THE FUNCTION OF QUANTITY IN FINNISH AND ESTONIAN

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The purpose of this paper[1] is to compare some aspects of the quantity systems of two related languages, Finnish and Estonian.

Finnish and Estonian belong to the Balto-Finnic branch of the Finno-Ugric language family. They have almost identical segmental phoneme inventories. Superficially it also seems that they have very similar word structures. Often Finnish and Estonian words can be matched morpheme for morpheme or even phoneme for phoneme. Both languages have fixed primary stress on the first syllable of a word.[2] In principle, both are quantity languages: oppositions between short and long phonemes permeate the phonological structure of both. Upon closer scrutiny, however, the quantity systems of the two languages show far-reaching differences.

Finnish has two degrees of quantity.[3] Every vowel is either long or short. Diphthongs count as equivalent to long vowels. Short and long vowels contrast in any syllable of a word; there are no positional restrictions, either with regard to place within the word or with regard to stress. The opposition between short and long consonants can be realized only in intervocalic position; there are no consonantal quantity contrasts in word-initial and word-final position. Long consonants in intervocalic position contain a syllable boundary and are distributed between the two syllables so that the first part of the consonant closes the preceding syllable and the second part starts the following syllable. Consonant clusters function, in general, in a similar manner.[4] No clusters occur in word-initial or word-final position, the positions where consonant quantity is noncontrastive. There are numerous segmental restrictions which eliminate some segmental sequences and influence the relative frequency of other combinations. The

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[2] Exceptions are some recent loanwords and certain native compounds in Estonian, and words to which a special type of emphatic stress has been applied in Finnish.

[3] For a description of Finnish quantity, see for example Antti Sovijärvi, *Über die phonetischen Hauptzüge der finnischen und der ungarischen Hochsprache*, Ural-Altaische Bibliothek II (Wiesbaden, 1956), and Paavo Ravila, 'Quantity and phonemic analysis', *Proceedings of the Fourth International Congress of Phonetic Sciences, Helsinki 1961* 490–3 (The Hague, 1962).

[4] The intervocalic behavior of certain clusters consisting of plosives and resonants requires special treatment at the segmental-quantity level in Finnish as well as in Estonian. At the level of syllabic quantity, such clusters fit within the general patterns.

present paper deals with the suprasegmental structure of words; segmental restrictions will not be considered in greater detail for either Finnish or Estonian.

The number of possible word types in Finnish, based on segmental quantity oppositions, can be expressed by a very simple formula.[5] Each word begins either with a vowel or with a consonant, whose duration is noncontrastive; thus there are two choices for the initial margin. Each following vowel and intervocalic consonant is either short or long, a fact which provides two possibilities for each segment. The word ends either in a vowel or in a consonant, again of noncontrastive quantity. The number of (short or long) vowels is equivalent to the number of syllables; thus the number of prosodic possibilities can be expressed as a function of the number of syllables as follows:

F1 $$P_n = 2^{2n+1}$$

where n is the number of syllables and P_n the number of prosodic possibilities. This formula is valid for n larger than 1. For $n = 1$, the formula would provide 8 types; but only seven occur, since there are no words consisting of a single short vowel. Thus the formula has to be modified for $n = 1$.

F2 $$P_n = 2^{2n+1} - 1$$

The formula for a dissyllabic word, which may serve as an example, is discussed below in greater detail. There are two choices for the beginning—presence or absence of an initial consonant. Then there are two choices for the vowel of the first syllable, two further choices for the intervocalic consonant; and two choices for the vowel of the second syllable. The word ends either in the vowel or in a consonant of noncontrastive duration; this provides two additional choices. Since the choices are cumulative, the total number of possibilities is $2 \times 2 \times 2 \times 2 \times 2$, or $2^5 = 32$. The exponent 5 corresponds to $2n + 1$. The possible word types can be arranged in the form of a matrix, where short segments are symbolized by single v or c, long segments by double symbols:

vcv	cvcv	vcvc	cvcvc
vvcv	cvvcv	vvcvc	cvvcvc
vccv	cvccv	vccvc	cvccvc
vvccv	cvvccv	vvccvc	cvvccvc
vcvv	cvcvv	vcvvc	cvcvvc
vvcvv	cvvcvv	vvcvvc	cvvcvvc
vccvv	cvccvv	vccvvc	cvccvvc
vvccvv	cvvccvv	vvccvvc	cvvccvvc

For the dissyllabic word, every cell in the matrix can be filled; for longer words, the claim can be made that every existing word will fit into the pattern, but not every possibility provided by the formulas is utilized in the language.

