



RESEARCH PAPER

Available Online at www.ijarcs.info**Developmental Patterns in Speech Analysis on the Basis of Time Duration**Komal Jindal^{*1}, Latika Singh² and Sumanlata Gautam³^{1,2,3}Department of Computer Science and Engineering

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Abstract: Speech Production researchers found that there was a variation in the spoken utterances of children of various ages due to the variability in their prosody or rhythmic pattern. This study dictated the mutation in the speech production of children between the age 4 and 8 year. We analyzed this hypothesis by observing the role of word and phrase duration while uttering meaningful words and phrases in 100 children of age between 4 to 8 years out of which 17 were learning music. Moreover, comparisons have been made for the observation of the variability in the speech production of normal developing children and the children who were learning music. We concluded that with the advancement in age, there was a significant fall in the word and phrase duration while the utterance of different words and phrases in dictating a fluent speech production as the child advance in age. Also, the children who were learning music showed significant decrease in the word and phrase duration while uttering different words and phrases suggesting more rhythms in their speech patterns.

Keyword:- Rhythm, prosody, Acoustic, Phrase duration, Word Duration, Speech Production.

I. INTRODUCTION

Prosody, or the way the terms are verbal, offers vital facts to figure out a speaker's communicative intent.[1,2]The five significant acoustic/prosody features include pitch, intensity, spectral qualities, pausing and duration. In this paper, we emphasize on the length of word duration and phrase duration in the utterances of children for fluent speech production. [3,4]A variety of acoustic and cross-sectional studies have explored that an extensive study of such kind of relationships will augment our knowledge of the basic mechanisms that are involved in the production of speech.

[5,6]With the advancement in age, the duration of the utterances of words and phrases keeps on decreasing which results in the indication of (1) word duration may be shorter or inter-word intervals may be smaller (2) word duration may be similar but inter-word intervals may be shorter (3) inter-word interval may be similar but word duration may be shorter.[7,8]Moreover ,the value of correlation between word duration and phrase duration indicates prominent dependence on age.[9,10]In this speech development investigation, we need to conclude how and at what age the variability and order of magnitude of temporal and acoustic parameters commence to exhibit patterns similar to that of adults.

A chronologically elaborated database has been piled up from a large number of speakers in order to better empathize the variation in the way of speech production in children with a wider range of age [11].The results and aggregations are posed by centring on age-dependent acoustic and temporal changes that are occurring during the speech development course. [12,13]As a child advances in age, the fluency with which he/she pronounces the words and phrases vary. [14,15]He/she then tends to utter the words fluently with a smaller inter-word interval while speaking different meaningful phrases.[16,17] Therefore, we need to observe the time duration which a child requires while uttering different words and the variation he/she shows in their way of speech production with the advancement in age.

Also, the children who are learning music seem to be more rhythmic while listening to their voice. [18,19]So, there must be a fluency in the production and pronunciations of words by a child who is learning music.

II. MATERIALS AND METHODS**A. Speech Database:**

Database dissected in this research was obtained from 100 children out of which 83 were normal developing children and 17 children in the age group 4-8 years were learning music. The youngest children (4 years old) had been divulged to English learning for the shortest period of time, that is, 1 year. Simultaneously, the youngest children have been divulged to music learning also for the shortest period of time. Each recording session lasted for 1 minute. In the recording session, the children were asked to pronounce some words and phrases on the behalf of which all the observations based on how much time they require in uttering different words and phrases were performed. No specific directions were provided to children regarding the manner of speech production. None of the children reported any kind of speech or language disorder.

B. Elicitation Procedure:

The analysis reviewed here relates to the two primary dimensions to our investigation that are, word duration and phrase duration. The screening procedure began with a picture naming task. Subjects next read the chosen phrases. The spoken stimuli were phonetically rich and easy enough to be uttered by a 4 year children. The reasons for the elimination of subjects include any dialect assessment in subjects or in case of any evidence of speech or language disorder in subjects.

For the production study, mutually annotated and segmented spoken utterances were recorded using a Dell laptop in a sound treated room using a low impedance dynamic microphone which was affixed to a headset and kept at a distance of approximately 4 cm from the speaker's mouth. The digitization and quantization of the spoken utterances were performed at a sampling rate and bit depth

of 44.1 kHz/16 bit-mono. The elicitation procedure began with a familiarization of the participants with the name of the pictures. Prior to the recording procedure, the subjects were also familiarized with the target words. While conducting the recording session, if a child identified any picture incorrectly as a different lexical item then the correct modelling of the target word was done in order to direct the child for the repetition of the target word. Background information such as age, music learning years and the native language of the subjects was also obtained for the statistical analysis. Accent verification test was conducted before including any speaker in the production study.

