THE MAINTAINING OF DURATIONAL RATIOS IN QUANTITY DISTINCTIONS IN CONVERSATIONAL SPEECH

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ABSTRACT

It is a well known fact that segments may occur in a great variety of different phonetic realizations in conversational speech. The question addressed here is to what extent the durational component of linguistic quantity in conversational speech will differ from that associated with citation forms. Durational ratios play a significant role in the realization of different quantity degrees in Skolt Sámi (a Finno-Ugric language). This language makes lexical as well as grammatical use of the quantity feature. The objective of this study is to examine the maintaining of linguistically significant durational ratios in conversational speech. The results of three experiments designed to determine the role of duration in quantity realization point to (i) recognizing the significance of certain durational ratios associated with different morphological classes in Skolt Sámi, and (ii) there being a definite tendency to maintain these ratios in speaking modes radically different from those occurrences of speech where more articulatory precision is needed.

INTRODUCTION

Previous analyses of Sámi quantity have established that disyllabic units (stress-groups) are to be regarded as the domain of quantity [1]. It has generally been accepted that within the disyllabic unit there exists a definite durational interdependency between the first syllabic vowel, the consonant(s) following it, and the second syllabic vowel [3]. The results of the acoustic analysis reported on here derive from three experiments all directed toward examining durational interdependencies from the perspective of the maintaining of the characteristic durational ratios that exist between the first syllabic vowel and the consonant(s) following it. These ratios were discussed in [4, 5]. The maintaining of these ratios were examined (i) in disyllabics were compensatory lengthening occurred (first experiment); (ii) in larger grammatical units (second experiment); and (iii) in disyllabics occurring in spontaneous conversations in which the same speakers participated as in the first two experiments (third experiment). On the basis of the result of the first experiment it was concluded that durational ratios rather than absolute durational values are relevant in the signalling of different quantity degrees in Skolt Sámi. The second experiment showed that the tendency to maintain the durational ratios overrides the apparent tendency to keep the duration of larger grammatical units (such as the paragraph) constant. The third experiment implies that there is a definite tendency to keep the durational ratios unchanged -- thus phonetic variations that occur in conversational speech will not affect durational ratios relevant in the realization of distinctive quantity degrees.

EXPERIMENTS

In all three experiments described below the recording was made with a Scully Full-Track Broadcast Machine tape recorder in a sound-proof room. The recording speed was 7.5" per second. The software for making durational measurements was the Signalyze (Version 3.12) with a Macintosh computer.

Durational ratios in compensatory lengthening

In the first experiment recordings of 1,200 disyllabics belonging to the five types of disyllabics [3,4] were made by two speakers. They were asked to place the test-words in the sentence frames *cie'lk e'pet* and *saar ... epet* 'say ... again' respectively.

Skolt Sámi has a phonological rule that either reduces or drops word-final vowels (the latter being more common in

connected speech). There are five structural types of disyllabics where this rule may apply [3]: Type 1 (containing a long geminate), Type 2 (containing a long consonant cluster), Type 3 (containing a single consonant), Type 4 (containing a short geminate), and Type 5 (containing a short consonant cluster). Type 1 has two sub-groups: 1a (containing liquids, nasals or non-sibilant fricatives), and 1b (containing plosives, affricates or sibilant fricatives). Similarly, Type 4 has two sub-groups: 4a (containing voiced fricatives); 4b (containing a plosive, affricate or voiceless fricative). Durational mesurements were made of the first syllabic vowel, the consonant(s) following and the second syllabic vowel (when present). *Table 1* summarizes the results of these measurements when there is a full vowel in the second syllable; *Table 2* summarizes the results of these measurements when there is a reduced vowel or no vowel at all word-finally. Mean durations ($\bar{x}$) and standard deviations (SD) are given for each segment in each structural type (durational values are given in milliseconds). These tables also show the V/C ratios.

Table 1. Durational measurements of disyllabics with a full vowel in the second syllable

Type	V		C		V/C
	$\bar{x}$	SD	$\bar{x}$	SD	
1a	209	13	171	20	1.22
1b	188	16	222	16	0.84
2	147	14	322	16	0.45
3	273	20	85	8	3.21
4a	206	15	146	10	1.41
4b	206	15	207	17	0.99
5	229	21	163	17	1.30

The results of the durational measurements, as presented in *Table 1* and 2, show the realization of the compensatory lengthening process. It can clearly be seen that all these structural types behave similarly in terms of durational increase as a result of compensatory lengthening: i.e. the duration of the vowel that has become reduced or deleted in the second syllable is added to the duration of both of the preceding segments. The durational increases in the relevant segments average 32 msec for vowels and 38 msec for the first syllabic consonant(s).

Table 2 Durational measurements of disyllabics with a reduced vowel or no vowel word-finally

Type	V		C		V/C
	$\bar{x}$	SD	$\bar{x}$	SD	
1a	240	22	207	18	1.15
1b	220	19	265	21	0.83
2	170	13	373	21	0.45
3	349	20	89	7	3.80
4a	233	15	179	16	1.30
4b	233	15	253	20	0.92
5	269	18	198	16	1.35

The pattern of durational increase, observable in the five structural types where compensatory lengthening is present, suggests two important trends: (i) the durational ratios remain constant, and (ii) the durational increase occurs in both the consonant(s) and the vowel segment preceding the second syllabic vowel. The different behavior of disyllabics belonging to the third type have been discussed in detail in [3,4] and its implications are not relevant in this context.

The above measurements thus indicate the maintaining of durational ratios even though absolute durational values change due to compensatory lengthening.