Some simplification can be achieved if the number of contrastive word types is

[5] The idea of expressing the suprasegmental structure of a word by a formula showing the number of prosodic possibilities as a function of the number of syllables was suggested by a recent article by Pavle Ivić, 'Broj prozodijskih mogućnosti u reči kao karakteristika fonoloških sistema slovenskih jezika', *Južnoslovenski filolog* 25.75–113 (Beograd, 1963).

calculated on the basis of oppositions between long and short syllables rather than on the basis of segmental quantity oppositions. A syllabification rule prevails in Finnish—as well as in Estonian—that a short intervocalic consonant starts a syllable, while a long intervocalic consonant contains a syllable boundary and closes the preceding syllable. There is some justification for classifying syllables into short and long, since the meter of Finnish and Estonian folk songs is based upon systematic arrangements of short and long syllables. In this system, an open syllable ending in a short vowel counts as a short syllable. All other syllables are long—open syllables ending in long vowels or diphthongs, and all closed syllables regardless of the quantity of the vowel.

Since each syllable in a Finnish word is either short or long, the number of contrastive word types, based on syllabic quantity oppositions, is 2^n. In dissyllabic words, for example, there are four possibilities compared to the 32 different types that have to be specified if the description is based on segmental quantity.

F3 $$P_n = 2^n$$

The Finnish system is essentially very simple. The problem in Estonian is much more complicated. For some time, there has been an argument about the number of quantity oppositions in Estonian.[6] In the heat of the argument, some interesting problems seem to have been overlooked. I feel that the essential point in the quantity system of Estonian—and one of the chief differences between the Estonian and Finnish systems—is that in Estonian, quantity cannot be satisfactorily analyzed as something that is associated with segmental phonemes exclusively. According to the theory which I have been developing for some time, quantity functions differently at various levels within the language; at certain levels, morphological and phonological factors intersect in determining the phonological shape of words, and rules that are valid at a lower level may be overruled or modified when lower-level units become part of higher-level units within the phonological hierarchy.[7]

The controversy between adherents of the theory of three quantities and those who admit only two contrastive quantities concerns the interpretation of certain generally known facts, not their existence. All observers agree that three-way quantity contrasts exist between words whose segmental structures are identical. For example, in the set of words *lage* 'bare', *lake* 'thin gruel', and *lakke* 'to the ceiling', illative sing., the segmental phonemes are identical; the three different meanings are associated with the three different durations of the intervocalic consonant. The same applies, mutatis mutandis, to a set like *sage* 'frequent', *saage* 'get', 2d pers. plur. imper., and *saage* 'saws', partitive plur., where the difference is associated with the different durations of /a/.[8] I choose to call the quan-

[6] For a summary of the history of the problem, cf. my 'Segmental and syllabic quantity in Estonian', *American studies in Uralic linguistics* 21–82 (Bloomington, 1960), and Robert T. Harms, *Estonian grammar* 143–67 (Bloomington, 1962).

[7] These arguments are developed more fully in my paper 'Juncture', to appear in the *Proceedings of the Fifth International Congress of Phonetic Sciences* (Münster, 1964; in press).

[8] The Estonian words are quoted in their standard orthography. In the case of plosives, the letters *b d g* stand for a short voiceless lenis consonant. Intervocalic *p t k* indicate a so-called short geminate; *pp, tt, kk* stand for overlong geminates. One vowel symbol is

tities of /k/ in the first set of words segmental quantity 1, 2, and 3, and the quantities of /a/ in the second set likewise segmental quantity 1, 2, and 3. Now if the possibilities for the occurrence of contrastive quantities were the same in Finnish and Estonian, there would be three possible contrasts in the first vowel, three possible contrasts in the consonant between the first and second syllable, three possible contrasts in the next vowel, and so forth to the end of the word. In fact the occurrence of three-way contrasts is severely restricted, and the conditioning factors are to a great extent associated with the syllabic structure of the word.

