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DIFFERENT IPA EQUIVALENTS FOR SOME LITHUANIAN AND LATVIAN VOWELS

Kodėl skiriasi kai kurių lietuvių ir latvių
kalbų balsių tarptautiniai fonetinės abėcėlės
atitikmenys?

ANNOTATION

Despite the common Baltic origin, the inventories of vowel and consonant phonemes in contemporary Standard Lithuanian and Standard Latvian have differences, firstly, because of functional significance which is not universal: what is phonologically relevant in Lithuanian, cannot be so in Latvian or some other language, because the importance of vowels and consonants in distinguishing one word from another varies from language to language; all languages use a limited number of vowels and consonants that are able to distinguish word meanings. Also, the analysis of acoustic and articulatory phenomena and processes involves the study and comparison of sounds (for example, their distinctive features) of different languages on the basis of similar principles and similar methods by also providing some universal (international) transcription.

Nowadays Lithuanian and Latvian vowels (as well as consonants) can be transcribed using not only national (traditional) phonetic symbols but also international phonetic alphabet(s) (universally agreed system(s) of notation for the sounds of languages).

In the present article the choice of non-identical equivalents of the International Phonetic Alphabet (IPA) for the long and short monophthongs of contemporary Baltic languages is mainly discussed by highlighting terminology and other nuances of classifying sounds on the basis of different criteria since there can be various (traditional acoustic, articulatory, functional, international articulatory and the like) classifications provided for Lithuanian and Latvian vowel systems. For a comparative research study on Lithuanian and Latvian vowels it was necessary to establish a common synchronous vowel

classification (traditional or international). Traditional (acoustic or articulatory) vowel classifications of both Baltic languages follow a similar pattern.

The analysis of the comparative experimental research of Lithuanian and Latvian monophthongs showed that different IPA symbol equivalents for some vowels of contemporary Baltic languages have been chosen due to the closely related but quite different acoustic qualities and not identical production as well as auditory features.

KEYWORDS: contemporary Baltic languages, Standard Lithuanian, Standard Latvian, vowel, transcription, international phonetic alphabet.

ANOTACIJA

Nors lietuvių ir latvių kalbos giminiškos, jų balsinių ir priebalsinių fonemų inventoriai turi skirtumų, pirmiausia dėl funkcinio relevantiškumo, kuris nėra visuotinis dalykas: kas lietuvių kalboje reikšminga, gali būti nereikšminga latvių ar kitoje kalboje, todėl į tai atsižvelgtina tiriant ir lyginant skirtingų kalbų garsyną (ir jų diferencinius požymius). Taip pat atsižvelgtina į lyginamąją skirtingų kalbų garsų akustinių ir artikuliacinių ypatybių analizę, kurią svarbu atlikti pagal panašius principus ir tą pačią ar panašią metodologiją. Lyginamuosius kalbų garsus aprašyti patogiau naudojant bendrą (tarptautinę) fonetinę transkripciją.

Lietuvių ir latvių kalbų balsyno (kaip ir priebalsyno) transkripcija galima ir nacionaliniais (tradiciniais) rašmenimis, ir taikant vienos ar kitos tarptautinės fonetinės abėcėlės atitikmenis (standartizuotą universalią garsų fonetinių rašmenų žymėjimo sistemą ar sistemas).

Šiame straipsnyje aptariami lyginamų trumpųjų ir kai kurių ilgųjų dabartinių lietuvių ir latvių bendrinių kalbų balsių nevienodi (nesutampantys) tarptautiniai fonetinės abėcėlės (an. IPA) atitikmenys. Taip pat atkreipiamas dėmesys į terminijos įvairovę, kuri priklauso nuo to, kokių pagrindų ir pagal kokius kriterijus lyginamųjų kalbų balsiai skirstomi (galimos tradicinės akustinės, artikuliacinės, funkcinės, tarptautinės artikuliacinės ir pan. klasifikacijos), ir nuo kitų dalykų. Lyginamieji baltų kalbų garsų tyrimai padeda išryškinti, kodėl lyginant svarbu pritaikyti bendrą sinchroninę klasifikaciją ir kokie galimi tradicinių fonetinių ir fonologinių klasifikacijų ir tarptautinės klasifikacijos niuansai. Pagal tradicinę (akustinę ar artikuliacinę) klasifikaciją baltų kalbų balsiai skirstomi pagal panašų modelį.

Lyginamoji instrumentinio lietuvių ir latvių kalbų monoftongų tyrimo analizė parodė, kad kai kurie nevienodi tų pačių šių giminiškų kalbų fonemų tarptautinės fonetinės transkripcijos simboliai pasirinktini dėl tam tikrų akustinių, artikuliacinių ir psichofizinių požymių skirtumų.

ESMINIAI ŽODŽIAI: dabartinės baltų kalbos, bendrinė lietuvių kalba, bendrinė latvių kalba, balsis, transkripcija, tarptautinė fonetinė abėcėlė.

INTRODUCTION

The use of the International Phonetic Alphabet (or IPA) is guided by some principles, one of which says that “when two sounds are very similar and not known to be employed in any language for distinguishing meanings of utterances, they should, as a rule, be represented by the same symbol. Separate symbols or diacritics may, however, be used to distinguish such sounds when necessary” (HIPA 2007: 159–160). Since Lithuanian and Latvian languages belong to the Baltic branch of the Indo-European language family, the group of Eastern Baltic languages, the two languages are often placed next to each other as particularly close languages; phonological systems of vowel phonemes are quite similar in both languages. However, some previous experimental studies show that despite the common Baltic origin, different IPA symbols for some corresponding (very similar) Lithuanian and Latvian vowels are to be used. Could such very similar vowel phonemes of different languages sharing a common Baltic origin be so different in acoustic qualities and articulation? A question may be answered by reviewing the spectral characteristics and various distinctive features based on the results of the instrumental research¹ of the sounds of contemporary Baltic languages in order to choose as accurate symbols (equivalents) of the IPA for all the Lithuanian and Latvian vowel phonemes as possible, considering that the quality and quantity of the Baltic sounds have been studied using the same methods, sound processing and analysis software and hardware, so that a reliable comparison of phonetic inventories of both languages would be available (for some intermediate results, see some previous studies: Grigorjevs, Jaroslavienė 2015a; 2015b; Jaroslavienė 2014; 2015)². A reliable comparison highlighted the differences of the phonemic inventories

¹ The research project *Acoustic characteristics of the sounds of the contemporary Baltic languages (experimental study)* was funded by the Research Council of Lithuania in 2013–2015 (MIP-081/2013). As native speakers are best capable of identifying the functionally relevant elements of the language through hearing and perception in case of any language, including the Baltic languages, the task of investigating and comparing the sound systems of contemporary Baltic languages was taken on by a group of competent Lithuanian and Latvian native speaking researchers specializing in experimental phonetics: Jurgita Jaroslavienė and Jolita Urbanavičienė (Lithuanian), Juris Grigorjevs and Inese Indričāne (Latvian).

