Standard Lithuanian

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The Lithuanian language, together with Latvian, belongs to the Baltic branch of the Indo-European language family and to the group of Eastern Baltic languages. The two surviving Baltic languages have many common features of phonemic inventories: opposition of long and short vowels, an abundance of diphthongs, a system of pitch accent. They have also developed substantial differences, e.g. Latvian has fixed stress and a set of palatal consonants, while Lithuanian has free (distinctive) stress and a phonological opposition between palatalized and non-palatalized consonants (Poliakovas 2008: 9, 42; Dini 2019: 577; Jaroslavienė et al. 2019: 263; Gelumbeckaitė & Pakerys 2020). In contrast to other Indo-European languages, the Baltic languages have lost *j* between a consonant and a front vowel, and have preserved *m*, rather than assimilated it, before the dental consonants *d*, *t*, which has not become *n*[1] (Endzelynas 1957: 8). Lithuanian has preserved the manner of articulation of Indo-European plosive consonants (Bonfante 2008: 40). As a result of the continuous and long-lasting contact of Baltic with Slavic languages, these language groups also share common linguistic features (discussed later).

Today, Lithuanian is spoken by approximately three million people living for the most part in the Republic of Lithuania, located in the central part of Europe on the south-eastern coast of the Baltic Sea (see Figure 1); Lithuanian is also spoken by national minorities in Latvia, Belarus and Poland, and by respective immigrant communities in the USA, Canada, the United Kingdom, Ireland, Spain, South America and elsewhere. Although the number of Lithuanian speakers is not large, and their geographical distribution relatively limited, different historical, social and other factors (for example, Baltic tribal substrate, the late formation of a standard language after Lithuania regained independence in 1918, the boundaries of the old administrative units, the sedentariness of the rural population, etc., see Zinkevičius 2006) have shaped the heterogeneity of the Lithuanian language, which is characterized by great

[1] As in Lithuanian *šimtas* 'hundred', *simts* in Latvian, but *centum* in Latin, and *hundert* in German.

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Note: More about Lithuanian regional variation, population, language norms and other related questions can be found in e.g. Mikulėnienė et al. 2014, 2019; Aliūkaitė et al. 2017; Miliūnaitė 2018, 2019; Lithuania 2020.

Figure 1 (Colour online) Lithuania and bordering countries (Map of Lithuania 2020).

regional variation. One of the variants – Western Aukštaitian of Kaunas – served as a basis for the Standard Lithuanian language that has the status of the official language.

This Illustration is based on a recording made by a female 48-year-old Lithuanian native speaker whose pronunciation is representative of Standard Lithuanian. She works as a researcher and speaks the Western Aukštaitian subdialect of Kaunas, which is closest to Standard Lithuanian. The speaker grew up in a monolingual environment and studied additional foreign languages (Latvian, Russian, English and German) at school and university.

The material for this paper was recorded with the help of a Tascam DR-100MK II digital high-resolution audio recorder and an AKG C 520 head-set microphone. The signal was sampled at a rate of 44.1 kHz (16-bit quantisation). The analysis of the sounds and prosodic features was performed using the sound processing and analysis software program *Praat* (Boersma & Weenink 2018). The data obtained were further processed using *MS Excel* and *SPSS* (IBM Corporation).

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The Illustration contains examples (the transcribed words and the text of 'The North Wind and the Sun') presented in a simplified transcription variant: the quantitative and more important qualitative variants of phonemes are marked; however, more subtle qualitative variants that occurred due to such general laws of coarticulation as nasalization and labialization are unmarked.

Consonants

The consonant system of the Lithuanian language consists of 45 consonant phonemes (Pakerys 2003: 73; LG 2006: 39; Girdenis 2014: 224; Stundžia 2014b: 10). Six phonemes (/f fʲ x xʲ ɣ ɣʲ/) are peripheral: they occur only in loanwords or onomatopoeic words (see Consonant Table below).

MANNER OF ARTICULATION			PLACE OF ARTICULATION											
			Bilabial		Labioden-tal		Dental		Postalveolar		Palatal		Velar	
			Voice-less	Voiced	Voice-less	Voiced	Voice-less	Voiced	Voice-less	Voiced	Voice-less	Voiced	Voice-less	Voiced
Non-sonorant	Plosive	Non-palatalized	p	b			t	d					k	g
		Palatali-zed	pʲ	bʲ			tʲ	dʲ					kʲ	gʲ
	Fricative	Non-palatalized			f		s	z	ʃ	ʒ			x	ɣ
		Palatali-zed			fʲ		sʲ	zʲ	ʃʲ	ʒʲ			xʲ	ɣʲ
	Affricate	Non-palatalized					ʦ	ʣ	ʧ	ʤ				
		Palatali-zed					ʦʲ	ʣʲ	ʧʲ	ʤʲ				
Sonorant	Approximant	Non-palatalized				ʋ						j		
		Palatali-zed				ʋʲ								
	Nasal	Non-palatalized		m				n						
		Palatali-zed		mʲ				nʲ						
	Lateral	Non-palatalized						l						
		Palatali-zed								lʲ				
	Trill	Non-palatalized								r				
		Palatali-zed								rʲ				

