ASPECTS OF EMOTIONAL PROSODY IN MALAYALAM AND HINDI

ABSTRACT

Emotional prosody is considered as the ability to express emotions. Intonation is one parameter of prosody that gives information on the production aspects of emotions. The aim was to study the intonation patterns in two languages, Malayalam and Hindi, from two different language groups in India and also to document if there are differences in the patterns produced across gender groups. Eight native speakers of Malayalam and Hindi, in the age range of 18-40 years were considered for the study (two males and two females for each of the languages). Simple sentences with five basic emotions were used as the stimuli and the samples were recorded in Motor Speech Profile software (MSP) of Computerized Speech Lab 4150. The patterns were plotted using the PHH model. Acoustic data were subjected to statistical analysis, using Mann Whitney U Test (SPSS Version 16).The results of this study reveal that across the five emotions, the terminal intonation pattern has a falling contour, except for the emotion of anger in females, which has a raising contour. This was observed in both the languages. On subjective observation, there were instances of differences in the patterns across the genders, but these were not statistically significant.

INTRODUCTION

Prosody, being an important and integral part of spoken language can be classified as linguistic and emotional prosody (Raithel & Hielscher-Fastabend, 2004). Linguistic prosody is used to disambiguate or to mark the internal organization of sentence constituents or to convey the intonation contour of a sentence (Lieberman, 1968). On the other hand, emotional prosody is defined as the ability to express emotions. Emotions influence a person's way of speaking, and it is possible to identify the emotional state of a speaker by merely listening to spoken utterances. Supra segmental features of a sentence are highly variable to different emotional states.

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The difference between linguistic and emotional prosody is its lateralization in the brain. Emotional processes, music, holistic thinking, emotional experiences, and visual spatial relations are lateralized in the right hemisphere. It still remains unclear in which hemisphere linguistic prosody is lateralized. Some hypothesize that all prosody is lateralized to the right hemisphere, while others state linguistic prosody is dependent on the subcortical processes and not localized to any hemisphere (Bryan, 1989). There are also evidences from the brain damaged individuals that substantiate these views. Right hemisphere damaged individuals have been reported to perform poorly in the perception and production of emotive intonation compared to left hemisphere damaged or non-brain damaged (Ross, 1981). Damage to both the cortical and subcortical structures are reported to give rise to impaired prosody (Kent & Rosenbeck, 1982).

Emotional prosody can be studied as events of perception and production. Intonation is one parameter of prosody that gives information on the production aspects. Intonation is referred to as the phenomenon which has a very clear center of pitch contrast, and a periphery of reinforcing and occasionally contradicting contrasts of different order (Crystal, 1969). That is, it projects the variation in fundamental frequency (F0) superimposed on the sentence (Bollinger, 1972). Thus, it can be hypothesized that pitch patterns or contours can signal linguistic and emotional aspects of speech.

Intonation patterns are specified as an abstract sequence of high and low tones. These tones have no absolute physical value. Rather, they are implemented relative to each other through the manipulation of pitch and the fundamental frequency (F0) of the voice (Ladd 1996). There is no real agreement amongst phonologists about the exact number of intonation patterns in speech, but all agree on at least four. These include the low tone (L), high tone (H), low-high tone (LH) and high-low tone (HL) as shown in Table 1.

Table 1: The fundamental frequency (F0) patterns commonly seen in languages

S No:	Intonation types	Pitch patterns
1.	Fall	↘
2.	Fall - Rise	↘↗
3.	Rise	↗
4.	Rise - Fall	↗↘

Some studies also analyze intonation according to the PHH model proposed by Pierrehumbert and Hirschberg (1990). The model's units are the simplest possible code levels of relative pitch: High pitched peaks, H: low pitched regions, L: and combination of these events with stress (*) and end of utterance (%). Thus, the F0 patterns are described as series of high and low tones relative to each other.

There have been a few attempts made to study intonation patterns in Indian languages. Studies on expression of emotions of anger, frustration, grief, joy, jealousy, neutral, surprise and worry were done in Tamil, Malayalam, Telugu and Bengali languages. Emotions in Tamil were characterized by final fall F0 pattern and fear was characterized by final rise patterns (Varshini & Nataraja, 2000). While in Malayalam and Telugu languages all types of emotions were characterized by final fall patterns (Mini & Nataraja 2000; Sandhya & Nataraja, 2000). In Bengali, all emotions had terminal falling F0 patterns except those expressing fear and surprise (Saha & Nataraja, 1999). Another study in Punjabi done on emotions of anger, happiness, sadness and neutral revealed that emotions with more excitement were spoken with raising F0 patterns, whereas the less excited emotion was spoken with falling contour (Dawood, Shahid, & Touqeer, 2004).