The only one-to-one correspondence between the two quantity structures is the quantity of word-initial consonants, which is noncontrastive in both Finnish and Estonian. Vowel quantity in Estonian is contrastive only in the first syllable of a word. In a monosyllabic word, the vowel is either long or short, but a short vowel is always followed by a long consonant. In the first syllable of a polysyllabic word, all nine vowels occur in three contrastive quantities, and 19 of the 23 diphthongs occur in two contrastive quantities. Vowel quantity is not independently variable in any other position; the structure of a preceding syllable determines the phonetic length of the vowel of the following syllable. For example, after a short first syllable, the vowel of the second syllable is half-long; its duration is approximately between that of vowels in segmental quantity 1 and 2. After an overlong syllable, the vowel of the second syllable is phonetically much shorter.[9]

The maximum number of consonantal quantity contrasts is found in the position between the vowel of the first syllable and that of the second. All consonants (except /v/) occur in this position in three contrastive quantities. The realization of consonant quantity oppositions in other positions depends on the number of syllables in the word and on the quantity of the syllables preceding that in which the consonant occurs.

The notion of syllabic quantity should perhaps be reviewed at this point. In Estonian, the first syllable of a polysyllabic word is in one of three contrastive quantities, which may be called syllabic quantity 1, 2, and 3, or short, long, and overlong. Syllabic quantity is not the sum of the segmental quantities of its components. Several possible consonant and vowel quantity combinations yield the same syllabic quantity; but some combinations that apparently should fall in the same category do not in fact produce quantitatively equivalent syllables. For example, a vowel in quantity 1, followed by an intervocalic consonant in quantity 2, yields a first syllable of quantity 2; a vowel in quantity 2 and a consonant in quantity 2 yields likewise a syllable in quantity 2; a vowel in quantity 1, followed by a consonant in quantity 3, or a vowel in quantity 3, followed by a consonant in quantity 1, yield syllables of quantity 3, although the sum of the segmental quantities is four segmental units in the last two types, as it is also when the vowel and the consonant are both in quantity 2. As I mentioned before, the quantity of the first syllable of a dissyllabic word determines the phonetic duration of

used for a short vowel; standard spelling does not distinguish between the long and overlong durations of vowels, both symbolized by a sequence of two vowel letters.

[9] These generally known facts are outlined at greater length in my paper cited in footnote 6. Cf. also Paul Ariste, *Eesti keele foneetika* 89–95 (Tallinn, 1953).

the vowel of the second syllable; thus the duration of the vowel provides a check on the quantity of the preceding syllable.

All three segmental consonant quantities occur between the first and the second syllable, between the third and the fourth syllable, and between the fifth and the sixth syllable, regardless of the structure of the rest of the word. The statement may be generalized to apply to the position between odd- and even-numbered syllables. Of course the length of words is finite, but there is no theoretical restriction upon the number of syllables in a word.

Three-way consonant quantity oppositions occur also between even- and odd-numbered syllables, provided that the preceding syllable is overlong, i.e. contains a combination of vowel and consonant quantity that yields an overlong syllable. If the preceding syllable is either in quantity 1 or in quantity 2, i.e. in short or long (but not overlong) quantity, only two contrastive consonant quantities occur.

Of these two quantities, one is clearly identifiable with consonant quantity 1. The other is ambiguously long, and cannot be immediately identified with either quantity 2 or quantity 3. The assignment of this long quantity to 2 or 3 is a problem I have discussed elsewhere in greater detail.[10] Briefly, the duration of the ambiguously long consonant between the second and the third syllable, in a word like *salata* 'to deny', is equivalent to the duration of a consonant closing an initial syllable that contains an overlong vowel in a word like *saata* 'to send'; however, both durations are between the average durations of /t/ in quantity 2 in words like *kata* 'cover' 2d pers. sing. imper., and /t/ in quantity 3 in words like *katta* 'to cover'.

