DISTINCTIVE FEATURES IN MALAYALAM

ARATHI VENKATARAMAN

Introduction:

"I find my position as an articulate mammal
bewildering and awesome.
Would to God I were a tender
apple blossom"

—OgdenNash

Human beings do really find themselves at times in most bewildering of positions when encountered with delicate subtelities and intricacies of language, of these permutations and combinations of sounds which are used to naturally emit. Language is built of words, words or sounds or phonemes and phonemes of features, which are distinctive from each other. The distinctive features can be thus referred to as "building blocks of the phoneme". Speech specialists are interested not only in the combination of various features in the phoneme but also in the way these, *"features"* are acquired, maintained and lost during pathology. Articulation disorders have been recognized as a form of "distinctive feature deviation" (Singh, 1972). Very few studies have been done in India to establish distinctive feature system in Indian languages.

Ahmed and Agarawal (1969), Phalguni Pathak (1982), Ramaswami (1980) have proposed distinctive feature systems in Hindi, Gujarathi and Tamil respectively. Valentine (1977) proposed a system for classifying phonological sejments into the following features :

(1) Back/nonback
(2) Nasal/'nonnasal
(3) Obstruent/nonobstruent
(4) Continuant/noncontinuant
(5) Retracted/nonretracted
(6) Retroflex/nonretroflex
(7) Aspirate/nonaspirate
(8) Palatal/nonpalatal
(9) Retracted/nonretracted nonlateral non obstruent

(tO) Coronal/noncoronai

(11) Lateral/nonlateral

(12) Retracted/nonretracted nonconsolital obstruent

(13) Voiced/voiceless

The purpose of the present study was. to-

1. Establish a distinctive feature system for 38 phonemes in Malayalam.
2. To find acoustic correlates of the proposed features.
3. To find out the information carried out by each of the features
4. To find if there is a difference between Malayalam and non-Malayalam speaker with respect to nasal phonemes and other minimal pairs when presented in a quiet situation

METHOD :

A distinctive feature in Malayalam was proposed on the distinctive feature system (Valentine, 1977). Modifications of this system was done in the sense that only the broad classification of retracted/nonretracted was taken. The other features proposed are given in the earlier part of the paper.

Two experiments were carried out in order to find acoustic and perceptual correlates of the proposed feature system.

1. Spectrographic/acoustic analysis, 2. Perceptual analysis.

STIMULI : 308 word pairs differing atleast by one feature were constructed using Gunderts Nikhandu (1962).

SPEAKER : A native speaker of Malayalam served as the speaker.

PART I : ACOUSTIC ANALYSIS

EQUIPMENT: Speech spectrograph VIC MK 700.

PROCEDURE : 37 and 38 phonemes were selected and were subjected to-acoustical analysis. Recording was done in a quiet condition and intensity was monitored by VU metere Wide band spectrograms were obtained using VIC MK 7OO

PART II : PERCEPTUAL ANALYSIS

This was done in two parts.

A, 308 words were recorded individually in random order using cassette tape recorder (National Panasonic) and Sony cassette by the experimenter. A gap of approximately 5 seconds was introduced between the words to allow for response from the subjects.

SUBJECTS : 30 subjects (19—39 years) 15 males and 15 females, whose mother tongue was Malayalam. They had no history of speech and hearing problems.

PROCEDURE : The recorded words were played to listeners in a quiet room. The subjects were instructed to repeat whatever they had heard and this was tape recorded.

SCORING : Responses were scored as correct or incorrect The incorrect responses were further analyzed into substitutions.

PART B

STIMULI—Same as Part A.

PROCEDURE—Same as Part A.

SUBJECTS—30 Kannada speakers-15 males, and 15 females (17 to 44 years).

SCORING—Same as Part A

RESULTS AND DISCUSSION :

VOICING +	1. Regular vertical situations in low frequency region which occurs simultaneously with burst indicating voicing lead.
	2. Decreased intensity of burst when compared to its voiceless counterpart.
NASALITY	Presence of low frequency formant tail like appearance.

ASPIRATION	Presence of aperiodic noise in the higher frequencies.
LATERAL	Presence of small gaps associated with vowel like (continuous bars and gaps-consonants).
RETROFLEX	Presence of relatively low frequency energy concentration and upward transition.
CONTINUANT	High frequency turbulance of longer duration.
OBSTRUENT/NONOBSTRUENT	Fill at around 4 KHz.

