made cochlear in September 2009, unaided ear hearing 100dB. The child suffered a weak controllability of respiratory muscle and started to join in a rehabilitation training program in language and hearing center clinic. After a year-training program, the child preliminarily acquired the initials, finals and monosyllables in Standard Chinese.

2.2. Recording materials and measuring method

The study used a real-time speech apparatus, Dr. Speech (produced by Tiger Drs Inc), to measure and assess the child's acquisition of monosyllable and disyllable tones before and after therapy.

Designed list for monosyllabic reading is as follows, it consisted of the [uA] with the four Chinese lexical tones.

Monosyllabic Reading List				
Pinyin	wā	wá	wǎ	wà
Character	蛙	娃	瓦	袜
Meaning	frog	baby	tile	socks

The disyllabic reading list consisted of the sequences [xéiuA], [paiuA], [tsuA],[lyuA] with all 16 possible bi-tonal combinations of four Standard Chinese tones.

Disyllabic reading list				
Pinyin	hēiwā	hēiwá	hēiwǎ	hēiwà
Character	黑蛙	黑娃	黑瓦	黑袜
Meaning	black frog	black baby	black tile	black socks

The child was asked to read the lists following a therapist in a natural way. The materials were recorded and saved as wave file, the sampling frequency is 44100Hz, quantification precision is 16b, and monophonic recording was used in this case.

2.3. Statistic measurement and process

We extracted the sample words and save them as wave files, used Dr. Speech to measure the frequency of the starting-point, midpoint and end in the finals' stable section. F_0 can be also transferred to semitone. The equation of semitone is given below:

$$St=12*\log_2(F_0/FreF) \quad (1)$$

In this equation, F_0 stands for the frequency. $FreF$ stands for reference frequency.

By means of the combination of the analysis of the child's F_0 curve and our auditory impression, we found that although the child had acquired the basic changes of monosyllable tones before training, he failed to master the rules of Chinese disyllable tones. Under this circumstance, we proposed a rehabilitation treatment for this child in order to improve the child's acquisition of tones. The treatment carried out five times a week and last for two months.

3. THE TREATMENT

3.1. Processing falling tone training with “en-heng”

The sound “en-heng” is considered to be the closest tone to natural tone, so the child is asked to pronounce it in a natural way to look for the target tone. The child is asked to learn this tone and tries to use it in communication. Record the child's pronunciation and the therapist should listen to it carefully, observe if the child is able to pronounce it. If not, more practice are needed until the child successfully pronounces the exact or similar tone.

3.2. Natural tone training

There are four lexical tones in Standard Chinese, High-level (Tone1), Mid-Rising (Tone2), Falling-Rising (Tone3) and High-Falling (Tone4). The monosyllabic and disyllabic reading list are used to train the child step by step in order to help the child understand the changes in monosyllable tones and the combination of disyllable tones.

3.3. Professional phoniatrics software

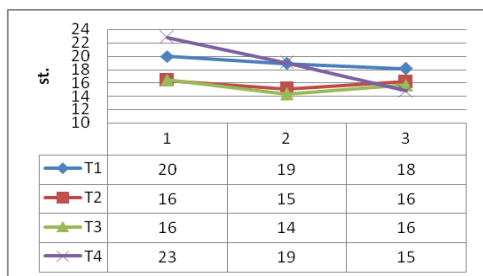
Dr. Speech is used for disyllable tones training. Due to the fact that the child has a better condition of acquiring Tone1 and Tone4, the training materials place extra emphasis on Tone2 and Tone3.

4. RESULTS AND DISCUSSION

4.1. Analysis

Editing and sorting out the child's monosyllable and disyllable tones. Each final's stable section would be chosen three points, then measure the pitches of three monosyllable points and six disyllable points. The child's pitch tendency has been drawn.

Figure 1: The child's monosyllable tones semitone before training.



The child's end point of Tone1 is lower than the starting point, but it can be regarded as high-level tone. Tone2 and Tone3 are both low level tone which cannot be distinguished clearly. Tone4 is a falling tone.