The distribution of consonant quantity contrasts may be summarized as follows. There are no contrasts in initial position; three contrasts between odd- and even-numbered syllables; three contrasts between even- and odd-numbered syllables, if the even-numbered syllable follows an overlong syllable; and two contrasts between even- and odd-numbered syllables if the preceding syllable is not overlong. A final syllable ends either in a vowel or in a consonant; in this position, the consonant has likewise two contrastive quantities.

An attempt was made to develop a formula that would express the number of possible Estonian word types, based on segmental quantity oppositions, as was done for Finnish. Because of the great number of segmental restrictions, the formula is applicable only to a highly simplified situation. It does not take into account any consonant clusters and ignores the occurrence, under certain conditions, of a particular type of final syllable containing an overlong diphthong followed by a noncontrastively short consonant.[11] Two separate formulas had to be developed for words with odd and even numbers of syllables.

[10] Cf. my 'The function of consonant quantity in establishing phonological units in Estonian', to appear in *American studies in Uralic linguistics II* (Bloomington, 1966; in press).

[11] The formula applies to noncompound words. In the case of compounds and certain derivative suffixes that share many characteristics of words, the pattern starts again after the word or suffix boundary. Such derivative suffixes have not yet been exhaustively studied in Estonian. For a similar phenomenon in Finnish, cf. Martti Sadeniemi, *Metriikkamme perusteet* 43–9 (Helsinki, 1949).

E1 $$P_n = 2 \times 17 \times 7^{\frac{n-3}{2}} \times 3$$
for $n \geqslant 3$, and n odd.

E2 $$P_n = 2 \times 17 \times 7^{\frac{n-4}{2}} \times 3 \times 3$$
for $n > 3$, and n even.

The formula is effective only with words of three or more syllables. Monosyllabic and dissyllabic words have to be explained separately.

Each word begins either with a vowel or with a consonant of noncontrastive quantity. This provides two choices. In a monosyllabic word, the vowel is short or long, giving two choices for the vowel. The word ends either in a vowel or in a consonant; if it ends in a consonant, the consonant is short or long. This formula provides $2 \times 2 \times 2 \times 2$, or 16 possible types. In fact only eight occur. If the vowel is short, it can only be followed by a long consonant; this eliminates two successive choices.

A dissyllabic word begins either with a vowel or with a consonant. The vowel is in one of three quantities; the consonant between the first and the second syllable is likewise in one of three quantities, except that two of the nine possible combinations do not occur.[12] The quantity of the vowel of the second syllable is not independently contrastive; but the word ends either with that vowel or with a short or long consonant, which provides three possibilities for the final syllable. The total number of possibilities is thus $2 \times 7 \times 3 = 2 \times 21$. The possible and actually occurring word types are presented below in the form of a matrix. The symbols v, vv, vvv, and c, cc, ccc stand for vowels and consonants in the three contrastive quantities. C stands for a noncontrastively long consonant, i.e. a consonant in a position in which there is no contrast between segmental quantities 2 and 3.

vcv	cvcv	vcvc	cvcvc	vcvC	cvcvC
vvcv	cvvcv	vvcvc	cvvcvc	vvcvC	cvvcvC
vvvcv	cvvvcv	vvvcvc	cvvvcvc	vvvcvC	cvvvcvC
vccv	cvccv	vccvc	cvccvc	vccvC	cvccvC
vcccv	cvcccv	vcccvc	cvcccvc	vcccvC	cvcccvC
vvccv	cvvccv	vvccvc	cvvccvc	vvccvC	cvvccvC
vvvcccv	cvvvcccv	vvvcccvc	cvvvcccvc	vvvcccvC	cvvvcccvC

A trisyllabic word has first of all the choice of beginning with a consonant or a vowel. There are seven possible combinations of vowel quantity and consonant quantity in the initial dissyllabic sequence, and three possibilities for ending the word. The variable that remains to be accounted for is the quantity of the consonant between the second and third syllable. After three of the vowel-consonant quantity combinations in the first two syllables, this consonant is in any of three contrastive quantities; after four of the combinations, it is in one of two contrastive quantities. The three combinations are those which yield a syllabic quantity 3; the four combinations provide an initial dissyllabic sequence in which the

[12] Vowel quantity 2 is never followed by consonant quantity 3, and vowel quantity 3 is never followed by consonant quantity 2. The problem is discussed in more detail in the article quoted in footnote 10.

first syllable is either in quantity 1 or 2. The total number of possibilities is thus $2 \times (4 \times 2 + 3 \times 3) \times 3 = 2 \times 17 \times 3 = 2 \times 51$.