C. Phrase and time duration measures:

To begin, the utterances of words and phrases over time are reckoned. Low quality waveform files were excluded from the study. The overarching investigation aim addressed in this production study was of developing a methodology that would grant us to acoustically analyze the type of variability in word and phrase duration observed while the utterances by the subjects who are learning English sequentially for a period of time and the subjects who are learning music. Phrase and time duration were computed for the analysis of the spoken utterances. Comparisons were performed by taking in consideration the phrase and time duration factors for normal developing children and the children who are learning music.

III. RESULTS

A. Phrase and Word Duration Analysis:

a. Phrase and Word Duration Analysis for normal developing children: Phrase and Word duration for normal developing children of different ages were analysed while their spoken utterances. It has been observed that younger children showed an increased value of word and phrase duration during the utterances of words and phrases. As the children advances in age their spoken words tend to be spoken fluently and thus the value for word and phrase duration shows a significant decrease while the utterance of different phrases and words.

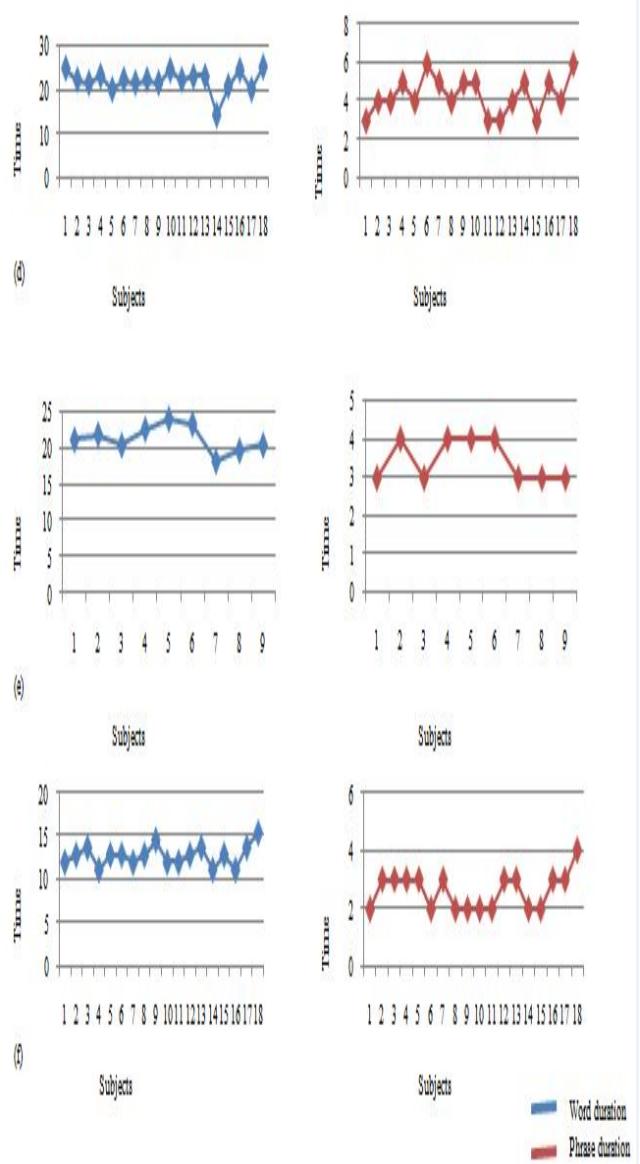
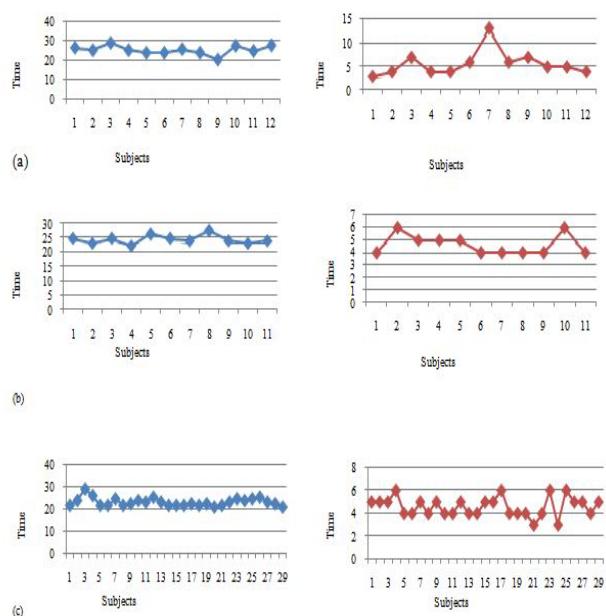


