WORD TONES IN DOGRI

Ved Kumari Ghai

1. Introduction.

This paper aims at giving a brief historical, phonological and phonetic description of the tone types in Dogri as spoken in Jammu city - the winter capital of J&K State of India. According to the census of India 1961, Dogri is spoken by 879,748 people. Grierson, in his Linguistic Survey of India, has grouped Dogri with Panjabi, but Dogri possesses various characteristics which are different from those of Panjabi, and it might be interesting to study the relationship of Dogri with Panjabi on one hand and with various dialects of Western Pahari on the other.

Of the three prosodic features - stress, pitch and vowel quantity - the last is independently phonemic in Dogri as there is contrast between some long and short vowels in non-final position. As regards stress and pitch, both are involved in the tone system of the language.

Dogri, like its neighbouring language Eastern Panjabi, possesses three significant tones which may be described as neutral (tone I), falling (tone 2), and rising (tone 3). Since 1913 when professor T. G. Baily noticed the existence of significant tones in Panjabi these tones have been described by many writers, but instrumental methods have not been used by any of them. As regards tones in Dogri no study, traditional or experimental, is available as yet.

2. Phonological (phonemic) aspect.

These three tones have to be regarded as pitch phonemes (or tonemes), because they are the only distinctive features in such sets of words as kâ^{1}:r 'work', kâ^{2}:r 'house', kâ^{3}:r 'line'. The meaning differentiated by these tones is mostly lexical but in some rare cases it is grammatical. The verb paɽ occurs in non causal form with tone 3 and in causal form with tone 2. All these tones are word tones in the sense that only one significant tone occurs on a simple word. They can, however, be described as syllabic tones in the sense that the nucleus of a tone occurs on any one of the syllables in a polysyllabic word while other syllables are adjusted to the starting point and the end point of the tone-bearing syllable. It is thus

not only tone but also the position of the tone which is significant.

o pa$\overset{2}{}$ra: rda$\overset{1}{}$: ha$\overset{1}{}$: 'he was filling (something)'
o pa$\overset{2}{}$ra: rda$\overset{1}{}$: ha$\overset{1}{}$: 'he was getting (something) filled'

The syllable containing the nucleus of tone has also stronger stress (including a certain lengthening and a more precise quality of the vowel).

3. Historical aspect.

Tones are by themselves, like stress and quantity, supra segmental features, but it is interesting to know that tones in Dogri and Panjabi can be traced historically to segmental features. What we perceive as a tone is a mixture of various factors, but its main determinant is the rate of laryngeal vibration which is called fundamental frequency. It is related to such segmental features as voice, aspiration, and glottalization.

The tones of Dogri have nothing to do with the musical accent of the Vedic language, the earliest stage of Old Indo-Aryan, but the stress accent of Classical Sanskrit i.e. a later stage of Old Indo-Aryan has played a role in determining their nature. Stressed syllables in later OIA and MIA are generally preserved in Dogri as syllables with stress as well as tone. If there is no aspiration in the word in the OIA or the MIA stage, the tone is mid level or neutral, i.e. tone 1, but if there is aspiration (generally voiced) in the neighbourhood of the stressed vowel, the tone is either falling, i.e. tone 2,or rising, i.e. tone 3. The aspiration of the voiced aspirated stops of OIA and MIA and of mh nh lh as well as the h sound, which either developed from aspirated stops or sibilants of OIA or existed in words borrowed from other languages, disappears in Dogri giving rise to tone 2 if the stressed vowel follows it and to tone 3 if it precedes it.

Thus intervocalic h appears as tone 2 or tone 3

OIA	'loha:	Dogri	lo$\overset{3}{}$a:	'iron'
OIA	loha'ka:ra	Dogri	lua$\overset{2}{}$:r	'ironsmith'

Initial h and final h are replaced by tone 2 and 3 respectively.

OIA	'hasta	Dogri	a$\overset{2}{}$tth	'hand'
Arabic	sa'la:h	Dogri	sala$\overset{3}{}$:	'consultation'

Similar is the case with voiced aspirated stops.

OIA sva'bha:va Dogri su$b\overset{2}{a}$: 'nature'

OIA 'la:bha Dogri $l\overset{3}{a}$:b 'benefit'

The voiced aspirates lose their voice when occurring initially or when preceded by a prefix, but this devoicing may not take place if the voiced aspirated stop is preceded by a prefix which is not realized as a prefix in Dogri, or if the prefix is inconstant in rapid speech.

OIA 'bha:ra Dogri $p\overset{2}{a}$:r 'weight'

OIA pra'dha:na Dogri $prad\overset{2}{a}$:n 'chief'

OIA a'bhya:sa Dogri $by\overset{2}{a}$:s 'practice'

The aspiration of the unvoiced aspirated stops is preserved, but there is a tendency to pronounce the neighbouring stressed vowel with tone 2 or tone 3.

OIA 'khalla Dogri $kh\overset{3}{a}$ll 'down'

OIA 'kheda Dogri $kh\overset{2}{e}$d 'play'

4. Instrumental investigation.

A preliminary study of tones in Dogri was undertaken by the author under the guidance of professor Eli Fischer-Jørgensen, director of the Institute of Phonetics at the University of Copenhagen. The study is limited for the most part to monosyllabics, although disyllabics and words having vowel sequences have also been considered to some extent.

The speech of five informants - native speakers of Dogri belonging to Jammu Province - has been used. Eighty-six words of which fifty-three are monosyllabics and thirty-three are polysyllabics including examples of all three tones have been placed in one or two or three of six sentence-frames.

Frame I ʃail - ai. 'good - is'

Frame II ʃail - ai? do., interrogative intonation

Frame III - ʃail ai. ' - good is'

Frame IV isi - 'this - '

Frame V isi - te dikkh. 'this - and see' (isi is an accusative form

Frame VI mẽ tusẽ -glā:yā: 'I (to you) - said'

Frames I, II and III have been used for substantives, frames IV and V for verbs in imperative forms and frame VI has been used for sets of words belonging to different grammatical categories.

To avoid contrastive pitch, these sentences were arranged in randomized lists which were read twice by each informant. Tape-recordings of these lists spoken by two informants were made in Copenhagen and Stockholm respectively on professional tape-recorders. The rest of the informants recorded the text in India in the studio of Radio Kashmir Jammu.

The instruments used were the Trans Pitchmeter and the Intensity Meter built by B. Frøkjær-Jensen of the Institute of Phonetics at Copenhagen University, and the mingograph type 42 made by Elema Schönander (Stockholm, Sweden).

Pitch curves, intensity curves and duplex oscillograms were made from the material recorded on tape. In the case of the pitch curves low-pass filters with cutoff frequencies of 3oo (VK), 2oo (RK), and 15o (SL RN DD) cps were used. Two intensity curves, one linear without filtering and the other logarithmic with a high-pass filter set at 5oo cps were made. For male voices a 5 milliseconds' integration time was used in the case of the linear curve and 2,5 milliseconds in the case of the logarithmic curve. For female voices it was 1o milliseconds and 5 milliseconds respectively.

4.2. Discussion of measurements.

4.2.1. It is relative pitch and not the absolute pitch which is significant for the perception of tone. The same absolute pitch may b be perceived differently as high or low in accordance with the different voice range of different speakers and in accordance with sentence intonation. In the material used in this investigation the voice range of the informants is as follows:

TABLE 1: Voice Range of Informants

Informant	Lowest F_o in cps	Highest F_o in cps	Max. range of modulation within one vowel in cps	Mid point of the voice range in cps
VK (Female)	12o	4oo	165	26o
RK (Female)	14o	35o	15o	245
SL (Male)	11o	25o	1oo	18o
DD (Male)	1oo	4o5	15o	252
RN (Male)	65	21o	13o	137

4.2.2. Description of tones. Tone 1 can be described as mid level tone. It starts generally at a point lower than that of tones 2 and 3 and may remain static or fall or rise in accordance with sentence intonation. It is better to describe it in negative terms, because