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/p/	[$^{2\uparrow}$pɐːdʌs]	*pãdas*	‘sole’[2]	/nʲ/	[$^{2\uparrow}$nʲiːrʌ]	*nỹra*	‘(s/he, it, they) dive(s); is/are dislocated’
/pʲ/	[$^{1\uparrow}$pʲeːdʌs]	*pė́das*	‘sheaf’	/l/	[$^{2\uparrow}$lɐːpʌs]	*lãpas*	‘leaf; page’
/b/	[$^{2\uparrow}$bɐːrʌs]	*bãras*	‘public bar’	/lʲ/	[$^{\downarrow}$lʲɪpʌ]	*lìpa*	‘(s/he, it, they) climb(s)’
/bʲ/	[$^{1\uparrow}$bʲeːrʌs]	*bė́ras*	‘bay’	/ʃ/	[$^{2\uparrow}$ʃɐːlʌ]	*šą̃la*	‘(s/he, it, they) freeze(s); is/are getting cold’
/m/	[$^{2\uparrow}$mɐːrʌs]	*mãras*	‘plague’	/ʃʲ/	[$^{\downarrow}$ʃʲɪlʌs]	*šìlas*	‘forest’
/mʲ/	[$^{2\uparrow}$mʲæːlʌs]	*mẽlas*	‘lie’	/ʒ/	[$^{2\uparrow}$ʒɐːlʌs]	*žãlas*	‘reddish brown’
/f/	[$^{2\uparrow}$fɐːnʌs]	*fãnas*	‘fan’	/ʒʲ/	[$^{\downarrow}$ʒʲɪlʌs]	*žìlas*	‘grey’
/fʲ/	[$^{\downarrow}$fʲɛnʌs]	*fènas*	‘blow-dry’	/tʃ/	[$^{2\uparrow}$tʃɐːdʌs]	*Čãdas*	‘Chad’ (country)
/ʊ/	[$^{2\uparrow}$ʊɐːdʌs]	*vãdas*	‘commander’	/tʃʲ/	[$^{\downarrow}$tʃʲɛkʌs]	*čèkas*	‘Czech’
/ʊʲ/	[$^{2\uparrow}$ʊʲæːdʌ]	*vẽda*	‘(s/he, it, they) lead(s); marries/marry’	/ʤ/	[$^{1\uparrow}$ʤɐˑʊʲɪs]	*džáulis*	‘joule’
/t/	[$^{2\uparrow}$tɐːkʌs]	*tãkas*	‘path’	/ʤʲ/	[$^{\downarrow}$ʤ ʲɛmʌs]	*džèmas*	‘jam’
/tʲ/	[$^{2\uparrow}$tʲæːkʌ]	*tẽka*	‘(s/he, it, they) rise(s); flow(s); marries/marry’	/r/	[$^{2\uparrow}$rɐːtʌs]	*rãtas*	‘wheel’
/d/	[$^{2\uparrow}$dɐːroː]	*dãro*	‘(s/he, it, they) do(es), make(s)’	/rʲ/	[$^{\downarrow}$rʲɪtʌ]	*rìta*	‘(s/he, it, they) roll(s)’
/dʲ/	[$^{2\uparrow}$dʲæːrʌ]	*dẽra*	‘(s/he, it, they) match(es); yield a good harvest’	/j/	[$^{2\uparrow}$jo̜ːnʌs]	*Jõnas*	‘John’ (name)
/s/	[$^{2\uparrow}$sɐːkoː]	*sãko*	‘(s/he, it, they) say(s)’	/k/	[$^{2\uparrow}$kɐːrʌs]	*kãras*	‘war’
/sʲ/	[$^{2\uparrow}$sʲæːkʌ]	*sẽka*	‘(s/he, it, they) follow(s)’	/kʲ/	[$^{2\uparrow}$kʲæːrʌs]	*kẽras*	‘bush’
/z/	[$^{\downarrow}$zʊjɛ]	*zùja*	‘(s/he, it, they) scurries/scurry about’	/g/	[$^{2\uparrow}$gɐːrʌs]	*gãras*	‘steam’

[2] A raised number [1] before a stressed syllable signals the acute accent; a raised number [2] marks the circumflex accent (for more details see section ‘Pitch accent (toneme)’ below). Short syllables do not have pitch accents and are therefore not numbered. The Lithuanian transcription tradition is somewhat different to the one used in this Illustration. For more information, see VLKK 2021.

