A BRIEF ANALYSIS OF THE LITHUANIAN AND LATVIAN NASAL SONORANTS AND THEIR VELAR ALLOPHONES

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In this paper the main spectral characteristics of the following Lithuanian and Latvian sonorants and their velar allophones are briefly described: Lith. /m/, /mʲ/, /n/, /nʲ/, [ŋ], [ŋʲ] and Lat. /m/, /n/, /ɲ/, [ŋ]. Until now, there has been only one comparative study on acoustic features of Lithuanian and Latvian nasals using a similar methodology [11]. For the Lithuanian part of the study, isolated sequences (of CVC type), as well as disyllabic, mostly nonsense words (of CVCV type; in the case of [ŋ], [ŋʲ], VCCV type) were selected, while for the Latvian language isolated monosyllabic sequences (of CVC type; in the case of [ŋ], CCVCC type) were analysed. Only the first non-stressed consonant is the object of this paper.

Key words: *Standard Lithuanian, Standard Latvian, sonorant, formant structure, spectral analysis, acoustic feature, spectral characteristics.*

All Lithuanian and Latvian sonorants are assigned to the class of voiced consonants and have no voiceless counterparts. In production of sonorants the element of tone dominates, their formant bands are quite well defined; therefore, these consonants are called sonorants while the different types of noise (the characteristic of consonants) are more visible (although non-systematically) in some sonorants only [cf. 3; 7; 8; 9; 10; 17; 18; 19; 20; etc.].

Formant structure and spread of energy in sonorants, like in vowels, very much depend on the resonators (mouth and nose cavities), their size and proportion: for example, although nasal sonorants are quite sonorous, their spectral analysis is more difficult because of the influence of nasalization; due to its effect the formants in their spectrograms tend to be not very clear, fractured, with the first formant usually most clearly defined [cf. 4; 6; 7; 8; 12; 13; 14; 15; 16; 19; 20; 21; 22; 23; 24 etc.). Because of the features of articulation, the formant bands in the spectra of nasals are not only less pronounced, but also broader than of the adjacent vowels, with the spectral energy spread over wider frequency range.

As in other languages of the world [cf. 5; 16], the nasal formant of the nasal consonants in contemporary Standard Lithuanian and Standard Latvian is located in the range of the lowest frequencies. In male data the first formant bandwidth does not show statistically significant differences; it is confirmed by large statistical deviation. However, the values of the first formant bandwidth for females are narrower in both Lithuanian and Latvian data, to compare to males.

As is known, the first formant depends to a larger extent on the resonator of the mouth, openness of articulation (openness of the mouth), position of the tongue (raised or lowered) [20]. While producing different nasal consonant these articulatory features (openness and the position of the tongue) change little [22]. For example, comparison of the first formant for the labial and dental [m] and [n] shows that in Lithuanian the first formant of the hard non-labial sonorant tends to be higher, but the differences are not statistically significant.

Comparison of the first formant for the Lithuanian [m^{j}], [n^{j}] and the Latvian [m], [n], [ɲ] next to vowels of different quality did not reveal any distinctive tendencies. Non-palatalized and palatalized counterparts of the same class, i.e. Lithuanian [m] and [m^{j}], particularly [n] and [n^{j}] also differ very little in this respect. Therefore, to distinguish the Lithuanian and Latvian nasal sonorants, other acoustic characteristics must be analysed, e.g. anti-formants (Z_1).

Conclusions of similar study on consonants in other languages [see 12] show that the change of tongue position in the front part of the mouth (as well as other articulatory features) and the resulting change of the volume of the oral cavity is inversely proportional to anti-formant frequency: the frequency of the first nasal resonance and the anti-formant (oral zero) are both higher, the more front is the articulation (i.e. the shorter the length of the resonant cavity and the further back towards the palate the tongue) [16]. Comparison of anti-formants of Lithuanian and Latvian sonorants shows that the results essentially correspond to the trends in research on other languages [for more, see: 8; 11; 24]. For example, the lowest anti-formant values are for labials in both Baltic languages. The frequency range of allophones of the same sonorant can vary to some extent due to the influence of the adjacent vowel, also the male and female data may show some differences, but the relationship in all cases remain the same. In non-labial sonorants (Lithuanian [n], [n^{j}], Latvian [n] and particularly [ɲ]) anti-formants are higher than in the case of labial sonorants.