The maintaining of durational ratios in larger grammatical units

This second experiment consisted of the recording of six paragraphs by the same two speakers, each paragraph being recorded twice; thus the total number of recorded paragraphs was 24. Each of the six paragraphs under investigation contains three sentences. The sentences in these paragraphs were the same, except for their ordering. More details of this experiment were discussed in [5]. Suffice it here to say that the clearly recognizable timing strategies by the speakers that aim at a certain durational target are associated with shorter word duration in sentences in the third (i.e. last position). Consequently, segment durations in these words are also significantly decreased. Durational changes manifested in these segments were examined in relation to the constant

durational ratios between the first syllabic vowel and the consonant(s) following it as discussed above in connection with the compensatory lengthening phenomenon. Thus, it was to be expected that shorter word duration associated with paragraph-final sentence position will correspond with shorter segment duration. The question I tried to answer was whether or not absolute durational change -- in this case, decrease in duration -- affects the ratios of first syllabic segment duration. In particular, the issue addressed in this experiment was whether there is a tendency to keep durational ratios between the relevant segments constant.

The result of this present experiment indicates that changes in absolute duration indeed do not affect durational ratio values. *Table 3* shows mean durations of the first syllabic segments of disyllabics together with their durational ratios; *Figure 1* summarizes the changes in absolute duration in relation to constant durational ratios. The paragraph-final words that contain the segments analyzed here belong to the first structural type, Type 1a and 1b (see above).

Table 3. Mean duration and durational ratios of segments in disyllabics Types 1a and 1b of paragraph-final words

Type	V		C		V/C
	x̄	SD	x̄	SD	
1a	174	21	139	20	1.25
1b	155	19	164	18	0.94

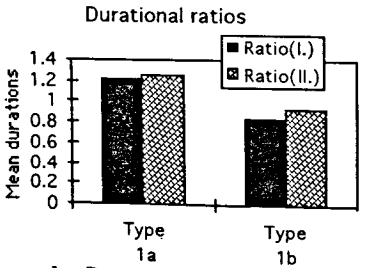

Figure 1. Durational ratios of shorter segment duration in relation to ratios of average segment duration

A comparison of the durational values in the above table with those in *Table 1* confirms the importance of durational ratios. That these segmental durational changes occur in paragraph-final positions points to the relevance of a temporal organization strategy in keeping the targeted duration of the paragraph constant. These absolute durational changes do not affect durational ratio values, which are in accordance with the same tendency observed in connection with the compensatory lengthening phenomenon referred to above. *Figure 1* illustrates the durational patterns summarized in *Table 3*.

The maintaining of durational ratios in spontaneous conversation

In the third experiment audio recordings were made of spontaneous conversation in which the same two speakers participated. 110 utterances were analyzed, 55 for each speaker. The analysis here focussed on the durational properties of disyllabic stress-groups, and, similarly to the above two controlled experiments, the first syllabic vowel and the consonant(s) following it were analyzed. According to the varying speech tempo, the relevant segment durations displayed a rather wide variety. It proved to be practical to divide them into several groups within each structural type on the basis of of the apparent durational properties associated with the segments under investigation in relation to the speech tempo variations. In this place only those disyllabics are analyzed which showed significant durational difference from those of the citation form presented in *Tables 1* and 2. While disyllabics in citation forms averaged word durations between 550 and 720 msec (depending on structural types), in this fastest speech tempo that occurred in the conversation recorded word durations averaged between 177 and 302 msec. *Tables 4* and 5 summarize the durational measurements and the V/C ratios of disyllabics occurring in spontaneous speech with or without a second syllabic vowel. The durations of the second syllabic vowel have a mean average of 56 msec.

Tables 4 and 5 indicate a definite tendency to keep durational ratios constant. This can be stated despite (i) the evident large standard deviation

values associated with varying speech tempo, and (ii) the noticeable different ratio values when compared with those presented in *Table 1* and 2 representing citation forms in controlled experiments. It has to be noticed, however, that (i) these differences are largest in connection with the third type -- but even with this difference it clearly separates this type from the others, and (ii) ratio values in all the other types can clearly be related to those ratio values characteristic of the citation forms. *Figure 2* summarizes durational ratio values associated with spontaneous speech and those associated with the citation forms.

Table 4. Segment durations and V/C ratios in spontaneous speech with a full vowel in the second syllable

Type	V		C		V/C
	x̄	SD	x̄	SD	
1a	124	28	103	23	1.20
1b	96	28	127	32	0.75
2	92	25	160	31	0.57
3	139	35	61	18	2.27
4a	155	23	110	27	1.40
4b	139	24	157	34	0.78
5	149	34	102	27	1.46

Table 5. Segment durations and V/C ratios in spontaneous speech with no vowel in the second syllable

Type	V		C		V/C
	x̄	SD	x̄	SD	
1a	135	31	120	26	1.12
1b	110	29	138	34	0.79
2	104	25	172	31	0.60
3	151	35	83	21	1.81
4a	172	30	132	29	1.30
4b	153	27	173	35	0.88
5	157	31	121	34	1.29

Conclusion

Articulatory simplicity associated with spontaneous speech, though changing absolute durational values, will not affect the realization of significant durational ratios in Skolt Sámi, a language with contrastive quantity degrees. It can thus be concluded that this study supports the claim that languages with distinctive duration tend to maintain characteristic durational patterns more consistently in conversational speech, while in those languages where duration is not contrastive, characteristic durational values tend to be less stable in a more casual speaking mode [6].

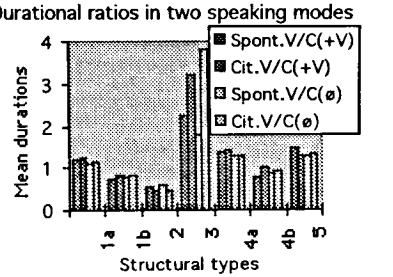

Figure 2. Durational ratios in spontaneous speech in relation to ratios of segment duration in citation forms

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