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/zʲ/	[ˈ²zʲiːzʲɛ]	*zỹzia*	‘(s/he, it, they) whine(s)’	/gʲ/	[ˈ²gʲæːrʌs]	*gẽras*	‘good’
/ts/	[ˈ²tsɐːrʌs]	*cãras*	‘tsar’	/x/	[ˈxɔrʌs]	*chòras*	‘chorus’
/tsʲ/	[ˈtsʲɛxʌs]	*cèchas*	‘workshop’	/xʲ/	[ˈxʲɛbʌs]	*Chèbas*	‘Cheb’ (town)
/ʣ/	[ˈ²ʣuːkoː]	*dzūko*	‘resident of Dzūkija’ (ethnographical region, GEN.SG.M)	/ɣ/	[ˈɣɔrʌs]	*Hòras*	‘Horus’ (name)
/ʤʲ/	[ʤʲụˈdɔ]	*dziudò*	‘judo’	/ɣʲ/	[ˈɣʲɛrʌ]	*Hèra*	‘Hera’ (name, VOC.SG)
/n/	[ˈ²nɐːrʌs]	*nãras*	‘diver’				

Palatalized and non-palatalized consonants

The Lithuanian language has secondary palatalization. The existence of palatalized and non-palatalized consonants is one of the main phonological features of the Lithuanian consonant system (as in Russian, for example). This feature distinguishes Lithuanian from another Baltic language, Latvian, which has palatal and non-palatal consonants (Urbanavičienė et al. 2019: 327). Secondary palatalization is characterized by the elevation of the middle part of the tongue towards the hard palate, and constitutes an additional articulatory feature of the palatalized consonants. The only palatal consonant is /j/, e.g. *jáunas* [ˈ¹jæ·ʊnʌs] ‘young’, *juõkas* [ˈ²jụɔkʌs] ‘laughter’. Secondary palatalization in Lithuanian is regular, unlike in Slavic languages, for example (see Yanushevskaya & Bunčić 2015: 222; Bird & Litvin 2021: 452–454): in Lithuanian each consonant has both palatalized and non-palatalized counterparts.

Compared to the corresponding palatalized sounds, the articulation of the non-palatalized consonants /l ʃ ʒ/ is characterized by velarization (a secondary articulation involving movement of the back of the tongue towards the velum), and Lithuanian non-palatalized postalveolar /ʃ ʒ/ are labialized.[3]

Both palatalized and non-palatalized consonants occur before back vowels, e.g. *sùsti* [ˈsʊsʲtʲɪ] ‘grow scabby, wither’ : *siùsti* [ˈsʲụsʲtʲɪ][4] ‘be in a bad temper; be angry’, *gabùs* [gʌˈbʊs] ‘talented’ : *gabiùs* [gʌˈbʲụs] ‘talented ones’ (ACC.PL.M), *trapùs* [trʌˈpʊs] ‘fragile’ : *trapiùs* [trʌˈpʲụs] ‘fragile ones’ (ACC.PL.M), *galù* [gʌˈlʊ] ‘end’ (INSTR.SG) *: galiù* [gʌˈlʲụ] ‘(I) can’ (so called non-motivated palatalization[5]). Palatalized consonants are also used before front vowels (e.g. *tylė́ti* [tʲiːˈ¹lʲeːtʲɪ] ‘be silent’, *nẽšėme* [ˈ²nʲæːʃʲeːmʲɛ] ‘(we) carried’, *kíetis* [ˈ¹kʲiɛtʲɪs] ‘sagebrush’) and before other palatalized consonants or the palatal /j/ (so called motivated palatalization), e.g. *baltì* [bʌlʲˈtʲɪ] ‘white’ (NOM.PL.M), *balsiùs* [bʌlʲˈsʲụs] ‘vowels’ (ACC.PL), *pjáuni* [ˈ¹pʲjæ·ʊnʲɪ] ‘(you) cut; saw; reap’ (SG). At the end of a word, the opposition between palatalized and non-palatalized consonants is neutralized to non-palatalized consonants (Balode & Holvoet 2001: 48), e.g. *eĩti* [ˈ²ɛɪ·tʲɪ] ‘go’ – *eĩt* [ˈ²ɛɪ·t] ‘go’, *kélsiu* [ˈ¹kʲæ·lʲsʲụ] ‘(I) shall raise, lift’ – *kelĩs* [ˈ²kʲɛl·s] ‘(s/he, it, they) will raise, lift’.

[3] For animated images of speech articulators pronouncing Lithuanian sounds, see TARTIS.