² A complete set of IPA symbols adapted to the Latvian language was presented in the academic *Grammar of the Latvian Language* published in 2013 (see LVG 2013: 23–26). Until then, they were used in individual publications and works dealing with the comparison of English and other languages. For example, to choose the IPA symbol equivalents for Latvian monophthongs, the acoustic data of Latvian monophthongs produced in isolation were compared with the data of the cardinal vowels, because the system of cardinal vowels forms a base for the IPA vowel

of different languages, nuances of possible phonetic and phonological classifications, universal distinctive features of sounds, even the peculiarities of the empirical material and methods in use, the possible aims of the instrumental analysis, and other matters.

THE AIM AND OBJECT OF THIS PAPER

Since the IPA system is very handy for comparative linguistics, the main aim of this paper is to explain the choice of the IPA equivalents (see Table 1) for the monophthongs of contemporary Baltic standard languages by highlighting terminology related nuances when classifying vowels on the basis of different classification criteria, since the use of symbols and acoustic, articulatory or some other classifications in representing the sounds of a particular language are usually guided by particular methodological backgrounds and principles.

As it is known, the IPA is a standardized International Phonetic Alphabet – an internationally recognized and best-known set of phonetic symbols and diacritics designed to represent, describe and analyse sounds of any spoken languages of the world through the articulatory features (according to a tongue height, tongue backness and lip rounding) of the sounds they represent (HIPA 2007: 159–160, 194–196, Appendix 1; IPA 2015a; 2015b; 2017; also cf. Jones D. 1949; Olson 2015; Jones T. 2016). The Association recommends that a phonetic transcription should be enclosed in the following brackets: “[]”. A transcription that notes phonological contrasts should be enclosed in slanted lines “/ /”. The sounds that the IPA symbols represent are available under the Interactive IPA Chart (<http://www.ipachart.com/>), but it should be remembered that there may be lots of variation in how these sounds are pronounced depending on the language (or context), and contemporary Baltic languages would not make an exception.

system (Grigorjevs 2012: 178; also cf. Jassem 1973: 190; Ladefoged 1975: 194–199; Roca, Johnson 1999: 114–140).

In Lithuanian linguistics, one of the first attempts to use the IPA as a complete set in representing Lithuanian sounds was the academic grammar of the Lithuanian language *Lithuanian Grammar* (ed. by Vytautas Ambrazas, 1997). Some of the IPA equivalents represented there differ from those provided in this study. In earlier times, there were some more attempts to use the IPA in some individual publications and works (cf. Ekblom 1922; Sveciavičius 1960; Mikalauskaitė 1975; also see Stundžia 1990).

Table 1. Symbols for pure (simple) vowels of Standard Lithuanian and Standard Latvian according to the traditional (national)³ and international (IPA) phonetic alphabets

Lithuanian graphemes	Lithuanian phonemes, national (Copenhagen) transcription	IPA equivalents for Lithuanian phonemes	Latvian graphemes	Latvian phonemes, national transcription	IPA equivalents for Latvian phonemes
i	<i>i</i>	ɪ	ī	<i>ī</i>	ɪ
e	<i>ē</i>	e	e	<i>e</i>	e
e, (i)a	<i>e</i>	ɛ	e	<i>ē</i>	æ
a	<i>a</i>	ɐ	a	<i>a</i>	ɑ
o	<i>o</i>	ɔ	o	<i>o</i>	ɔ
u	<i>u</i>	ʊ	u	<i>u</i>	u
y, ĭ	<i>ī</i>	i:	ī	<i>ī</i>	i:
ė	<i>ē</i>	e:	ē	<i>ē</i>	e:
e, ē, (i)a, (i)ą	<i>e</i>	æ:	ē	<i>ē</i>	æ:
a, ą	<i>a</i>	ɑ:	ā	<i>ā</i>	ɑ:
o	<i>o</i>	o:	o	<i>ō</i>	ɔ:
ū, ū	<i>u</i>	u:	ū	<i>ū</i>	u:

³ In the Lithuanian phonological system, /ie/ and /uo/ also function as long vowels of non-uniform articulation (DLKG 2005; Girdenis 2014). Possible IPA equivalents are /ie/, /iɛ/ and /uo/, /ʊɔ/ due to the following reasons: in *Contemporary Grammar of the Lithuanian Language* (DLKG 2005: 23–26) and in *Theoretical Foundations of Lithuanian Phonology* (Girdenis 2014: 223, Table 23) Lithuanian sounds of non-uniform articulation /ie/, /uo/ are classified as non-high vowels; on the basis of the latest experimental investigations (see Girdenis 2009: 213–242 and the references) and the results of the mentioned research (see footnote 1), Lithuanian /ie/, /uo/ are to be considered as independent long, high phonemes of non-uniform articulation (Jaroslaviene 2015: 3, Table 1).

In the Latvian grammatical tradition /ie/, /uo/ are still classified as diphthongs, though there is actually no single approach to the phonological interpretation (Laua 1997: 12; LVG 2013: 46; Markus, Bonda 2014: 68–72; Grigorjevs 2016: 151).

Also, it appeared that native speakers of Standard Lithuanian do not regard the short [e] (the variant of the ‘Janus’ phoneme /e/) as a separate sound and therefore cannot pronounce it in isolation. It must be agreed that the non-high (mid-high) vowel [e] fails to find a strong position in the system of Standard Lithuanian because of its peculiar usage, its optional status, and the lack of distinctive function; besides, in written language it is represented with the same character as

The object of this study is long and short pure vowels (of uniform articulation) (see Table 1) pronounced in a zero context or isolation⁴ by 24 informants (aged 20–50 years) having faultless articulation of Standard Lithuanian or Standard Latvian, 6 males and 6 females for each language⁵. Table 1 presents the equivalents of the graphemes of both contemporary Baltic languages in both traditional (national)⁶ systems of phonetic transcription and the International Phonetic Alphabet (IPA).