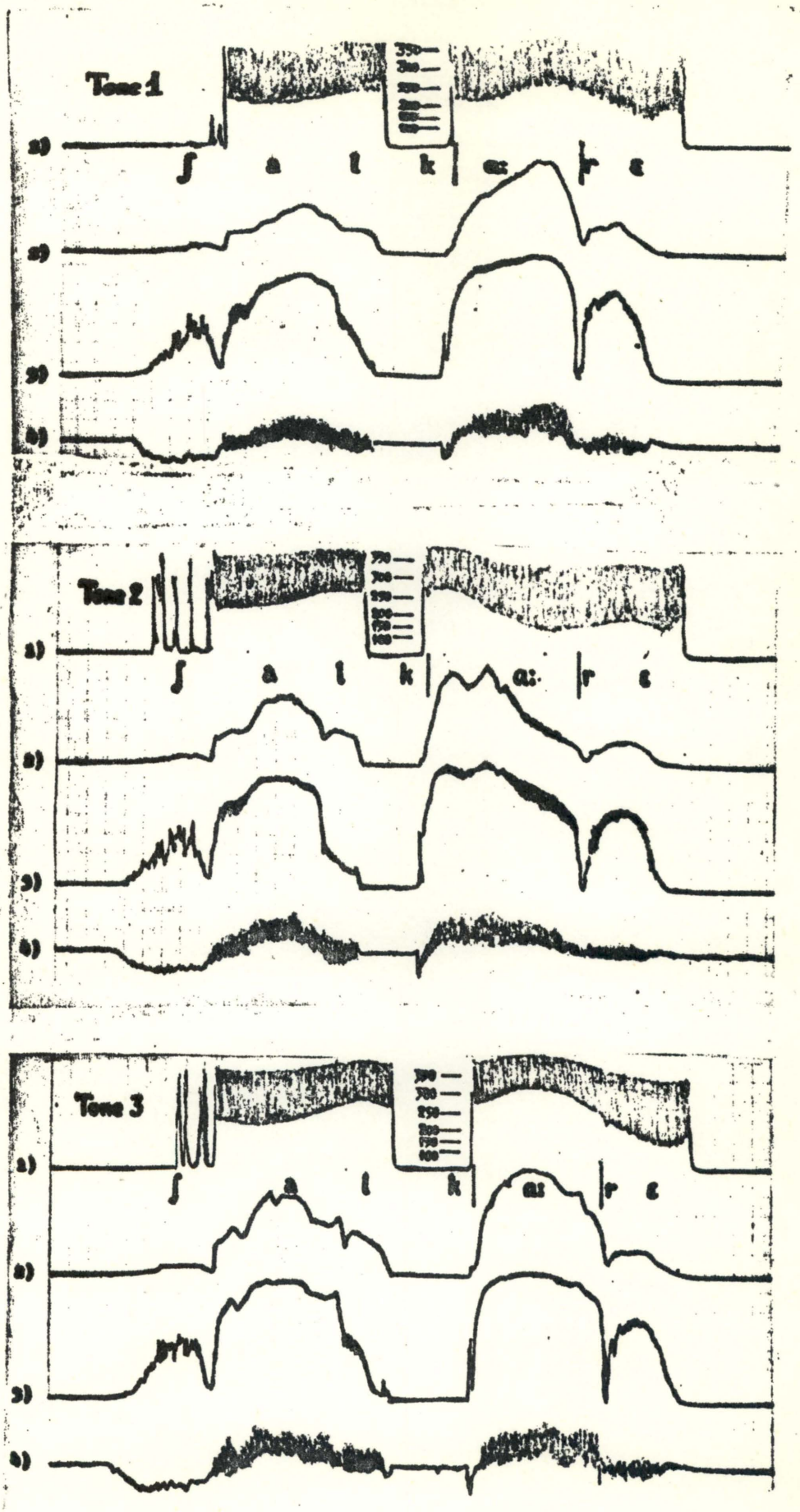


Fig. 1: Specimens of mingograms. The four traces are: 1) fundamental frequency curve; 2) intensity curve, linear, no filtering; 3) intensity curve, logarithmic, high-pass 500 cps; 4) duplex oscillogram.

its characteristic feature is absence of the features of tone 2 and tone 3.

Tone 2 is a falling tone which starts at a point generally higher than the middle of the voice range of the speaker and then falls to the lowest point. In the case of vowels of longer duration it generally rises again although this rise depends also on sentence intonation and is individually conditioned.

Tone 3 is a rising or rising-falling tone which starts at a level generally lower than the middle of the voice range and then rises to the highest level or at least to a level higher than the middle of the voice range.

Tables 2-6 contain averages of the fundamental frequency measured at a few points which seemed to be relevant - for tone 1 beginning and end of the vowel, for tone 2 beginning, minimum, and end of the vowel, for tone 3 beginning, maximum, and end. The frame has been measured at a point which seemed to be relatively constant, 10 cs after the beginning of the vowel in ʃail and the beginning of the second vowel in isi.

4.2.3. Cases of similarity between tone 1 and tone 2 or 3. Tone 2 shows fall and tone 3 shows rise in all the frames as uttered by all informants, but tone 1 is sometimes similar in contour to tone 2 or 3, and it is necessary to see how it is distinguished from tone 2 and tone 3.

DD's tone 1 in frame I (table 6) shows an average rise from 174 cps to 240 cps and tone 3 in the same frame shows a rise from 197 cps to 288 cps. Thus tone 3 starts at a higher pitch than does tone 1 and rises more than tone 1. Another difference is that tone 3 reaches its highest point sooner than tone 1. The maximum occurs at 23.1 cs (93.1% of the vowel duration) in the case of tone 1, and at 15.3 cs (67.1% of the vowel duration) in the case of tone 3. In the case of tone 1 the rise is generally slow in the first half of the vowel as compared with the second half. In the case of tone 3 it is quicker in the first half. The general level is also slightly higher in tone 3.

RK's tone 1 (table 3) shows a fall in frame I, and it falls even to the same level as tone 2, but as tone 2 starts higher than tone 1, the total fall in the case of tone 2 is far greater (91 cps) than in the case of tone 1 (40 cps). In frames IV and VI tone 1 shows

an average rise of 28 cps and 13 cps in contrast with a corresponding rise of 99 cps and 77 cps in tone 3.

In RN's tone 1, the rise in frames IV and VI is 3o cps and 37 cps against the corresponding rise of 67 cps and 88 cps in tone 3 (table 4).

SL's tone 1 is almost static in frame III and may show a slight fall in frames IV and I. The fall however is less (11 cps in frame I and 7 cps in VII). The minimum in tone 1 in frame I occurs at 7.0 cs from the beginning of the vowel while it occurs at 17.8 cs in the case of tone 2.

VK's tone 1 shows fall or rise in frame I and rise in frames II III IV V VI, but the occasional fall is much less in tone 1 than in tone 2, and the rise is always slower in tone 1 than in tone 3.

4.2.4. Tones in disyllabics. The tone-bearing vowel in disyllabics shows the same contour as in monosyllabics, but part of the contour is seen on the second vowel.

4.2.5. Tones in different frames. Sentence intonation and the position of the test-word in the sentence affect all tones. Both frames I and III are statements, but while in I the test-word is placed in the middle, in III it is placed initially. The result is: in VK's speech tone 1 is generally slightly falling in frame I and rising in frame III, tone 2 shows a greater fall in frame I, and in tone 3 the second part (falling) is longer in frame I. In the case of DD the difference is only seen for tone 3. Similarly a comparison of frame IV and V shows that tone 1 and 3 give more rise in frame IV,and tone 2 shows more fall in frame IV.

The influence of the sentence types is seen by a comparison between frame I (statement), frame II (interrogative), and frame IV and V which are imperative sentences. Frame II brings about an overall rise of the pitch of all the tones. In frame IV all subjects show a stronger rise in tone 1 and 3 than they have in frame I, and in tone 2 all except RK show a strong rise at the end as compared to frame I.

4.2.6. Individual differences. DD has a strong tendency toward rising tone. In his case tone I is clearly rising and tone 2 is falling-rising in all frames. RK has no rise in tone 2 in frame I and a slight rise in only one example in frame IV.

4.2.7. Influence of surrounding sounds and the quality of vowel. As expected, the close vowel i shows a higher pitch than the open vowel a: Generally the pitch starts higher after voiced consonants. After unvoiced aspirated stops it often starts lower but shows a quick rise in the beginning. The preceding voiced consonant does not take part in the relevant tonal movement, but a following n or l generally continues the movement of the tone.

4.2.8. Vowel length. The vowel bearing tone 2 is generally longer in duration than the vowel bearing tone 1 and 3, and the vowel having tone 3 is generally shorter in duration than the vowel having tone 1 and 2. The differences are small, but relatively constant.

Illustrations.

