LINGUISTICA URALICA XLVIII 2012 3 doi:10.3176/lu.2012.3.04

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A PRELIMINARY COMPARISON OF ESTONIAN AND FINNISH PLOSIVES

Abstract. It has been impressionistically suggested that Estonian short plosives are somehow "weaker" than Finnish short plosives. This paper reports the results of an acoustic comparison of short plosives in the two languages in segmentally highly similar words. It was observed that, both in word-initial and word-medial position, closure durations were systematically shorter in Estonian than in Finnish. In word-medial position, the Estonian /k/ had shorter burst duration than Finnish /k/. Moreover, a large proportion of the Estonian /k/ tokens were burstless, i.e. completely voiced. The short burst of the velar plosive seems to be a specific characteristic of Estonian, which sets the language apart from many other languages.

Keywords: Estonian, Finnish, burst, plosives.

1. Introduction

The starting motivation for this comparison was Leho Võrk's (1972) impressionistic description of some differences between Estonian and Finnish short/single plosives. According to Võrk (1972 : 14), "a word-initial [invariably short] plosive in native Estonian words and in old loanwords is regularly written using the graphemes *p*, *t*, *k*. They are preferably pronounced in a somewhat weaker manner than in Finnish."[1]

As for medial short/single plosives, Võrk (1972 : 15) wrote that "in Estonian, [the graphemes] *b*, *d* and *g* denote short, voiceless lenis plosives [as in the word *luba*, *kade* and *lugu*]. They are voiceless like Finnish *p*, *t* and *k* [as in the words *lupa*, *kate* and *luku*], but they are pronounced very loosely and with a weak pressure of air, so that also their explosion burst is weak". Notice that, despite the potentially confusing spellings, both Estonian and Finnish traditionally lack a voicing contrast in plosives, although both languages show signs of acquiring one, under pressure from foreign languages. In this experiment, however, no oppositions based on voicing alone are involved.

Võrk thus claims that in Estonian, word-initial plosives are "preferably" pronounced as weaker than in Finnish, and that there is, between e.g. the Estonian words *luba*, *kade* and *lugu* and the Finnish words *lupa*, *kate* and *luku*, a difference such that in Estonian the medial plosive is pronounced more loosely and with a

[1] Translation of this and the next quotation by KS. In the Finnish original: "Sananalkuista [aina lyhyttä] klusiilia merkitään viron omissa sanoissa sekä vanhoissa lainasanoissa säännöllisesti kirjaimilla *p*, *t*, *k*. Ne äännetään mieluimmin jonkin verran heikompina kuin suomessa", and "Virossa [kirjaimet] *b*, *d* ja *g* tarkoittavat lyhyitä, soinnittomia leenisklusiileja [kuten sanoissa *luba*, *kade* ja *lugu*]. Ne ovat soinnittomia, kuten suomen *p*, *t* ja *k* [kuten sanoissa *lupa*, *kate* ja *luku*], mutta ne äännetään hyvin löyhästi ja heikolla ilmanpaineella, jolloin niiden eksploosiopaukahduskin on heikko."

weaker explosion burst than in Finnish. Võrk's impressionistic descriptions are in agreement with our similar impressionistic intuitions, and we decided to investigate whether such differences can be observed experimentally.

This can be considered a pilot study. The materials come from another experiment designed to investigate the durational realisation of quantity in the two languages. Target word selection was determined by the existence of word triplets in Estonian which differ from each only in terms of quantity but not in terms of segment quality, and the existence of sufficiently similar word pairs in Finnish (see below). Therefore, the materials were not specifically selected to enable the comparison here undertaken, one consequence of which is that there were no target words with word-initial /p/. Even so, we believe that the results are suggestive.