The sounds that are represented by the national and international symbols in Table 1 are primarily those that serve to distinguish one word from another in a language. As one can see, there are differences between the traditional (national) and international phonetic alphabets since national transcriptions vary from language to language, the same as written languages look alike the world over. Despite the common Baltic origin, there are differences between Lithuanian and Latvian IPA equivalents too. It will be further explained that the choice of these equivalents was not random (compare similar or corresponding vowel phonemes in Fig. 12–13 and 14–15); also, it will become obvious why knowing the IPA system and using it for different languages, i.e. using particular IPA symbols to transcribe Lithuanian and Latvian monophthongs on the basis of acoustic and articulatory characteristics in this case, is like seeing the matrix (pattern) when learning, studying or comparing sounds of two (or more) languages.

the low short [e] (cf. Pakerys 2003: 29, Diagram 2; 32–34 and the references; Girdenis, Pupkis 1978: 61–62; Girdenis 2014: 201–202; Jaroslavienė 2015: 2–3).

In contrast to Lithuanian, the Latvian short [e] is used and can be pronounced as a separate sound.

⁴ This natural hyper-articulation differs from the production of the cardinal vowels (for more details, see Grigorjevs, Jaroslaviene 2015a: 58–59 and the references).

⁵ It is important that almost all informants not only speak the standard language but also one or more dialects and foreign languages. The standard language was considered as a standardized variety of language used for the needs of public life and culture (LKE 2008: 87–91).

⁶ Lithuanian and Latvian traditional transcriptions are different (both for standard languages and dialects). Features of the traditional transcription of the Lithuanian and Latvian dialects and suitability of the International Phonetic Alphabet to represent sounds of the Lithuanian and Latvian dialects are not discussed in the present article. For example, since the 20th century, there has been a tradition in Lithuanian linguistics to use a Copenhagen transcription which was adopted by Georg Gerullis (1930); nowadays, symbols of the font *Polemonas* are available for a traditional (national) transcription of Lithuanian sounds (see Skirmantas, Girdenis 2001; Aleknavičienė, Grumadienė, Gurskas, Skirmantas, Strockis, Tumasonis 2005 and others). For the opportunities of the International Phonetics Alphabet application to the sounds of Lithuanian dialects, see Bakšienė, Čepaitienė 2017a; 2017b.

THE INTERNATIONAL PHONETIC ALPHABET (IPA)

As it was already mentioned, for over a century the IPA has been widely used as a standardized system by linguists (as well as others concerned with languages), making the IPA quite well suited for use in all disciplines in which the representation of speech sounds is required (HIPA 2007). Different quality of vowel sounds can be adequately described according to the following parameters: the position of the tongue – height and backness as well as mouth openness, as there is a correlation between mouth openness and tongue elevation when producing vowels – and the shape of the lips (lip rounding) (HIPA 2007: 10–13).

Tongue height. In Figure 1 (also see Fig. 2), the vertical axis of the chart is determined by vowel height. Height refers to how high the body of a tongue is in one's mouth; varying degrees of mouth (jaw) openness correspond to different degrees of tongue height. Vowels pronounced with the tongue lowered are at the bottom, whereas vowels pronounced with the tongue raised are at the top: close vowels (with the mouth relatively closed) are articulated with a relatively high tongue position; open vowels are produced with a relatively low tongue position; close-mid and open-mid vowels are produced with the tongue elevation in a mid-position.

As we will see in further sections, varying degrees of mouth openness also correspond to different degrees of tongue height in Lithuanian and Latvian (cf. Fig. 2, 14, and 15): high vowels are made with the front of the mouth less open because the body of the tongue is raised, or high; mid vowels are produced with an intermediate tongue height; low vowels are pronounced with the front of the mouth open and the tongue lowered.

Tongue backness. In Figure 1 (also see Fig. 2), the horizontal axis of the chart is determined by vowel backness. Tongue backness refers to how far front or back the highest point of one's tongue is: vowels with the tongue moved towards the front of the mouth are to the left in the chart, while those in which it is moved to the back are placed to the right in the chart.

Lip rounding. In places where vowels are paired (see Fig. 1), the right represents a rounded vowel (in which the lips are rounded) while the left is its unrounded counterpart. Roundedness is named after the rounding of the lips in some vowels. In most languages, roundedness is a reinforcing feature of mid to high back vowels rather than a distinctive feature as it is in contemporary Baltic languages. Usually, the higher a back vowel, the more intense the rounding is.