Tables 2-6 below (= pp. 14o-15o) are followed by some examples of tone curves (Figs. II, III, V, VIII, IX, XI) drawn from mingograms (cp. Fig. 1). These generally represent the 1st reading (R I). Examples belonging to the same word types have been superposed in the same figure to give a visual impression of the variation. The averages are given below the curves ("beg." = beginning of vowel, "min." = minimum, "max." = maximum). For disyllabics the second syllable has been separated from the first by a vertical stroke.

Table 2 a.

Informant VK (fem)
Monosyllabics

	Fr.	N	Fundamental frequency (cps) Frame beg.	Vowel of test word beg.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)	
TONE 1									
a:s,ka:r,ba:r,ʈha:r, sa:l,*ra:,(sa:ɳ), (bel),(ma:l)	I	16	2o5	212		197	-15	35.2	
a:s,(ka:r),ba:r,sa:l, (ʈha:r),ra:, (sa:ɳ), (bel),ma:l	II	14	2o2	264		3oo	+36	32.3	
a:s,ka:r,ba:r,ʈha:r, sa:l,*ra:,ma:l, (sa:ɳ),(bel)	III	17	188	2o9		263	+54	32.8	
la:,(ga:),pa:ɽ,pi:	IV	8	279	221		331	+11o	37.6	
la:,ga:,pa:ɽ,pi:	V	8	234	213		235	+22	36.2	
ma:l,ta:ɽ,kol, khoɽ, pi:	VI	1o		229		26o	+31	28.3	
TONE 2				min.					Place of min.(cs)
a:r,ka:r,ba:r,sa:b, (ra:),(beɽ),(sa:ɳ)	I	11	21o	27o	149-121	155	+6	37.5	3o.9
a:r,ka:r,ba:r,sa:b, (ma:l),(ra:), (beɽ),(sa:ɳ)	II	12	2o6	316	213-1o3	227	+14	36.8	26.6
a:r,ka:r,ba:r,sa:b, ra:,beɽ,sa:ɳ	III	11	196	238	175 -63	2o7	+32	34.2	23.8
la:,ba:,ca:ɽ	IV	6	278	285	162-123	297	+35	43.7	2o.8
la:, ba:, ca:ɽ	V	6	226	237	145 -92	225	+8o	42.o	21.2
ma:l,ta:ɽ,kol,pi:	VI	8		282	184 -98	186	+2	3o.5	26.5
TONE 3				max.					place of max.(cs)
a:r,ka:r,*sa:ɳ,tha:r, da:ɽ,*ra:,(ma:l),(bel)	I	16	2o6	238	314 +76	233	-81	34.o	15.o
a:r,ka:r,*sa:ɳ,tha:r, da:ɽ,*ra:,(ma:l), (bel),(sa:l)	II	18	2o5	26o	341 +81	318	-23	33.2	18.3
a:r,ka:r,*sa:ɳ,tha:r, da:ɽ,*ra:,ma:l, (bel),(sa:l)	III	18	188	23o	334+1o4	3o4	-3o	3o.6	2o.8
la:,ba:,ca:ɽ,pi:	IV	8	27o	248	377+129	373	-4	33.5	
la:,ba:,ca:ɽ,pi:	V	8	231	251	318 +67	2o8	-11o	32.o	13.6
ma:l,ta:ɽ,kol,pi:, khol	VI	1o		264	337 +73	327	-1o	25.o	19.8

Table 2 b.

Informant VK (fem)

Words containing vowel sequences.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	min.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)	place of min.(cs)
TONE 1										
ra:i,su:i, dua:r	I	6	2o3	226			192	-34	43.5	
ra:i,su:i, dua:r	II	6	183	254			3o4	+5o	46.3	
ra:i,su:i, dua:r	III	6	192	2o6			281	+75	37.3	
na:i,khoi	VI	4		22o			269	+49	31.5	
TONE 2										place of min.(cs)
dua:r	I	2	212	262	14o	-122	232	+92	51.o	39.o
dua:r	II	1	2oo	325	21o	-115	21o	+o	47.o	38.o
dua:r	III	2	19o	225	175	-5o	24o	+65	42.o	29.5
na:i, thoi	VI	4		269	171	-98	18o	+9	32.o	23.5
TONE 3					max.					place of max.(cs)
ra:i:,su:i:, ɟua:r	I	6	2o8	231	331	+1oo	21o	-121	41.o	18.o
ra:i:,su:i:, ɟua:r	II	6	188	244	353	+1o9	328	-25	41.3	16.8
ra:i:,su:i:, ɟua:r	III	6	17o	225	352	+127	29o	-62	36.5	2o.2
mana:i:,khoi:	VI	4		247	339	+92	289	-5o	28.o	18.3

Table 2 c.

Informant VK (fem)

Disyllabics.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)		Fundamental frequency second syllable beg.	end
TONE 1											
ba:ri:, na:ɽi:, pa:ɳi:, phora:	I	8	198	239		191	-48	19.4		196	192
ba:ri:, na:ɽi:, pa:ɳi:, phora:	II	8	183	283		279	-4	19.4		3o4	316
ba:ri:, na:ɽi:, pa:ɳi:, phora:	III	8	186	2o1		224	+23	23.o		247	245
phoɽa:, ma:ɽi:	VI	4		226		218	-8	19.5		239	264
TONE 2					Place of min.				Place of min.(cs)		
ba:ri:, na:ri:, ka:ɳi, thoɽi:	I	8	2oo	275	193	-82	193	+o	2o.6	2o.6	165	175
ba:ri:, na:ri:, ka:ɳi, thoɽi:	II	8	186	312	216	-84	216	+o	23.4	23.4	193	298
ba:ri:, na:ri:, ka:ɳi, thoɽi:	III	8	197	224	184	-4o	184	+o	2o.5	19.6	185	288
ma:ɽi, thoɽa:	VI	4		278	195	-83	195	+o	19.5	19.5	183	183
TONE 3					Place of max.				Place of max.(cs)			
da:ɽi:, ta:lli:	I	4	2o3	248	29o	+42	29o	-o	16.5	16.5	328	2o4
da:ɽi:, ta:lli:	II	4	187	261	331	+7o	331	-o	17.o	16.2	35o	338
da:ɽi:, ta:lli:	III	4	18o	23o	326	+96	326	-o	16.5	16.5	353	254
ma:ɽi, thoɽa:	VI			235	316	+81	316	-o	16.o	15.8	34o	3o1

Table 3 a.

Informant RK (fem)

Monosyllabics and words containing vowel sequences.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)	place of min. (cs)
TONE 1									
Monosyllabics:									
a:s,ka:r, (ba:r), tha:r,(sa:ɳ),sa:l, ra:,(bel)	I	13	242	212		172	-4o	19.o	
la:,ga:,pa:ʔ	IV	6		2o9		237	+28	21.8	
ma:l,ta:ʔ,khoʔ, (kol),pi:	VI	9		22o		233	+13	16.9	
Words containing vowel sequences:									
dua:r	I	1		25o		16o	-9o	26.o	
na:i:,khoi:	VI	4		2o9		224	+15	23.o	
TONE 2				min.					place of min. (cs)
Monosyllabics:									
a:r,ka:r,ba:r,sa:ɳ, sa:b,ra:	I	12	238	257 166	-91	166	+o	2o.1	19.8
(la:),ba:, ca:ʔ	IV	5		278 15o	-128	16o	+1o	23.o	22.o
ma:l, ta:ʔ,kol,pi:	VI	8		274 175	-99	179	+4	17.7	17.o
Words containing vowel sequences:									
dua:r	I	1		225 16o	-65	16o	+o	25.o	25.o
(na:i),thoi	VI	3		245 183	-62	183	+o	2o.o	13.o
TONE 3				max.					place of max. (cs)
Monosyllabics:									
a:r,ba:r,da:ʔ,tha:r, sa:ɳ,sa:l,ra:,(bel)	I	15	241	222 273	+51	247	-26	18.9	13.4
la:,ba:,ca:ʔ	IV	6		214 3o8	+94	3o8	-o	2o.5	17.5
ma:l,ta:ʔ,kol, pi:,khol	VI	1o		237 314	+77	3o7	-7	17.7	15.8
Words containing vowel sequences:									
mana:i	VI	2		245 3o5	+6o	26o	-45	22.5	14.5
ɟua:r	I	1		225 285	+6o	26o	-25	26.o	23.o

Table 3 b.