2. Methods

The materials come from Suomi, Meister, Ylitalo, Meister [to appear]. From among the target words of that larger study all those words were chosen for this experiment that contained initial and/or medial plosives. In the larger experiment, two types of target word sets (which are only a small selection of the different quantity patterns in either language) were chosen, one set in which the quantity oppositions are mainly signalled by consonant duration (the C set) and another set in which the quantity oppositions are mainly signalled by vowel duration (the V set). Target words, all with stress on the first syllable, were selected in such a way as to minimise segmental differences between the target words within a given set. Example word series from both sets are:

	Estonian			Finnish	
	Q1 (short)	Q2 (long)	Q3 (overlong)	C/V	CC/VV
C set	*kade*	*kate*	*katte*	*katu*	*katto*
V set	*keda*	*keeda*	*keeda*	*kita*	*kiito*

Notice that in e.g. *keeda* (Q2) and *keeda* (Q3) the quantity difference is not indicated in orthography. Although the focus of the present study is on short plosives, we also looked at (over)long/double plosives to determine whether patterns observable in short/single plosives also apply to (over)long/double plosives. Meaningful carrier sentences for the target words were constructed, e.g. (with target word underlined):

Q1 *Ütlesin, et olen <u>kade</u> maja pärast.*
Q2 *Ütlesin, et tuleb <u>kate</u> paigaldada.*
Q3 *Ütlesin, et tahan <u>katte</u> paigaldada.*
C *Sanoin, että vilkas <u>katu</u> suljettiin.*
CC *Sanoin, että vanha <u>katto</u> korjattiin.*

The sentences were elicited in such a way that the target words occurred under three degrees of prominence: unaccented, thematically accented and contrastively accented. The degrees of accentuation were elicited by using written context sentences imagined to precede the test sentences. For example, for the Finnish target word *kela* 'coil' the imagined context sentence intended to elicit an unaccented version was *Sanoitko, että uusi kela h a j o s i*? 'Did you say that the new coil w a s b r o k e n?', and the test sentence was *Sanoin, että uusi kela k a t o s i* 'I said that the new coil d i s a p p e a r e d'. Accordingly, there should be contrastive accent on *katosi* 'disappeared' and no accent on the target word. The context sentence intended to elicit the accented version was *Mitä sanoit*? 'What did you say?', and the test sentence was the same as before, but this time without any bold face. This time the target word is new information and should accordingly be accented. The context sentence intended to elicit the contrastively accented version, finally, was preceded by the context sentence *Sanoitko, että uusi k e l l o katosi*? 'Did you say that the new c l o c k disappeared?' and the test sentence was *Sanoin, että uusi*

k e l a katosi. Now a contrastive accent should fall on the target word (contrasting 'coil' with 'clock'). Thus the test sentence was always verbatim the same, and differences in accentuation were elicited by the context sentences read by the informants before uttering the target sentence. The Estonian sentences were constructed in the corresponding manner. For example, for the target word *kilu* 'sprat' the test sentence was *Ütlesin, et väike kilu k ü p s e t a t i* 'I said that the little sprat was f r i e d', and the context sentences were *Kas sa ütlesid, et väike kilu k e e d e t i*? 'Did you say that the little sprat was b o i l e d?', *Mida sa ütlesid*? 'What did you say' and *Kas sa ütlesid, et väike k a l a küpsetati*? 'Did you say that the little f i s h was fried?'.

Nine female speakers were recorded in both languages, the Estonian speakers in Tallinn and the Finnish speakers in Oulu, using high quality digital equipment and highly similar instructions. The numbers of short/single plosive tokens studied were as follows:

	Estonian	Finnish
Word-initial (only /t/ and /k/)	648	430
Word-medial (/p/, /t/, /k/)	232	241

The durational measurements were made using Praat (Boersma, Weenink 2011) and standard segmentation criteria.

