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ACOUSTIC MEASUREMENTS OF SOME QUANTITY PATTERNS IN KILDIN LAPP

Quantity problems of Kildin Lapp have been dealt with by T. I. Itkonen (1916), E. Itkonen (1941, 1946, 1971), and G. Kert (Kept 1971). In his phonological survey E. Itkonen (1971) has presented essential quantity patterns of this dialect both in phonemic as well as in phonetic transcription.

The quantity of Kildin has noticeable common features with that of Estonian: some paradigms resemble the three known quantity degrees of Estonian, although a closed syllable seems to be slightly stronger than the second degree in Estonian (cf. *sgra* [sgra] 'bilberry (dimin.), gasg., npl.' — *lq'nnen* [lq'nnen] 'town, ess. sg.' — *sarra* [sarra] 'bilberry, ill. sg.', *lanna* [lanna] 'town, ill. sg.', *lq'nn* [lq'nn] 'town, nsg., gasg., npl.'). The most peculiar opposition is *šq'lden* [šq'lden] 'floor, ess., transl. sg.', *šqlda* [šqlda] 'floor, ill. sg.', *šq'ld* [šq'ld] 'floor, nsg.' — *šq'ldest* [šq'ldest] 'floor, iness., elat. sg.', *lānda* [lānda] 'bird (dimin.), gasg., npl.', *šq'ld* [šq'ld] 'floor, gasg., npl.' (the transcription of the examples originates from Itkonen 1971). It is rather difficult to pronounce a long lenis stop after a sonorant in the last words of the opposition; so is the pronunciation of the last long stop in the stop cluster (cf. *poīk* 'seineful' — *potk* 'seinefuls'). Pronunciation is much easier when a fortis stop or a geminate follows a sonorant (cf. the Estonian *pard* 'beard, nsg.' — *part* 'duck, nsg.'). Though Kert (Kept 1971) accepts T. I. Itkonen's (Itkonen 1916; see also E. Itkonen 1971) duration pattern as regards the phonological opposition under discussion, the duration data presented by him evidence that these words do not differ considerably in the duration of the last consonant of the consonant cluster. This was noticed by Kuruč (Kuruč 1981), who then offered a hypothesis that as far as duration goes the mentioned opposition $\bar{C}_1C_2 - C_1\bar{C}_2$ is actually $\bar{C}_1C_2 - C_1C_2$ (e. g. *čalm* 'eye, nsg.' — *čalm* 'eyes, npl.'). There is also another possibility: the opposition may rest on differences of the whole syllables; it may be associated with different accentuation of the syllables. In order to put this and some other quantity patterns to test we carried out an experiment.

The speech material was recorded in a studio of the Estonian Radio (over 40 words or word combinations; two informants — NA and LJ¹; the main informant LJ was born in Šonguj in 1918, his present residence is

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in Lovozero). The words recorded from the informant LJ were fed into an EC-1010 computer where spectrograms, tone contours and intensity curves of the words were obtained (for the applied computer methods, see Mihkla et al. 1982). The durations of sounds were measured from dynamic spectrograms using additional information from the intensity and tone contours. Vowel qualities were identified on the basis of the first and second formants (F_1 and F_2). At this the acoustic space in the F_1 and F_2 axes of the Estonian vowels was taken as a reference system² (Table 1 from Liiv, Remmel 1970 was used). Thus in phonetic transcription vowel symbols and their diacritics denote the placement of Kildin Lapp vowels in the acoustic quadrangle of Estonian vowels (consequently, e. g., [\bar{a}] denotes such a sound which is pronounced fronter of the Estonian [a] region; it is an intermediate sound between the Estonian [a] and [\bar{a}]). Since acoustic descriptions of the Kildin Lapp vowel system are hitherto lacking it was inevitable to rely on some other definite reference.

We present the data on segmental durations in a numbered word list as follows: the first column presents the phonetic transcription according to Itkonen 1958 (whenever possible) and the translation; the next columns present segment durations in milliseconds; the last columns — a phonetic transcription and some possible phonemic transcriptions proceeding from the present data.