Informant RK (fem)

Disyllabics.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)		Fundamental frequency second syllable beg.	end
TONE 1											
pa:ni:	I	2		225		175	-5o	12.5		2oo	192
phoɽa:, ma:ɽi:	VI	4		216		193	-23	11.o		218	222
TONE 2					min.				place of min.(cs)		
ka:ɳi:	I	2		267	245 -22	245	+o	11.5	11.5		
thoɽa:, ma:ɽi:	VI	4		259	195 -64	195	+o	12.2	12.2	17o	21o
TONE 3					max.				place of max.(cs)		
ta:ɳi:	I	2		24o	257 +17	257	-o	13.o	13.o *)		
(thoɽa:)	VI	1		225	28o +55	28o	-o	9.o	9.o	3oo	

*) could not be measured.

Table 4 a.

Informant RN (masc)
Monosyllabics and words containing vowel sequences

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	min.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)	place of min.(cs)
TONE 1										
Monosyllabics:										
a:s,ka:r,ba:r,tha:r, sa:ɳ, (ra:),(bel)	I	12	87	92			86	-6	25.2	
la:, ga:, pa:ɾ	IV	6		93			123	+3o	27.8	
ma:l,ta:ɾ,(khoɾ), kol,pi:	VI	9		112			149	+37	21.3	
Words containing vowel sequences:										
dua:r	I	1		1oo			8o	-2o	33.o	
na:i, khoi	VI	4		93			163	+7o	19.o	
TONE 2					min.					place of min.(cs)
Monosyllabics:										
a:r,ka:r,ba:r,sa:ɳ, sa:b,(ra:),(beɾ)	I	12	91	139	74	-65	82	+8	28.o	21.o
la:,ba:,ca:ɾ	IV	5		15o	76	-74	144	+68	32.o	17.o
ma:l,(ta:ɾ),kol,pi:	VI	7		182	87	-95	134	+67	25.o	
Words containing vowel sequences:										
(dua:r)	I	1		145	8o	-65	8o	+o	29.o	29.o
na:i,thoi	VI	4		135	84	-51	149	+65	23.5	1o.5
TONE 3					max.					place of max.(cs)
Monosyllabics:										
a:r,ka:r,da:ɾ,(sa:ɳ), sa:l,tha:r,(ra:), (bel)	I	13	95	95	141	+46	121	-2o	24.6	17.7
ba:,ca:ɾ	IV	4		116	183	+67	158	-25	26.o	11.5
ma:l,khol,(kol),pi:	VI	7		14o	228	+88	228	-o	18.6	18.6
Words containing vowel sequences:										
mana:i,khoi:	VI	4		1o3	2o4	+1o1	2o4	-o	2o.5	

Table 4 b.

Informant RN (masc)

Disyllabics.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word				Vowel length (cs)		Fundamental frequency second syllable	
			beg.	rise (+) fall (-)		end	rise (+) fall (-)			beg.	end
TONE 1											
pa:ɳi:	I	2	95			82	-13	15.o		8o	85
phoʈa:	VI	2	9o			9o	o	9.o		92	135
TONE 2				min.					place of min. (cs)		
ka:ɳi:	I	1	15o	11o	-4o	11o	+o	14.o	14.o	8o	7o
thoʈa:	VI	2	2oo	1o2	-98	1o2	+o	12.5	12.5	87	15o
TONE 3				max.					place of max. (cs)		
ʈa:ɳi:	I	2	13o	16o	+3o	16o	-o	18.5	18.5	16o	145

Table 5 a.

Informant SL (masc)
Monosyllabics and words containing vowel sequences.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	min.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)	place of min. (cs)
TONE 1										
Monosyllabics:										
a:s,ka:r,ba:r,ʈha:r, sa:ɳ,sa:l,(ra:),bel	I	15	146	148			137	-11	26.3	
la:,ga:,pa:ɽ	IV	6		158			158	o	26.8	
ma:l,ta:ɽ,khoɽ,kol,pi:	VI	1o		172			165	-7	21.6	
Words containing vowel sequences:										
na:i,khoi	VI	4		164			169	+5	22.o	
dua:r	I	2		145			135	-1o	31.5	
TONE 2					min.					place of min. (cs)
Monosyllabics:										
(a:r),ka:r,ba:r,sa:ɳ, sa:b,(ra:),beɽ	I	12	148	174	122	-52	135	+13	27.7	17.8
la:,ca:ɽ,ba:	IV	6		188	131	-57	15o	+19	28.5	16.7
ma:l,ta:ɽ,kol,pi:	VI	1o		196	132	-64	138	+6	21.8	15.7
Words containing vowel sequences:										
na:i,thoi	VI	4		193	132	-61	158	+26	25.o	12.5
dua:r	I	2		162	117	-45	131	+14	33.o	23.o
TONE 3					max.					place of max. (cs)
Monosyllabics:										
a:r,ka:r,da:ɽ,tha:r, sa:ɳ,sa:l,ra:,bel	I	15	146	156	191	+35	169	-22	24.o	16.8
la:,ba:	IV	4		158	211	+53	199	-12	23.8	17.5
ma:l,(khol),(kol),pi:	VI	6		198	239	+41	239	-o	17.8	17.8(?)
Words containing vowel sequences:										
mana:i,khoi	VI	3		185	235	+5o	225	-1o	19.o	16.o
ɟua:r	I	2		147	177	+3o	167	-1o	28.o	23.o

Table 5 b.

Informant SL (masc)

Disyllabics.

	Fr.	N	Fundamental frequency(cps) Frame	Vowel of test word				Vowel length (cs)		Fundamental frequency second syllable	
			beg.		rise (+) fall (-)	end	rise (+) fall (-)			beg.	end
TONE 1											
pa:ɳi:	I	2	157			14o	-17	17.o		145	145
phoɽa:, ma:ɽi	VI	4	158			146	-12	14.o		148	157
TONE 2				min.				place of min.(cs)			
ka:ɳi:	I	2	192	127	-65	13o	+3	19.o	15.o	138	143
thoɽa:, ma:ɽi:	VI	4	182	127	-55	127	+o	13.o	13.o	127	147
TONE 3				max.				place of max.(cs)			
ʈa:ɳi	I	2	175	195	+2o	195	-o	16.o	16.o	2o5	14o
thoɽa:	VI	1	19o	2oo	+1o	2oo	-o	12.o	12.o	2oo	2oo

Table 6 a.

Informant DD (masc)
Monosyllabics and words containing vowel sequences.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)	
TONE 1									
Monosyllabics:									
*a:s,*ka:r,ma:l, sa:l,ra:,(ba:r)	I	13	2oo	174		24o	+66	24.6	
ka:r,ba:r,ma:l, (tha:r),sa:l	III	9	196	191		261	+7o	21.7	
la:,pa:ʔ,(pha:ʔ)	IV	5		188		288	+1oo	16.2	
la:,(ga:),pa:ʔ, (pi:),(pha:ʔ)	V	7		178		149	-29	25.7	
Words containing vowel sequences:									
ra:i,dua:r,su:i	III	6	2o2	197		253	+56	21.8	
TONE 2					min.				place of min.(cs)
Monosyllabics:									
a:r,ka:r,ma:l,*sa:b, pa:kh,pa:r,(ba:r)	I	14	212	222	135	-87	223	+88	25.2	1o.7
ka:r,ba:r,ma:l, sa:b,(pa:kh)	III	9	188	231	171	-6o	232	+61	27.8	13.4
la:,ca:ʔ,(ba:), sa:l,(sa:)	IV	8		258	178	-8o	279	+1o1	19.4	8.4
la:,ca:ʔ,ba:,sa:l, (sa:)	V	9		262	161	-1o1	168	+7	29.1	1o.9
TONE 3					max.				place of max.(cs)
Monosyllabics:									
a:r,(ka:r),sa:ɳ,tha:r, da:ʔ,ra:,(ga:k)	I	12	2o1	197	288	+91	249	-39	22.6	15.3
(ka:r),(ba:r),(tha:r), sa:ɳ,da: ,ga:k	III	9	196	2o7	298	+91	272	-26	2o.3	17.7
la:,ca:ʔ,ba:,a:ɳ	IV	8		241	359	+118	358	-1	16.7	16.o
(la:),ca:ʔ,ba:,a:ɳ, (pi:)	V	8		212	296	+78	167	-23	22.5	1o.9
Words containing vowel sequences:									
ɟua:r,ra:i,su:i		6		22o	314	+94	274	-4o	2o.8	14.3

Table 6 b.

