INTONATION CURVES - NORMAL AND DEVIANT

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ABSTRACT

This study was designed to observe individual differences in the production of intonation by normal-hearing (NH) and hearing-impaired (HI) children. Three types of intonation curves (declarative, Wh- and Yes/No questions) were produced in orally read sentences by 18 HI and 10 NH children (age group 9-12). F_0 measurements were obtained at the midpoint of vowels along the sentences. The results show that NH like HI may have some deviation in so-called normal patterns.

1. INTRODUCTION

It is known that hearing-impaired speech is characterized by high fundamental frequency, pitch breaks and difficulties in the production of the usual language-related intonation patterns. These characteristics, apart from articulation errors, may contribute to the general lack of intelligibility in the speech of the hearing-impaired. There have been a number of studies employing different approaches, which have demonstrated significant differences between normal-hearing (NH) and hearing-impaired (HI) children in both perception and production of intonation [4,6,7,8,9,11,12,13,14].

In many of the studies acoustic analysis concentrated on group values of NH children's intonation patterns which were compared with the values of HI children. In this study special interest was focused on the intonation curves produced by each of the normal-hearing children in order to observe possible individual differences.

2. METHOD

Eighteen HI children, 9-12 years old (mean age 10.4 years) and 10 NH children (mean age 9.9 years) were recorded in quiet rooms in their respective schools. The HI subjects who attended special classes for HI students in a regular school, were orally educated and were reported by their teachers to be good readers. Their average hearing loss in the better ear was 99.2 dB, SD 8.9 dB. The NH children were randomly selected. They had no hearing problem.

The recorded material consisted of 18 orally read sentences as follows: 3 short (5-7 syllables) and 3 long (11-14 syllables) sentences of each type: declarative, Wh- and Yes/No questions. The short sentences were taken from a previous list of one of the authors [2] and were extended by a modifier and a content word. Each sentence ended with appropriate punctuation and was written separately on a card. All of the children, NH and HI, were familiar with the function of punctuation. Each child read the sentences quietly to himself, and then he read the sentences aloud in random order. The recording was done by a SONY Casette Recorder TCM-848 with the microphone held at a steady distance of 12-15 centimeters from the mouth. Spontaneous speech was elicited by a picture of a simple family-scene. The children were instructed to describe some of the objects in the picture and then to ask the examiner questions about them. In this way we succeeded to get declarative sentences and also some questions from all the children.

The acoustical data consisted of 18 read and 4 spontaneous sentences. Measurement of F_0 was done at the midpoint of vowels, using a Kay Elemetrics Visipitch 6087 instrument. In this study only the data of the read sentences will be presented.

3. RESULTS

The mean fundamental frequency of the 18 sentences produced by the HI children was compared with the mean fundamental frequency of the NH children. The measured average F_0 of all the 18 sentences for the normal-hearing group was 247.73 Hz SD 26.10 Hz and for the hearing-impaired 316.73 Hz SD 38.03 Hz. The mean F_0 of the HI children was significantly higher (T=5.60, DF=24.70, p=.000).

In evaluating the intonation patterns, a grading system was used that presumed the possible configurations of the intonation curves (in relation to the 3 sentence types). It was found that there were no significant differences between the children of the two groups in the production of all the declarative sentences, neither the short nor the long ones. Also there was no significant difference in the intonation production of the short Wh-questions, while in the longer Wh-questions the difference was significant at the 5% level (T=2.46, Df=25.87, p=.021). Even so, statistical analysis of the measured values of all the Wh- questions together did not show a significant difference between the HI and the NH children. Only all the Yes-No questions, short and long, showed a significant difference (T=3.60, df=25.99, p=.000) between the NH and the HI children.

Until now group differences were presented. Examples of productions of individual children that may be informative are shown in the following two figures.

Fig. 1 shows two NH individual expressions of a short declarative sentence as compared to the mean F_0 pattern of the HI and the mean F_0 pattern of the NH. While the mean patterns of both groups show a declination, the individuals (A & B) are very different. B expresses the sentence in the usual way and A expresses it with a rising contour.