As the informant's speaking rate was very slow, difficulties arise when differentiating long and short vowels. In the analyzed words the duration of a long vowel was usually over 250 ms whereas the duration of a short vowel could reach up to 200 ms. Data on fundamental frequency and overall intensity will be presented in the comments.

(1) <i>s̄īnv̄^o</i>	<i>s</i>	<i>i</i>	<i>j</i>	<i>n</i>	<i>e</i>	<i>s̄īñe</i> / <i>sīñe</i> /
'to laugh'	180	180	260	200	110	
(2) '(he) laughed'	150	190	120	180	130	<i>s̄īñe</i> / <i>sijne</i> /

On phonetic considerations it is possible to express the opposition $\bar{j}n - j\bar{n}$ as $\bar{j}n - jn$ (i. e. regarding the duration of n as indifferent in respect of the opposition although in word (2) it is longer than j). The most essential difference lies in the duration of j . In the word *s̄īñe* $i\bar{j}$ is pronounced with a level tone which rises by 1 st at the end of j (being up to 3 st higher than the F_0 of the same segments of *sijne*); the intensity of j is indeed decreased by 2—3 dB as compared to the preceding i , but in the word *sijne* intensity falls from the first third of i to the end of j even more (8—9 dB). Thus in addition to the different durations of the syllable-final j in words (1) and (2) the intrasyllabic distribution of pronouncing activity likewise acts differentiatingly: in the word *s̄īñe* the syllable-final part is pronounced more intensively while in *sijne* the beginning of the syllable is stronger. Itkonen (1971 : 108) has noticed this kind of syllable stress replacement from the syllable end in the word *šies̄* (nsg.) to the syllable beginning in the weak grade genitive singular form of the same word with the duration of the consonant remaining constant. Our examples show that the phenomenon described by Itkonen is of wider spread.

² Audible quality definitions of Lapp vowels given by non-Lapps have probably always been influenced by the hearer's native vowel system (Wiik 1979 has shown how acoustically identical vowel stimuli are grouped into different vowel categories depending on the hearer's mother tongue).

(3) 'cloud'	<i>v</i>	<i>e</i>	<i>e</i>	<i>χ</i>	<i>t</i>	<i>věčt̄</i> <i>veeχt̄</i> ~ <i>vex̄t̄</i>
	150	100	130	290	280	
(4) 'clouds'	130	130	50	80	250	<i>věχt̄</i> <i>veeχt̄</i> ~ <i>vex̄t̄</i>

The word-final *t* is long in both cases, much as in Kert's examples (Kepr 1971 : *vupt̄* — *vupt̄*, where $t=170$ ms and $\bar{t}=190$ ms). Audibly this sound is inert for differentiating the contrasted words; we do not perceive in the words *siĵne* (2) and *vex̄t̄* (4) that the second consonant of the clusters is considerably longer than the first. Therefore this difference is not noted in our phonemic transcription. The most important difference is that between the durations of *χ*. In addition: in word (3) the pronunciation intensity culminates in the *χ* segment, whereas in word (4) this takes place at the beginning of the vowel as a result of which the second component of the diphthong (?) or diphthongized vowel shortens. Thus the half length (') of the first vowel of both word (2) as well as word (4) rather denotes the accentuation of the syllable-initial part than its length in our phonetic transcription. As the shortness of the following consonant and the accentuation of the initial part of the vowel are concurrent phenomena we do not reflect accentuation as a redundant feature in our phonological transcription.

