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Acoustic Correlates of Stress in Konkani Language

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Abstract

Stress is an extra effort put on a word or a syllable or a phrase to emphasize special meaning. The acoustic cues for stress include fundamental frequency, increased amplitude, lengthened duration and increased vowel quality. Thus cues vary depending on the languages.

The acoustic correlates of stress in Konkani language is not well understood. Hence the present study attempted to investigate the acoustic correlates of stress in Konkani language. A total of 10 subjects in the age range of 18-40 years participated in the study. Ten naïve speakers of Konkani language were asked to speak two word phrases (adjective + noun) with and without stress on the adjectives. Praat software was used to extract peak f₀, peak intensity and duration of the first word (adjective) in both the conditions. Independent t test was employed to compare the significance of differences of means between the stressed and unstressed conditions.

The results revealed significant increase in word duration in stressed conditions when comparison to unstressed condition in all the speakers at $p < 0.001$. The increase in duration in stressed conditions may be attributing towards the differences between long and short vowels in Konkani language.

Introduction

Stress is an extra effort put on a word or a syllable or a phrase to emphasize special meaning. It has been called the most elusive of all prosodic features (Lehiste, 1970) which refers to accentuation or emphasis, laid on syllable or word.

The acoustic correlates for stress include fundamental frequency, increased amplitude, lengthened duration and increased vowel quality. These cues vary depending upon the language. The relative importance of f₀, intensity and duration as acoustic correlates of stress has been studied experimentally in several languages by various researchers.

In languages such as English (Bolinger, 1958; Morton & Jassem, 1965), French (Rigault, 1962) and Polish (Jassem, Morten & Steffen-Botog, 1968), fundamental frequency is reported to be the major correlate. Duration is found to be the major correlate of stress in Swedish (Westin, Buddenhagen & Obrecht, 1966), Estonian (Lehiste, 1968a) and Italian (Bertinetto, 1980).

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There have been very few studies done on acoustic correlates of stress with respect to Indian languages. Among Indian languages like Tamil (Balasubramanyam, 1981) and Kannada (Savithri, 1987; Raju Pratap, 1991; Savithri 1999 a, b), duration is reported to be the major correlate of stress and duration and fundamental frequency in Hindi (Ruchi, 2007). Thus, the major acoustic correlates of stress differ depending upon the languages.

The same has not been explored in many Indian languages. Konkani is one such language which has not been focussed in many studies till date. Konkani is a language of India, and belongs to the Indo-European family of languages. It is an Indo-Aryan language, spoken on the west coast of India called Konkan (Cited in Wikipedia). It includes a significant number of loan words derived from Dravidian languages including kannada and tulu.

Need for the study

As the acoustic correlates of stress vary depending upon the language, there is a need to study stress in different languages. There have been no studies reported on acoustic correlates of stress in Konkani language and so, the same was investigated in this study.

Aim of the study

To study the acoustic correlates of stress in Konkani language.

Method

Subjects

A total of 10 adults in the age range of 18 to 40 years were taken for the study. Five males and five females were included to reduce the gender effect. The subjects were selected based on the following criteria:

- None of the subjects had history of any speech, language or neurological symptoms.
- None of the subjects had any history of otological symptoms
- All the subjects had received formal education up to 10th grade.
- All the subjects included in the study were from the Roman Catholic community with Konkani as mother tongue.

Materials used

Stimuli consisted of 10 two word Konkani phrases, the first one being the adjective and the second being a verb in each of the phrases. It was ensured that all adjectives selected were bisyllabic and none of the syllables were aspirated or had geminate clusters. The appendix details on the stimuli used for the study.

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Procedure

The subject was seated comfortably in a chair in a sound treated room. The subject was instructed to read the given material, first without stressing on the phrases and then to read by stressing on the adjective in each of the phrases. The microphone was placed at a distance of 10 cm from the subject's mouth for the recording. The order of reading was maintained for all the subjects. Praat software (version 4.1.21) was used for analysis of fundamental frequency, duration and intensity in both stressed and unstressed conditions. Mean and SD of the three acoustic correlates in both conditions were computed. Independent t test was employed to find out the significant difference between stressed and unstressed condition.

