



## An Acoustic Analysis on Speech of Tamil Children with Autism

### KEYWORDS

Autism, acoustics, pitch, rhythm, formants

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**ABSTRACT** *Speech refers to the basic verbal means of communicative feature. It consists of articulation voice and fluency. To communicate even with one word or two word utterances articulation voice and fluency is significant. Mispronounced words (articulation problem), over/ under toned voice or hoarse voice (voice problem), and un-rhythmic production of word or a sentence (fluency problem) may distract the listeners perception. Speech intelligibility becomes questionable in that situation. Autism is one among pervasive developmental disorders having impairment mainly in social interaction and, communication. Children with Autism have speech problems. Though this is an extensively observed issue, acoustic analysis on the speech of children with autism is often perceived as an under researched area. The aim of the study is to find out the deviance in speech characteristics of autism. This study acoustically examined the aspects of speech in children with Autism of 4-7 years whose speaking ability is very low. It studies the pitch, formant frequencies, intensity, duration of produced words and compared it with children with and without autism. The analysis of the present study shows that the speech features are abnormal in Children with Autism and gives an insight to provide remedial measures for articulation and voice therapy.*

### Introduction

In linguistics, there is a difference in usage of terminologies, speech and language. Language is different from speech in the sense; language comprises socially shared rules like, meaning of word (semantics), word formation (morphology), rules to put words together (syntax), and usage of the word combinations in appropriate situations (pragmatics) whereas; speech refers to the basic verbal means of communicative feature. It consists of articulation, voice and fluency; where **Articulation** is about how speech sounds are made or produced; **Voice** is about the use of the vocal folds and breathing to produce sound; and **Fluency** is a rhythm of speech. To communicate even with one word or two word utterances articulation, voice and fluency is significant. Children with Autism exhibit an unusual or odd-sounding speech. Though this is an extensively observed issue, prosodic ability in autism spectrum disorders is often perceived as an under researched area.

### Autism

Autism is a pervasive developmental disorder that manifests in the first 36 months of life (Diagnostic and Statistical Manual-IV [DSM-IV], 1994) and has been defined as a triad of impairment in reciprocal social interaction, communication and imagination which includes restricted, stereotyped and repetitive behaviours (Wing & Gould, 1979). It is a spectrum disorder, ranging from severe autism with associated learning difficulties, to high-functioning autism (HFA) with normal non-verbal ability but preschool language delay and Asperger's Syndrome with no clinically important language delay. In Kanner's (1943) original description of autism, he detailed several features of disordered communication such as echolalia, pronoun reversal, pragmatic difficulties and unusual expressive prosody.

People with autism may be verbal or non-verbal, depending on the level of their autism; those who are verbal are often described as having high-functioning autism. Speech has been noted as atypical in such individuals: this was attested first by those who originally identified autism and

since then by many. Atypical speech in autism has not, however, received a great deal of attention in research, and has been labeled with adjectives that are vague (e.g. 'bizarre') and sometimes contradictory (e.g. 'monotonous' as well as 'exaggerated').

Children with autism are considered to be deficient in prosodic skills, and having a developmental speech and language impairment both in understanding and expressing communication. Their speech has been known to have a sing-song, atypical voice quality, and also described as being deviant in terms of voice volume (i.e. monotonous, too loud or soft), and atonal, arrhythmic, and hollow pitch accents, boundary tones, and a phrasing.

### Aim

This paper aims to establish whether there is a speech disorder in autism by comparing them with control group of typically developing children, and what generalizations can be made about its various manifestations. This study using the software PRAAT, will examine acoustically the prosodic aspects of speech in children with Autism of 7-9 years whose speaking ability is very low.

### Methodology

#### Information selection

Ten Children with Autism and ten typically developing children for control group participated in this study. The autistic participants were a part of the disordered population who got and those who were getting training in 'Centre for Speech and Language Disorders', Annamalai University. According to assessment using CARS, children with Autism selected for the study fall under moderate and severe. All are Tamil mother tongue children. They were diagnosed as Autistics with normal intellectual level by the Pediatric neuro psychiatrist.

#### Data collection methods

The word and phrases used during the therapy session

were recorded using tape recorder. It has been digitalized and used for acoustic analysis of speech features of these children.

The recorded data has been analyzed through the software PRAAT [version 4.2.25]. The pitch, intensity, duration and formant frequencies are taken into account for this study. The results were presented in qualitative manner. The present study is operated on data-driven direction.

**Acoustic features of speech**

The speaking voice is heard as the  $F_0$  (pitch) and its harmonics which are multiples of the  $F_0$ . Some of the harmonics are emphasized because of the resonant characteristics of the vocal tract. These high energy harmonics are called formants. While most voices have several formants, clinical research has generally been concerned with  $F_1$  and  $F_2$ .  $F_1$  related more to tongue height, and  $F_2$  is related to the antero-posterior position of the tongue.