BACK AND PALATAL : It is not possible to differentiate a back and non-back as these sounds vary only in terms of duration of VOT, as the constriction in vocal tract moves backwards, the duration of VOT increases. Here, the distinction between back/nonback depend upon raising back of the tongue and nonback are tongue tip sounds produced with the anterior l/3rd of the tongue. Only nonback sounds can be divided into palatal (+) and palatal (—). As the duration of the VOT cannot be considered as binary it was not possible to find acoustic correlates of back and nonback. Thus both articulatory and acoustic features become essential in describing the consonants of Malayalam

PERCEPTUAL ANALYSIS :

The responses given by the two groups were analyzed using a confusion matrices. A measure of convariance based on information theory (Shannon and Weaver, 1969) was used to find the information transmission for each feature.

Formula $T(X,Y) = \$ \sum Pij \log \frac{pi\ pj}{Pij}$

T(X,Y) = Information transmission from input variable X to output variable Y in bits/stimulus.

ni = Freqitency of stimulus i

nj = Frequency of responses.

nij = Frequency of joint occurrence of stimulus i and response j in a sample of 'n' observations.

The Table - 1, shows the information transmission for the features, proposed for the two groups viz , Malayalam and Kannada speakers. Further information transmission for the phonemes were also found out using the same formula as shown above. The Tables 2 and 3 show the information in bits/stimulus for each phoneme.

The results indicated that both the groups ranked the features differently The retracted nasal(x/y), /n̲/, are unique to Malayalam language and hence they were identified better by Malayalam speakers. Thus the findings of the present study support the motor theory of speech perception (Liberman, 1970) since the Kannada speakers do not perceive certain phonemes as /n̲/ and /n/r / since they are infrequently used in their language if used at all.

The following conclusions were drawn from the study ;-

1. Malayalam has a distinctive feature system.
2. It is possible to propose a distinctive feature system in Malayalam.
3. Consonants in Malayalam are made of the following features :-

   1) Back/nonback, 2) coronal/noncoronal, 3) palatal/nonpalatal,
   4) retroflex/nonretroflex, 5) retracted/nonretracted,
   6) consonantal/nonconsonantal, 7) obstuent/nocebstruent,
   8) continuant/noncontinuant, 9) nasal/nonnasal,
   10) voiced/nonvoiced, 11) aspirate/nonaspirate.

4. Information value of each feature defers.
5. Each feature has a definite acoustic characteristic.
6. Significant differences found between the listening performances of Malayalam and Kannada speakers when words with minimal pairs are presented in a quiet room situation.

7 There is a significant difference between Malavalam and non-Malayalam speakers with respect to perception of nasal phonemes ; the Malayalam group performing better.

This study has implications for further development of articulation test in Mahyalam, and the study of perception of those with Malayalam as their mother tongue and other groups whose mother tongue is not Malayalam.

TABLE-1

ComparisoB of the information content for the features of the two groups
(Kannada and Malayalam)

SI. No.	Feature	Language Group 1 (Malayalam)	Language Group 2 (Kannada)
1.	Back/nonbaek	0.954051 bits/stimulus	0.98489 bits/stimulus
2.	Nasal/nonnasal	0.612574 bits/stimulus	0.3709865 bits/stimulus
3.	Palatal/nonpalatal	0.57044066 bits/stimulus	0.42650 bits/stimulus
4.	Retracted/nonretracted nonlaferal/non obstruent	0.55219818 bits/stimulus	0.9929 bits/stimulus
5.	Retracted/n®n retracted nasal	0.5143512 bits/stimulus	0,41642 bits/stimulus
6.	Aspirate/non aspirate	0.49947721 bits/stimulus	0 748143 bits/stimulus
7.	Continuant/non continuant	0.463187 bits/stimulus	0.212034 bits/stimulus
8.	Voiced/voiceless	0.42981683 bits/stimulus	0.760904 bits/stimulus
9.	Coronal/noncoronal	0.39456872 bits/stimulus	0.93449 bits/stimulus
10	Obstruent/non obstruent	0.37962598 bits/stimulus	0,748143 bits/stimulus
11.	Lateral/nonlateral	0.360293 bits/stimulus	0.334984 bits/stimulus
12.	Retracted/non retracted non consonantal/ obstruent	0.35292969 bits/stimulus	0.9929 bits/stimulus
13.	Retrofiex/non retroflex	0.3296284 bits/stimulus	0.704669 bits/stimulus.

