

## COMPARATIVE STUDY OF INTONATION PATTERNS IN NORMAL HEARING AND HEARING IMPAIRED INFANTS

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### 1. INTRODUCTION

The purpose of this study was to develop an objective method for measuring infant intonation contours and to assess the sensitivity of this method by comparing the intonation patterns in normal hearing and hearing impaired infants.

This study arose from the need for more information concerning the developmental sequence of pre-linguistic skills as noted by Carroll (1961), Chase (1967), Kaplan (1970) and others. Knowledge in this area would aid in the understanding of language development and particular deviations from the normal pattern would provide information to aid in early diagnosis and treatment of potential cases of delayed language and speech development.

The importance of intonation as a pre-linguistic skill has been emphasized by Lenneberg (1967), Crystal (1969) and Menuyk (1970). However, experimental investigations have been limited due to a lack of agreement in defining the parameters of intonation and the difficulties of objectively measuring these parameters. This study uses instrumentation recently devised by Leon and Martin for measuring the three parameters they and Crystal considered most important in intonation: fundamental frequency, intensity and time.

### 2. PROCEDURE

The subjects were ten infants, aged 12-24 months with a clinical diagnosis of a mild to severe hearing loss who were matched in pairs with ten subjects with normal hearing with respect to age, sex, language used in the home, social class and the presence of siblings.

The tape recorded intonation patterns were those used in a 'demand cry'. These recordings were obtained by the experimenter in the child's home. The mother presented an object (predetermined to be desirable to the infant) and withheld it until the infant focused on the object and vocalized a desire for it.

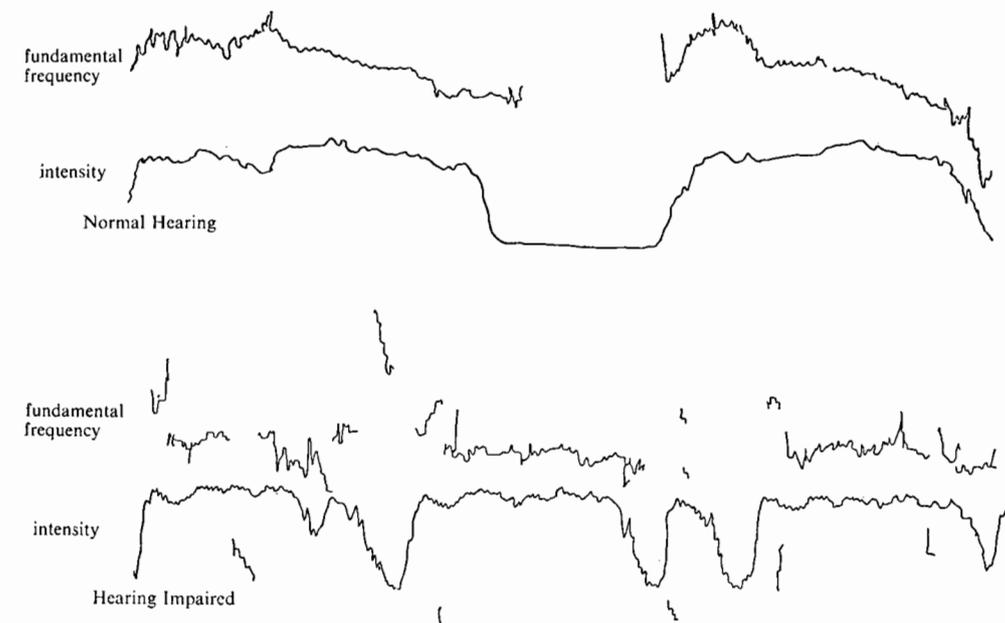


Fig. 1. Example of differences in Intonation Contour in a Demand Cry between a Normal Hearing and Hearing Impaired Infant.

Three demand cries for each subject were dubbed from the recording onto a master tape, which was fed into the University of Toronto speech analyzer.

As no similar analysis of infant intonation has been done it was necessary to determine a procedure for extracting information from the fundamental frequency and intensity contours. The measures recorded were (1) the direction of change, (2) the size of change, (3) the time required to make the change, (4) the time when maintained after a change, (5) the number of changes during a 5 sec. demand cry, and (6) the total time the fundamental frequency occurred within five bandwidths.

