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Acoustical Study of Intonation

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Abstract: The present study focuses on the intonation pattern of human language. The linguists of different areas and sub-areas classified the research on intonation of a language into different approaches/techniques- Structuralist, Generativist, Instrumental, Acoustical etc. This work is based on the acoustical study of intonation.

Keywords: Acoustical study, Intonation, Spectrographic analysis, Pitch.

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INTRODUCTION

Intonation in the broad sense contains all prosodic characteristics of a linguistic utterance that are not tied to a single sound. Since intonational features are an overlay on the segmental individual sounds, they are also called suprasegmentally features [now Auto segmental features]. In the narrow sense, Intonation is the occurrence of pitch as it relates to morphologically defined segments (morph words) in tonal languages. The term ‘tone’ is used to refer to distinctive levels of pitch in a language. The term ‘intonation’ used in this study, refers to the distinctive use of patterns of pitch, tone or melody. Every language has its pattern of pitch/tone/melody, and several ways of analyzing intonation have been suggested by linguists in their approaches. In some approaches, the pitch patterns are described as contours and analyzed in terms of levels of pitch as pitch phonemes and morphemes; in others, the patterns are described as tone units or tone groups, analyzed further as contrasts of nuclear tone, tonicity etc. The three variables of pitch range, height and direction are generally distinguished during phonological representation of a language. In this proposed work, Punjabi language is taken into consideration for phonological representation.

As we already know that intonation patterns can be seen as a sequence of pitch levels, or ‘tones’, but, here, this use of ‘tone’ has to be distinguished from that encountered in the phrase 'tone language', where it refers to the use of pitch to make contrasts of meaning at word level. So in this study the prosodic word level is extended to intonational phrase level. As described by [1, pg. 210], prosodic word is a part of phonological phrase (also known as Intonational Phrase) so the universal prosodic hierarchy will be described in terms of a grammar of Intonation in this proposed work.

AIMS AND OBJECTIVES

The proposed study is aimed at focussing on the intonational patterns. The main aim of this study is to analyze the intonational process of Punjabi with the help of the non-linear model of generative phonology. Actually the intonation process is not a word-based process, in fact it functions at the utterance level of the speech process. Hence, the objective of this study is related to examining the phenomena of the intonation at the level of phonological phrase, and to view the role of intonational phrase within the utterance as a unit in the context of Punjabi language. This study as already discussed earlier, intends to focus on the role of pitch patterns (also known as intonational pattern) in the intonation process. As we know, pitch plays as important role in Intonation process. As [2, pg. 483] says: “Pitch is used phonologically in an intonational function when significant melodic patterns of pitch-movement are distributed over units larger than the single word”.

Review of Work on Intonation in Punjabi

Some work on intonation in Punjabi has been done by scholars like Bhatia (1993); Kalra (1982); Malik (1995); Joshi (1989); & Singh (2007 & 2014). These scholars have not dealt with the problem at length but have given brief insights.

The pitch pattern (=international pattern) of Punjabi has been seen by [3, pgs. 345-346] to be

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consisting of at least four different major types of intonational patterns, which are the following:

- High-fall ↘
- High-rise ↗
- Rise & fall
- Mid-level

These intonation contours can be seen in the examples given below:

1. mai jana nai caunda
   I go (Inf) neg want-prst-m.s.
   "I do not want to go"
2. o kal otthe gia si?
   he yesterday there go-pst-m.s. was
   "Did he go there yesterday?"

Example (1) shows the high-fall intonation pattern and example (2) the high-rise patterns. It can be seen in the above examples that Bhatia's (1993) distinction of intonation patterns has syntactic rather than a discourse function, because intonation peaks are generally positioned either on the negative particle or on the question word as in the examples (1) and (2). Bhatia, however, has not looked at the elements of the phrase or sentence in discourse contexts. The above examples show variations in pitch patterns based on some context hence, there is a need to look at the intonation patterns of Punjabi in detail.