(5) <i>maĵk^A</i>	<i>m</i>	<i>a</i>	<i>ĵ</i>	<i>ɔ</i>	<i>k</i>	<i>maĵk</i> <i>majĵk</i> ~ <i>majhk</i>								
'big marena'	80	200	120	180	210									
(6) <i>maĵk^A</i>	60	200	60	60	160	<i>māĵk</i> <i>majĵk</i> ~ <i>majhk</i>								
'big marenas'														
(7) 'big marena ess. sg.'	<i>m</i>	<i>a</i>	<i>ĵ</i>	<i>ɔ</i>	<i>k</i>	<i>e</i>	<i>n</i>	<i>maĵkeñ</i> <i>majĵkeñ</i> ~ <i>majhkeñ</i>						
	110	210	160	190	120	140	220							
(8) 'big marena comit. sg.'	100	210	110	60	150	200	80	<i>māĵkeñ</i> <i>majĵkeñ</i> ~ <i>majhkeñ</i>						
(9) <i>sōĵtte^δ</i>	<i>s</i>	<i>o</i>	<i>ĵ</i>	<i>ɔ</i>	<i>t</i>	<i>e</i>	<i>soĵt̄e</i> <i>soĵte</i> ~ <i>soĵhte</i>							
'to bend'	140	110	70	170	260	240								
(10) 'to bend a little'	120	100	60	70	170	150	230	90	120	<i>a</i>	<i>ś</i>	<i>t</i>	<i>e</i>	<i>sōĵtwište</i> <i>soĵtašte</i> ~ <i>soĵhtašte</i>

In the examples above we come across the phenomenon which Itkonen (1971 : 102) has called preaspiration, or a voiceless vowel. Preaspiration occurs before a voiceless stop or an affricate. The symbol *ɔ* after the vowel-matter has been used for denoting it. In word pairs (5—10) it is conceivable to treat the sequence *ĵɔ* together (*majĵk* — *majĵk*, etc.) but the main difference lies in the duration of preaspiration itself (thus, *majĵk* — *majĵk*, etc., while the denotation *majĵk* — *majĵk* is again phonetically ungrounded). In these words we can also notice the different accentuation of syllable components. In the strong grade forms of words (5, 7, 9) the pronunciation intensity consistently culminates at the end of the voiced part of *ĵ* (the overall intensity is the weakest at the beginning of the vowel, and the strongest during *ĵ*; the pitch during the vowel and the following voiced segment of *ĵ* is steadily rising); in the weak grade form (6, 8, 10) the peak of the pronunciation intensity, on the contrary, is in the initial part of the first vowel (see Figure 1).

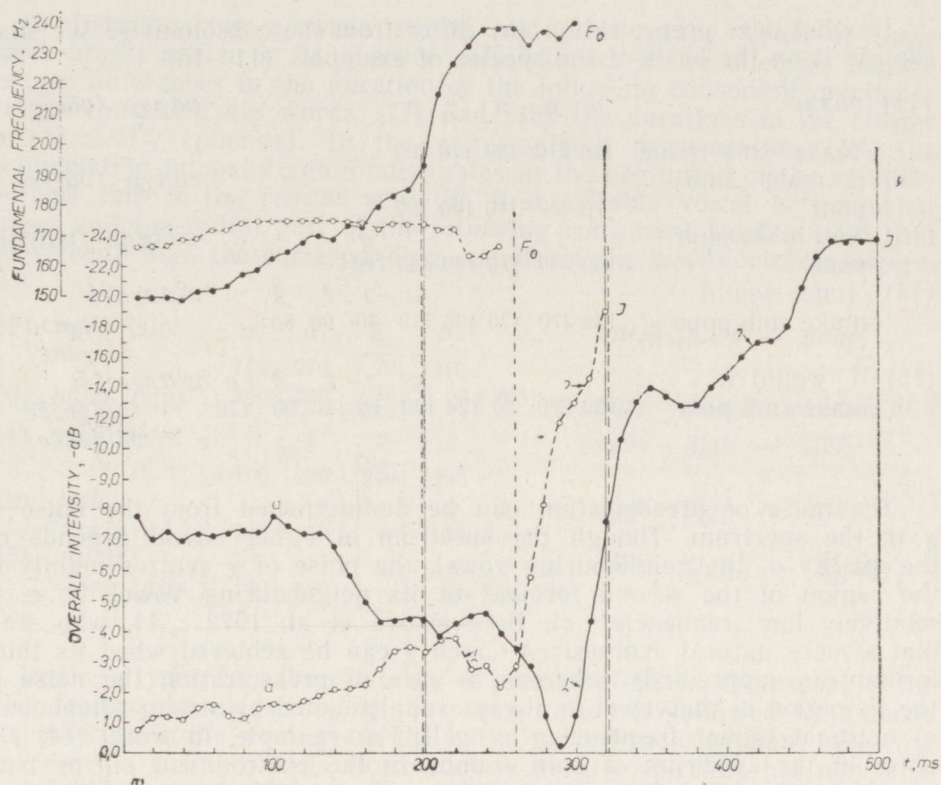


Figure 1. The overall intensity (in -dB) and pitch curves of the word parts *-aj̄-* and *-aj̄-* (from the words *maj̄k* 'big marena' and *majk* 'big marenas').

