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## GEMINATION IN THE MORDVIN LANGUAGES

**Abstract.** In Erzya- and Moksha-Mordvin, vowel and consonant durations are not phonologically distinctive. There is, however, a morphophonologically conditioned difference between single consonants and secondary geminates that occurs at morpheme boundaries: E *kaññems*, M *kaññəms* (*kand-o-ms*, *kand-ə-ms* 'to carry' + *-ñ-* of the frequentative suffix). This article focuses on the durational relationship between geminates and singletons in Moksha. The material includes also word-internal intervocalic consonants, among them voiceless plosive and fricative singletons that allegedly lengthen in this position and sound as geminate-like segments. The results show that geminates are twice as long as singletons, including voiceless plosives and fricatives, and relative duration between geminates and singletons is segment-inherent (1.8 for voiceless and 2.1 for voiced consonants). The geminates, compared to the singletons, produced a more salient shortening effect on the preceding vowels. The collected data are necessary for defining the vowel-consonant durational relationship within prosodic units. An extensive analysis of gemination in Erzya and Moksha would be useful for a future investigation of morphophonological changes in the Mordvin languages.

**Keywords:** Mordvin, consonants, geminates, duration, syllable.

### Introduction

In the consonant inventories of Finno-Ugric languages, geminates have a special place. The origin of geminates has been among the most debated questions of historical phonology. Primary, or underlying, geminates belong to the phonological systems of the Finnic languages, in which distinction between the degrees of consonant quantity hypothetically derives from the system of proto-Uralic quantity opposition. In other languages, including Mordvin, primary geminates are missing. However, the possibility that underlying geminates might have belonged to the proto-system of consonants in Mordvin has been considered, as well (see our survey of literature on this issue in Lehiste, Aasmäe, Meister, Pajusalu, Teras, P., Viitso 2003 : 42–46). Moreover, the hypothetical replacement of geminate plosives (*\*kk*, *\*pp*, *\*tt*) with single consonants (*k*, *p*, *t*) and the "combinatorial" change of voiceless plosives to voiced ones (*k* > *g*, also > *j*; *p* > *b*, also > *v*; *t* > *d*)

has been regarded as one of the major phonological changes in the history of Mordvin (Grünthal 2012 : 305).

Concerning the development of geminate consonants in Mordvin, Heikki Paasonen (1903 : VII, 3–4, 20–21) and earlier authors maintained that voiceless plosive and fricative singletons (*k, p, t, χ, f, s, š*) between vowels (also between *l, r, v, j* and a vowel) sound longer than in other positions. Hence, they may be geminates consisting of two short segments (e.g., *tokkams* for *tokams* 'to touch'). Alongside these geminate-like segments, Paasonen accounted for the secondary geminates that evolved due to suffixation — the assimilated geminates. In the production of these, palatalization, devoicing, and certain other phenomena take part (e.g., *kaśś/kasś* < *kas-oms* 'grow' + *-ś*, past tense, 3d person, singular; M *kutt* < *kud* 'house, home' + *-t*, plural).

The observation concerning the intervocalic geminate-like singletons has been used as an argument in favour of the idea of the existence of Proto-Mordvin geminates discussed in the context of Finno-Ugric historical linguistics (for details, see Халман 1969). In view of this assumption, it might seem that in Erzya and Moksha there is an additional degree of consonant duration, produced by the intervocalic voiceless singletons that developed from historical geminates, in addition to the durations of single consonants and of secondary geminates. However, M. E. Evsev'jev (Евсевьев 1963 : 315) and other authors have rejected the idea that intervocalic voiceless singletons might be identified as geminate-like consonants. A different point of view has also been expressed regarding the question of geminates in the proto-systems of Finno-Ugric languages. Alo Raun (1974 : 305; 1971 : 23–24), for example, wrote that consonant length was originally intersyllabic, as no initial or final consonant clusters were tolerated, and termed two identical consonants occurring in intervocalic positions occasional (not structural) geminates.

Empirical data that would allow comparing the durational relationship between the consonants of Erzya and Moksha have not been hitherto available. The present analysis, which focuses on the durations of geminate and single consonants in Moksha, introduces some measurement results obtained from target groups of consonants including the aforementioned geminate-like segments. The primary aim of the data analysis was getting cues for the preferences of syllabification in Mordvin — an unsolved question that was posited in our earlier research of prosody in Erzya (Aasmäe 2006 : 43–44) and Moksha (Aasmäe, Lippus, Pajusalu, Salveste, Zirnask, Viitso 2013 : 41–46).