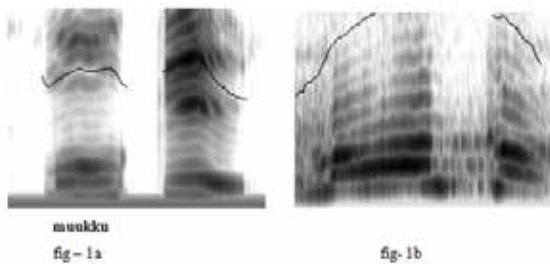
The frequencies of formants are influenced by three factors: the degree of constriction created by the height of tongue; the distance from the larynx at which this constriction occurs and the amount of lip-rounding, lip-protrusion or lip-spreading present. The relationship or distance between  $F_1$  and  $F_2$  has been used to describe the normal production of vowels.

For the present study, pitch, intensity, duration and formant frequencies are analyzed and presented the in terms of  $F_0$  (Htz), decibels, milliseconds and  $F_1$  (Htz) and  $F_2$  (Htz). Comparison of pitch for identifying voice disorder,  $F_1$  and  $F_2$  is to find out articulation deviance and duration to find out.

**Pitch deviance the rhythm in speech**

Analysis of pitch defines the voice quality of a person. It helps us to find the atypical phonation found among these children. Rise and fall of the voice pitch (Intonation) is found to be deviant from speech of typically developing children. Pitch-span (difference in Hz between lowest and highest  $F_0$  of a speaker's total utterances) is also found to be deviant from speech of typically developing children.

Fig.1a shows the spectrogram of pitch in typically developing child and Fig.1b child with Autism

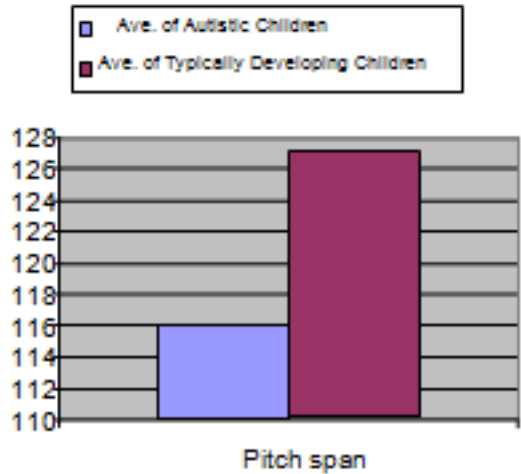


The following table -1 and graph -1 shows average pitch span of autistic and typically developing children.

Table -1

Informants	Pitch span
Average of Children with Autism	116
Average of Typically Developing Children	127

Graph-1



From fig-1a, fig 1-b, table-1 and graph 1, it is inferred that the pitch of children with autism is abnormal when compared with typically developing children.

**Intensity**

According to the analysis it shows that, the intensity of the Children with Autism is relatively more than that of typically developing children.

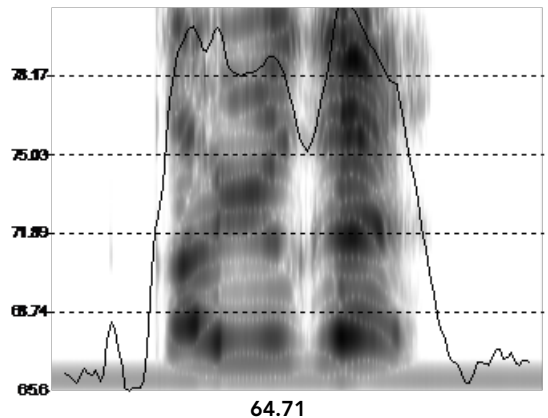


Fig.2a shows the intensity of the typically developing child

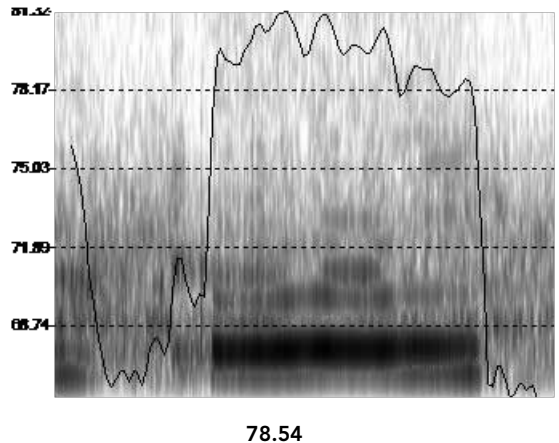


Fig.2b shows the intensity of the child with Autism

**Duration**

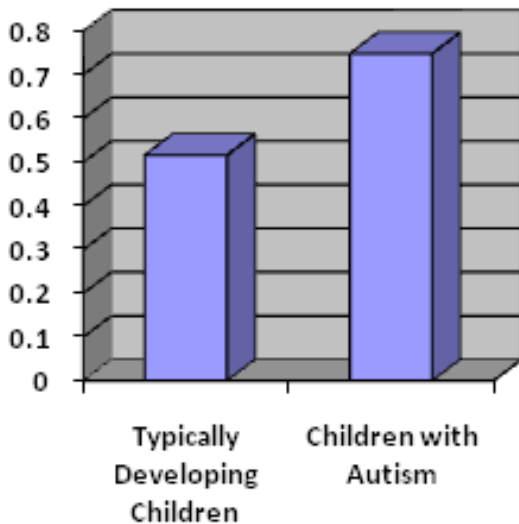
Duration is found to be more in children with Autism than

that of typically developing children. This is because, they are in the initial phase of speech development and they feel hard to pronounce multi syllable words and they extend the duration to produce such words.