4.2. The analysis of disyllable tones

4.2.1. The disyllable tones starting with Tone1

There are four combinations of disyllable tones beginning with Tone1: T1T1, T1T2, T1T3, and T1T4.

Figure 2: The child's semitone of T1T1 and T1T2 before and after training.

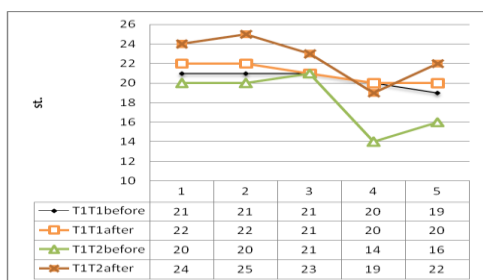
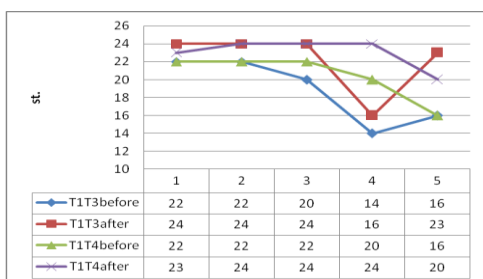


Figure 3: The child's semitone of T1T3 and T1T4 before and after training.



Before the treatment, the first three points remain stable and the last three points drop slightly in T1T1, but the whole tone pattern maintains high level. In T1T4, the first three points remain high and flat, when it reaches the peak at the fourth point, the pitch curve goes down steeply. As for T1T2 and T1T3, although the child has realized the difference between them and T1T1, he fails to

distinguish T2 and T3, which can be easily discovered from his pronunciation of T1T2 and T1T3. The F₀ of T1 is high and stable, but we can hardly tell the difference between the T2 and T3 through our auditory impression. After two months treatment, the last three points of T1T2 and T1T3 have appeared a remarkably difference. The auditory impression also proves this difference.

4.2.2. The disyllable tones starting with Tone2

Before the treatment, the last three points of T2T1 keeps high and flat, T2T4 is a low tone. The first three points of T2T1 shows a state of lowing, the last three points of T2T2 is falling-rising just liking "T3", the first three points of T2T3 is lower. After treatment, the first three points of T2T1 have a tendency of rising. The latter parts of T2T2 is high-level, the F₀ curve of T2T2 rises first, then keeps high and flat. The latter parts of T2T2 and T2T3 have obvious difference, the latter part of T2T3 is low-rising and T2T2 remains low. Hence, further training is necessary in order to raise the latter part of T2T2 and reach the ideal condition.

Figure 4: The child's semitone of T2T1 and T2T2 before and after training.

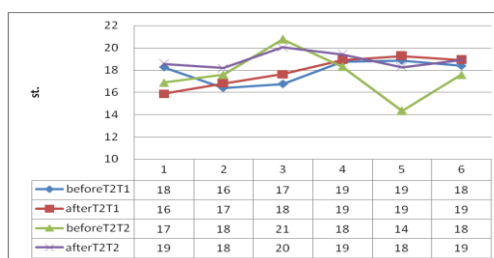
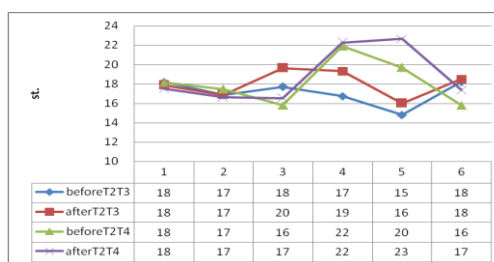


Figure 5: The child's semitone of T2T3 and T2T4 before and after training.