Prior to the analysis of durational data, we take account of some relevant questions concerning the morphophonology of gemination, which justify the choice of materials. Some of these questions warrant a detailed study.

### Geminate consonants in contemporary Erzya and Moksha

Present-day Erzya and Moksha display secondary gemination at morpheme and word boundaries. Geminates arise by a simple concatenation of identical consonants at the boundary of a stem and an adjoining suffix: E *surkesso*, M *surkssə* (*surks* 'ring' + *-so, -sə*, inessive) or between words in a phrase:

М *putk keskavt'*, Е *putik keskavont'* 'put the bag (down)'; М *pižəm marṭə* (Е *pižeme marto*) 'with rain'. At morpheme and word boundaries, occurrences of sandhi contribute to gemination, whereby different types of assimilated geminates occur in these two positions. Compare Е *odtomo* > *ottomo* (*od* 'new' + *-tomo*, abessive) and *od tarka* > *od darka* 'a new place': the voiceless and voiced *tt* and *dd*, respectively, are the result of regressive versus progressive assimilation at morpheme and word boundaries. The types of assimilation that culminate in geminates have received the attention of authors in pre-experimental studies of these consonants (e.g., Бибин 1968 : 395–399; Цыганкин 1979 : 105; Zaicz 1998 : 186; Имайкина 2008 : 165–167, 194–198). In Е *kaññems*, М *kaññəms* 'carry' (< *kand-o-ms*, *kand-ə-ms* 'carry' + *-ñ-* of the frequentative suffix), for instance, the geminate *-ññ-* arises as the result of the palatalization of the stem consonant *-n-* under the influence of the *-ñ-* of the suffix, in addition to the deletion of the consonant *-d-*.

There are, however, underdescribed aspects of gemination in both languages. Firstly, the inventory of secondary geminates in both languages needs further work to ensure completeness. Alongside *kk*, *tt*, *t't'*, *ss*, *śś* (mentioned by Н. Paasonen; see also e.g., Биушкин 1968 : 277), the occurrence of *ññ*, cf. Е *lomaññeñ* (*lomañ* 'person' + *-ñeñ*, dative); М *toññə* (*toñ* 'your' + *-ñə*, definite, pl) is attested (see e.g., Rédei 1984 : 214, Имайкина 2008 : 165). In Moksha, the occurrence of some other geminates is not excluded (Кабаева 2006 : 67; 2007 : 124). Secondly, a detailed description of the morphophonological patterns of gemination is needed. Certain pairs of distinctive opposition arise due to the occurrence of a single and a geminate consonant: Erzya *putan* 'I put' and *puttan* 'I put you' differentiate between the forms of the indefinite and definite conjugation (for more examples, see Марков 1961 : 28; Давыдов 1963 : 147; Деваев 1963 : 303; Биушкин 1968 : 277). In addition, there are paradigms that regularly display the occurrence of singletons and secondary geminates in certain forms (e.g., *-t'*, the plural suffix: Е *pešte*, *päštə* 'nut' — *pešt't'*, М *päšt't'* 'nuts'; some case endings: Е *surks/so*, *-sto* < *surks* 'ring' + *-so*, inessive; *-sto*, elative; the diminutive suffixes: Е *kesakke* < *kesak* 'bag' + *-ke*, *narmuññe* < *narmuñ* 'bird' + *-ñe*). Thirdly, no systematic studies of the sources and effects of gemination in the two languages have been reported. Sharing common features, Erzya and Moksha reveal diverging forms: cf.: М *vattamə*, Е *vantano* 'we look'; М *vät'tamə*, Е *vetatano* 'we lead/drive'; М *pat'tə*, Е *pañ'tan* 'I will chase you away'. It seems that in Moksha, gemination is facilitated by radical unstressed vowel reduction; hence, it might be more extensive than in Erzya.

### Analysis of durational data: the case of Moksha

As stated in the introduction, the primary task of the present analysis was collecting acoustic data on the durations of geminate and single consonants in Moksha, which in future research would allow for gaining insights into the problem of syllabification in Mordvin. The data were obtained from the measurement of intervocalic consonant durations in word-internal geminates, which arise from affixation, and single consonants, including the aforementioned geminate-like segments. Differentiation between

types of geminates (concatenated and assimilated) is beyond the scope of this description.