Informant DD (masc)

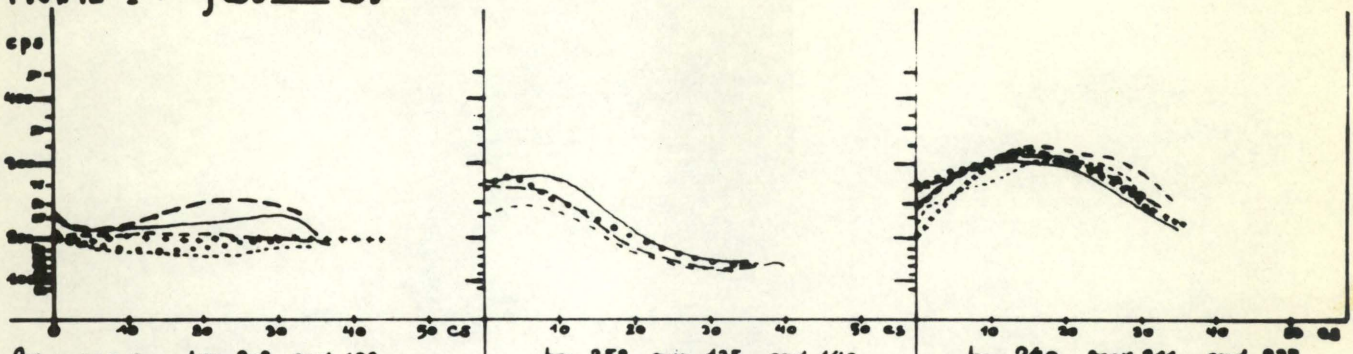
Disyllabics.

	Fr.	N	Fundamental frequency (cps) Frame	Vowel of test word beg.	rise (+) fall (-)	end	rise (+) fall (-)	Vowel length (cs)		Fundamental frequency second syllable beg.	end
TONE 1											
pa:ni:, ba:ri:, mu:rat, na:ɾi:, phoɾa:	III	1o	193	2o9		263	+54	12.7		251	244
TONE 2				min.				place of min.(cs)			
ka:ni:, ba:ri:, (mu:rat), (thoɾa:)	III	6		231	183 -48	183	+o	12.o	9.6	192	243
TONE 3											
talli:, da:ri:, mi:na:		6		223	279 +56	28o	-1	8.3	8.3	311	285

FIG. II INFORMANT VK, reading I

TONE 1	TONE 2	TONE 3

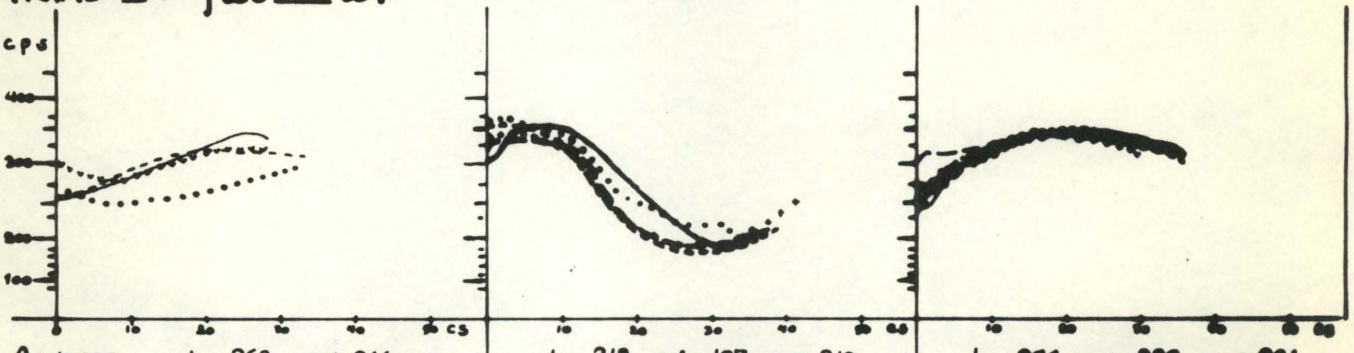
FRAME I: ʃæl___æ.



Av. in cps : beg. 203, end 199 | beg. 258, min. 135, end 140 | beg. 240, max. 311, end 237

TONE 1		TONE 2		TONE 3	
a:s	——	tha:r	-----	a:r	——	tha:r	-----
ha:r	— —	sa:l	. . .	ha:r	— —	sa:ŋ	. . .
ba:r	— — —	ra:	. . .	ba:r	— — —	ra:	. . .
				da:ʈ	— — —		

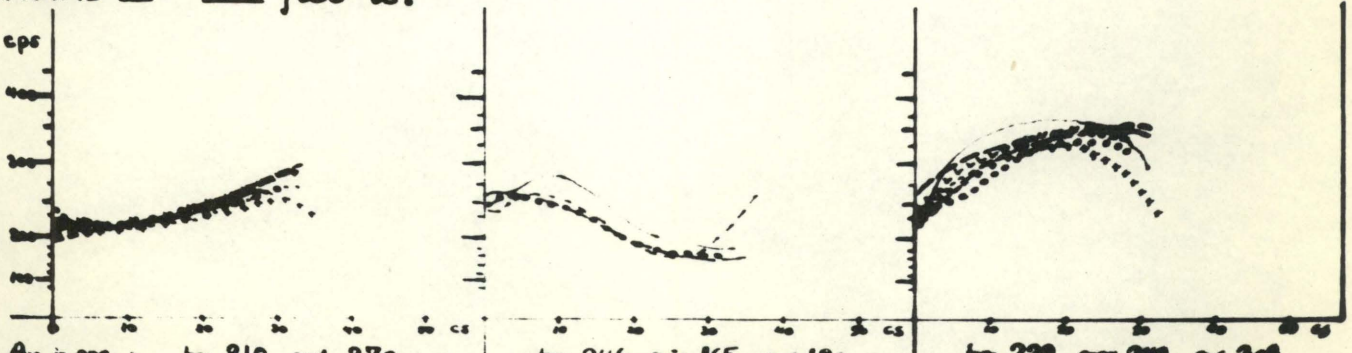
FRAME II: ʃæl___æ?



Av. in cps : beg. 262, end 316 | beg. 318, min. 197, end 219 | beg. 286, max. 339, end 281

TONE 1		TONE 2		TONE 3	
a:s	——	sa:l	. . .	a:r	——	sa:b	. . .	a:r	——	tha:r	-----
ba:r	— — —	ma:l	. . .	ha:r	— —	ra:	. . .	ha:r	— —	sa:ŋ	. . .
				ba:r	— — —			da:ʈ	— — —	ra:	. . .
										ma:l	. . .

FRAME III: ___ʃæl æ.



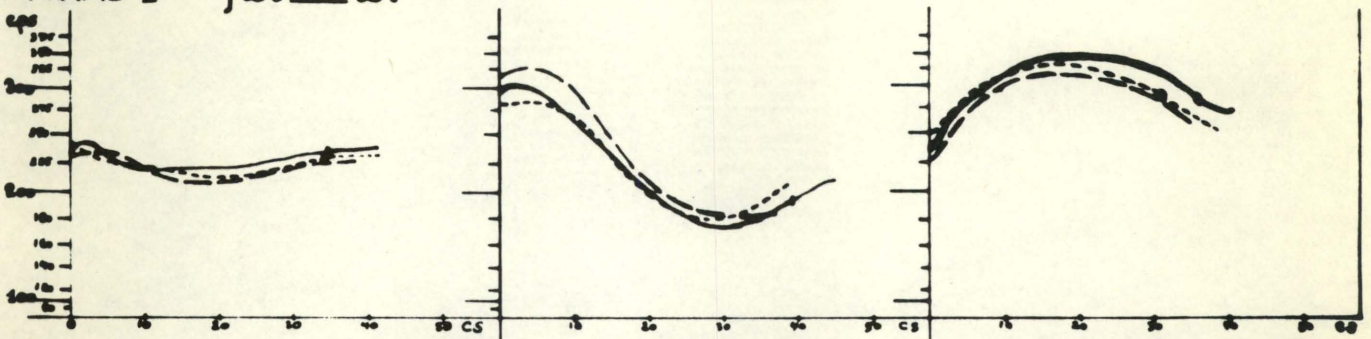
Av. in cps : beg. 210, end 270 | beg. 246, min. 165, end 190 | beg. 229, max. 293, end 268

TONE 1		TONE 2		TONE 3	
a:s	——	tha:r	-----	a:r	——	sa:b	. . .	a:r	——	tha:r	-----
ha:r	— —	sa:l	. . .	ha:r	— —			ha:r	— —	sa:ŋ	. . .
ba:r	— — —	ra:	. . .	ba:r	— — —			da:ʈ	— — —	ra:	. . .
		ma:l	. . .							ma:l	. . .