Continuous line ————— *maj̄k*, dotted line *majk*.
The corresponding vertical lines denote the sound boundaries.

Let us come back to preaspiration. In all the words (5–10) the initial part of *i* forms a voiced *j*-glide while the final part changes into a voiceless fricative whose quality (i. e. the timbre of the noise) depends on the timbre of the preceding voiced vowel-matter. In the present case we audibly (and according to the data of spectrograms) have to do with a $\zeta \sim (h')$ -like sound while in the examples below the voiceless noise of preaspiration has either the shade of *ä*, *e*, *a*, or *i* depending on the preceding vowel. The quality of preaspiration of informant NA of a younger generation slightly differs from that of the older informant LJ. NA pronounces the sound *h* abruptly after the voiced part of the vowel while LJ's preaspiration sounds like the damping of the vowel or rather like breaking off the vowel's voicedness in such a way that the pre-stop noise (*h*-ness) is weaker. It is a paradoxical phenomenon: in case of preaspiration the intensity of the voiced part of the vowel is the strongest immediately before the cessation of voice (interruption of the tone); usually the pitch, too, has reached its maximum by this time. One gets an impression as if the tone interruption is the result of laryngeal overstraining. Preaspiration pronounced by LJ sounds like *stød*, the only difference being that preaspiration is of longer duration and takes place at the end of a vowel (cf. Riber Petersen 1973).

In what does preaspiration (*h*) differ from the consonant χ ? We shall explain it on the basis of the spectra of examples (11—15).

(11)	<i>vālχe^δ</i>	<i>v</i>	<i>a</i>	<i>λ</i>	<i>χ</i>	<i>e</i>		<i>vālχe</i>	/vālχe/	
	'make smb pour'	120	210	120	170	200				
(12)	'I make smb pour'					<i>a</i>		<i>vālχv</i>	/vālχa/	
		70	310	140	140	220				
(13)	'you make smb pour'						<i>g</i>	<i>vālχag</i>	/vālχag/	
		150	230	110	140	140	110			
(14)	'(one) would make smb pour'				<i>a</i>	<i>ɔ</i>	<i>t</i>	<i>š</i>	<i>v^δālχaʔš</i>	
		130	270	130	130	110	40	90	80	
									/vālχaʔč ~ vālχahč/	
(15)	'I would make smb pour'				<i>e</i>	<i>ɔ</i>	<i>t</i>	<i>š</i>	<i>v^δālχeʔš^se</i>	
		130	270	80	120	120	60	120	90	170
									/vālχeʔče ~ vālχehče/	

The noise of preaspiration can be distinguished from the noise of χ in the spectrum. Though the spectrum of either sound depends on the quality of the neighbouring vowel, the noise of χ centres mainly in the region of the second formant of its neighbouring vowel (i. e. at relatively low frequencies; cf. Borovičková et al. 1972 : 44, who state that a more natural synthesized Czech χ can be achieved when its third formant is suppressed), whereas in case of preaspiration the noise in the F₂ region of the vowel is always supplemented by strong components of noise at higher frequencies as well. For example, in word (14) the noise in the spectrum of both sounds in the environment of the back vowel occurs at low frequencies, but in preaspiration strong components of noise at higher frequencies are added. It is fully conceivable to transcribe preaspiration by means of the letter *h*.

While in words without preaspiration (11—13) the intensity of the vowel of the second syllable is weaker than in the first syllable, a second syllable with preaspiration (14—15) has an overall intensity either stronger than, or at least as strong as, in the first syllable of the word. A syllable with preaspiration is always pronounced with a higher tone. Probably this is the reason why a preaspirated syllable in longer words seems to carry secondary stress (*'vālχag* — *'vālχahč*). It can also be heard in the following loanword pairs: *'čaińek* 'tea-pots' — *'čaińěhk* 'tea-pot', *'krāvaf* 'beds' — *'krařvāhf* 'bed', etc.