## Materials and method

Measurements of target segment durations were made in subsets of test words contained in the Moksha prosody corpus (Aasmäe, Lippus, Pajusalu, Salveste, Zirnask, Viitso 2013 : 89–90). The test words, which were embedded in a carrier sentence (*märgəl'ín p i n̄ ə m, af t' i n̄ ə* 'I would say o a t s, n o t y o u r s'), occurred in phrase- and sentence-final positions. This method allowed testing the possible effects of sentence prosody on the durations of segments. Eight native speakers of Moksha, aged 34 to 56, read the sentences. The speakers were residents of the following localities, situated in the Central dialect area: Mordovskaya Kozlovka, of the Atjurgevo region (four speakers); Zaitsevo, of the Kovilkino region (two speakers); Poľskoje Tsybajevo, of the Temnikov region (one speaker); Mordovskije Parki, of the Krasnoslobodsk region (one speaker). The recorded utterances of the speakers were analysed with the computer program Praat (Boersma and Weenink, 2010).

## Results and discussion

In light of the fact that the utterances recorded from speakers of varieties of the same dialect yielded comparable results, we used averaged durations obtained from the utterances of the eight speakers in the analysis. As expected, sentence-final position produced the effect of consonant lengthening. The results consistently showed statistically significant differences between the durations of consonants in phrase- and sentence-final positions. For example, the single stop *t* of the word *šit* 'days' was 39.5 ms longer in sentence-final position than in phrase-final position (179.4 ms versus 139.9 ms; [ $F(1, 14) = 6.7, p < 0.05$ ]). For this reason, only the measurement results obtained from phrase-final words were considered (the total number of tokens — 207). Another preliminary note concerns the durations of consonants and those of their palatalized counterparts (e.g., *t* and *t'*). As seen from the measurement data, there was no statistically significant difference in duration for such pairs. For example, the average durations of *t* and *t'* in the words *šit* 'days' and *šit'* 'at daytime' were 139.9 ms and 134.4 ms in phrase-final position and 179.4 ms versus 161 ms in sentence-final position, respectively. The difference between the average durations of *t* and *t'* was not statistically significant in either of the two positions ([ $F(1, 14) = 0.24, p < 0.6$ ], [ $F(1, 14) = 1.2, p < 0.3$ ]), which allowed using pooled results for the two consonants. On the other hand, the durations of voiced and voiceless consonants (e.g., *d'* and *t'* measured in the words *ved'* 'water' and *vet'* 'at night') differed in both phrase- and sentence-final positions. The differences between the consonant durations in the two positions (63.6 ms versus 103.4 ms for *d'* and 122.0 ms versus 169.8 ms for *t'*) were statistically significant ([ $F(1, 14) = 11.33, p = 0.005$ ] and [ $F(1, 14) = 9.9, p < 0.05$ ], respectively).

Table 1 shows the measurement results comprising the average durations of single and geminate consonants (C, CC), voiceless versus voiced, which occurred in an intervocalic position (-VCV-, -VCCV-). The target

consonants followed the vowel of the stressed first syllable in all of the words. The durations of the vowel (V) segments were taken into account, to define the relationship between vowel-consonant durations in the -VCV- and -VCCV- sequences.

The table is followed by a list of the test words containing the target consonants.

Table 1

Average consonant durations, in ms, of intervocalic single and geminate consonants (-VCV-, -VCCV-): V — a vowel, C — a single consonant, CC — a geminate, av. dur. — average duration, st. dev. — standard deviation, N — number of tokens (data of read speech)

-VCV-, -VCCV-		V	C	CC	V
C (voiceless)	av. dur.	114	136		95
N = 56	st. dev.	26	21		26
C (voiced)	av. dur.	134	92		108
N = 24	st. dev.	29	17		19
CC (voiceless)	av. dur.	94		248	82
N = 15	st. dev.	23		26	13
CC (voiced)	av. dur.	118		192	100
N = 16	st. dev.	29		21	17

Test words:

C, voiceless: *käpə* 'barefooted', *nupə́n* 'moss'; *vä́ti* 'leads', *süt'av* 'quiet'; *pekə* 'stomach', *nokan* 'I want'; *śísəm* 'seven'

C, voiced: *śadə* 'hundred', *vedu* 'watery'; *pižəl* 'rowan'; *pińəm* 'oats'

CC, voiceless: *kuttət* 'house (possessive, ablative)', *vattadə* 'you look (plural)'

CC, voiced: *t'íńńə* 'yours (plural)', *tońńə* 'yours (singular)'

Segment durations were measured in disyllabic words (with the exception of the disyllabic foot *vatta-* of the trisyllabic word *vattadə* 'you look'). It should be noted that the voiceless plosive *p*, due to its limited distribution in Erzyan and Mokshan words (Деваев, Цыганкин 1970 : 29–38, 65–68; Современные мордовские языки 1993 : 116–117), was observable only in intervocalic position and the plosives *p* and *k* were observable only as singletons.