FIG. III INFORMANT VK, list 3

TONE 1	TONE 2	TONE 3

FRAME I: ʃæl___æ.



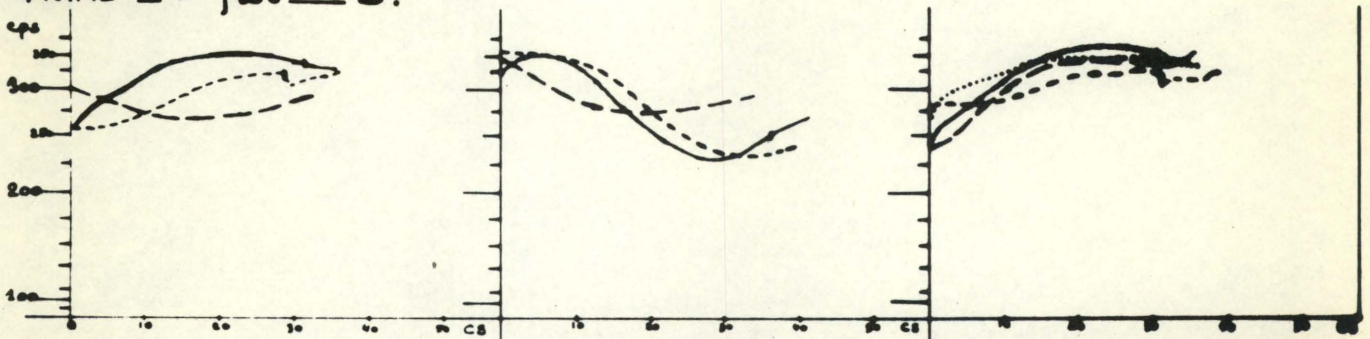
Av. in cps: beg. 233, end 235 | beg. 302, min. 180, end 193 | beg. 235, max. 330, end 272

sa:ɳ —— ph
ra: — —
bel ---- pl

sa:ɳ —— ph
ra: — —
beʃ -----

sa:ɳ —— ph
ra: — —
bel ---- pl

FRAME II: ʃæl___æ?



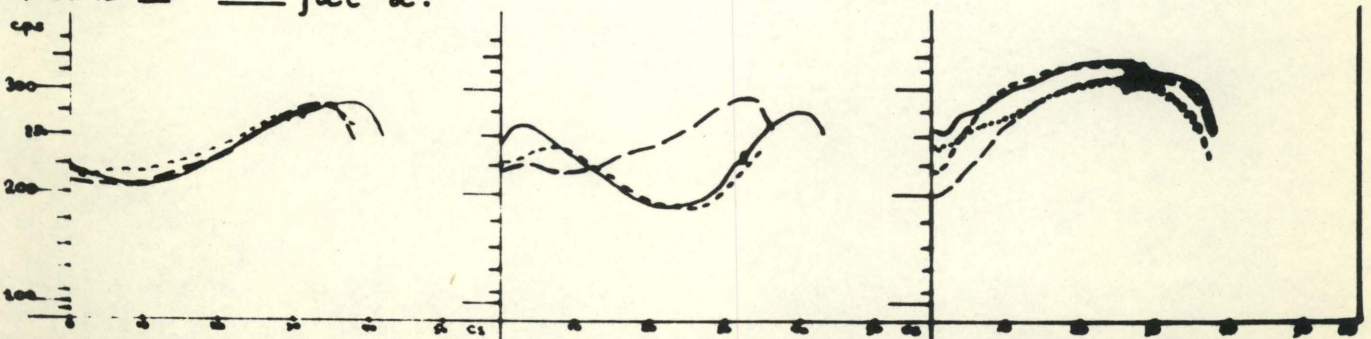
Av. in cps: beg. 267, end 310 | beg. 328, min. 243, end 260 | beg. 260, max. 343, end 330

sa:ɳ —— ph
ra: — —
bel ---- pl

sa:ɳ —— ph
ra: — —
beʃ -----

sa:ɳ —— ph
ra: — —
bel ---- pl
sa:l ..... ph

FRAME III: ___ʃæl æ.



Av. in cps: beg. 220, end 248 | beg. 232, min. 200, end 235 | beg. 225, max. 321, end 300

sa:ɳ —— ph
ra: — —
bel ---- pl

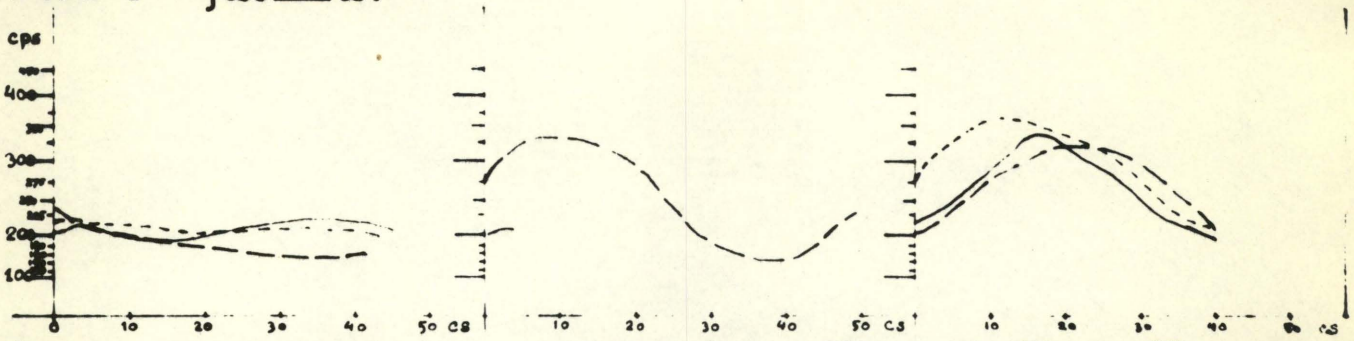
sa:ɳ —— ph
ra: — —
beʃ -----

sa:ɳ —— ph
ra: — —
bel ---- pl
sa:l ---- ph

FIG. V — INFORMANT VK, reading I

TONE 1	TONE 2	TONE 3

FRAME I: ʃæl___æ.



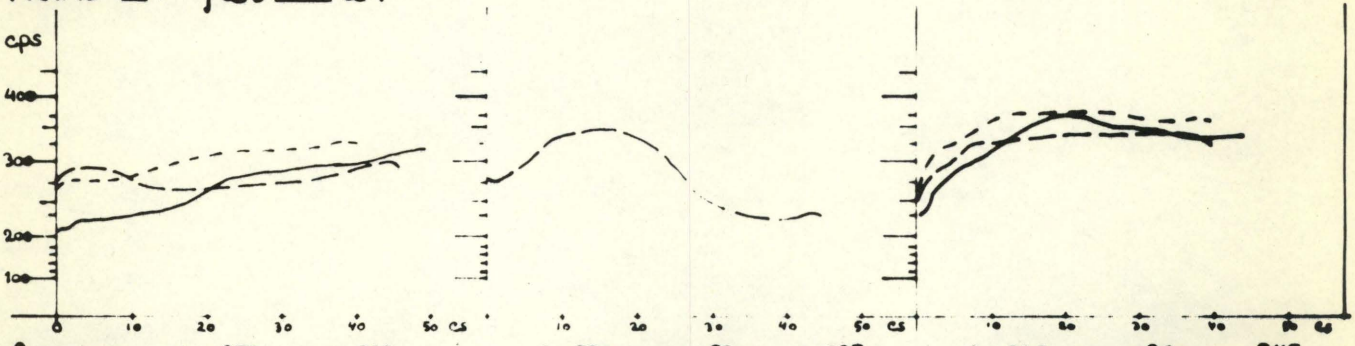
Av. in cps: by 217, end 190 | by 275, min 140, end 225 | by 233, max 338, end 203.

ra:i: ——·
dua:r — —
su:i ----

dua:r — —

ra:i: ——·
ʃua:r — —
su:i ----

FRAME II: ʃæl___æ?