Figure.1 Average Phrase and Word duration Analysis for children (a) 4 years (b) 5 years (c) 6 years (d) 7 years (e) 8 years (f) Adults

b. Phrase and Word Duration Analysis for children learning music: The analysis of phrase and word duration has also been performed for the children who were learning music for a sequential period of time. They were asked to utter the same words and phrases as spoken by a normal developing children. Similarly ,there was a picture naming task, along with that there was a word repetition task which was followed by a phrase utterance task. For this, we have made three different age groups-GI(4-5 years children),GII(6-7 years children) and GIII(8-11 years children). We plot the phrase and word duration for GI,GII and GIII groups. A significant reduction in the value of word and phrase duration has been observed while the utterance of words as the children advances in age from GI to GII which indicates a fluency of speech utterance with the increased age factor due to faster word planning and smaller inter-word interval.

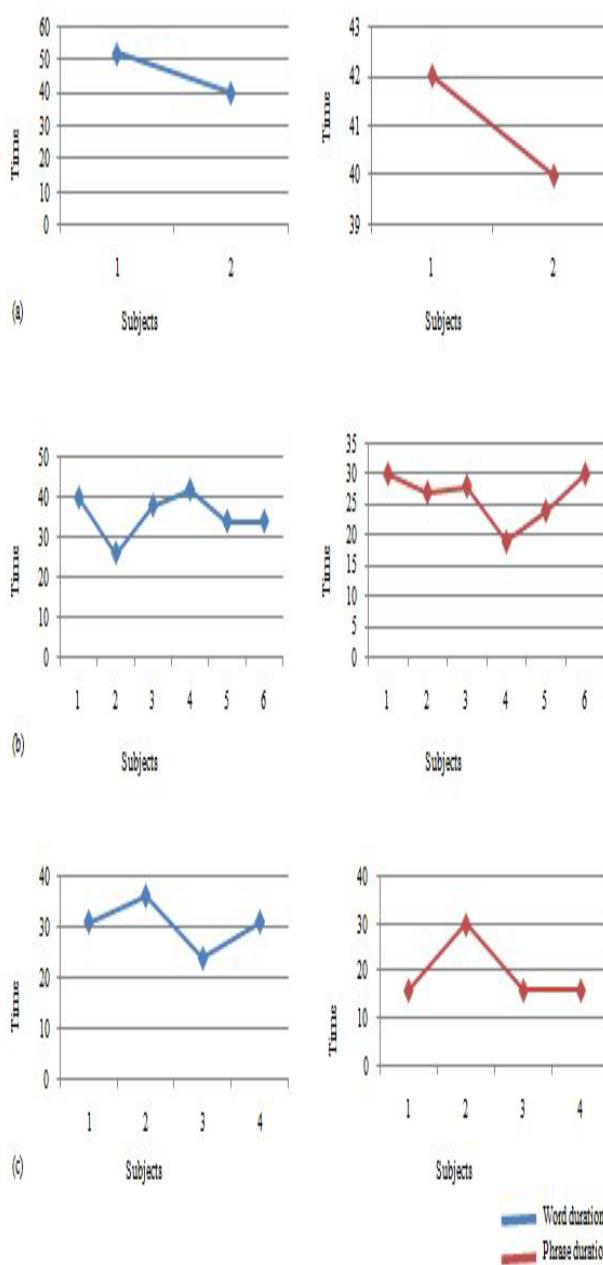


Figure 2 Average Phrase and Word duration Analysis for
(a) GI (b) GII (c) GIII

B. Comparison of Phrase durations for normal developing children and children learning music

A comparison has been made for the time duration children of different age group require in uttering different meaningful phrases. This investigation was performed for both normal developing children and the children who were learning music for a sequential period of time. The observed results indicated that in every age group the children who are learning music shows a significant reduction in the phrase duration while the spoken utterances as compared with the phrase duration of normal developing children because of the fluency in the speech of children who are learning music. This analysis indicated that the children who were divulged to music learning were more rhythmic than the normal developing children as observed from the samples of the way they produces speech.