3. Results

When segment durations are compared across languages, using different speaker groups, it is important to control that any differences observed are not due to potential differences in mean speaking rate across the speaker groups. Evidently, and luckily, there was no such rate difference in Suomi, Meister, Ylitalo, Meister [to appear], and hence in this experiment. Thus, (i) the grand mean duration of V_1 across the quantities was statistically the same in both languages, (ii) the grand mean duration of C_2 across the quantities was the same in both languages, and (iii) the absolute amount of accentual lengthening was the same in both languages. However, the mean total target word duration was longer in Estonian (377 ms, s.d. = 50.0) than in Finnish (358 ms, s.d. = 30.7), a difference that was statistically significant [$F(1, 88) = 4.09$, $p < 0.05$]. If anything at all could be predicted from this difference, the only feasible prediction would be that durations of segments (and their parts) would be longer in Estonian than in Finnish. Below, however, we present results to the opposite effect (i.e. s h o r t e r durations in Estonian). The obvious conclusion then is that the results represent real differences between the two languages, they are not due to differences in speaking rate.

3.1. Word-initial plosives (C_1)

Notice that in both languages C_1 is outside the quantity system (i.e., there is no quantity opposition in C_1).

3.1.1. Closure duration

The closure durations pooled across initial /t/ and /k/ in the three degrees of prominence are shown in Table 1. Closure durations were systematically shorter in Estonian than in Finnish [$F(1, 102) = 17.86$, $p = 0.001$], and plosives had longer closure duration in the contrastively accented words than in the unaccented and accented ones [$F(2, 102) = 71.18$, $p = 0.001$]; there was no interaction between Language and Prominence.

Table 1

Mean durations (in ms) of initial plosives in the three degrees of prominence (una = unaccented, acc = accented, con = contrastively accented, standard deviations in parentheses)

	Estonian	Finnish
una	57 (11)	69 (16)
acc	57 (10)	72 (13)
con	97 (21)	109 (21)

Obviously the observed cross-language difference constitutes part of the more general pattern according to which the duration of C_1 is shorter in Estonian than in Finnish. As can be seen in Table 2, based on the results in Suomi, Meister, Ylitalo, Meister [to appear], i.e. including initial consonants other than plosives, C_1 had a systematically shorter duration in Estonian than in Finnish, both in absolute and in proportional terms.

Table 2

Mean absolute and proportional duration of C_1 in the three degrees of prominence (una = unaccented, acc = accented, con = contrastively accented, standard deviations in parentheses; data from Suomi, Meister, Ylitalo, Meister [to appear])

	Absolute (ms)		Proportional (% of total word duration)	
	Estonian	**Finnish**	**Estonian**	**Finnish**
una	67 (9)	81 (14)	20.1 (3)	25.9 (3)
acc	68 (11)	82 (12)	20.9 (3)	25.4 (2)
con	104 (22)	111 (19)	22.4 (4)	25.4 (2)

3.1.1. Burst duration

There was no cross-language difference in mean burst duration which was 22 ms (s.d. = 5.8) in Estonian and 24 ms (s.d. = 8.2) in Finnish, [$F < 1$]. Prominence had no effect [$F < 1$], and there was no interaction [$F < 1$]. Further analyses showed that in both languages, /k/ had a longer burst (Estonian: 27 ms; Finnish: 30 ms) than /t/ (Estonian: 18 ms; Finnish: 17 ms) [$F(3, 32) = 17.28$, $p < 0.001$].

3.2. Word-medial short/single plosives (C_2)

We looked at all medial plosives, but there were cross-language differences in burst durations only among the short/single plosives (and the differences in closure duration due to quantity are beyond this paper). Example words with medial short/single plosives are Estonian *kade* (Q1), *keda* (Q1), *keeda* (Q2), *keeda* (Q3) and Finnish *katu* (CVCV), *kita* (CVCV), *kiito* (CVVCV). That is, we did not distinguish between short/single plosives according to word structure, something that might be profitably done in a future, larger-scale study.

3.2.1. Closure duration

The closure durations pooled across medial /p/, /t/ and /k/ in the three degrees of prominence are shown in Table 3. Closure durations were again systematically shorter in Estonian than in Finnish [$F(1, 155) = 15.45$, $p = 0.001$], and plosives had longer closure duration in the contrastively accented words than in the unaccented and accented ones [$F(2, 155) = 30.53$, $p = 0.001$]; there was no interaction between Language and Prominence.