Av. in cps: by 258, end 312 | by 280, min 220, end 225 | by 242, max 360, end 345

ra:i: ——
dua:r — —
su:i ----

dua:r — —

ra:i: ——
ʃua:r — —
su:i ----

FRAME III: ___ʃæl æ.

Av. in cps: by 210, end 285 | by 225, min 180, end 230 | by 225, max 347, end 285

ra:i: ——
dua:r — —
su:i ----

dua:r — —

ra:i: ——
ʃua:r — —
su:i ----

FIG. VIII INFORMANT: RK

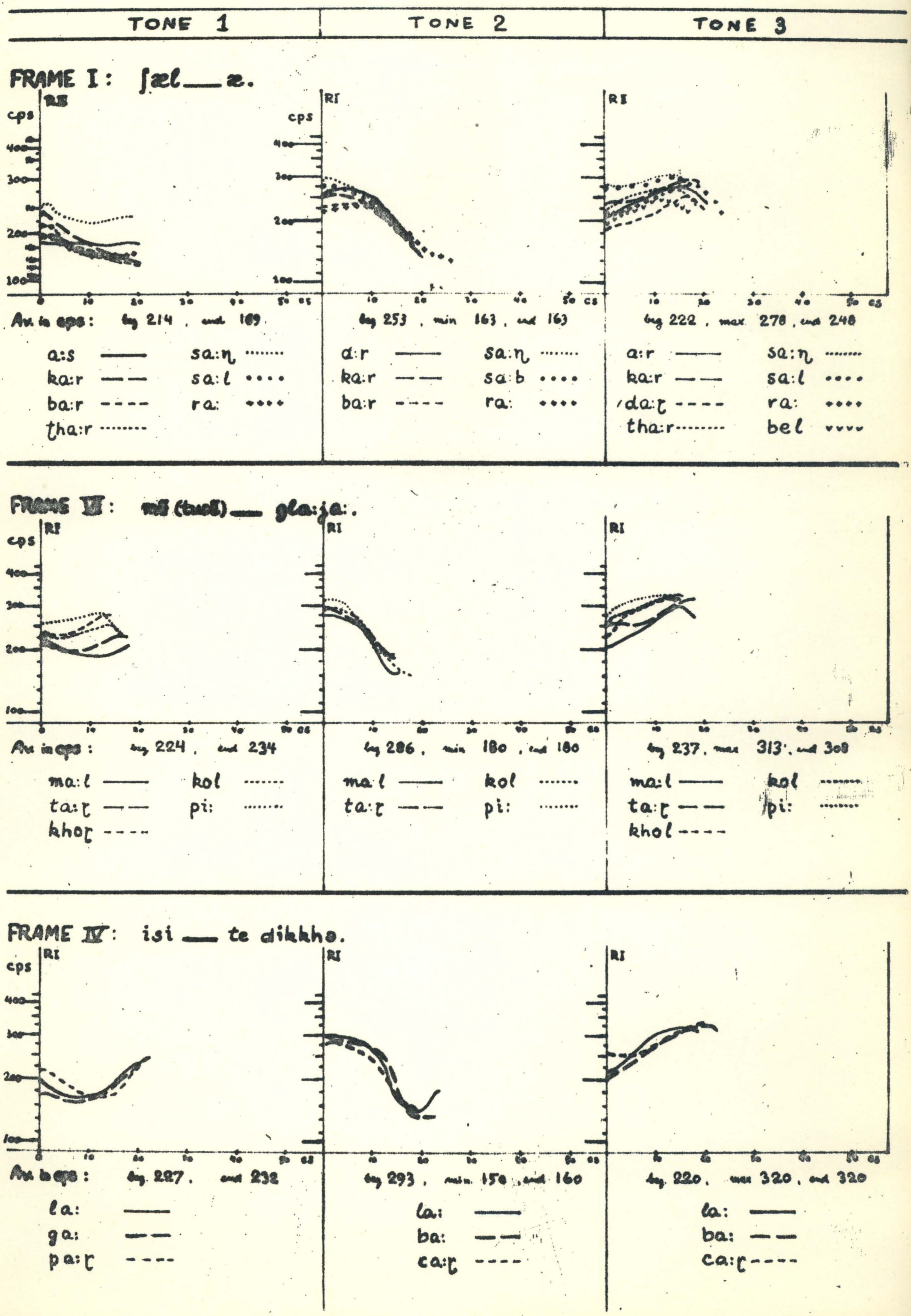
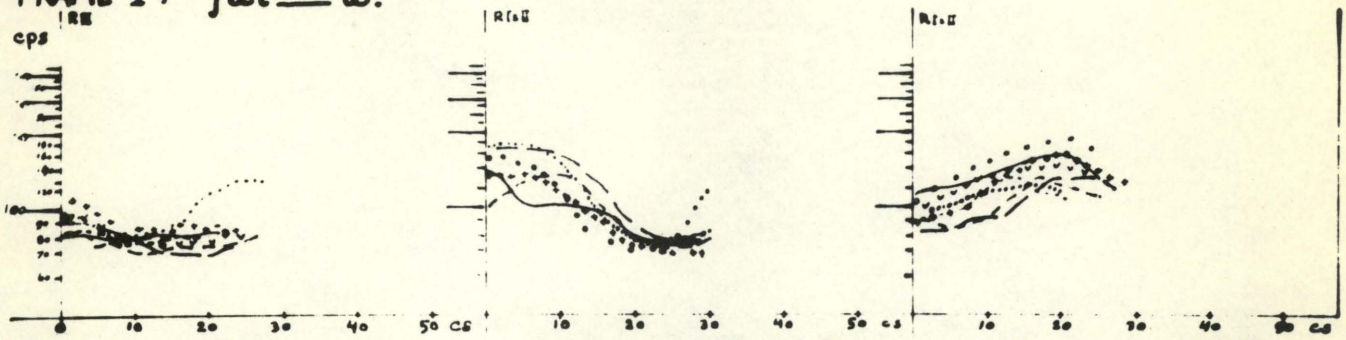


FIG. IX INFORMANT RN

TONE 1	TONE 2	TONE 3

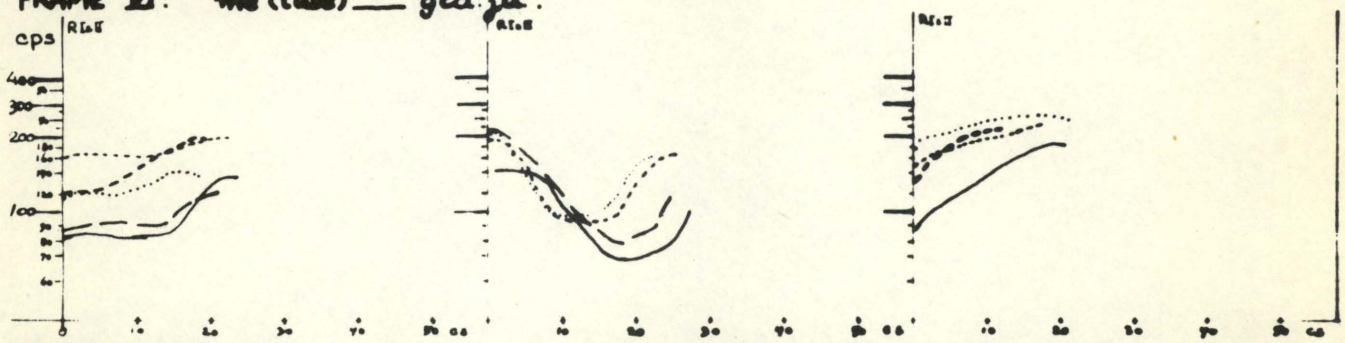
FRAME I: ʃæl ___ æ.



