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SOME BASIC PROBLEMS OF THE MODELLING OF THE BALTIC – SCANDINAVIAN PROSODIC AREA

0. The Baltic–Scandinavian area has been the focus of continuous linguistic interest as most the language phenomena found around the Baltic Sea can be explained better in the context of usage in other parts of the territory, often even in the whole area. And what is especially important, an idea of the whole is necessary not only (and not even too much) for the descriptive approach ("it is interesting to note that in the neighbouring area...") but also (as) from the formalizing point of view. The point is that in the case of rather strong mutual influence as is supposed to have occurred in the Baltic – Scandinavian language area a preciseness-oriented linguist cannot avoid problems arising from the relative nature of language descriptions. In choosing a concrete model of description one has to realize its objective indeterminacy. Next we are going to demonstrate some problems ensuing from this indeterminacy on the prosodic material of the Baltic–Scandinavian area.

1. According to the traditional theory the prosodic system of a language can use three vehicles to realize its oppositions: stress, tone and duration. At the same time we know from speech acoustics that there is quite a strong correlation between the physical parameters concerned, i. e. a higher intensity is usually accompanied by higher frequency and longer duration, and vice versa. The current theory of prosody does not deny this correlation, yet it presumes (either openly or covertly) that in every concrete case one of three media (stress, tone, duration) dominates over the remaining two and structures the prosodic oppositions so that type recognition (i. e. the attribution of a language to this or that prosodic type) should not present any particular problems. According to that conception the change of the prosodic type of a language can be imagined as proceeding through three stages: type A → prosodic chaos → type B. This means that a leap is assumed.

Such treatment defies operational use of the notion of the prosodic type of a language as there are no operations, no algorithm that would lead us formally to the definition of the prosodic type of a language, i. e. that would enable us to say whether a concrete prosody is based on tonal, stress or durational oppositions (or any combinations of the three). As we still have no operational means of specifying the prosodic type of a language and as in the case of a similarity of other conditions there

is a strong mutual correlation between frequency, intensity and duration as prosodic features one should reach a logical conclusion that it is inevitable to turn to alternative descriptions. This means that prosodically any language could be described in turn as based on either tonal, stress or durational oppositions, one could even base one's description on an arbitrary mixture of the three "pure" alternatives, yet remaining unable to demonstrate operationally the superiority of the resulting prosodic model to the others. The fact that reality is far less arbitrary than that (making the indeterminacy under discussion seem just a bit of superfluous theorizing) does not mean that there is a basic difference in the situation. The prosodic type is still unoperational and strong correlations between the three main oppositions constitute a phonetic universal. The reality seems less ambiguous just because in classifying languages prosodically we usually take into account additional factors — typological, genetic and areal — so that if a language falls into one and the same group according to genetic, typological and areal characteristics, it is probably also classified as having the same prosodic type as its "groupmates".

Now let us take a closer look at the situation in the prosodic theory just described from a practical point of view. Usually, languages are divided into tone and accent languages on the one hand and quantity languages on the other. As for the prosodic means the notion of an accent language may be rather variable in content: accent may involve pitch, loudness as well as duration. In parallel to the term "accent language" one can also find "stress language" (often used interchangeably), but actually the latter notion lets itself be defined somewhat less ambiguously through intensity parameters.

As mentioned above, the very term "accent language" escapes an unambiguous phonetic definition. In order to give it one yet there are several cases where one has given up the treatment of tone and accent languages as being in opposition. The idea of opposition is replaced by that of continuous transition, i. e. every prosodic system is assumed to contain both tonal and stress elements. Further, it is assumed that tonal and stress elements occur in a fixed proportion while the probability of the tonal elements replacing the stress elements is higher than that of the opposite process. It is possible, however, that the latter statement about the asymmetry of replacements suffers from subjectivity as it is based on but scanty reconstructions concerning, by the way, Indo-China, Central Africa and North America.