Different IPA Equivalents
for Some Lithuanian and Latvian vowels

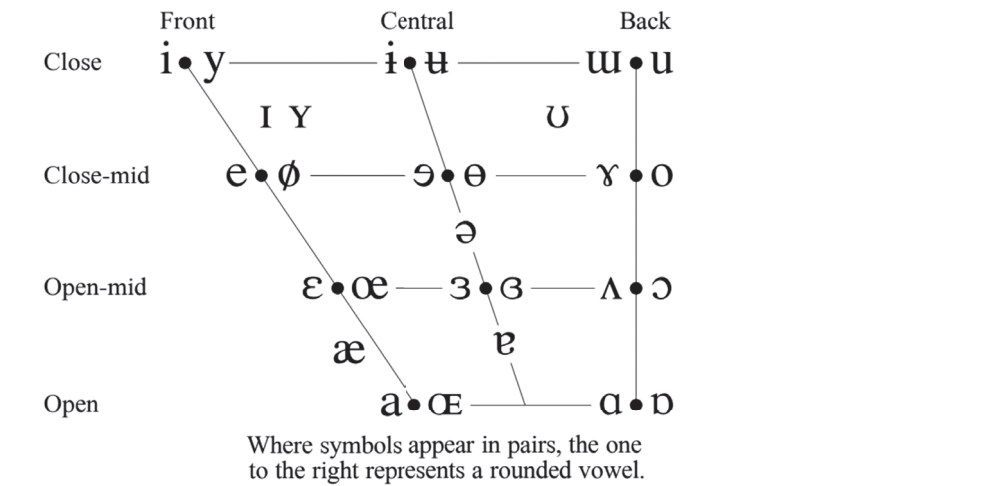


FIGURE 1. Vowels. The International Phonetic Alphabet (revised to 2015)⁷

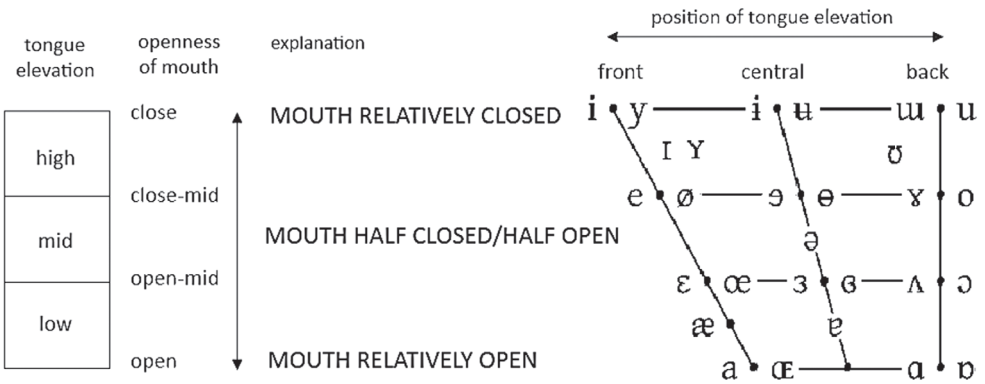
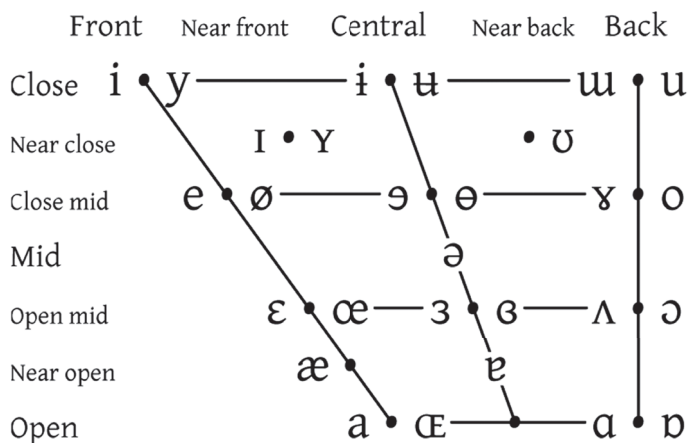


FIGURE 2. Correlation between the tongue and the openness of the mouth⁸: the elevation of the tongue describes the position of the tongue on the vertical axis (high, mid, low), the ‘position of tongue elevation’ refers to where this elevation takes place on the horizontal axis (front, central, back).

⁷ Illustration is available from IPA 2015a.

⁸ The chart represents the shape of the mouth based on the vertical axis of the height of tongue elevation and the horizontal axis of the position of tongue elevation. For an illustration, see the e-book *English Speech Sounds 101* (Williamson 2015).

Also, there can be some more articulatory parameters available when classifying vowels of any particular language of the world: compare seven degrees of vowel height and five degrees of vowel frontness vs. backness in Figure 3.



Vowels at right & left of bullets are rounded & unrounded.

FIGURE 3. Seven degrees of vowel height and five degrees of vowel backness⁹

There can be many vowel systems of languages that conform to the principles of the IPA. As one will see further in the article, Lithuanian and Latvian traditional (national) classifications do not coincide with the one suggested by the International Phonetic Association.

The acoustics of vowels. It is well known that the quality of vowels can be realized in acoustic analyses of vowels by relative formant values: by the acoustic resonances of the vocal tract showing up as dark bands on dynamic spectrograms, which display the acoustic energy at each frequency, and how this changes over time (cf. Fig. 4–11, also see Fig. 12–15). The spectral characteristics of vowels are closely associated with potential articulatory properties; the vocal tract acts as a resonant cavity, and the position of the tongue, jaw (mouth), and lips affects the parameters of the resonant cavity, resulting in different formant values: for example, the first formant (F1) corresponds to vowel openness (vowel height), the second formant, F2, corresponds to vowel frontness. Open vowels have high F1 frequencies, while close vowels have low F1 frequencies, and back vowels have low F2 frequencies, while front vowels have high F2 frequencies. Also, an alternative measurement, F1 against F2–F1, to represent vowel quality

⁹ Illustration is available from <https://en.wikipedia.org/wiki/File:IPA_vowel_chart_2005.png>. Also see IPA 2015b.

is recommended (cf. Ladefoged, Maddieson 2002: 284–286). Since sounds having a fully identical spectral structure can be perceived differently if their phonetic surroundings differ (Girdenis 2014: 239; also cf. Jassem 1973: 112 ff.), it should be noted that the quality of a vowel mainly depends on the relationship between the formant frequencies (values) for that vowel and the formant frequencies of other vowels produced by the same speaker (Ladefoged 1975: 97).

RESEARCH METHODS APPLIED TO DEFINE THE IPA EQUIVALENTS FOR THE PURE VOWELS OF CONTEMPORARY STANDARD BALTIC LANGUAGES

In contemporary Lithuanian linguistics, the phonological vowel system of Standard Lithuanian consists of eight long /i: ɛ: æ: α: o: u: uɔ/ and six short /ɪ <e> ɛ ɐ ɔ ʊ/ vowel phonemes (LG 1997: 28; DLKG 2005: 23–26; Girdenis 2014: 201–223 ff.)¹⁰. In the Latvian grammar tradition, Standard Latvian has six long and six short phonemes: /i: e: æ: α: ɔ: u:/ and /ɪ ɛ æ α ɔ u/ (Laua 1997: 12–25; LVG 2013: 37–44)¹¹. This article will describe Lithuanian and Latvian monophthongs – pure vowels – only.

The results of the comparative experimental research¹² as well as some previous studies (cf. Grigorjevs, Jaroslavienė 2015a; 2015b; also see Jaroslavienė 2014; 2015) based on the extensive acoustic analysis of spectral characteristics and distinctive features of the sounds of contemporary Baltic languages were the main criteria to define the correct IPA equivalent for each sound (vowel phoneme).

The analysis of the sounds of both Baltic languages was performed using free license sound processing and analysis software: *Praat* (developed by Paul Boersma and David Weenink), *WaveSurfer* (developed by Kåre Sjölander and Jonas Beskow). To study the qualitative vowel features, the full interval of the steady state was measured in Lithuanian and Latvian vowels (see examples of dynamic spectrograms in Fig. 1–8) to determine the frequency values (in hertz, Hz) of the

¹⁰ The short /ɔ/ and the optional /e/ are considered to be peripheral: [ɔ] is mostly used in the words of foreign origin and some Lithuanian proper names; the optional close, mid-high vowel [e] is usually replaced with the simple short [ɛ] (Girdenis 2014: 201–202; Pakerys 2003: 32–35, etc.).