Av. in cps: beg 90 end 89 | beg 146 min 71 end 86 | beg 93 end 189

a:s ——	sa:ɳ ·····	a:r ——	sa:ɳ ·····	a:r ——	sa:ɳ ·····
ka:r — —	ra: ····	ka:r — —	sa:b ····	ka:r — —	sa:l ····
ba:r - - - -	bel ····	ba:r - - - -	ra: ····	da:ʈ - - - -	ra: ····
tha:r ·····				tha:r ·····	bel ····

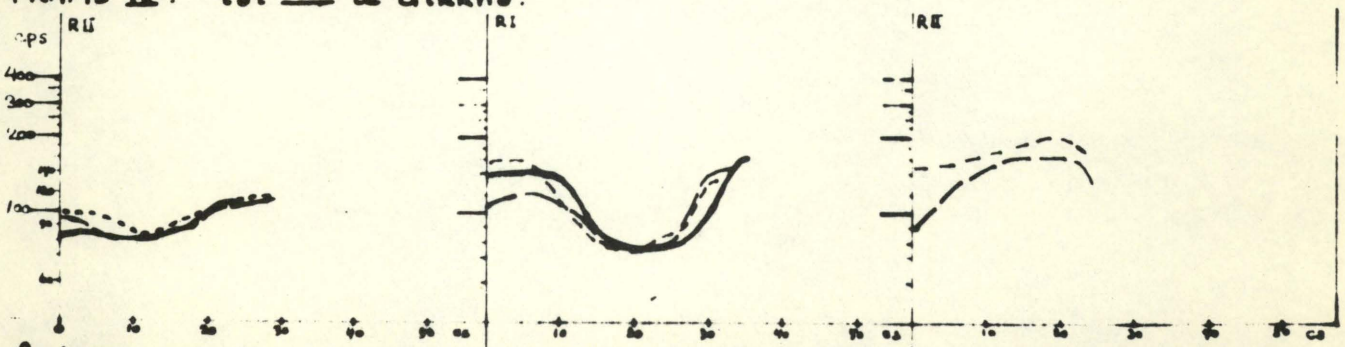
FRAME II: mẽ (tuẽ) ___ gla:ja:.



Av. in cps: beg 110 end 158 | beg 186 min 85 end 138 | beg 135 end 221

ma:l ——	kol ·····	ma:l ——	kol ·····	ma:l ——	kol ·····
ta:ʈ — —	pi: ·····	ta:ʈ — —	pi: ·····	khol - - - -	pi: ·····
khol - - - -					

FRAME IV: isi ___ te dikkho.



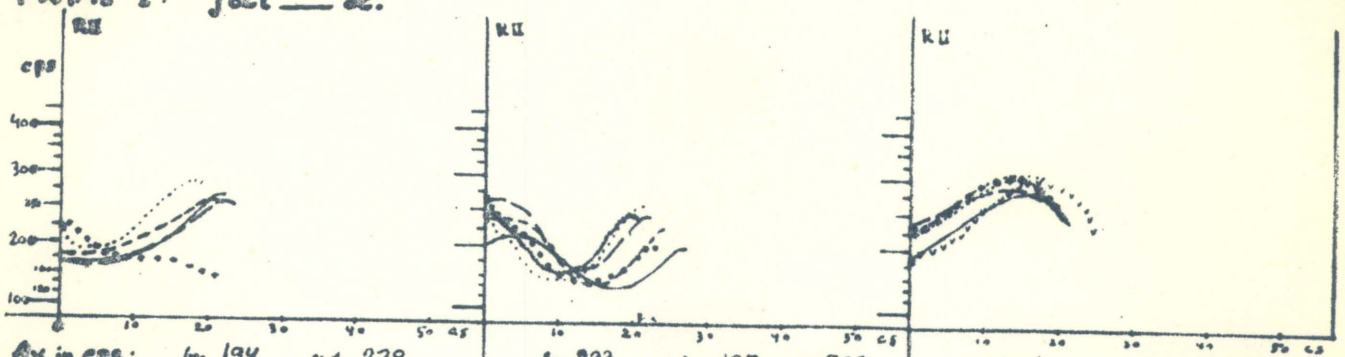
Av. in cps: beg 95 end 113 | beg 140 min 75 end 157 | beg 120 min 180 end 140

la: ——	la: ——	
ga: — —	ba: — —	ba: — —
pa:ʈ - - - - -	ca:ʈ - - - -	ca:ʈ - - - -

FIG. XI INFORMANT DD

TONE 1	TONE 2	TONE 3

FRAME I: ʃæl ___ æ.



Av. in cps: beg 194 . end 238

a:s ——— sa:l .....
ka:r — — ra: ....
ma:l - - - -

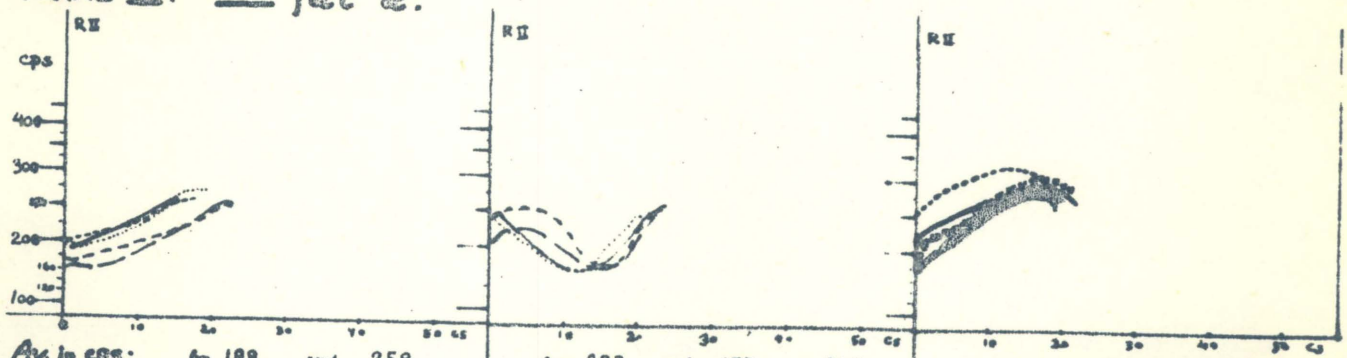
beg 233 . min 135 , end 229

'a:r ——— sa:b .....
ka:r — — pa:kh ——
ma:l - - - - pa:r ....

beg 213 max 300 , end 261

a:r ——— sa:ɳ .....
ka:r — — ra: ....
tha:r ------ da:ʈ ....

FRAME III: ___ ʃæl æ.



Av. in cps: beg 188 . end 258

ka:r ——— sa:l .....
ba:r — —
ma:l - - - -
tha:r .....

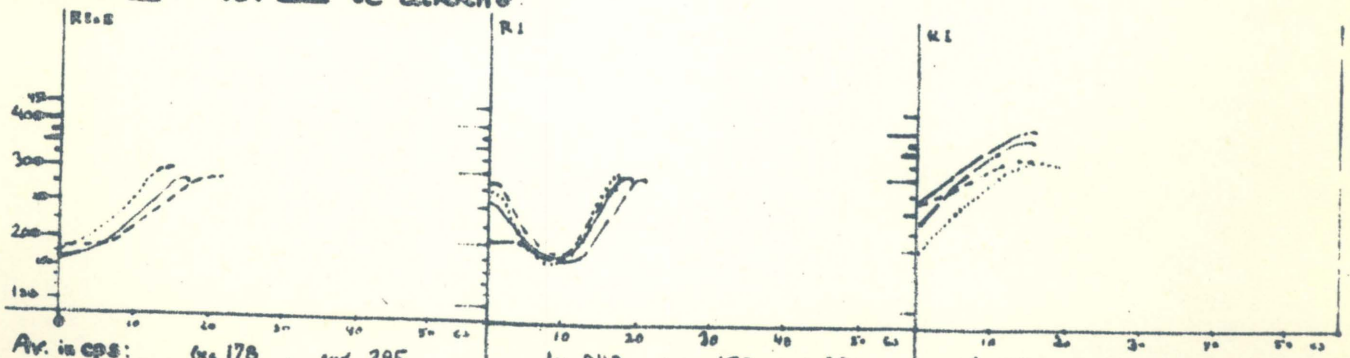
beg 233 . min. 175 , end 248

ka:r ——— sa:b .....
ba:r — —
ma:l - - - -

beg 211 max 303. end 266

ka:r ——— sa:ɳ .....
ba:r — — da:ʈ ....
tha:r ..... ga:k ———

FRAME IV: isi ___ te dikkha



Av. in cps: beg 178 , end 285

la:ᵃ ———
pa:ʈ - - - -
pha:ʈ .....

beg 249 , min. 178 end 281

la: ———
ba: — —
ca:ʈ - - - -
sa:l .....

beg 240 , max. 365, end 363

la: ———
ba: — —
ca:ʈ - - - -
a:ɳ .....