As for quantity languages they form a relatively more clear-cut group from the point of view of traditional prosodic theory displaying, however, a certain overlap with accent languages. The "overlap" means that there are several publications of analyses where both accent and quantity models have been used to describe the prosody of one and the same language. At the same time parallel analyses with a parallel application of tone and quantity paradigms are few. Of those few one could men-

tion, e. g. the algorithms of automatic recognition of Vietnamese and Chinese where, instead of the frequency, the duration of tone contours is analysed.

As we have already emphasized, the prosodic type of language could hardly be called "pure" being rather a mixture of three basic oppositions. This is also the main reason why we still lack an operational technique for prosodic classification. Thus another problem arises: if an operational approach is unfeasible (at least now), one could possibly use a weaker procedure. Perhaps it is possible, for example, to say at least which of the two given languages is closer to tonal (or stress, or quantity) languages. It seems that if we deal with the segment structures of the languages, it is quite correct to set the problem like that. The reality, however, is a bit more complicated: in order to be able to determine the relative position of two languages in the coordinate space of prosodic typology one has to know the degrees of freedom and dependency of frequency, time and intensity factors in either language under comparison. The ways to that knowledge are evidently many, but a first approximation — we are speaking from experience — is attainable also by ordinary correlation analysis. At that one can, on account of what is known of general phonetics, at once dismiss intensity, because intensity-bound parameters feature strong mutual correlations, thus being of no use in typology-building. What remains is time and frequency, the mutual correlations of which might be represented roughly as can be seen in Fig. 1.

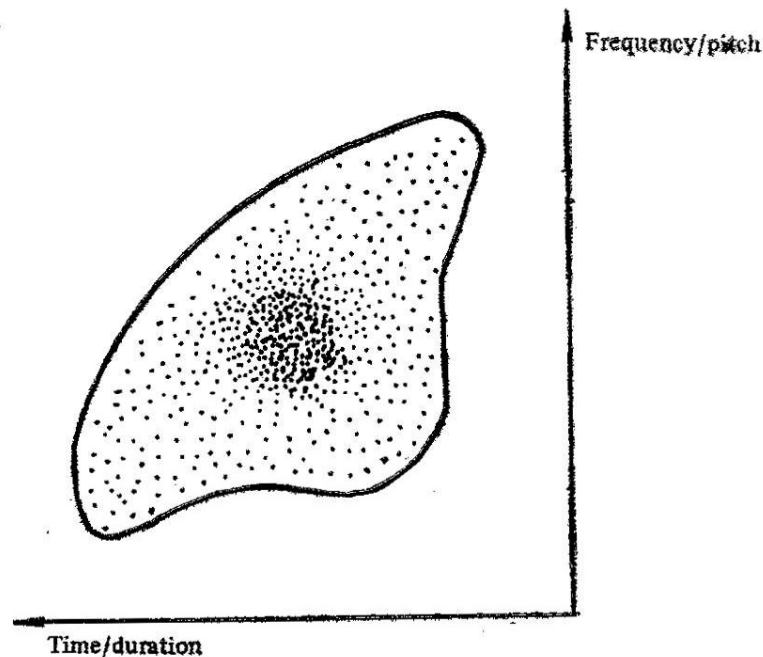


Figure 1. Possible correlations between frequency and time parameters in the prosodic system of different languages

Here the vertical axis carries the strength of the correlations between frequency parameters. This means that the position of a language with regard to this axis depends on the predictability of its frequency parameters. If knowing the pitch of the beginning of the nucleus of the first syllable we can tell more or less exactly the pitch

of the beginning of the nucleus of the second syllable, then the language is placed higher on the vertical axis than a language where correlations of that kind are weaker (as is the case with purer tone languages, for example).

The horizontal axis carries the correlations of time parameters. As isochrony generally brings about a negative correlation between time parameters (i. e. the longer a segment absolutely or relatively the shorter another segment) the axis is placed with its (negative) values growing (in absolute values) to the left.

The figure between these axes represents the space for prosodic systems if they are treated as points in a phase space. (The matter that the figure is just a product of imagination rather than a result of computations is irrelevant here.)