Comparison of non-palatalized and palatalized Lithuanian consonants shows that the anti-formants of palatalized sounds [m^{j}], [n^{j}] start in higher frequencies than anti-formants of the corresponding non-palatalized consonants [for more detail on consonant palatalization in Lithuanian and other languages of the world, see 2; 4; 20; other]. The intervals of anti-formants for [m^{j}], [n^{j}] overlap (in all data), although anti-formants of the non-labial nevertheless tends to be higher. Anti-formants of the Latvian palatal [ɲ] and the dental [n] before the vowels of [e] and [i] type are higher than anti-formants of the dental [n] before [a], [u].

The localization of the second formants are considered to be one of the most important features in differentiating palatalized and non-palatalized sonorants in Lithuanian [as well as other languages, for more, see 1].

As is known, the localization of the second formants in sonorants, particularly in nasals, is hard to determine, therefore it is important to take into account the quality of the adjacent vowel and F2 transition (i.e. the place of articulation in nasal sonorants is related to their phonetic context). For example, spectrograms of Lithuanian palatalized and non-palatalized sonorants and their adjacent vowels show that the onset and the middle formant frequencies differ depending on the adjacent sonorant. Besides, the spectrograms for sounds produced by males and females can differ. Considering the spectral characteristics of nasal consonants and F2 onsets the assumption is made that Lithuanian and Latvian [m] has lower timbre than [n], while the Lithuanian [m^j] and [n^j] have higher timbre than the non-palatalized [m] and [n].

In Latvian, nasal sonorants can be differentiated by the F2 onsets and F2 middle frequencies of the adjacent vowels, which vary depending on the nasal sonorant next to them, but the differences are not as obvious as in the case of Lithuanian [also cf. 14, 22]. The loci serve as indicators for the place of articulation of palatalized and non-palatalized Latvian nasal sonorants. Male and female data differ considerably, but, as usual, the tendencies remain the same as the separate sets of data show similar relationships.

Generalized Lithuanian and Latvian data show that the nasal sonorants of both languages differ from other sounds, as well as among themselves in more than one important acoustic feature. Firstly, like in other languages of the world, the formant structures of nasal sonorants is different than of other sounds; in nasal sonorants of both languages the spectral energy is spread over wider frequency range [besides, their spectra have more particular characteristics, see 11]. Secondly, the loci of the second formant were found to be an important feature in differentiating Lithuanian palatalized and non-palatalized nasals and other sonorants and their allophones: taking into account the onset and middle formants of the adjacent vowels, palatalized sounds had higher timbre than the correspondent non-palatalized sounds (Latvian language does not have the opposition between palatalized and non-palatalized consonants, but nevertheless Latvian sonorants had higher timbre in positions next to the front vowels, to compare to the positions next to back vowels). Thirdly, anti-formants of palatalized (and palatal) sounds tend to be higher than of their non-palatalized equivalents (it is explained by the decrease in the mouth cavity volume), though it must be noted

that their intervals overlap. In both languages, anti-formants of labial sounds usually are lower than of the corresponding non-labial consonants; the highest anti-formant was observed for velar allophones of the Lithuanian /n/, /nʲ/ and Latvian /n/ [for more details, see 11]. Anti-formants of the Latvian palatal [ɲ] and the dental [n] before the vowels of [e] and [i] type are higher than anti-formants before [a], [u]. The intervals of anti-formants for Lithuanian [mʲ], [nʲ] overlap (in all data), although anti-formants of the non-labial consonant nevertheless tends to be higher.

Results of the comparison of anti-formants in Lithuanian and Latvian nasal sonorants basically correspond to the tendencies discovered in research on other languages: the lowest anti-formants are for labials of both languages. The range of anti-formant frequencies can vary somewhat depending on the quality of the adjacent vowel and between male and female data, but the relationship remains rather stable.

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