Information on the above measures was tabulated on each subject for the first of the demand cries which was 5 sec. or longer in duration.

### 3. RESULTS

The Mann Whitney U Test was used to determine whether differences between groups was statistically significant. Results indicate (1) hearing impaired infants had significantly more fundamental frequency changes  $\geq 50$  Hz than did normal hearing infants ( $p = .025$  one tail), (2) hearing impaired infants had significantly larger fundamental frequency changes (that is 200, 300 and 400 Hz) than normal hearing subjects ( $p = .0281$  or less, one tail), (3) hearing impaired infants had significantly more amplitude variations than normal infants ( $p = .05$  one tail), (4) normal hearing infants

used the bandwidths 400-500 Hz significantly more than hard of hearing infants ( $p = .05$  two tail).

#### 4. DISCUSSION

The instrumentation and procedure used in this study differentiated between intonation contours in normal hearing and hearing impaired infants, thus demonstrating that this procedure is sensitive to gross differences in intonation contours. Further research is necessary to determine the sensitivity of this procedure to differences in intonation between other groups such as: infants with other congenital abnormalities and environmental differences.

Instrumentation should be set to analyze at frequencies greater than 500 Hz, and computer programs used to analyze results. The relationship between intensity and amplitude contours as well as pause time to vocalization time should also be explored. It would seem that the method of measuring infant intonation contours developed for this study should provide a useful technique for the accumulation of knowledge of this important pre-linguistic skill.

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#### DISCUSSION

FRY (London)

Mrs. Manolson's results seem to me very important as indicating rather clearly the establishing of the vital links between the auditory and the kinaesthetic feedbacks at the stage of babbling.

I should like to put in one comment about babbling which may be of interest. There has for a long time been discussion as to whether at the babbling stage infants were indulging in an activity which has more or less universal features or whether it is culture and language bound. On the one hand observers have noted that the range of articulations in babbling is so wide that for infants from different communities there is a great deal of overlap; on the other hand it has been noted that among a group of babies of different nationalities, observers can often pick out infants of their own nationality. I suspect that this is to be explained in the following way. It seems certain that a baby's imitation of intonation patterns begins much earlier than any imitation of articulation and it is therefore likely that very early in the babbling period the child is already producing tunes which are imitated, and therefore sound familiar to a listener of the language community; at the same time his articulations are entirely pre-linguistic and exploratory and are not dictated by the pattern of the language of his environment so that they appear to be quasi-universal in

character. In other words at this stage we have articulatory patterns which are not language or culture bound but they are carried on intonation patterns which are already language bound.

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Dr. Fry's comments further emphasize the importance of intonation contours as one of the first features of natural language to be observed in infant babbling. It has also been proposed by Blasdel and Jensen that the child perceives whole patterns rather than segments and that the intonation contour provides cues from which the infant develops the strategy to decode his linguistic environment. Crystal and Menyuk suggest that intonation contours may constitute the infants first generative markers. Unfortunately little research has been done to investigate these observations. It is hoped that the method used in this study will provide a useful technique for research on infant intonation.

In speech pathology, my field of interest, research on the developmental sequence of pre-linguistic skills is of the utmost importance. Early diagnosis and treatment of delayed language and speech is imperative when we consider the evidence supporting the concept that there is an optimum period during which language skills can be developed. Treatment beyond this point minimizes the advantages of the natural potential of the organism. Knowledge of normal progression in the development of pre-linguistic skills and deviations from the norm would make the goal of early diagnosis of potential cases of delayed language and speech a real possibility.

ABBERTON (London)

Some related work is being carried out in the Department of Phonetics at University College, London and the Childbirth Research Unit at University College Hospital. We are recording the cries of normal and brain-damaged babies using the University College laryngograph and examining some of the excitation characteristics and fundamental frequency contours in an attempt to define patterns for normal and abnormal cries. It would be interesting to see if the control by deaf babies and children of the mode of vibration of their vocal folds is impaired in somewhat the same way as you have found for their control of fundamental frequency.

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Miss Abberton's remarks point to the importance of controlling the many variables involved in the production of infant vocalization. One specific problem is definition of the type of vocalization studied. It appears that Miss Abberton recorded 'reflexive cries' whereas this study recorded voluntary attempts at communication. It is reasonable to expect that these two types of vocalization would differ greatly as the latter is greatly affected by maturity and language environment.