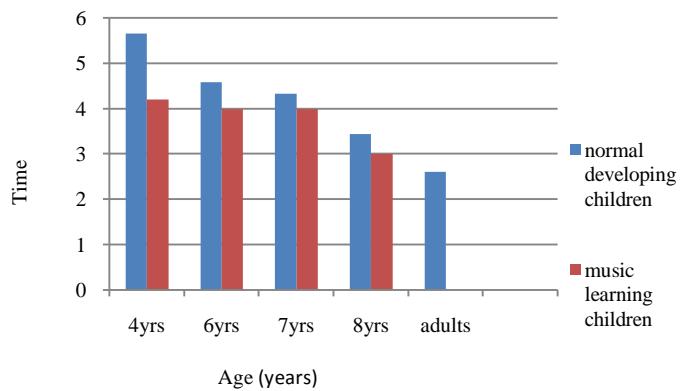


Fig. 3 Comparison of phrase duration for normal developing children and the children who are learning music

C. T-pair Testing:

- a. **T-pair Testing for normal developing children:** Word and Phrase duration values were calculated through their speech samples collected by us for both normal developing children and for the children who were divulged to music learning T-pair testing on the phrase duration values that were collected for the spoken utterances of normal developing children was performed. The T-pair testing results for the children of various ages are given below:

Table 1. T-pair testing for normal developing children

Sr. No.	Age(years)	$P(T \leq t)$ one-tail
1.	4-5 years	0.116854
2.	4-6 years	0.112676
3.	4-7 years	0.032378
4.	4-8 years	0.023883
5.	4-Adults	0.000765

- b. **T-pair testing for normal developing children and children learning music:** Simultaneously, T-pair testing was performed on the values of phrase duration while the recording samples obtained for normal developing children and the children who were divulged to music learning. The T-pair testing results observed between the phrase duration values for both normal developing and music learning children of various age groups are given below:

Table 2. T-pair testing results for normal developing children and children divulged to music learning

Sr. No.	Age(in years)	$P(T \leq t)$ one-tail
1.	4 years	0.012726
2.	6 years	0.02029
3.	7 years	0.000215
4.	8 years	0.008663

IV. DISCUSSION

The aim of the investigation was to explore the way the fluency and the rhythmic pattern varies in the voice of normal developing children from the children who were divulged to music learning for a sequential period of time.

Various samples were recorded by providing a word and phrase repetition task, picture naming task, phrase utterance task to the children of different age groups. The samples were observed and the values for phrase and word duration for different individuals have been plotted for normal developing children and for the children who are learning music. The word and phrase duration values as observed in the spoken utterances of the normal developing children and the children who were divulged to music learning indicated that as the children advances in age, word by word planning tends to get improved with a shorter inter-word interval due to the rhythms in their voice because of divulgence to music learning for a period of time. The length of word and phrase duration for the younger children comes out to be higher than that of the elder ones because of the fluency in the utterances of elder children while pronouncing different words and phrases while the recording session. With the advancement in age a significant reduction in these values also gives an idea of decreased length of inter-word interval while uttering phrases.

The similar analysis has been performed for the children who were divulged to music learning. Significant reduction with the advancement in age has been observed in these samples also. Furthermore, comparisons have been made in the length of word and phrase duration for normal developing children and the children who were learning music which results in the reduction of the length of words and phrase duration for the children of same age group but learning music. This observation leads to a fact that the children who were learning music speaks fluently than the normal developing children because of their rhythmic voice pattern. The investigation summarizes the fact that the fluency in the speech tends to increase as the individual advances in age and if the individual tends himself to learn music then also the fluency in utterance of different words and phrases tends to increase due to the decrease in the inter-word interval and due to the way of planning words while uttering them sequentially. Younger children need to do word by word planning while his/her speech that leads to the higher value of the length of word and phrase duration. The resultant values indicated the fluency and rhythmic patterns in the speech production of the children of various age groups who were divulged to music learning for a sequential period of time.

V. CONCLUSION

The extensive study on the phrase and word duration that a child require while uttering different words and phrases indicated that with the advancement in age a child tends to speak fluently. Furthermore, the children who were divulged to music learning seems to show more rhythmic patterns in their speech as their duration of uttering a word is significantly less than a normal developing children. Therefore, the prosody of the children who were learning music for a sequential period of time found out to be more fluent and rhythmic.

VI. ACKNOWLEDGEMENTS

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