In a word with four syllables, there are the two initial possibilities and seventeen possibilities for the sequence up to the intervocalic consonant between the third and fourth syllables. Odd-numbered syllables have the characteristic that they contain a consonant in any of the three quantities, regardless of the preceding sequence. Since vowel quantity is not contrastive, except in the word-initial syllable, the number of quantity contrasts provided here is 3. The final syllable provides three additional possibilities. The total number of possibilities is $2 \times 17 \times 3 \times 3 = 2 \times 153$.

The same procedure can be applied to words with progressively greater numbers of syllables. The component 7 which appears in formula E1, E2 with an exponent related to n refers to medial (i.e. noninitial and nonfinal) dissyllabic sequences, where three consonantal oppositions occur, two of which are followed by two oppositions and the third by three oppositions, yielding seven possible combinations.

It is obvious that the number of possibilities rises rapidly with increasing n. A considerable economy is achieved if the formula is recast in terms of syllabic quantity.

In positions in which three consonantal quantity contrasts occur, syllables have three contrastive quantities. In positions in which two consonantal quantity contrasts occur, syllables are likewise either short or noncontrastively long. Short syllables end in a short vowel; all nonshort syllables count as long in positions in which only two oppositions occur. Again, separate formulas had to be developed for words with odd- and even-numbered syllables.

E3 $$P_n = 7^{\frac{n-1}{2}} \times 2$$

for $n > 1$, and n odd.

E4 $$P_n = 7^{\frac{n-2}{2}} \times 3 \times 2$$

for n even.

In the formula, the figure 7 denotes the number of syllabic quantity combinations in a nonfinal dissyllabic sequence. The number is based on the fact that in a dissyllabic sequence, the first syllable has three oppositions; if the first syllable is in quantity 3, the following (nonfinal) syllable likewise has three oppositions, while a first syllable in either quantity 1 or quantity 2 is always followed by a syllable with two quantity oppositions. In a word with an odd number of syllables, the last syllable is long or short, which provides the last factor 2; in a word with an even number of syllables, the expression 3×2 reflects the observation that the three quantities of the penultimate syllable (which is odd-numbered) are followed by either a short or a long final syllable.

There is only one exception. The formula provides two possibilites for a monosyllabic word, whereas only one type occurs. No monosyllabic word ends in a short vowel, unless it has become part of a higher-level phonological unit. Thus all monosyllabic words are overlong. The formula is as follows:

E5 $$P_n = 7^{\frac{n-1}{2}} \times 2 - 1$$

for $n = 1$.

	1	2	3	4	5	6	7	n
Finnish								
Syllabic quantity	2	4	8	16	32	64	128	2^n
Segmental quantity	(7)	32	128	256	512	1024	2048	2^{2n+1}
Estonian								
Syllabic quantity	(1)	6	14	42	98	294	686	odd: $7^{\frac{n-1}{2}} \times 2$
								even: $7^{\frac{n-2}{2}} \times 3 \times 2$
Segmental quantity	2×4	2×21	2×51	2×153	2×357	2×1071	2×2399	odd: $2 \times 17 \times 7^{\frac{n-3}{2}} \times 3$
								even: $2 \times 17 \times 7^{\frac{n-4}{2}} \times 3 \times 3$

TABLE 1. NUMBER OF POSSIBLE WORD TYPES IN FINNISH AND ESTONIAN AS A FUNCTION OF THE NUMBER OF SYLLABLES

The formula for syllabic quantity in Estonian may be represented by the following graph, in which 1, 2, and 3 refer to syllabic quantities in positions where three contrasts occur, and I and II refer to the short vs. long opposition in positions in which two contrasts occur.