The above studies also noted that female participants used varying F0 patterns when compared to males in all the languages. This finding is not similar to that of a study done by (Raithel & Hielscher, 2004), who concluded that there is no difference between genders concerning their ability to perceive and express emotional prosody in German language.

As can be understood the concepts of emotional prosody are not well explored in India. Being a mulitilingual country, there is a wealth of information to be obtained by studying these aspects in the various languages. This would provide speech language pathologist an understanding on the normal and abnormal aspects of prosody, which would aid in the assessment and management of prosodic errors in individuals with communication disorders. This would also throw some light on the parameters of prosody that need to be incorporated for the synthesis of speech in the Indian languages.

Need for the study:

Emotion in speech' is a topic that does not receive much attention. There is a paucity of information and studies done with respect to intonation patterns and the influence of language and gender on emotional prosody. Study of prosody with respect to the production of emotions in any language yields information on the essential suprasegmental aspects of speech which adds meaning and melody to a speaker's production. Knowledge of the normal patterns of prosody aids in the understanding of abnormal aspects, as in the case of communication disorders. Also, such database can be incorporated in the corpus for speech synthesis. Synthetic speech is widely being used in the

field of mass media and communication as well as in the field of speech and hearing, especially with respect to the development of speech stimuli as part of test procedure. Thus, an attempt is being made in this study to understand the intonation contours, expressed as changes in F0 patterns, for two languages, Malayalam (a Dravidian language) and Hindi (an Indo-Aryan language).

Objective of the study:

This study aims at understanding the F0 patterns in the production of emotions in two languages, Malayalam and Hindi, from two different language groups in India and also to document if there are differences in the patterns produced by male and female speakers of the respective languages.

METHOD

Participants: Four native speakers of Malayalam and Hindi, in the age range of 18-40 years participated in the study. There were two males and two females for each of the languages. All the participants were normal healthy individuals, devoid of speech and language problems, neurological symptoms and hearing disorders.

Protocol:

a. Preparation of test stimuli: Simple sentences randomly chosen from books served as test stimuli in both the languages. These sentences had emotion laden words which easily depicted the most commonly occurring emotions anger, fear, jealousy, joy and sadness. Three sentences were selected for each emotion.

b. Instrumentation: Motor Speech Profile software (MSP) of Computerized Speech Lab 4150 from Kay Elemetrics, New Jersey was used.

c. Procedure: The recording was done in a sound treated room, with the participant seated on a comfortable chair and the microphone of the CSL hardware was placed at a constant distance of 10 cm away from the mouth. The participants were visually presented with the sentences written on cards one by one and instructed to say the sentences with the appropriate emotions. They were also provided with a model of how each sentence had to be uttered with the specific emotion. Each sentence was recorded thrice and the second repetition was considered for the analysis.

d. Acoustic analysis: For the purpose of computing the intonation patterns, only one sentence for each of the emotions was selected. The sentences are as included in Appendix 1.

The F0 patterns for these sentences were plotted from the spectrograms obtained in CSL, by an experienced speech language pathologist using the PHH model of intonation; H for high tone, L for low tone, (*) to mark the stress and (%) to mark the end of utterance.

For the acoustic analysis, the following parameters from MSP were considered: (1) rfo (running speech average fundamental frequency, /Hz/)- this is the average Fo of during the vocalization; (2) rFhi (running speech highest fundamental frequency, /Hz/)- this is the highest Fo during the vocalization; (3) rFLo (running speech lowest fundamental frequency, /Hz/)- this is the lowest Fo during vocalization; (4) rvFo (running variability , /%/)- this is a parameter which tracks the degree of pitch variability; (5) rvAm (amplitude variability , /%/)- this is a parameter which tracks the degree of amplitude variability. The analysis was carried out separately for Malayalam and Hindi languages.

The readings from MSP were subjected to statistical analysis, using Mann Whitney U Test (SPSS Version 16) to explore the possibilities of gender differences in the production of emotions.