4.2.3. The disyllable tones starting with Tone3

Before the treatment, only the combination T3T4 is relatively ideal, the first half part is low and F₀ of the latter part goes down sharply. However, the T3 in the first half part of T3T1 does not show its lowness and even has a higher F₀ than the last T1. The tendency of T2 part in T3T2 is more like T3 part in contrast to the T3 part in T3T3. After

the treatment, there is slightly change in T3T4, the first half part of T3T1 goes down a little, only T3T2 has a remarkable change after the treatment, the F_0 of the first half part is low and the latter part has a tendency of rising. But in other combinations, the first half parts of three other combinations are still higher, which need further treatment.

Figure 6: The child's semitone of T3T1 and T3T2 before and after training.

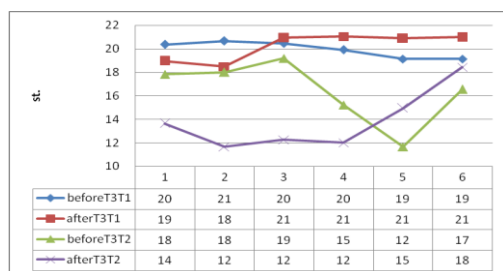


Figure 7: The child's semitone of T3T3 and T3T4 before and after training.

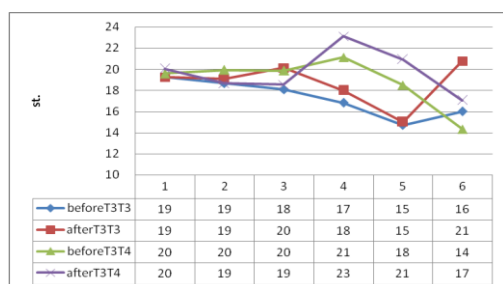


Figure 8: The child's semitone of T4T1 and T4T2 before and after training.

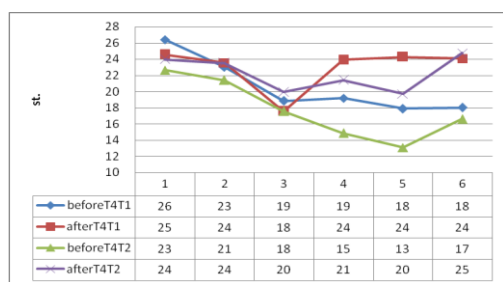
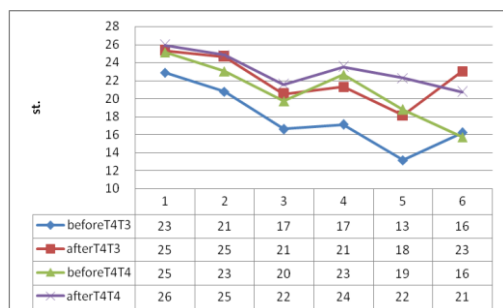


Figure 9: The child's semitone of T4T3 and T4T4 before and after training.



4.2.4. The disyllable tones starting with Tone4

The combinations of T4T1 and T4T4 are comparatively ideal before the treatment, the first three points of T4T1 are falling, and the last three points are high and flat. However, the F_0 contour of T4T2 and T4T3 are almost the same and can hardly be distinguished by auditory impression. After the treatment, the first three points of T4T1 are low, and the last three points remain high and flat, the semitone is also higher than before. T4T4 has slightly difference than before, but the latter parts of T4T2 and T4T3 have appeared distinct difference, the last part of T4T2 is higher than before, which has achieved great improvement. The F_0 contour of T4T3 is higher than before, the sounds of it more likes natural tones.

5. DISCUSSION

There are all kinds of reasons that can cause hearing impaired children's tone impediment. Through quantitative measurement of the child's F_0 value, objective statistics are received. By contrasting these parameters before and after the training program and combining the statistics with the auditory impression, the instable factors of child's disyllable tones acquisition are determined. On the basis of clear diagnosis, relevant training treatment is formulated. A real-time measurement and evaluation has also been taken during the treatment. The whole speech rehabilitation process strictly follows the procedure of "assessment—therapy—assessment—therapy—assessment". The child has greatly improved in the tone impediment in a short time. The results indicated that the combined therapy is effective for the improvement of disyllable tones.

6. REFERENCES

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