The results for the single consonants show that the average duration of the voiceless C (*p*, *t*, *k*, *ś*), 136 ms, exceeded that of the voiced C (*d*, *d*, *ž*, *ń*), including the sonorant, 92 ms. (In the duration of the voiceless plosives, the duration of the portion containing the release was included.). The difference found between the average durations of voiceless and voiced consonants is analogous to the difference between the durations of voiced and voiceless consonants in other languages (cf. e.g., Lehiste 1970 : 28–29; Maddieson 1997 : 626).

To see whether the intervocalic position lengthens the durations of the singletons, the consonants *t*, *k*, *s*, *ń* were also measured in a position, where they precede or follow another consonant (test words: *pit'ni* 'expensive', *pit'ńə* 'price', *šit'ńə* 'the days'; *maksə* 'liver', *maksat* 'you give'; *kenžə*, also: *keńdžə* 'nail'; the number of tokens — 64). The average durations of the

voiceless consonants *t'*, *k*, *s* preceding or following another consonant (135 ms, 126 ms, 117 ms, respectively) did not deviate from the average duration of the intervocalic voiceless C (136 ms; see Table 1). There were also comparable results for the average durations of the sonorants *n*, *ń* preceding another consonant (89 ms), and for the intervocalic voiced C (92 ms; see Table 1).

Voiceless geminates were found to be longer than voiced ones (average durations: 248 ms vs. 192 ms, respectively); voiceless and voiced singletons (average durations: 136 ms vs. 92 ms), being shorter than geminates, had an analogous durational relationship. As far as the average durations of the voiceless singletons and geminates (136 ms vs. 248 ms) are concerned, the geminates were nearly twice (1.8) as long as the singletons. Voiced geminates were twice (2.1) as long as voiced singletons (192 ms vs. 92 ms).

In light of the findings of typological research on the acoustic characteristics of single and geminate consonants (cf. e.g., Lahiri, Hankamer 1988; Ladefoged, Maddieson 1996; Ohala 2007; Ridouane 2010), the analysis of the data in Moksha yielded consistent results. Geminates were found to be significantly longer than singletons. On average, the ratio between the durations of geminates and singletons, 2.0, is characteristic of many languages, though it may vary from language to language.

Typological studies have also shown that the durational relationship between geminate and single consonants is segment-inherent. In Figure 1, the average durations of the geminate and single consonants *ńń* and *ń*, measured in the disyllabic words *pińem* 'oats' and *t'íńńə* 'yours (plural)' (174 ms vs. 76 ms) are compared. The relation between the durations of the geminate *ńń* and of the singleton *ń* was 2.3, on average.

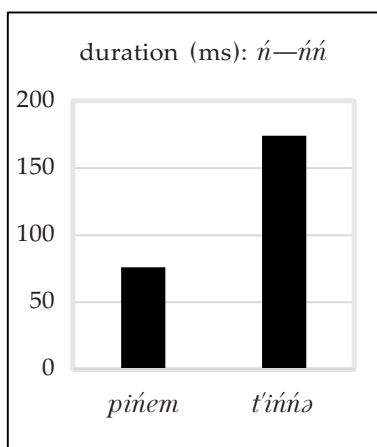


Figure 1. The average duration of the singleton *ń* and geminate *ńń*, in milliseconds (ms), produced in the words *pińem* 'oats' and *t'íńńə* 'yours (plural)'.

As a secondary correlate of geminates, typological studies have identified the effect of vowel shortening, which geminates produce on preceding vowels in some languages (for literature, see Ohala 2007 : 353). The effect of vowel shortening before consonants in general and in sequences of consonants, including geminates, in particular, has been previously reported in the material on monosyllabic words in Moksha (Aasmäe, Lippus, Pajusalu, Salveste, Zirnask, Viitso 2013 : 43). Figure 2 shows the relationship between vowel durations measured in words that end in a vowel, CV, and in a consonant or consonants, CVC(C), including gemi-



nates. The average vowel durations in the series of words were found to be 154.0 ms vs. 141.5 ms, respectively (the number of tokens — 57 and 156). The difference between the average vowel durations was statistically significant ( $[F(1, 78) = 4.29, p = 0.04]$ ).