RESULTS AND DISCUSSION

This study aimed at understanding the F0 patterns in the production of emotions in Malayalam and Hindi and also to document the differences in the patterns produced by male and female speakers of the respective languages.

Within each language, the F0 patterns did not vary among the participants of each gender. This was observed throughout for all the emotions under consideration, thus only one pattern has been plotted for reference. Patterns of the F0 variations plotted for the emotions in Malayalam and Hindi are as shown in Table 2.

1) F0 patterns for emotions in Malayalam:

As shown in the table 2, the emotion of anger was characterized as LH*L% in males, whereas in females as LH*LH%. Fear was represented as HLH*L% for both males and females. Jealousy was marked as LH*L% in males and LH*LHL% in females. Joy was represented as LH*L% for males and HLH*L% for female participants. Sadness was marked as HLH*L% in males and LH*LHL% in females. It is clear that all the emotions had a terminal falling pattern, except anger which was characterized by a raising pattern in females. Loci of stress were different for the same emotion between and HLH*L% for female participants. Sadness was marked as HLH*L%

Table 2: Intonation patterns for Malayalam and Hindi with respect to the emotions.

Sno	Emotion	Malayalam		Hindi	
		Male	Female	Male	Female
1.	Anger				
2.	Fear				
3.	Jealousy				
4.	Joy				
5.	Sadness				

in males and LH*LHL% in females. It is clear that all the emotions had a terminal falling pattern, except anger which was characterized by a raising pattern in females. Loci of stress were different for the same emotion between males and females. Also, females had multiple points of emphasis in most emotions. Thus, the intonation patterns differ for males and females for all emotions, except fear. It was also observed that, the females had emphasis on multiple words than the males, who stressed mostly on only one word in the sentence.

2) F0 patterns for emotions in Hindi:

As shown in the table 2, The F0 patterns for the emotion of anger were characterized as HLH*L% in males and HLH*LH% in females. Fear, jealousy and sadness were the same for the male and female participants. It was represented as LH*L%. Joy was characterized as LH*LHL% in the males and LHLH*L% in females. As can be seen, all the emotions had a terminal falling pattern, except anger which was characterized by a raising pattern in females. Also, the emotions of fear, jealousy, joy and sadness had similar F0 patterns for both males and females. For the emotions of anger and joy, it was seen that the loci of stress were different for males and females. It was also observed that, the females had emphasis on multiple words than the males,

who stressed mostly only on one word in the sentence. Thus the patterns varied.

Table 3 gives the mean for parameters that assess variation of F0 pattern for males and females, in Malayalam and Hindi for the five emotions under consideration.

3) Fundamental frequency variations for emotions in Malayalam:

From Table 3, it can be understood that there is no statistically significant difference between the males and females in all the F0 parameters across all the emotions, in Malayalam.

4) Fundamental frequency variations for emotions in Hindi:

From Table 3, it can be understood that there is no statistically significant difference between the males and females in all the F0 parameters across all the emotions, in Hindi.

In summary, a comparison of the trends of intonation patterns for both Malayalam and Hindi indicates that, the terminal F0 pattern for all the emotions is a falling contour. The exception to this observation was the emotion of anger in females, which had a raising terminal contour in both the languages. The finding of falling intonation contour for all the emotions are in coherence with the study done previously in Malayalam and Telugu (Mini & Nataraja 2000; Sandhya & Nataraja, 2000).

Another interesting observation is that, on the spectrographic analysis, there were instances of different intonation patterns between males and females, across few of the emotions. This was seen in both the languages. The reason for this difference in the patterns can be primarily attributed to differences in the loci of stress among the genders. Females demonstrated multiple loci within a sentence for most of the emotions. One could also make an assumption that females show variation in the production of emotions. But, the acoustic analysis revealed that there were no significant differences between the genders for any of the parameters of intonation. This finding is not in coherence with the studies done in Tamil, Malayalam, Telugu and Bengali, which report that females are different in their intonation patterns than males for all the emotions considered (Varshini & Nataraja, 2000; Mini & Nataraja 2000; Sandhya & Nataraja, 2000; Saha & Nataraja, 1999). But it is similar to the study done in German language where they concluded that there was no difference between the genders concerning their ability to perceive and express emotional prosody in German language (Raithel & Hielscher-Fastabend, 2004). This phenomenon of differential trends among males and females, of varied linguistic backgrounds, in the production of emotional prosody needs to be explored.