¹¹ Latvian /ɔ:/ and /ɔ/ are used in new loanwords only (Laua 1997: 20).

¹² See the 1st footnote. The experimental research (and the acoustic analysis) of Latvian vowels produced in isolation was provided by Juris Grigorjevs.

first four formants, the fundamental frequency (in hertz) and the duration (in milliseconds, ms). Some examples of the dynamic spectrograms of Lithuanian and Latvian monophthongs produced in a zero context by native male speakers are provided in the article below. Spectrograms are a way of making the patterns of energy in the acoustic signal visible: dark bands reflect the changing resonances of the vocal tract as the sound is pronounced (looking from left to right).

Mean value was calculated as the average of all realizations of the sound. To achieve statistical reliability, the data were obtained by summing up all the realizations of the sound (from all informants); i.e. the quantitative or qualitative features of each sound in each language were measured no less than 30 times. The obtained data were further processed using *MS Excel*: there were statistical means (in bark units¹³, z and in hertz), standard deviation, coefficient of variation, and some other values calculated. Also, the values of the effective second formant ($F2'$, in bark units, z)¹⁴ and the fundamental frequency f_0) were determined using appropriate formula (see Bladon, Fant 1978: 3). To compare the female pronunciation data and the male data, the normalization of the results was performed. The analysis of both languages was based on objective methods.

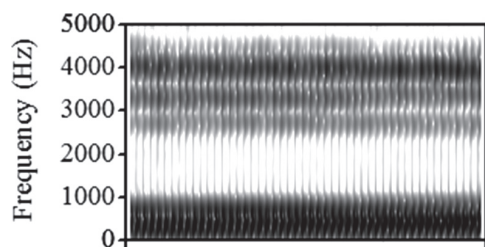


FIGURE 4. Lithuanian [e:]

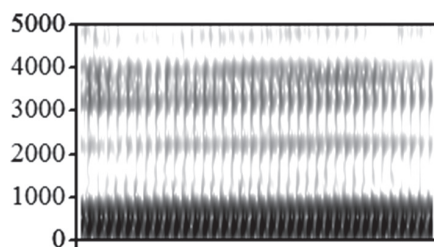


FIGURE 5. Latvian [e:]

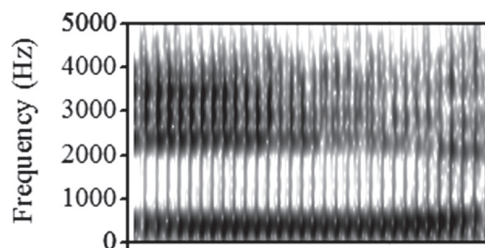


FIGURE 6. Lithuanian [o:]

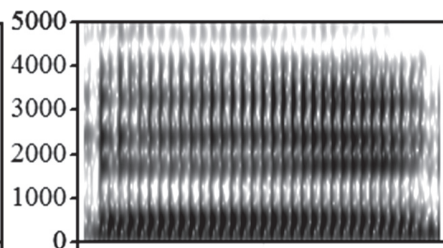


FIGURE 7. Latvian [o:]

¹³ The transformation of the results into bark units was performed using Traunmüller's formula (see Traunmüller 1988: 97; also cf. Grigorjevs, Jaroslaviene 2015a: 61).

¹⁴ For more information about the effective second formant, see Fant 1983: 7; Bladon, Fant 1978: 3; Grigorjevs, Jaroslaviene 2015a: 60.

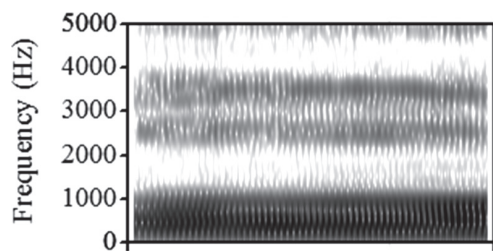


FIGURE 8. Lithuanian [æ:]

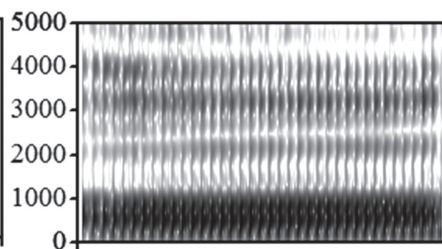


FIGURE 9. Latvian [æ:]

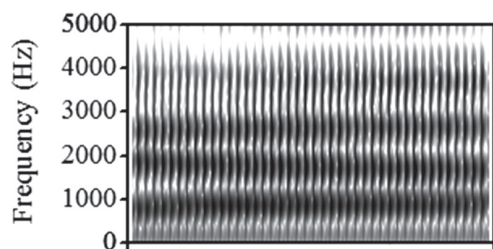


FIGURE 10. Lithuanian [u:]

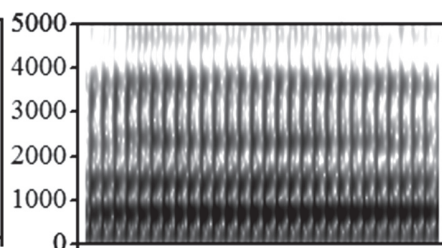


FIGURE 11. Latvian [u:]

The psycho-physical planes (in bark units) are used in this article for the graphical representations (Fig. 12–15), since it is assumed that such a representation of the vowel system considers the peculiarities of human hearing even better (Iivonen 1987; Grigorjevs 2013: 303). The size of the monophthong symbols on the psycho-physical space is chosen so that they are represented by circles with the diameter 1 bark, thus showing the zones of the equal perceptual quality (cf. Iivonen 1987).

DIFFERENT IPA SYMBOL EQUIVALENTS FOR SOME LITHUANIAN AND LATVIAN VOWELS PRODUCED IN ISOLATION

A concise review of different vowel classifications (on different methodological backgrounds) as well as qualitative and quantitative characteristics of Lithuanian and Latvian vowels should first be provided to explain the choice of the IPA symbols for the Lithuanian and Latvian monophthongs by also highlighting the variety of the terminology when describing Lithuanian and Latvian pure vowels on the basis of different principles.