[4, pgs. 296-315] has tried to relate tone with intonation process in Punjabi. According to him "Tone and intonation are cumulative". He finds contextual influence of the neighboring units, as shown in the following nine possible combinations, viz., Low tone preceded by Low, Mid or High tone; and High tone preceded by Low, Mid or High tone; Mid tone preceded by Low, Mid or High tone. Let us look at an example given by Kalra (1982).

e.g. one guná kita
he crime committed
"He committed a crime"

In this example, he says, the mid tonal contour of [one] lowers the pre-tonal syllable [gu-] which further lowers the onset of the following high tone in [-na]. This perception of intonation needs to be further studied. Kalra has not looked into the problem in detail. More data needs to be collected and analyzed to see how the cumulative effect of tone in an utterance works out.

[5, pg. 330] classifies intonation as phrase pitch. According to him, the Punjabi intonation morphemes or intonemes are made out of six ultimate phonologic constituents: three pitch-levels (PLs) and three terminal contours (TCs). He further states that the pitch-levels are contrasting phonemic levels, relative and not absolute in terms of frequencies. The three pitch-levels as shown by Malik are as follows:

- Low,
- High and
- average Middle pitch

In fact intonation in Punjabi needs to be looked at in more detail. E.g. the intonation in the grammatical contexts of imperatives, interrogatives, complex and compound constructions etc. have not been fully dealt with.

Joshi (1989) for the first time tried to work on intonation in Punjabi. Joshi described different patterns of pitch in Punjabi language but all his examples show changes in the clauses and not in the sentence as an intonation unit.

Singh (2007 & 2014) investigates the Punjabi intonation with the help of spectrographic analysis which is considered as the most advanced technique in the speech analysis [based on my Ph.D. thesis submitted in 2007(University of Delhi)].

PROCEDURE AND ANALYSIS

Some experiments may also be designed by employing techniques of acoustic phonetics to verify the main findings of the analysis. Spectrographic analysis is a common technique to analyze the intonation pattern. The physical properties of human speech are very useful for the speech analysis of the language data which is provided by the spectrograph of the intonation of a particular language.

Procedure

The investigation of the intonation pattern can be done with the concrete measurement and experimentation by applying certain acoustic parameters. In the current studies, the following three acoustic parameters are selected:

- Duration
- Pitch
- Intensity

All above mentioned parameters were selected in my previous work (2007) for the acoustic analysis. In several different experimental studies, certain software's have been used for doing different types of spectrographic analysis. I have been using PRAAT program for the study of spectrogram, pitch movements and waves since 2002 i.e. during the period of my Ph.D. research work. In the current research paper, the same program but with advanced version of PRAAT was used to analyze the intonation pattern of an ideal speaker of Delhi based Punjabi male.

Analysis

Analysis consists of measurements of intonation pertaining to the utterances in the form of three different sentences (as in example 1) in a single sample [the sample is similar to one of the examples of my previous work (2007 and published in 2014) but this

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sample is collected from the recordings of the different speaker (or subject who was not the part of my previous work) therefore all results are also different]. These sentences are digitized by PRAAT (version 4.2/4200) of program at the sampling rate of 22050Hz. The pitch, duration and intensity of these forms of sentences are measured for further analysis. The sentence for the analysis is as follows [along with PRAAT Pictures as Figures 1 and 2]:

1. e.g.
tusã: ra:m di ta:ri:f kittisi. kittisi nã:? hɛ̃ nã:?
"you" "Ram" "of" "appritiation" "did" "did" "not" "didn't"
"You praised Ram. Didn't you? Didn't?