E. Itkonen (1971) does not consider preaspiration a separate phonological unit (the phenomenon is not reflected in his transcription either), but T. I. Itkonen (1958) consistently marks preaspiration in his phonetic transcription. In the pronunciation of present Kildin Lapp the marking of preaspiration may appear to be necessary for there exist oppositions of the same syllabic structure which differ only in the presence or absence of preaspiration (cf. *majńk* 'big marena' — *siřt* 'winter village', *mařt* 'milk', *leřp* 'bread', and *majhk* 'big marenas' — *siřt* 'villages', *majt*, *leřp*).

(16)	<i>kieřpeř</i>	<i>k</i>	<i>e</i>	<i>ɔ</i>	<i>p</i>	<i>e</i>	<i>š</i>	<i>kⁱeřpeř</i>	kēřpeř ~
	'light'	?	230	80	250	160	130		kēřpeř/
(17)	<i>kēāřpne^δ</i>		<i>ā</i>			<i>n</i>	<i>e</i>	<i>k^eāřpne</i>	kāřpne ~
	'to lighten'	?	210	80	200	100	140		kāřpne/
(18)	<i>kie^bpne^δ</i>		<i>e</i>					<i>kⁱe^bpne</i>	kēřpne
	'to lighten'	?	260	—	200	80	220		

In distinguishing between strong and weak grade forms of these words preaspiration or its absence seems to act as an effective feature because differences in the duration of the following consonant or cluster are not consistent (in words (17) and (18) the durations of the cluster *pn* practically coincide). In the word without preaspiration (18) the pronunciation intensity again culminates at the beginning of the syllable. Perhaps this is the reason why the first syllable vowel is somewhat longer and the initial part of the following consonant weaker (lenis but not voiced) than the corresponding sounds in the words with preaspiration.

(19) <i>nāḗp</i> 'cup'	<i>n</i>	<i>a</i>	<i>ɔ</i>	<i>p</i>	<i>nāḗp̥</i> <i>nāḗp</i> ~ <i>nāhp̥</i>
	130	270	$\overline{70}$	210	
(20) <i>nāḗp</i> 'cups'	160	340	—	90+290	<i>nāḗp̥</i> <i>nāb' b'</i> ~ <i>nāb' p̥</i>
(21) <i>liḗk</i> 'work'	<i>l</i>	<i>i</i>	<i>ɔ</i>	<i>k</i>	<i>leḗk̥</i> <i>liḗk</i> ~ <i>lihk̥</i>
	100	230	$\overline{240}$	290	
(22) <i>liḡk</i> 'work npl.'	130	160	—	<i>g</i> <i>k</i> 130 200	<i>liḡk̥</i> <i>liḡg</i> ~ <i>liḡk</i>
(23) <i>liḡkḗ</i> 'work (dim.)'	90	150	—	<i>g</i> <i>k</i> <i>ε</i> 90 80 170	<i>liḡk̥ε</i> <i>liḡgä</i> ~ <i>liḡkä</i>

In these types, too, the existence of preaspiration or its absence is the main feature. In the strong grade preaspiration is followed by a fortis stop whereas in the weak grade the initial part of the consonant following the vowel is weak (a lenis stop which is usually voiceless but may also be voiced, see word (22)).

(24) <i>vājlaḗ</i> 'to forget'	<i>v</i>	<i>u</i>	<i>a</i>	<i>i</i>	<i>l</i>	<i>a</i>	<i>ɔ</i>	<i>t</i>	<i>e</i>	<i>vājlaḗ</i> <i>leḗje</i>
	150	190	110	230	100	110	$\overline{80}$	190	200	<i>/vājlaḗte</i> ~ <i>vājlahte/</i>
(25) '(he) forgets'	100	120	140	210	140	150	70	330		<i>vājlaḗt̥</i> <i>/vājlaḗt̥</i> ~ <i>vājlaht̥/</i>
(26) <i>vājlaḗ</i> 'I forget'	?	160	170	180	110	120	—	180	190	<i>a</i> <i>vājlaḗta</i> <i>/vājlaḗta</i> ~ <i>vājladta/</i>

In non-first syllables of verbs the same kind of consonant quantity alternation takes place as in examples (19—23).