According to the principles of classical phonology, an effective phoneme classification and distinctive feature system and hierarchy is to be such which permits as consistent and simple description of the relations between all phonological units and the functioning of the entire phonological system as possible (Girdenis 2014: 213–214). That is why, when classifying pure vowels (monophthongs) of both contemporary Baltic languages, the following correlation sets of binary distinctive acoustic (and articulatory) features¹⁵ (appropriate terminology to name these features is traditionally used) are to be used: ‘tense’ vs. ‘lax’ (‘long’ vs. ‘short’); ‘acute’ vs. ‘grave’ (‘front’ vs. ‘non-front’); ‘compact’ vs. ‘non-compact’ (‘open or low’ vs. ‘non-open or non-low’); ‘diffuse’ vs. ‘non-diffuse’ (‘close or high’ vs. ‘non-close or non-high’) (Grigorjevs, Jaroslavienė 2015b: 78–91; cf. Girdenis 2014: 201–214; 223, Table 23; 240–245).

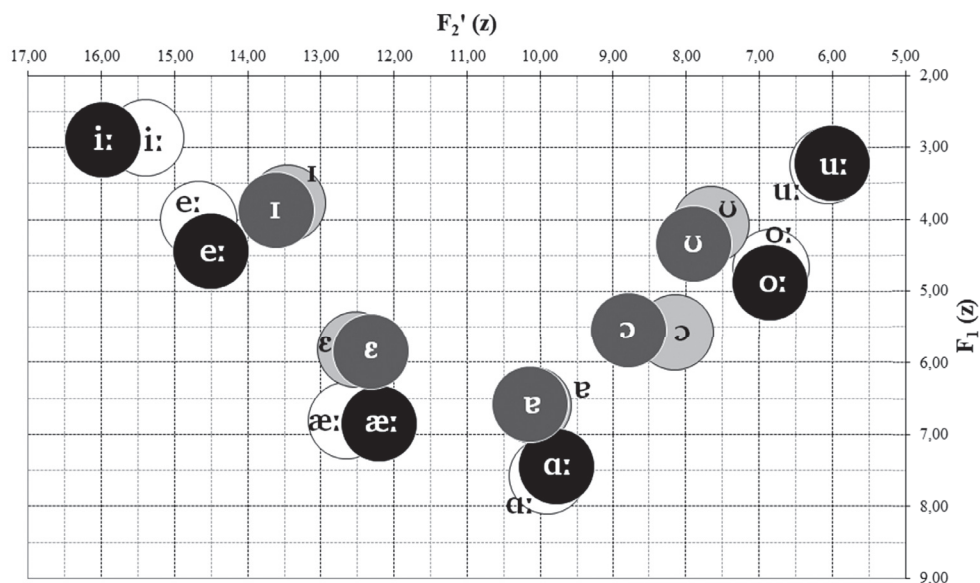


FIGURE 12. The mean data of the Lithuanian monophthongs produced in isolation by 12 native speakers in the psycho-physical plane (in bark units, z): *black circles represent long vowels produced by male speakers; white circles represent long vowels produced by female speakers; dark grey circles represent short vowels produced by male speakers; light grey circles represent short vowels produced by female speakers. Female data are normalized by $k=17\%$.*

¹⁵ It was found that the acoustic parameters being in the base of the feature system suggested by Fant failed “to make a distinction between front and central vowels, as well as between rounded front, central and unrounded non-low back vowels” (Grigorjevs 2012: 173–179; Grigorjevs 2013: 305; Grigorjevs, Jaroslavičienė 2015b: 88).

Different IPA Equivalents for Some Lithuanian and Latvian vowels

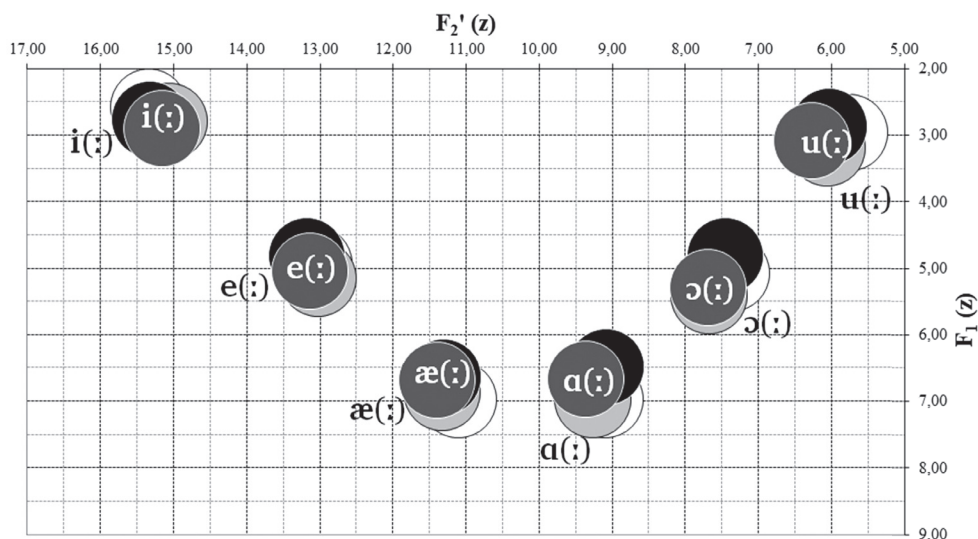


FIGURE 13. The mean data of the Latvian monophthongs produced in isolation by 12 native speakers plotted in the psycho-physical plane (in bark units, z): *black circles represent long vowels produced by male speakers; white circles represent long vowels produced by female speakers; dark grey circles represent short vowels produced by male speakers; light grey circles represent short vowels produced by female speakers. Female data are normalized by $k=21\%$.*