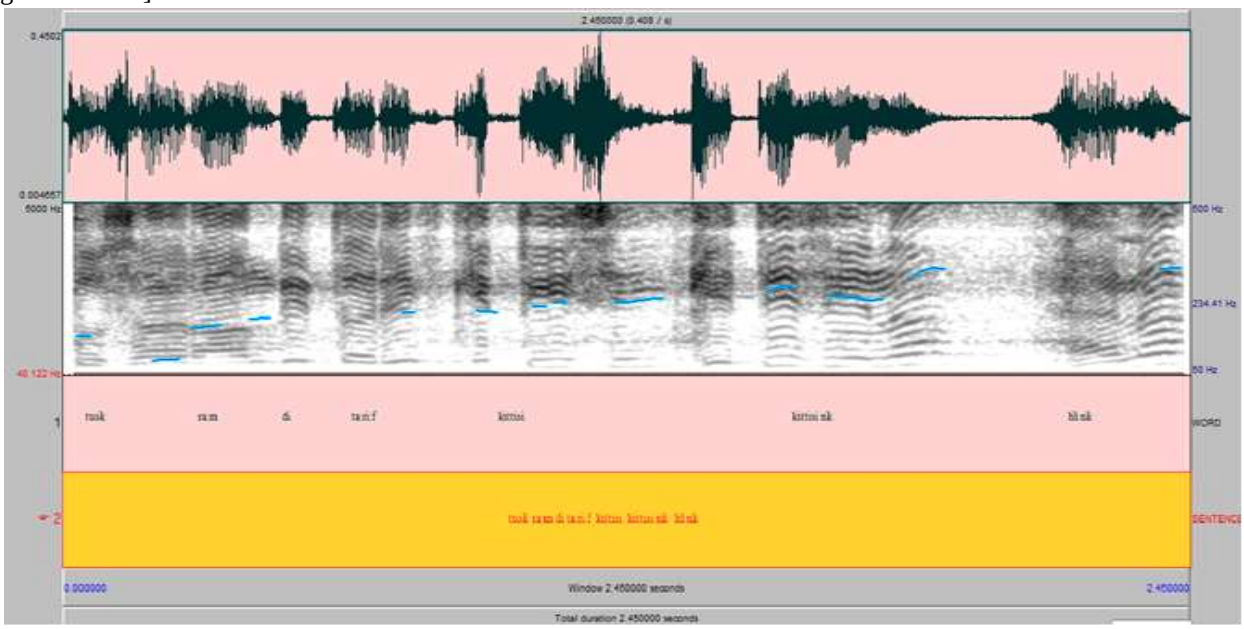

Figure 1: Spectrographic analysis of sentences with text-grid of two tiers [WORD&SENTENCE]

The above spectrographic analysis provides the following measurements:

Pitch Measurements -
Minimum- 90.96 Hertz
Maximum- 330.89 Hertz
Average- 234.41 Hertz

Intensity Measurement-
Intensity- 81.06 dB

Duration-
Total duration (selected/extracted) - 2.45 sec.

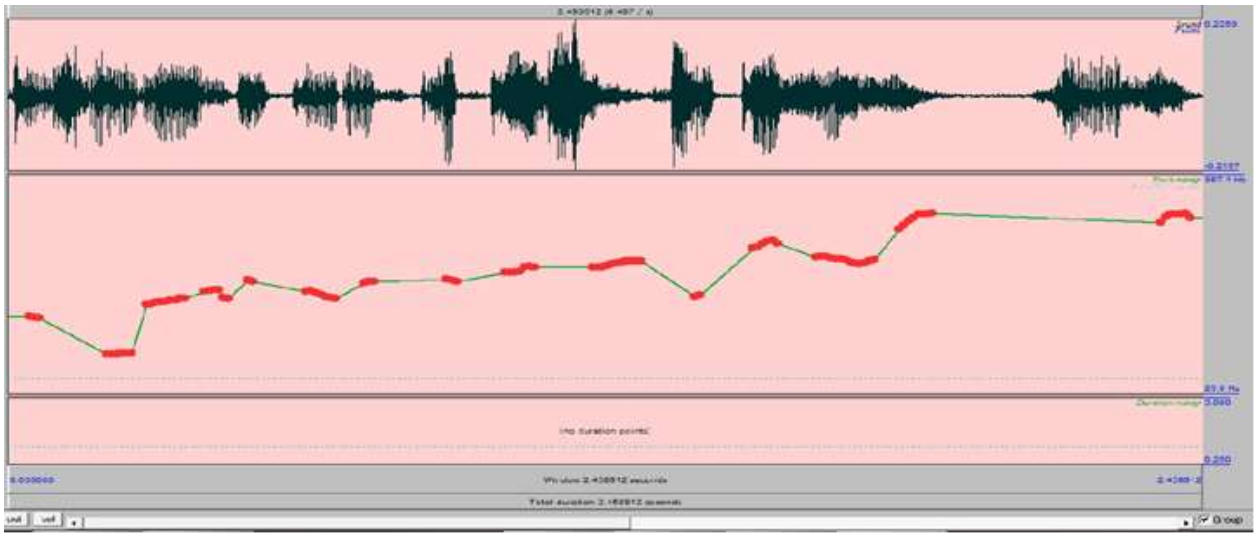

Figure 2: Intonation patterns of the Sentences

The above figure i.e. Figure 2 shows the intonation patterns of three different forms of the sentences. This figure demonstrates the fall and rise of the intonation on different points and these points are

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denoted by the thick red dots for different pitch movements. Figure 3 demonstrates the falling and rising pitch sequences of the intonation.