Table 3: Mean F0 pattern in Malayalam and Hindi for the five emotions

Language	Emotion	rfo M Mean	rfo F	rfo Z	rfo P value	rfhi M Mean	rfhi F	rfhi Z	rfhi P value	rflo M Mean	rflo F	rflo Z	rflo P value	rvfo M Mean	rvfo F	rvfo Z	rvfo P value	rvam M Mean	rvam F	rvam Z	rvam P value
Malayalam	Anger	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.50	2.50	.000	1.00
	Fear	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.00	3.00	-.775	.439	2.50	2.50	.000	1.00
	Jealousy	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.00	3.00	-.775	.439	2.00	3.00	-.775	.439
	Joy	1.50	3.50	-1.54	.121	2.00	3.00	-.775	.439	2.50	2.50	.000	1.00	2.50	2.50	.000	1.00	3.00	2.00	-.775	.439
	Sadness	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.00	3.00	-.775	.439	2.50	2.50	.000	.439
Hindi	Anger	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.50	2.50	.000	1.00
	Fear	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.00	3.00	-.775	.439	2.50	2.50	.00	1.00	3.50	3.50	-1.54	.121
	Jealousy	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	2.50	2.50	.000	1.00	2.00	3.00	-.775	.439	2.00	3.00	-.775	.439
	Joy	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-.154	.121	2.00	3.00	-.775	.439	2.50	2.50	.000	1.00
	Sadness	1.50	3.50	-1.54	.121	1.50	3.50	-1.54	.121	1.50	3.50	-1.59	.121	3.00	2.00	-.775	.439	2.00	3.00	-.775	.439

*Note: 0.05 level of significance considered

Also, there were the findings of intonation patterns being the same for different emotions in both the languages between males and females. In Malayalam, only the emotion of fear was same for both genders. While in Hindi, emotions of fear, jealousy and sadness had similar patterns for males and females. Thus, it can be understood that there are more differences in the production of emotions among the genders in Malayalam than in Hindi. This is contrary to the studies done in Tamil, Malayalam, Telugu and Bengali, which report a uniform pattern of difference in the production of emotions between males and females (Varshini & Nataraja, 2000; Mini & Nataraja 2000; Sandhya & Nataraja, 2000; Saha & Nataraja, 1999). But this statement needs further verification with larger sample size.

CONCLUSION

This study intended to identify the trends of emotional prosody in two different languages, Malayalam and Hindi, from the Speech Profile software (MSP) of Computerized Speech Lab 4150 from Kay Elemetrics. A comparison of the intonation patterns for both Malayalam and Hindi indicated that there are differences and similarities in the F0 patterns across the different emotions and indicates that the speakers of the two languages express emotions differently. It was also noted that female participants had more loci of stress than the males which was observed for both the languages. It was also concluded that there are no gender differences in the production of emotions in Malayalam and Hindi. There were few instances of the F0 patterns being different for certain emotions between males and females. But these differences were not reflected in the acoustic analysis. Further, it can be suggested that more studies are required with respect to other languages in India. One can arrive at a comprehensive picture by including more number of participants and also considering the aspects of linguistic prosody and stress patterns. In general, this study substantiates the need for understanding and developing the normative values for the Indian population in various languages which will aid the speech language pathologists in the assessment and management of various communication disorders.

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APPENDIX 1:

Sentences in Malayalam:

1) Anger: / pe:pəril opə vaŋa:n ni: mərənə po:jo /
2) Fear: / enikˆ vi:til ɵənitʃirika:n pe:dija:nə /
3) Jealousy: / enikum əvəlude: po:le oru puɵij kupa:jam venˆm /
4) Joy: / enikə ipraviʃˆm lotˆri aditʃu /
5) Sadness: / enikə ɵo il onumila /

Sentences in Hindi:

1) Anger: / ɵu: kagaz pˆr sain karva:na bhul gˆja hai /
2) Fear :   / mudze: gʰˆr me: ake:le rehˆnese: bahuɵ dˆr lˆgɵa: he /
3) Jealousy: / mudze: bhi uske: dzaise sundʰˆr kˆpˆdei tʃa:hie /
4) Joy: / me: is ba:r lotˆri dzi:ɵ gəja /
5) Sadness: / me: be:ro:zgʰa:r hu: /

[Transcribed according to the International Phonetic Alphabet, revised to 2005]