As it was mentioned, spectral characteristics of vowels are closely associated with potential articulatory properties (cf. Fig. 12–13): accordingly, Lithuanian long (tense) [i:], [e:], [æ:], and short (lax) [i], [e] and Latvian long (tense) [i:], [e:], [æ:], and short (lax) [i], [e], [æ] are considered to be front (acute) vowels while Lithuanian long (tense) [ɑ:], [o:], [u:], and short (lax) [ɐ], [ɔ], [ʊ] and corresponding Latvian long (tense) [ɑ:], [ɔ:], [u:], and short (lax) [ɑ], [ɔ], [u] are to be back (grave) (or non-front (non-acute)) vowels. In relation to the frequency of the first formant and its proximity to higher formants, Lithuanian long [i:], [u:], and short [i], [ʊ] and Latvian long [i:], [u:], and short [i], [u] are high close (diffuse) while Lithuanian long [æ:], [ɑ:], and short [ɛ], [ɐ] and Latvian long [æ:], [ɑ:], and short [æ], [ɑ] are low open (compact) vowels. In Standard Latvian, [e:], [ɔ:], [e], [ɔ] the same as corresponding Lithuanian [e:], [o:], [ɔ] are mid sounds because they are treated as neither close (diffuse) nor open (compact). As one can see, the national (traditional) articulatory vowel classifications of both Baltic languages follow a similar pattern: Lithuanian and Latvian long and short vowels (except that it should be taken into account that Lithuanian [e:] does not have the short counterpart) have the same three-dimensional distinction by vowel

height (high, mid, and low vowels), and two-dimensional distinction by vowel frontness vs. backness (front and back vowels). According to the position of the lips, Lithuanian [o:], [u:], [ɔ], [ʊ] and Latvian [ɔ:], [u:], [ɔ], [u] are rounded sounds. All the remaining vowels are unrounded.

TABLE 2. Relative duration (ratio) of the Lithuanian and corresponding Latvian monophthongs produced in isolation by 12 native speakers of each language (N=up to 72)

LITHUANIAN VOWELS	MALE DATA Relative duration (ratio)	FEMALE DATA Relative duration (ratio)	LATVIAN VOWELS	MALE DATA Relative duration (ratio)	FEMALE DATA Relative duration (ratio)
[i:]	2.11 : 1	2.06 : 1	[i:]	2.10 : 1	1.93 : 1
[ɪ]			[i]		
[e:]			[e:]	2.02 : 1	1.94 : 1
			[e]		
[æ:]	1.99 : 1	1.99 : 1	[æ:]	1.85 : 1	1.79 : 1
[ɛ]			[æ]		
[ɑ:]	2.16 : 1	2.06 : 1	[ɑ:]	2.06 : 1	1.9 : 1
[ə]			[ɑ]		
[o:]	2.16 : 1	2.14 : 1	[ɔ:]	1.94 : 1	1.92 : 1
[ɔ]			[ɔ]		
[u:]	2.22 : 1	2.07 : 1	[u:]	2.13 : 1	1.98 : 1
[ʊ]			[u]		
Long : Short		2.09 : 1	Long : Short 1.96 : 1		

Judging by vowel placement in psycho-physical F2/F1 (z) plane, despite the fact that vowel interrelations in both contemporary Baltic language systems are quite similar, Latvian short vowels pronounced in isolation tend to have a very close acoustic quality¹⁶ if compared with their corresponding long counterparts (see Fig. 12–13; also cf. Fig. 14–15). The symbols for short and long Latvian

¹⁶ It was observed in previous studies that despite the fact that the quality of Latvian monophthongs produced in isolation varies very little and the statistical analysis of the spectral characteristics

vowels overlap to a great extent, while the distances between the centres of the long and the corresponding short Lithuanian vowels exceed 1 z, thus signaling about the difference of their perceptual quality¹⁷ (also cf. intermediate results Grigorjevs, Jaroslavienė 2015a; 2015b).

Observations on duration (see Table 2) show that the distinction between long and short Latvian vowels produced in a zero context is mostly based on the relative duration, but between long and short Lithuanian vowels both on combined cues of the formant structure (see Fig. 12) and the relative duration (also cf. Grigorjevs, Jaroslavienė 2015b: 79, Table 1).

Finally, it can be concluded that the main differences in acoustic quality appear due to different production of the short (and some long) Lithuanian and corresponding Latvian vowels. To characterise the vowel systems of both contemporary Baltic languages in order to choose (or explain the choice) as accurate IPA symbol equivalents as possible, tonotopic distances between the fundamental frequency and the first formant (F1-f₀) and between the first and the second formant (F2-F1) were also calculated (cf. Fig. 14 and 15). It is well known that the first of these distances is closely related to sound openness vs. closeness, and the second to its frontness vs. backness (Miller 1989: 2119; Ladefoged, Maddieson 2002: 284–286; Grigorjevs 2012: 163–165).

Since the quality of Lithuanian short vowels significantly differs from their long counterparts (displaying the effect of the acoustic centralization if compared with the corresponding long ones) and corresponding short and some long Lithuanian and Latvian vowels vary, different (non-identical) IPA symbols have been chosen for corresponding Lithuanian and Latvian short monophthongs (except [ɔ]) as well as for long [o:] and [ɔ:]. Also, Lithuanian [e:] and Latvian [e:] are sounds of quite different qualities; though the IPA equivalent for these sounds coincides in both languages firstly because of consistency (the principles of the use of the IPA), there are no other IPA symbols to choose for these similar sounds; secondly, the production of similar sounds may vary from language to language (see Fig. 14–15 and 16–17; also cf. Fig. 4–11). Also, it should be noted that the IPA does not provide a phonological analysis for a particular language (HIPA 2007: 30); it is just a resource to express any analysis so that it is widely understood. Accordingly, after reviewing traditional functional and articulatory vowel classifications and comparing the vowel

shows contradictory results, the spectral structure of long and corresponding short counterparts may be perceived differently (see Grigorjevs, Jaroslavienė 2015a: 85).

¹⁷ It could be caused by the need to incorporate the possible fronted allophones of back vowels retaining their distinction from the front vowels into the Lithuanian vowel system (Grigorjevs, Jaroslavienė 2015b: 90).

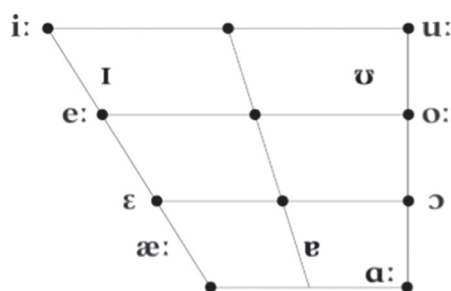


FIGURE 16. The IPA symbols used for the pure vowels of Standard Lithuanian

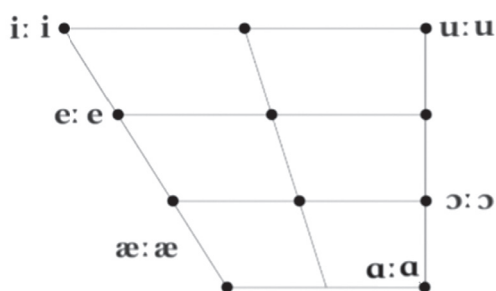


FIGURE 17. The IPA symbols used for the pure vowels of Standard Latvian

[ɔ]), also Lithuanian [e:], [æ:], [o:] and corresponding Latvian [e:], [æ:], [ɔ:] differ in their production vs. acoustic and auditory features, though the relationship between the systems of long Lithuanian and corresponding long Latvian vowels as well as the systems of short Lithuanian and short Latvian vowels follows a similar pattern.