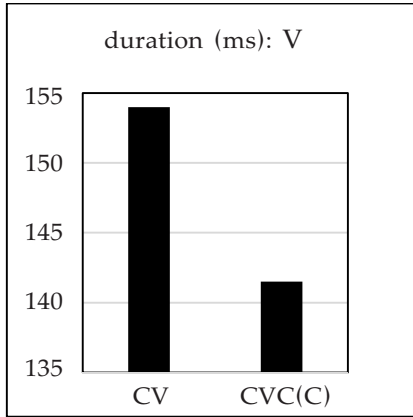


Figure 2. The average durations of vowels, in milliseconds (ms), measured in monosyllabic words ending in a vowel, CV, and in a consonant, including a geminate, CVC(C).

The data of vowel durations in disyllabic words (see Table 1 above), with vowels preceding a singleton (-VCV-) or a geminate (-VCCV-), show that before voiceless and voiced geminates, vowels were 94 ms and 118 ms long, before voiceless and voiced singletons, they were 114 ms and 134 ms long, respectively. As seen from these average vowel durations, vowels in the stressed first syllable were the shortest (94 ms) before voiceless geminates and the longest (134 ms) before voiced singletons. Vowels preceding voiced geminates and voiceless singletons had comparable durations. Figure 3 and Figure 4 illustrate the spectrograms of the single and geminate consonants *ń* and *ńń*, preceded by the vowel *i* in the words *pińam* 'oats' and *t'íńńə* 'yours (plural)' (produced by a female speaker). The singleton *ń* and the preceding *i* were 101 ms and 89 ms long, while the geminate *ńń* and the preceding *i* were 184 ms and 63 ms long; before the geminate, the vowel was 26 ms shorter than before the singleton.

The analysis of durational data obtained from the single and geminate (voiceless and voiced) consonants measured in intervocalic position unequivocally showed that geminates were, on average, twice as long as singletons. The geminates were also found to produce a more salient shortening effect on the preceding vowels than the singletons did.

As far as the durations of single consonants are concerned, the results did not support the assumption that voiceless plosive and fricative singletons in intervocalic position might tend to preserve the durational characteristics of historical geminates. According to the measurement data, the durations of intervocalic consonants, including voiceless plosives and fricatives, were comparable to the durations of the same segments in other word-internal positions (preceded or followed by another consonant). Compared to the intervocalic geminates, the singletons were twice as short. It may be assumed, however, that consonant lengthening in a -VCV-sequence is feasible due to other factors, for example, stress.

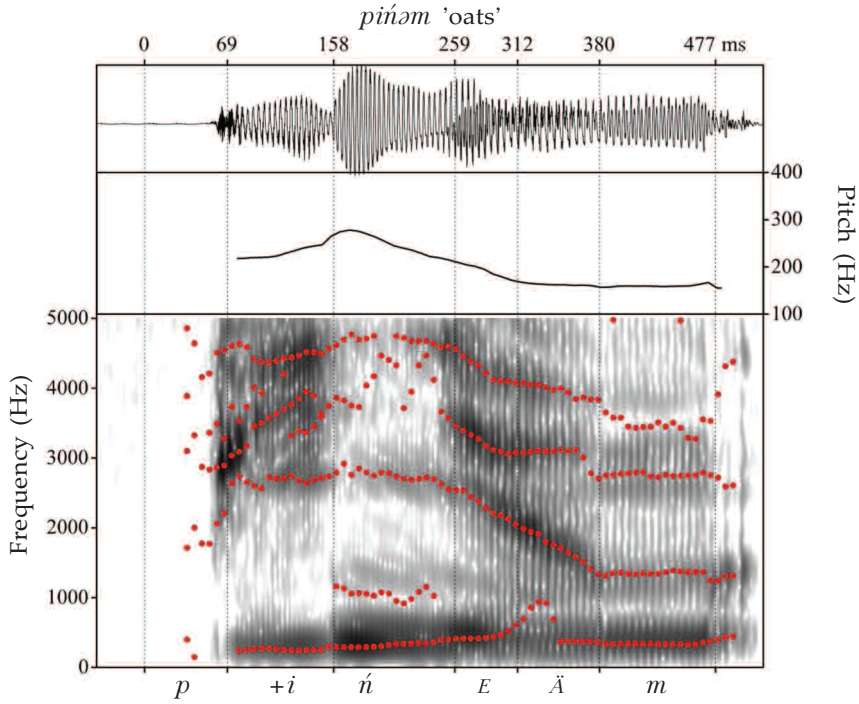


Figure 3. The spectrogram of the single consonant *ń* preceded by the vowel *i* in the word *pińəm* 'oats'.