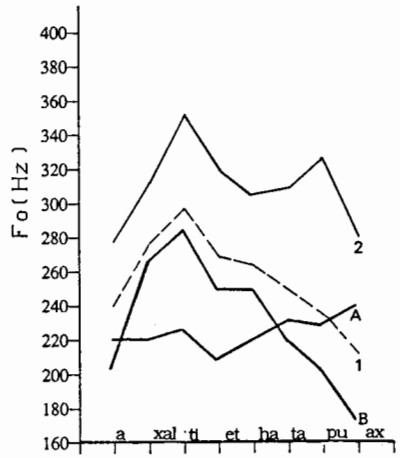

FIGURE 1: "axalti et hatapuax" (I ate the apple). 1=the average F_0 curve of NH. 2=the average F_0 curve of HI. A and B: different versions of 2 NH children

Fig. 2 shows 3 HI individual expressions of the same sentence as compared to both group means. In this example all the expressions have a falling contour.

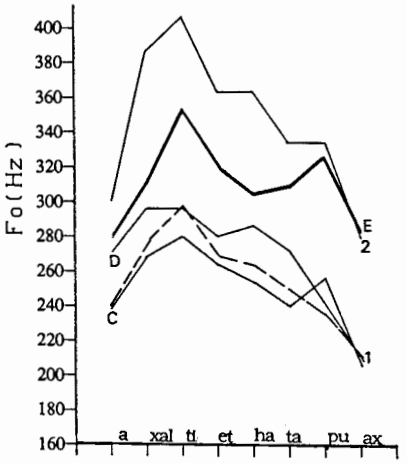

FIGURE 2: "axalti et hatapuax (I ate the apple). 1=the average F_0 curve of NH. 2=the average of HI. C,D,E different versions by 3 HI children.

4. DISCUSSION AND CONCLUSION

Higher average F_0 of HI children is a known phenomenon [9], although the measured values across the publications differ. It may be that different techniques for the measurement contribute to the varied values. In this study the mean F_0 of HI children is higher than that of the normal-hearing children of the same age group.

The evaluation of the patterns of the intonation curves showed that the Yes/No questions, short and long, were the most difficult to produce for the HI children. This result is in agreement with previous findings [13,2,91]. In the Hebrew language this type of sentence is identified by rising intonation only without any other syntactic cue. This type of production requires voice control and preplanning and therefore, may be very difficult for the HI child. Wh-questions allow for much more freedom of choice: after expression of the question word the rest of the sentence may show either a declination or a rise. Since HI children in this age group are able to produce the rise in a single word [2] they succeeded in executing this type of sentence when it was short. In the latter part of the longer sentences F_0 deviations may have occurred.

Declination of F_0 at the end of simple, neutral, sentences is considered to be a basic way of the intonation curve [1]. Observation of the mean F_0 curve of the declarative sentences, produced by the NH children as a group, confirmed this statement. However, when examining the individual curves of these NH children it was found that 2 out of the 10 children finished all their sentences with a rise of F_0 . One child exaggerated in pronouncing a final velar R, changing the declination to a rising curve, another one produced only flat and monotone curves. It is difficult to decide whether this phenomenon is "situation dependent" [10], a habit of expressing their wish to arouse attention, or it may be a language problem (they produced statements the same way in the spontaneous sentences).

Deviations in intonation patterns like these are generally attributed to the intonation production of HI children [7,5,9]. By grading the individual curves of the NH and those of the HI with the same expectations, according to the F_0 , the results showed no significant difference between the children in the production of simple read declarative sentences. The deviations in the intonation curves in the speech of HI children, as well as in the speech of the NH children, may be due to individual characteristics of expression and not necessarily to their hearing loss. This may be a way to explain the variations in intonation production by HI children with a similar hearing loss.

In applying intervention strategies for the intonation improvement of HI children, one should consider the possibility that deviant production of an intonation curve may be due to other causes beside their hearing loss.

ACKNOWLEDGEMENT

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