Results

The present study investigated the acoustic correlates of stress in Konkani language in adult speakers. The results revealed significant difference for peak f0 between stressed and unstressed conditions in males {t (98) = -5.433, p < 0.001} and females {t (98) = -4.041, p<0.001}. Table 1 shows the mean and SD of peak f0 in both the conditions.

Condition	Male	Female
Stressed(S)	175(19)	246(21)
Unstressed(US)	154 (17)	246(26)
S-U	21	0

Table 1. Mean & SD (in parenthesis) of peak f0 in two conditions.

As for the peak intensity, no significant difference between stressed and unstressed conditions was observed in both the genders. However, peak intensity was higher in stressed condition compared to unstressed condition. Table 2 shows the mean and SD of peak intensity in both conditions.

Condition	Male	Female
Stressed(S)	68(3)	65(0.72)
Unstressed(US)	67(2)	65(0.77)
S-U	1	0

Table 2. Mean and SD (in parenthesis) of peak intensity in two conditions.

A significant difference between stressed and unstressed conditions for the word duration was observed {t (98) = -4.418 p < 0.001}. Table 3 shows the mean and SD of word duration in both the conditions.

Condition	Male	Female
Stressed(S)	0.56(0.15)	0.640(0.11)

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Unstressed(US)	0.47(0.12)	0.444(8.77)
S-U	0.9	0.196

Table 3. Mean and SD (in parenthesis) of word duration (ms) in two conditions.

Discussion

The present study investigated the acoustic correlates of stress in Konkani language. The Peak F0, intensity and duration were compared in both stressed and unstressed conditions for all the stimuli. The results revealed higher F0, intensity and duration in males and higher word duration in females. The S-ratio (difference between stressed and unstressed words) was 21Hz, 1dB, 0.9 ms in males and 0 Hz, 0 dB, 0.196 ms for f0, intensity and word duration in females respectively. The fundamental frequency and intensity differences were not consistent across the gender. Hence F0 and intensity cannot be considered as a reliable cue for stress in Konkani language. It is possible that experimental condition had an effect on the male speakers.

From the above observation, it can be concluded that duration may be a cue for stress in Konkani language. A similar finding was reported in several other languages like Swedish, Estonian, Italian, Tamil and Kannada. (Westin, Buddenhagen & Obrecht, 1966; Lehiste, 1968a; Bertinetto, 1980, Balasubramanyam, 1981; Savithri, 1987; Raju Pratap, 1991; Savithri 1999 a, b) But in English, French and Polish languages, fundamental frequency was the primary correlate of stress (Bolinger, 1958; Morton & Jassem, 1965; Rigault, 1962; Jassem, Morten & Steffen-Botog, 1968). Duration is found to be the major correlate of stress in Swedish (Westin, Buddenhagen & Obrecht, 1966), Estonian (Lehiste, 1968a) and Italian (Bertinetto, 1980).

The increase in duration in stressed conditions may be attributing towards the differences between long and short vowels in Konkani language. Hence duration was used consistently by all the speakers to cue stress. Konkani is an Indo-Aryan language, spoken on the west coast of India with significant number of loan words derived from Dravidian languages including Portuguese, Kannada, Tulu, Marathi and Persian. It is interesting to observe here that durational cues are used for the identification of stress in Konkani as well as Kannada. The fact that the present study was conducted in an area where Kannada is the main language used for communication in the community may also be contributing towards this finding.

Conclusions

In the present study, acoustic correlates of stress were studied in Konkani speaking adults. The results showed that there is a significant increase in word duration consistently across the conditions in all the participants considered for the study. Therefore, it is possible that a Konkani speaker uses duration as a cue to indicate stress. This information would enable us to understand acoustic correlates of stress in Konkani language as well as in the assessment and treatment of prosodic disorders in Konkani speakers.

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APPNDIX 1: TEN KONKANI PHRASES

SL.NO.	STIMULI
1.	əambde kapa:d
2.	la:mb kes
3.	sobiə dolei
4.	la:n burge
5.	hun əople
6.	vichiər ka:ni
7.	Vodlo ro:k
8.	əi:k kadi
9.	ba:rik chedu
10.	boro monis

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