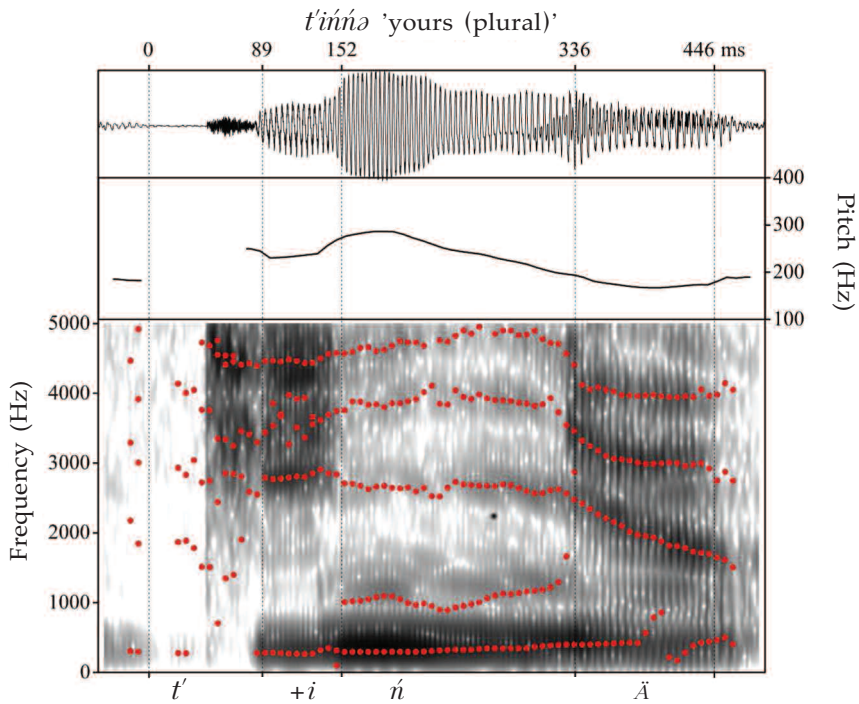


Figure 4. The spectrogram of the geminate consonant *ńń* preceded by the vowel *i* in the word *t'íńńə* 'yours (plural)'.



A detailed analysis of the durational characteristics of consonants with respect to stress in Erzya and Moksha is a task for future research. In the present analysis, consonant durations were compared in the environment of word-initial stress. Another question to be studied in the future concerns syllabification preferences in Erzya and Moksha. Until now, the question of syllabification in the research of prosody (Lehiste, Aasmäe, Meister, Pajusalu, Teras, Viitso 2003; Aasmäe 2006; Aasmäe, Lippus, Pajusalu, Salveste, Zirnask, Viitso 2013) has been approached from the point of view of vowel durations; the implications of the results for the identification of the patterns of syllabification, partly, were not explicit. There seemed to be a discrepancy between the expected phonological syllabification and the durational manifestations of vowels in certain series of words. The data of Moksha in Figure 5 (see Aasmäe, Lippus, Pajusalu, Salveste, Zirnask, Viitso 2013 : 46–49) showed statistically significant differences between the average vowel durations, V1 and V2 (V1 – the average vowel duration of the stressed first syllable, V2 – the average vowel duration of the unstressed second syllable), in the series of disyllabic phrase-final words. The average vowel duration ratios, V1/V2, obtained for some word structure types were not consistent.

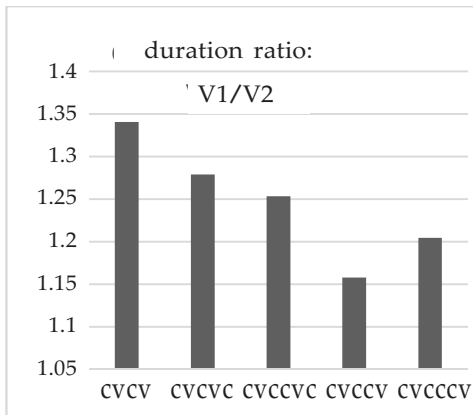


Figure 5. Duration ratios V1/V2 in series of disyllabic words (number of tokens — 438).