CONCLUSIONS

The analysis of the comparative experimental research of Lithuanian and Latvian monophthongs shows that different IPA symbol equivalents for some similar pure vowels of contemporary Baltic languages have been chosen because of closely related but quite different acoustic qualities and not identical production as well as auditory features (Table 1, Fig. 14–15 and 16–17) of the following vowels: compare Lithuanian [o: ɪ ε ʊ ɐ] and corresponding Latvian [ɔ: i æ ɑ u] (also [e:] and [æ:] are produced quite differently in both languages).

There can be various (traditional acoustic, articulatory, functional, international articulatory and the like) classifications provided for Lithuanian and Latvian vowel systems. For a comparative research study of the Lithuanian and Latvian vowels it was necessary to establish a common synchronous vowel classification (traditional or international). Accordingly, different terminology (as well as principles) are used when classifying Lithuanian and Latvian sounds on different methodological backgrounds. Traditional (acoustic or articulatory) vowel classifications of both Baltic languages follow a similar pattern.

Based on the principles of the IPA system (international classification), the position of tongue elevation (or backness which refers to how far front or back the highest point of one's tongue is) and by referring to the concise analysis of dynamic spectrograms (cf. Fig. 4–11), acoustic, articulatory and auditory characteristics (cf. Fig. 12–15) of the Lithuanian and Latvian monophthongs produced in isolation, long and corresponding short front (Lithuanian [i: e: æ: ɪ ɛ], Latvian [i: e: æ: i e æ]), central (Lithuanian short [ɐ]) and back (Lithuanian [ɑ: o: u: ɔ ʊ], Latvian [ɑ: ɔ: u: a ɔ u]) vowels could be distinguished, while traditionally (based on particular functional and articulatory features and principles) Lithuanian [i: e: æ: ɪ ɛ] and Latvian [i: e: æ: i e æ] are regarded as front and Lithuanian [ɑ: o: u: ɔ ʊ] as well as corresponding Latvian [ɑ: ɔ: u: a ɔ u] are regarded as back vowels. Vowels with the tongue moved towards the front of the mouth are to the left in Fig. 1, 14–15 and 16–17; those in which the tongue is moved to the back of the mouth are placed to the right in the mentioned figures.

By the tongue height (and varying degrees of mouth openness), vowels pronounced with the tongue lowered are at the bottom in Fig. 1, 14–15 and 16–17, and vowels pronounced with the tongue raised are at the top in the same figures: according to the international articulatory classification, Latvian [i: u: i u] and Lithuanian [i: u:] should be regarded as close vowels, and Lithuanian [ɪ, ʊ] are regarded as near-close vowels if compared with the corresponding Latvian counterparts. Lithuanian [e: o:] and Latvian [e: ɔ:] differ (in acoustic, articulatory and perceptual characteristics), though these vowels, except for Latvian [ɔ:], should be treated as close-mid vowels, while Latvian [ɔ: ɔ] as well as Lithuanian [ɔ ɛ] should be treated as open-mid sounds. Lithuanian low [æ:] and [ɐ] and Latvian [æ: æ] could be regarded as near-open or open vowels like Lithuanian [ɑ:] and Latvian [ɑ: ɑ]. According to traditional classifications, in relation to frequency of the first formant and its proximity to higher formants Lithuanian and Latvian have high ([i: u: ɪ ʊ] and [i: u: i u]), mid ([e: o: ɔ] and [e: ɔ: e ɔ]) and low ([ɑ: æ: ɐ ɛ] and [ɑ: æ: a æ]) vowels accordingly.

By the position of the lips, Lithuanian [o:], [u:], [ɔ], [ʊ] and Latvian [ɔ:], [u:], [ɔ], [u] are rounded sounds, and all the remaining vowels are unrounded, the same as it is according to traditional classifications.

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Kodėl skiriasi kai kurių lietuvių ir latvių kalbų balsių tarptautiniai fonetinės abėcėlės atitikmenys?

SANTRAUKA

Pastaraisiais metais aprašant dabartinių baltų kalbų garsyną, balsiai ir priebalsiai ne tik tiriama, klasifikuojami ir lyginami taikant vienodus ar panašius metodologinius principus, bet ir vienodinami šių kalbų garsų transkripcijos rašmenys. Vienokie ar kitokie tarptautinės fonetinės abėcėlės (TFA, an. *International Phonetic Alphabet, IPA*) rašmenys dabartinių bendrinių baltų kalbų balsiams parenkami neatsitiktinai. Šio straipsnio pagrindinis tikslas – glaustai paanalizuoti, kurie lietuvių ir latvių trumpųjų ir ilgųjų balsių tarptautinės fonetinės abėcėlės simbolių atitikmenys nesutampa ir kodėl. Straipsnyje atkreipiamas dėmesys, kokios galimos įprastos (tradicinės) dabartinių baltų kalbų pastovios artikuliacijos balsių klasifikacijos ir kuo skiriasi tarptautinis (pagal TFA principus standartizuotas) garsų skirstymas.

Kaip žinoma, tarptautinė balsių klasifikacija itin paranki pagal vienodus artikuliacinius principus tiriant ir lyginant skirtingų kalbų garsyną, todėl siekiant objektyvumo ir preciziškumo, TFA transkripcijos rašmenys lietuvių ir latvių kalbų balsiams parinkti, pirmiausia atsižvelgiant į instrumentinio tyrimo rezultatus (spektrines balsių charakteristikas, audicinį išpūdį, tarimą ir pan.).

Straipsnyje klasifikuojant lietuvių ir latvių kalbų balsius pagal skirtingą metodologiją, pabrėžiama ir skirtinga terminų vartoseną, kuri iki šiol nėra nusistovėjusi, lietuvių ir latvių kalbomis klasifikuojant ir lyginant garsyną pagal tarptautinę fonetinę abėcėlę.

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