Table 3

Mean durations (in ms) of medial plosives (pooled across /p/, /t/ and /k/) in the three degrees of prominence (una = unaccented, acc = accented, con = contrastively accented, standard deviations in parentheses)

	Estonian	Finnish
una	56 (13)	63 (15)
acc	54 (13)	66 (15)
con	74 (20)	85 (14)

3.2.2. Burst duration

It turned out that the places of articulation behaved differently with respect to burst duration, see Table 4 and Figure 1.

Table 4

Mean (and median) burst duration (ms) of medial short/single stops

	Estonian	Finnish	Statistical significance
/p/	13.0 (14.3)	17.2 (14.4)	n.s. (p = 0.578)
/t/	16.1 (15.0)	15.6 (14.7)	n.s. (p = 1.000)
/k/	19.3 (22.5)	33.4 (31.5)	p < 0.001

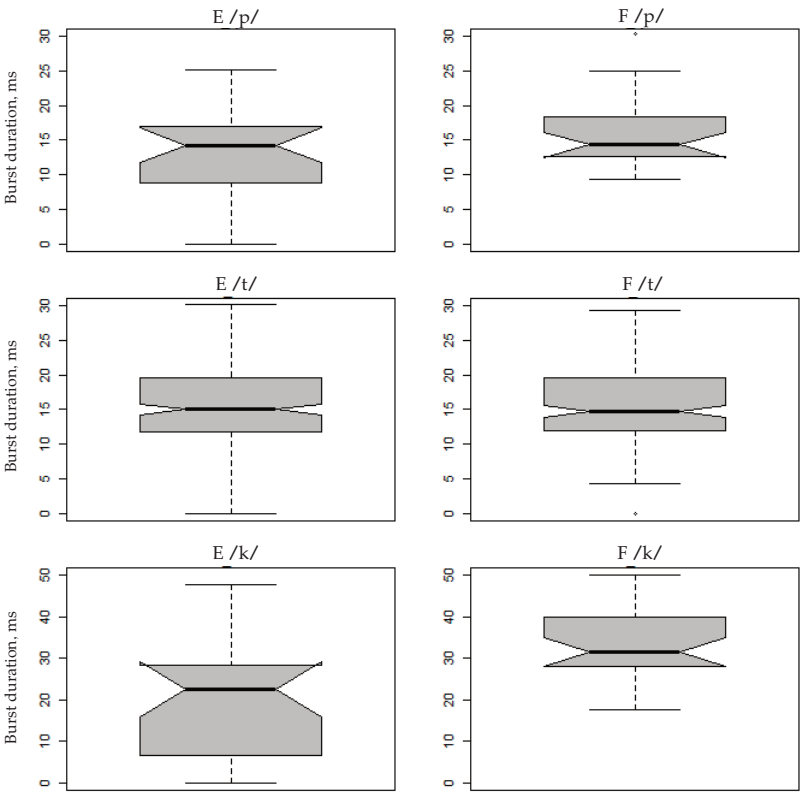

Figure 1. **Box-plots of burst durations of medial short/single stops (the left column: Estonian, the right column: Finnish).**

That is, burst duration of medial plosives was shorter in Estonian than in Finnish only in the velar place of articulation, but in the velar place the difference was very clear. It is noteworthy, as can be seen in Table 4, that in Estonian the difference between the velar plosives and the other ones is very small, in contrast to Finnish.

There was also a difference between Estonian and Finnish in the number of burstless (i.e. completely voiced) medial plosive tokens: 19 (5.9%) of the Estonian tokens were completely voiced, while this was the case in only 2 (0.8%) of the Finnish tokens. In Estonian, the percentages of completely voiced tokens were 1.1% for /p/, 3.3.% for /t/ and no less than 25.9% for /k/. What is exceptional in this pattern is that, usually it is the case that the velar plosives are the least prone to becoming voiced (for more on this see below).