In the figure the so-called quantity languages are placed near the frequency axis (as they have weaker correlations between their time parameters), whereas the so-called tone languages gravitate towards the time axis (having weaker correlations between their frequency parameters). Where is the place of the so-called accent languages? Probably somewhere about the bisector as its correlation values are near the average according to frequency as well as time parameters. The area beyond the curve should be reserved for non-prosody (or pure segmentality), while the origin of the coordinates should correspond to pure prosody that could as well be compared to music as none of its elements depends directly on any other. To end this section let us repeat once more that the figure is situated in the coordinate space of internal correlations of time and frequency parameters. The stronger the correlations the higher the predictability of the values of the corresponding parameters from others of their own kind which accordingly lessens the informational value of those parameters. If one rests one's operation system for prosodic classification on this logic, one has obviously got to use modalities different from classical logic. In this case the only thing we are justified to say about a language is that the language is probably not a tone (or accent, or quantity) language. Whether the language in question is a tone, accent or quantity language remains beyond us. It is even open if we shall ever find an operational way of answering this question. This is why it is expedient to consider an altogether different approach taking for granted that from the typological point of view there is an indeterminacy inherent in the prosodic system of any language. In other words, it could be assumed that the question what functional means dominate in the prosody of a given language can be answered with a certain probability only, not precisely. Being objective this indeterminacy would not decrease with a rise in the precision of the analysis. In view of everything stated above such a solution should not seem surprising at all, yet it involves consequences concerning practice no less than theory.

2. If we assume that the domination of certain parameters in the prosodic structure of a given language can be ascertained to a degree only and that the precision

of this judgement cannot be enhanced in principle, prosodic theory has to develop a technique to effect conversion from one way of presentation to another. In other words, the indeterminacy mentioned requires a formalism for getting alternative descriptions of one and the same prosodic system, i. e. an opportunity for changing the background is needed. It is also clear that in the case of the traditional prosodic theory where the choice of the only "right" system of description did not present particular problems there was absolutely no need for a formalism to perform background change (i. e. a change from the description of the prosody of a language as an accent-based system to a characterization of the same language in the quantity system, then in the tonal or stress system, etc.). It is not before one accepts indeterminacy that one feels the need for a formal technique to do that.

What has mathematics to offer to a seeker of such a formalism? We think that matrix calculus could certainly be considered as a provisional option. State matrices could be used in the description of the prosody of a given language on the background of any basic parameters, while transition matrices could present the probabilities of the description of a prosodic system being converted to another. Formal grammars could also be used, especially those where all the rules apply simultaneously with a certain probability. Now let us take a look at the Baltic—Scandinavian prosodic area.

3.0. The following generalization is based on seven languages: Lithuanian, Latvian, Estonian, Finnish, Livonian, Swedish, and Danish.

3.1. Duration is relevant in every language of the area. Usually the opposition is binary, in Estonian and Livonian, however, as well as in some dialects of Latvian the choice is between a ternary opposition or several binary ones. In the case of binary opposition the place of the long segment is rather well predictable in Swedish and Danish where one can use information about the segmental structure of the word. As for Lithuanian and Latvian the position of long and short segments is less predictable from the segmental structure, instead one can let oneself be guided by the syllabic structure. In Estonian and Livonian it is the syllabic structure of the word that contains (some) information on the place and character of durational oppositions, on segmental level the amount of such information is negligible.

3.2. Stress. Throughout the whole area stress tends to fall on the first syllable, only in the south-eastern part of the territory, i. e. in the eastern dialects of Lithuanian¹ and the eastern dialects of Latvian² the main stress may shift to the final or to the penultimate syllable.

¹ Зинкявичюс З. Литовская диалектология (Сравнительное изучение фонетики и морфологии): Автореф. дис. ... д-ра филол. наук. Вильнюс. 1967.

² Рудзите М. К. Латышская диалектология (Фонетика и морфология): Автореф. дис. ... д-ра филол. наук. Рига, 1969.