This discrepancy concerns words containing intervocalic single consonants, CVCVC, as well as sequences of consonants, CVCCV, including geminates, and CVCCCV (e.g., *vatt'ə* 'I look at you' and *kant'tə/kant'tə* 'I carry you'). Phonologically, the CVCVC series would be syllabified as disyllabic words with an open syllable followed by a closed syllable (CV.CVC), while in the words containing sequences of consonants, the syllable boundary would lie between a closed syllable followed by an open syllable (CVC.CV and CVC.CCV). This was found not to be the case in practice. The consonants must have influenced the vowel duration ratios, whereby gemination may have been the major source of these effects.

Syllabification, especially in the cases of intervocalic sequences of consonants, is of interest for the research of the cross-linguistic characteristics of syllables (for more details, see e.g., Redford 2003; Redford, Randall 2005). The definition of the relationship between the durations of vowel and consonant segments in a word is crucial for gaining insights into the intricate syllabification preferences of Erzya and Moksha.

## **Conclusion**

The present article offers a set of data on the durational characteristics of word-internal geminate and single consonants in Moksha. Word-internal geminates in Mordvin arise at morpheme boundaries due to suffixation. In the analysis, the average durations of intervocalic geminates and singletons were compared. The latter included voiceless plosive and fricative consonants, which in intervocalic position are, allegedly, longer than in other positions. The target segments occurred in disyllabic test words, where they were preceded by the vowel of the stressed first syllable. The data obtained in the analysis do not support the assumption that the voiceless plosive and fricative consonants might be longer in intervocalic position than in other positions.

The results of the analysis illustrate the typological maxim, which states that geminates having a longer duration than singletons is a characteristic of geminates. In the material of Moksha, geminates were twice as long as singletons, including those containing voiceless plosives or fricatives. The relative duration between the average durations of the geminates and singletons was found to be segment-inherent (1.8 for voiceless and 2.1 for voiced consonants).

A secondary characteristic displayed by geminates in some languages could be seen in the Moksha data — geminates compared to singletons produced a more salient shortening effect in the preceding vowels, whereby voiceless geminates shortened the preceding vowels more than voiced geminates.

The data obtained in the analysis are an important source for the definition of the vowel-consonant durational relationship and for the solution of questions related to syllabification in Moksha. An extensive comparison of gemination in Erzya and Moksha might be useful for the investigation of morphophonological changes in the development of the Mordvin languages.

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### ГЕМИНАЦИЯ В МОРДОВСКИХ ЯЗЫКАХ

Геминаты, наблюдаемые в эрзянском и мокшанском языках, образуются на стыке двух морфем в результате соединения двух сегментов, представляющих одну и ту же согласную фонему. Во многих случаях образованию геминат сопутствуют явления ассимиляции, например: эрз. *kaińems*, мокш. *kaińəms* 'нести' (< *kando/ə-ms* 'нести' + *-ń-* суффикса многократности). В данной статье приводятся результаты акустического анализа длительности удвоенных и одиночных согласных в мокшанском языке. Длительность согласных измерялась в положении между гласными. Составной частью материала были глухие смычные и щелевые согласные, долгота которых в позиции между двумя гласными (или гласной и согласными *l, r, v, j*), согласно распространенной точке зрения, сопоставима с долготой геминат (предположительно, на месте одиночных согласных ранее могли быть геминаты).

Результаты анализа показывают, что длительность мокшанских геминат в среднем вдвое больше, чем у одиночных согласных, включая интервокальные смычные и щелевые (относительная длительность у глухих согласных — 1,8, у звонких согласных — 2,1). Длительность гласных, предшествующих геминатам, сокращается под влиянием геминат больше, чем под влиянием одиночных согласных, при этом влияние глухих согласных проявляется более заметно, чем влияние звонких согласных.

Данные анализа необходимы, в частности, для выяснения соотношения длительностей гласных и согласных сегментов в слого. Рассмотрение вопросов, касающихся геминации в эрзянском и мокшанском языках, в целом, представляет интерес для исследования особенностей развития морфонологии двух близкородственных языков.