TABLE 2

Results of the phonemic analysis for information transmission for Malayalam Speakers,

SI. No.	Phoneme	Information	SI. No.	Phoneme	Information
1.	/k/	+ 2.018923	20.	/t/	+ 0 9639826
2.	/t/	+ 1.8214244	21.	/gh/	+ 0.9593396
3.	/d/	+ 1.8018147	22.	/s /	+ 0.9496943
4.	/p/	+ 1.7893997	23.	/ /	+ 0.7628097
5.	/c/	+ 1.6352528	24.	/th/	+0.7243562
6.	/m/	+ 1.6141874	25.	/dh/	+ 0.6600672
7.	/kh/	+ 1.6137475	26.	M	+ 0.6600
8.	/n/	+ 1.5504621	27.	m	+ 0.6339562
9. .	/s/	+ 1.4582572	28.	M	+0.5625502
10.	/s/	+ 1.4037825	28a.	M	+O. 565520
11.	/x/	+ 1.3823563	29.	/d/	+ 0.5500116
12.	/j/	+ 1.2186781	30.	/n/	+0.5495903
13.	/dh/	+ 1.2082081	31.	/l/	+ 0.3929617
14.	ksha	+ 1.1957439	32.	/R/	+ 0.3881423
15.	/r/	+ 1.1742822	33.	/bh/	+ 0..3842739
16.	/b/	+ 1.1669764	34.	/dh/	+ 0.2223851
17.	/n/	+ 1.1631853	35.	/tha/	+ 0.1614512
18.	/l/	+ 1.0552	36.	/jb/	+ 0 1173971
19.	/g/	+ 1.013468	37.	/Ph/	+ 0 0548962

TABLE 3 : Results of the phonemic analysis for information transmission for Non-Malayalam Speakers.

SI. No.	Phoneme	Information	SI. No.	Phoneme	Information
1	/d/	+ 1.953404	20	/gh/	4- 0.5743231
2	/k/	+ 1.3657368	21	/s/	+ 0.544234
3	/t/	+ 1.3412729	22	/g/	+ 0 .4838398
4	/p/	+ 1.2534215	23	/n/	+ 0.4296668
5	/ ch /	+ 1.1406631	24	/n/	+ 0.3745245
6	/m/	+ 1.1049362	25	/th/	+ 0.3435977
7	/ /	+ I.076909	26	/bh/	+ 0.3322
8	/s/	+ 0 9629852	27	/l/	+ 0.2952898
9	/bh/	+ 0 9170542	28	/i/	+ 0.2650442
10	/x/	+ 0.8876383	29	/n/	+ 0.2522527
11	/j/	+ 0.8187471	30	/ch/	+ 0.2426581
12	/kh/	4- 0.8120623	31	/kh/	+- 0.2380737
13	/w/	4- 0.7993225	32	/dh/	+ 0.1593191
14	/b/	4- 0-7816224	33	/Jh/	+ 0.1415C91
15	/r/	4- 0.698086	34	/sh/	+ 0.1393187
16	/n/	4- 0.697 853	35	/I/	+ 0.024778
17	/s/	4- 0.6287587	36	/R/	+ 0.00999317
18	/t/	4- 0.593215	37	/ph/	+ 0.0042015
19	/dh/	4- 0.5853785	38	/n/	+ 0.0032798

REFERENCES

Ahmed R and Agrawal. S. S. "Significant features in the perception cf (Hindi) consonants" Journal of Acoustical Society of America, 45 (3), 758-763, 1969.

Aitchson, Jean. "Articulate Manual, An introduction to psycholinguistics" Hutchinson, & Co. 1976.

Chomsky, N. and Halle, M. "The Sound Pattern of English" New York, Harpar and Row, 1968.

Fant. G. "Speech Sounds and Features" Cambridge, The M.T.T. Press, 1983,

Gunderts. "Nikhandhu in Malayalam" - Sahitya Pravartaka Ltd, 1962.

Gupta, J. P., Agrawal, S. S. and Ahmed, R. "Perception of ("Hindi) consonants in clipped speech". J. of Acoust. Soc. of Amer., 45(3), 770-773 (1969).

Jakobson, R , Fant, C. and Halle, M. "Preliminaries to speech analysis; The distinctive features and their correlates". Massachusetts, The M.I.T Press, 1969.

Kumudavalli, S ' Relationship between articulation and Discrimination of Kannada Speech sounds in terms of Distinctive features". Mysore Univ Dissertation, 1973.

Libermann, A.M., "Motor theory of Speech perception". In proceedings of Speech Communication Seminar, Vol.2, Stockholm, Royal Institute of Technology (1972).

Pathak, Phalguni. "Establishment of Distinctive feature system for consonants in Gujarati". M.Sc, dissertation submitted to Univ. of Mysore (1982).

Singh. S. "Distinctive features: Theory and Validation" Baltimore, University Park Press, 1976.

Shannon and Weaver. "A mathematical theory of communication" Language, 29 - 69 - 33 (1953).

Shyamala Kumari. "Malayalam Phonetic Reader" CIIL Publications, 1972.

Somasundaram. N, "A comparative phonology of Tamil, Telugu, Kannada, Malayalam based on distinctive features" Journal of All India Institute of Speech and Hearing, 3, 36-48, 1972.

Valentine. 'Features required to classify the underlying phonemes in Malayalam' Indian Journal of Dravidian Linguistics, Jan. 1977.