In Swedish³ the rules of stress distribution are comparatively simple. The stress in Swedish has strong correlations with other prosodic values: a stressed syllable is distinguished from an unstressed one by longer duration.

In Danish⁴ pitch is the most important stress marker, but duration and the character of the syllable nucleus have also their part to play⁵. Intensity is next to irrelevant.

In Finnish the place of the stress is almost automatic. It is represented by pitch and to a certain extent also by duration.

In Estonian the main stress falls on the first syllable, the system of secondary stresses, however, is rather complicated receiving implications also from morphology. Its main physical correlate is found in pitch, duration comes next.

3.3. Tone. As a phonetic opposition tone functions in Latvian,¹ Lithuanian, Livonian, Swedish and Danish with their dialects. In all these languages and dialects tone applies quite separately from the segmental structure of the word: depending on the language or dialect the tonal marker can fall either on a stressed or an unstressed syllable. The trend of the place of stød is also consistent in the Latvian–Lithuanian–Danish direction. Finnish makes practically no use of tonal means. As for Estonian and its dialects they serve as a transitional area with regard to tone application. To get a better idea of the situation a comprehensive survey was carried out by the first author of this paper. As a result of the study the following conclusions could be drawn about the prosodic inventory and its functions in the coastal dialects of Estonia:

– in several places over the contiguous area of Estonian coastal region a "change of setting" can be observed in the use of tonal means. This is accompanied by a change in the type of encoding – physiologically determined mechanisms are replaced by free organization;

– the "change of setting" just mentioned has a marked geographical trend lying from East to West (from South-East to North-West, to be more exact);

– a radical change takes place in pitch regulation: the so-called free fall of the pitch is replaced by a fall at regulated speed, the rising speed of the pitch is increased and its falling speed decreased, the mechanisms of stress regulation are separated

³ Linell P. Remarks on Swedish morphology // RUUL 1. Department of Linguistics. Uppsala University, 1972. P. 1–87.

⁴ Thorsen N. Sentence intonation in Danish // Preprints of Paper for the Working Group on Intonation. The 13th International Congress of Linguists. Tokyo, 1982. P. 47–56.

⁵ Basbøll H. The phoneme system of Advanced Standard Copenhagen // Annu. Rep. Inst. Phon., Univ. Copenhagen, 1968. Vol. 3. P. 33–54. Rischel J. Notes on the Danish vowel pattern // Ibid. P. 177–205.

from those of tone regulation, means of phrase intonation are also used in structuring word intonation.

Along the same trend the three-degree quantity system is replaced by a two-degree system. Those phenomena could perhaps be considered varietal if they did not admirably fit in the general system of the Baltic – Scandinavian prosodic area which we have good reason to call a prosodic *Sprachbund* with rather distinct trends. The main geographically systemic trends in the use of prosodic means are the following:

- the whole area is characterized by two-degree durational oppositions, deviations from this trend can be found in the central eastern and south-eastern part of the area (Estonia, East-Latvia, East-Lithuania);

- stress usually falls on the first syllable, in the south-eastern direction a shift to the final or the penultimate syllable may occur;

- tone is generally used as a free phonological means, only in the central-eastern (Estonia) and north-eastern part (Finnish and its dialects) it is physiologically bound, while Estonian dialects display a shift from a physiologically bound tone application to a physiologically free one with the trend lying from East (South-East) to West (North-West).

4. From the above we can conclude that there are at least three main problems to be considered when setting out to model the Baltic – Scandinavian language area:

- it is necessary to develop a formalism for conversion from one prosodic background to another which would enable one to create a unitary system of description for all the languages participating in the *Sprachbund* and having influenced one another;

- differences within the area should be found out, i. e. subareas should be delimited where a change in the prosodic background takes place (as for prosody, one of such sub-areas is defined by Estonian coastal dialects, in a wider context (including segmental phenomena) the whole territory of Estonian dialects could be regarded as transitional);

- also, a formal technique is required to allow historical treatment of background changes.