Our Finnish results on medial plosive burst duration are in agreement with previous ones (Suomi 1980); for Estonian, corresponding results are not available. In both Suomi 1980 and in the present experiment, /k/ had clearly longer burst duration (VOT) than /p/ and /t/. And this is the usual pattern across languages, see the small selection of languages in Table 5. (Notice that although Central Swedish voiceless plosives are aspirated at the onset of stressed syllables, at the onset of unstressed syllables they are unaspirated. The data by Helgason and Ringen (2008) referred to in Table 5 concern such unaspirated medial /p/, /t/ and /k/.)

Table 5

Mean burst durations (ms) of medial plosives as reported in the present study and in some earlier studies

	Present study (Estonian)	Present study (Finnish)	Suomi 1980 (Finnish)	Ringen, Suomi 2012 (Fenno-Swedish)	Helgason, Ringen 2008 (Central Swedish)
/p/	13	17	11	10	13
/t/	16	16	16	18	23
/k/	19	33	25	25	31

In light of the information in Table 5, it is obviously a special characteristic of Estonian that the burst duration of medial /k/ (orthographic *g*) is exceptionally short; it is not the case that the burst duration of Finnish /k/ is unusually long. It thus seems that, in word-medial position (at least intervocalically), Estonian /k/ differs from universal regularities according to which the burst duration of velar plosives is clearly longer than that of labial and coronal (dental or alveolar) plosives. Our results show that with respect to non-short velar plosives, Estonian behaves according to universal tendencies (i.e., velar stops had longer burst duration than labial and dental plosives).

4. Discussion

It appears clear that Estonian and Finnish short/single plosives differ from each other with respect to occlusion duration both in the word-initial position and in the word-medial position. According to our results, a difference in burst duration in the medial position concerns the velar place of articulation only. In Estonian there were also many more instances of completely voiced tokens, a circumstance that may contribute to the subjective impression of ”weakness”. It is very much possible that these durational differences are sufficient to explain the impressionistic differences between Estonian and Finnish short/single plosives mentioned by Võrk (1972).

Võrk also mentioned the relative weakness of the burst of Estonian medial short plosives. To test the existence of such an intensity difference between the two languages, a more controlled experiment is needed in which also Sound Pressure Level (SPL) is measured.

The Estonian short medial /k/ thus differs with respect to its burst duration from the corresponding plosives in e.g. Finnish, Fenno-Swedish and Central Swedish. Moreover, the Estonian medial short /k/ had completely voiced tokens much more often than did /p/ and /t/, although aerodynamic considerations would suggest the opposite. For example, if a member of the voiced plosive set is missing in a language, it is usually /g/ that is missing since, for aerodynamic reasons (the existence of a

small, unexpandable cavity above the glottis), maintaining the transglottal pressure difference required for phonation is relatively difficult in velar plosives (Maddieson 2011). In principle, the exceptional behaviour of the Estonian medial short /k/ may have its source in either glottal or in supraglottal manoeuvres, or in a combination thereof. It is clear that this Estonian consonant deserves closer examination.

Acknowledgement

We wish to thank Catherine Ringen for useful comments on earlier versions of this paper.

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ПЕРВОНАЧАЛЬНОЕ СРАВНЕНИЕ ЭСТОНСКИХ И ФИНСКИХ ВЗРЫВНЫХ СОГЛАСНЫХ

По слуховому восприятию утверждается, что эстонские короткие взрывные как бы «слабее» финских коротких взрывных. В статье представлены результаты акустического сопоставления коротких взрывных похожих по сегментам слов в двух языках. Было найдено, что как в начале, так и в середине слова, длительности взрыва систематически короче в эстонском языке, чем в финском языке. Особенно отличался эстонский /k/ в середине слова — длительность его взрыва была короче, чем длительность взрыва финского /k/ и, кроме того, бóльшая часть эстонских /k/ произносилась без взрыва, т.е. полностью озвученно. Создается впечатление, что короткий взрыв велярного взрывного является специфическим признаком эстонского языка и по этому признаку эстонский язык отличается от многих других.