(27) <i>vālam</i> '(I) pour'	<i>v</i>	<i>a</i>	<i>l</i>	<i>a</i>	<i>vālm</i> <i>vāla</i> ~ <i>vala/</i>	
	130	$\overline{180}$	$\overline{140}$	290		
(28) <i>vāllm</i> 'to pour'	170	330	270	210	<i>vāllm̥</i> <i>vālle/</i>	
(29) '(he) pours'	140	$\overline{260}$	$\overline{230}$	—	<i>vāl</i> <i>vāl/</i>	
(30) <i>sōja</i> 'I bend'	<i>s</i>	<i>o</i>	<i>j</i>	<i>a</i>	<i>sōjv</i> <i>soja/</i>	
	140	180	170	140		
(31) <i>sōijv</i> 'to bend'	160	140	190	120	170	
			<i>i</i>	<i>j</i>	<i>e</i>	
(32) 'he bends'	<i>s</i>	<i>o</i>	<i>a</i>	<i>i</i>	<i>j</i>	<i>sōij̥</i> <i>sojj/</i>
	120	40	140	200	180	

The contrast between a single consonant and a geminate (or a long consonant) is essential in words (27—32).

Summary. 1) From the phonetic point of view it is possible to express the contrast $\bar{C}_1C_2/C_1\bar{C}_2$ as $\bar{C}_1C_2:C_1C_2$. It can be motivated by two circumstances: (a) in contrasted words only the syllable-final consonant C_1 consistently differs in its duration while the duration of C_2 is unimportant for the contrast; (b) the pronunciation intensity in a strong grade form (in case of \bar{C}_1C_2) culminates in the end of the syllable, in a weak grade form (in case of C_1C_2) at the beginning of the syllable (the so-called different accentuation of syllables), e. g. *majh̄k* — *mājhk*, etc. Both features act consistently in words with preaspiration as well as without preaspiration (*sij̄ne* — *sijne*, *sij̄t* — *sijt*, *majh̄k* — *majhk*).

2) Preaspiration is followed by a fortis stop, while in the absence of preaspiration the vowel is followed by a geminate or a long stop which have a weak initial part (*lih̄k* — *ligk*).

3) Preaspiration is a *h*-like fricative before which the preceding vowel is pronounced with a higher pitch and a stronger intensity than a vowel not followed by preaspiration.

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АКУСТИЧЕСКИЙ АНАЛИЗ НЕКОТОРЫХ КОЛИЧЕСТВЕННЫХ МОДЕЛЕЙ КИЛЬДИНСКОГО ДИАЛЕКТА СААМСКОГО ЯЗЫКА

С фонетической точки зрения контраст $\bar{C}_1C_2/C_1\bar{C}_2$ можно выразить в виде $\bar{C}_1C_2:C_1C_2$. Это объясняется двумя обстоятельствами: а) в противопоставленных словах по длительности последовательно различается только C_1 на конце слога, поскольку длительность начального согласного следующего слога C_2 в отношении оппозиции не существенна; б) в сильноступенной форме (случай \bar{C}_1C_2) интенсивность произношения кульминирует в конце слога, в слабоступенной форме (случай C_1C_2) — в начале слога (т. н. различная акцентуруемость слога), например, *majh̄k* — *mājhk* и т. д. Оба при-

знака проявляются последовательно в словах как с преаспирацией, так и без нее (*siĭne — sijne, siĭt — sijt, majĭk — majhk, veĕzt — veĕyt*).

За преаспирацией следует сильный смычный, поскольку без преаспирации гемината или длинный смычный имеет слабое начало (*lĭhk — lĭgk*).

Преаспирация (оглушение конечной части гласного перед глухим смычным или аффрикатой) — это фрикативный звук, близкий *h*, гласный перед которым произносится более повышенным тоном и сильнее по сравнению с гласным в слове без преаспирации.