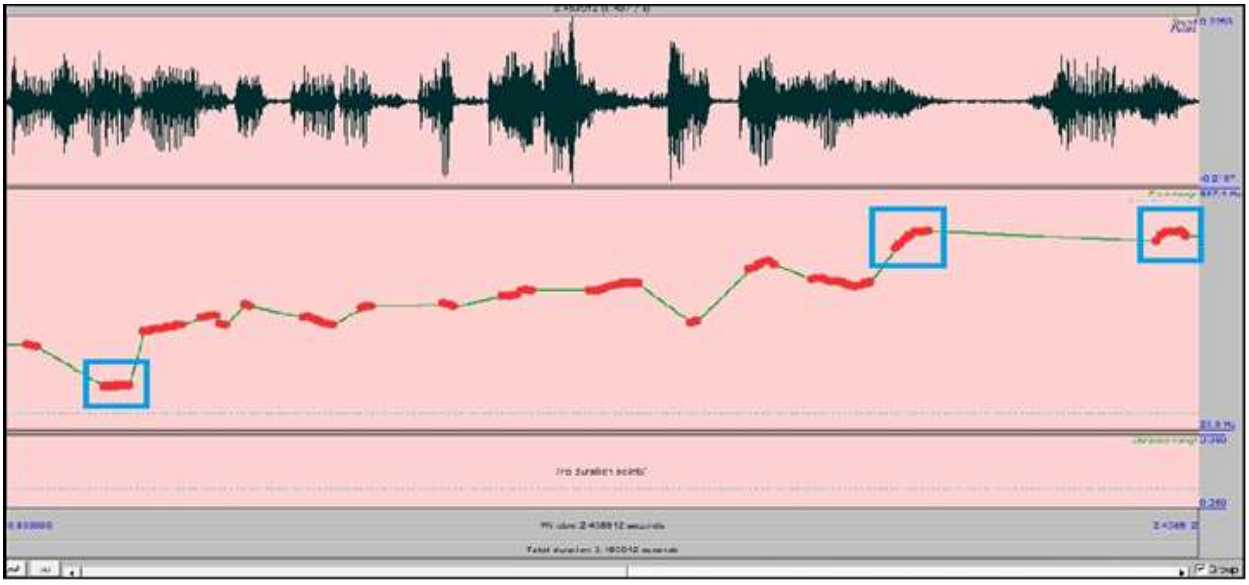

Figure 3: Falling and Rising pitch sequences of the sentences

In Figure 3, the sequences of different pitch movements are shown by the blue rectangular boxes.

Outcome

The acoustic results of the above mentioned sentences of a sample (in e.g. 1) show the interesting changes in the intonation sequences. To understand the acoustic impact, we have to review the acoustic measurements given above. According to the available measurements, the difference between maximum and minimum pitches is 239.93Hz. with Intensity- 81.06 dB and duration-2.45 sec., which is a crucial leap in the pitch movements from Minimum- 90.96 Hz. to Maximum- 330.89 Hz. Figure 3 clearly demonstrates that there is a fall in pitch in word ***tusã:(you)*** as already marked by the first rectangle from the left side of the PRAAT picture and the rest two rectangles show the rise in the pitch at two points- ***kittisi nã:? hɛ̃ nã:?(Didn't you?, Didn't?)*** specially at the negation parts of the utterances.

CONCLUSIONS

The acoustical study of intonation covers different technical angles of speech technology, language communication and language teaching. The data for the analysis in the current work was recorded in Delhi area of an educated Punjabi speaker. The focus of the study to demonstrate the different pitch patterns of Punjabi with the help a software- PRAAT. This study includes the acoustic parameters to measure intonation patterns along with the pitch sequences in Punjabi language. The results show that in the tag form we notice the steep rise in the pitch, which also indicate a confirmation including the tag question.

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