Table -2 and graph - 2 shows the Average duration of the word production

Words	Typically Developing Children	Children with Autism
Average	0.5161	0.7486

Graph-2



**Formants**

As said earlier in clinical research formants  $F_1$  and  $F_2$  have generally been concerned with as it describes the tongue position.

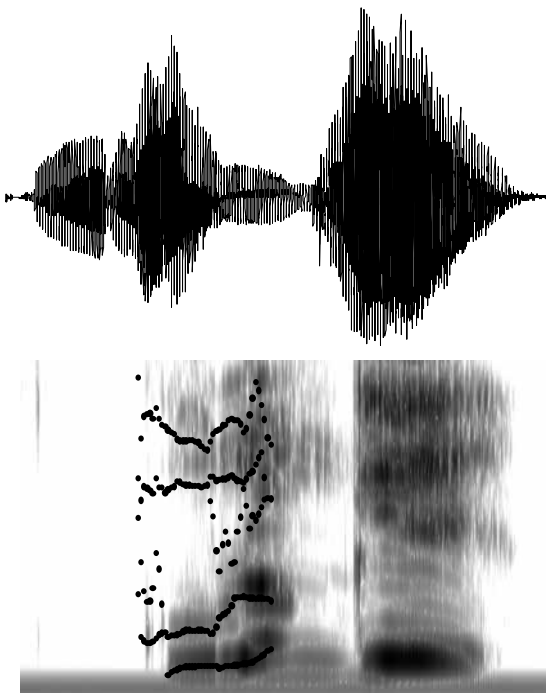


Fig.3a shows the formants  $F_1$  and  $F_2$  of the typically developing child

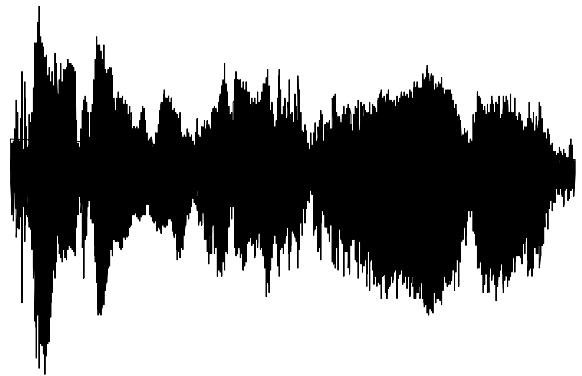


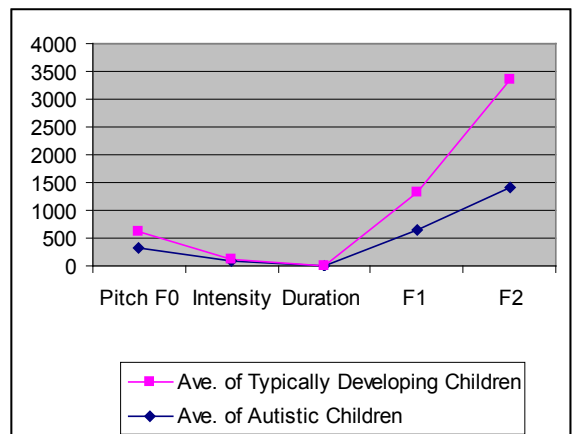
Fig.3b shows the formants  $F_1$  and  $F_2$  of the child with Autism

From fig. 3a and 3b, it is inferred that formants  $F_1$  and  $F_2$  are deviant in Children with Autism when compared to typically developing children.

Table- 3 and graph -3 shows average Pitch, Intensity, duration,  $F_1$  and  $F_2$  of autistic and typically developing children.

Informants	Pitch $F_0$	Intensity	Duration	$F_1$	$F_2$
Average of Children with Autism	321.6275	77.2875	0.748264	640.4625	1407.375
Average of Typically Developing Children	291.2875	54.6	0.59413	674.45	1944.8

Table- 3



**Graph-3**

From table-3 and graph 3, shows an overall picture of deviance found in the pitch, intensity, duration and formants  $F_1$  and  $F_2$  in children with autism is abnormal when compared with typically developing children.

**Conclusion**

The analysis of the present study shows that the speech features are abnormal in Children with Autism. Deviance in  $F_0$  shows the problem in phonation results in sing-a-song speech and atypical phonation. Deviant formants  $F_1$  and  $F_2$  show the improper tongue position in turn shows articulation problem. This study gives an insight to provide remedial measures for articulation and voice therapy which is not until concentrated during therapy sessions.

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