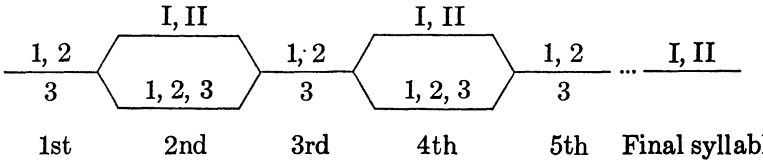

Table 1 presents a comparison of Finnish and Estonian, based on the number of possible word types expressed as a function of the number of syllables and calculated on the basis of both segmental quantity and syllabic quantity. Together with the formulas, this comparison reflects the differences between the quantity structures of the two languages in a relatively objective way. The formulas developed for Finnish and Estonian might be compared with formulas that could be developed for other Finno-Ugric languages, and for languages of other families with contrastive quantity. The method might provide a useful tool for the comparison of suprasegmental structures in general.

The specific results of this study raise several interesting problems. The scope of the paper does not allow their further development; but I would like to point out some of the directions in which I hope to pursue this research. It seems to me that the syllable has to be considered a basic structural unit both in Finnish and in Estonian. The segmental-quantity structure of Estonian cannot be completely described in terms of the segmental quantities of adjacent phonemes; the number of contrasts depends on the odd or even status of the syllable in which the sound occurs and on the nature of the preceding syllable. Segmental quantity is still relevant, since syllables of the same quantity can be made up of different and contrasting combinations of segmental quantity; the two are closely dependent, and neither can be fully predicted from the other. Another interesting feature is that the manifestation of syllabic quantities within the word can be described without reference to secondary stress. The occurrence of overlong syllables has hitherto been associated with the presence of some degree of phonemic stress. The relationship between syllabic quantity and secondary stress is probably more independent than has been assumed. On the other hand, the presence of secondary stress can still be noted in sequences consisting of short syllables exclusively, and its placement cannot be completely predicted from syllabic quantity.

One of the most thought-provoking results of this study is the emergence of the dissyllabic sequence as an essential building-block in the structure of Estonian words.[13] In the phonological hierarchy of Estonian, there are two intermediate

[13] The dissyllabic units here postulated were derived on the basis of observations of possible quantity contrasts in present-day Estonian. The significance of dissyllabic units in the historical development of Balto-Finnic languages and of Lappish has been recognized before. In a different context, Erkki Itkonen has written (*Struktur und Entwicklung der ostlappischene Quantitässysteme* 17 [Mémoires de la Société Finno-Ougrienne 88; Helsinki, 1946]: 'In bezug auf den Stufenwechsel müssen wir also konstatieren, dass die gegenseitigen Beziehungen des Vokals und des nachfolgenden Konsonantismus auf der Grenze der ersten

levels between the phoneme and the phonological word: the syllable and the dissyllabic sequence. Quantity is the factor which relates the units within the hierarchy to each other. Finnish, on the other hand, can be described quite adequately with segmental quantity alone. The different relations between segmental quantity and word structure constitute the basic difference between the Estonian and the Finnish quantity system.

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und zweiten Silbe prinzipiell andere als auf der Grenze der 2. und 3. Silbe sind. Hätten im letzteren Fall Vokal + Konsonantismus ein ähnliches festes Ganzes wie im ersteren Fall gebildet, so hätte der auf den Vokal der 2. Silbe folgende Konsonant immer im Stammkonsonantismus die schwache Stufe ausgelöst, also auch dann, wenn die 2. Silbe offen war. In die Ursachen dieser Doppelheit wollen wir uns hier nicht vertiefen—die Aufhellung der Frage setzt eine Lösung aller mit der ursprünglichen finnisch-lappischen Akzentuation verknüpften Probleme voraus—; jedenfalls dürfen wir es wohl als ausgemacht betrachten, dass die starke Stufe vor einem auf der Grenze der zweiten und dritten Silbe stehenden Einzelkonsonanten zunächst darauf beruht, dass der genannte Konsonant, wie man es aufgefasst oder empfunden hat, den Vokal der dritten Silbe verdeckt und den Vokal der zweiten Silbe offen lässt, mit anderen Worten auf der Silbenteilung, die nach der Ansicht Panconcelli-Calzias eine blosse Erdichtung ist.' Itkonen recognizes also that longer words are combinations of dissyllabic or trisyllabic 'speech measures' (ibid.).