[4] On orthography, the palatalization of the consonants that occur before back vowels is signaled by *i*. In other cases, the orthography does not capture palatalization.

[5] The source of this palatalization is not synchronically transparent but occurs before an etymological [j] that has since been lost (Kazlauskienė 2018: 52). Elsewhere palatalization is motivated, i.e., predictable based on the following vowel.

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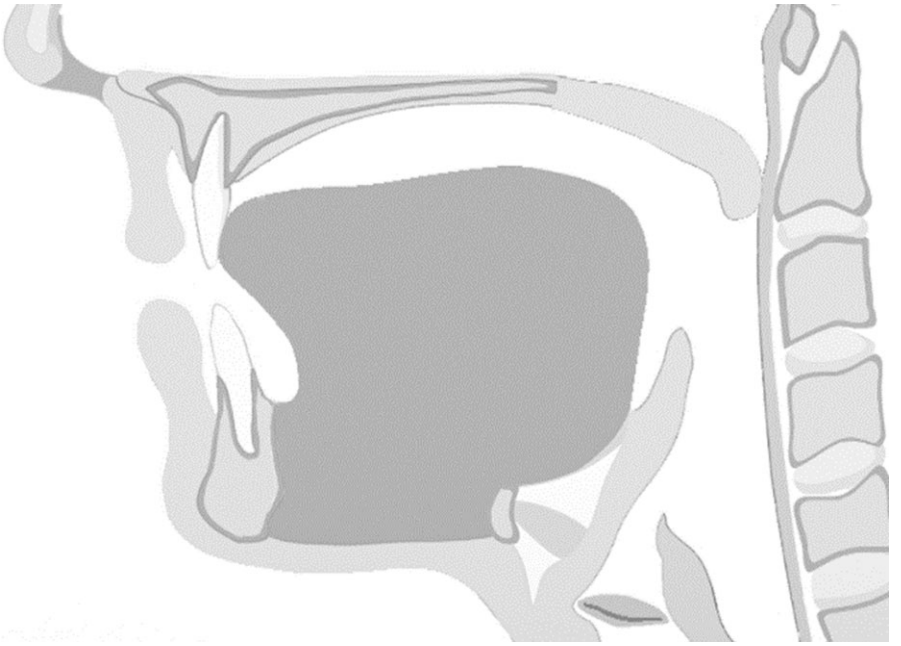

Figure 2 Speech articulators activity for pronouncing non-palatalized /l/.

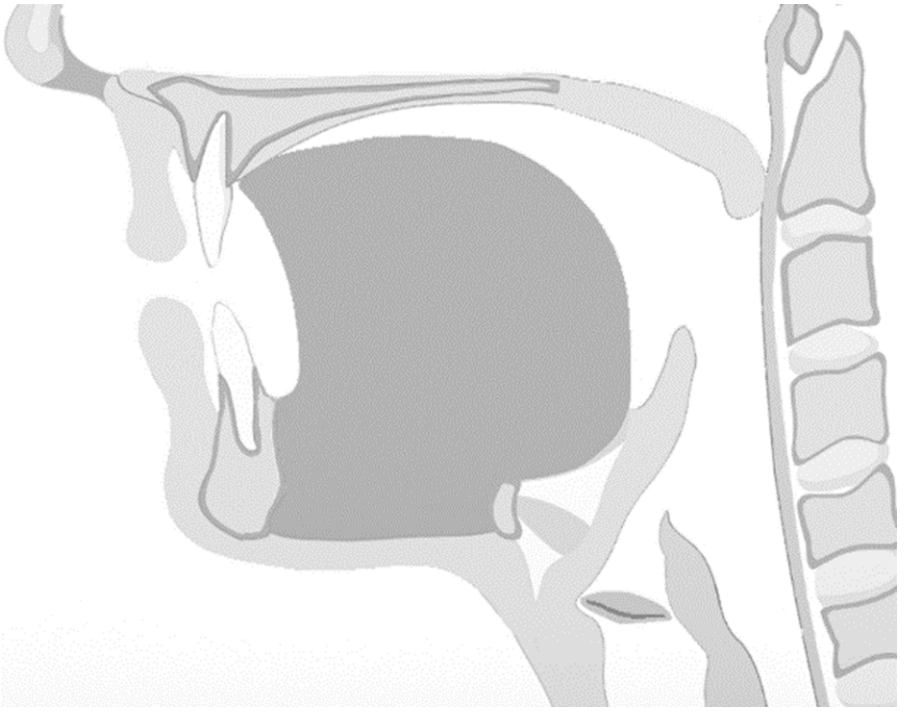

Figure 3 Speech articulators activity for pronouncing palatalized /lʲ/.

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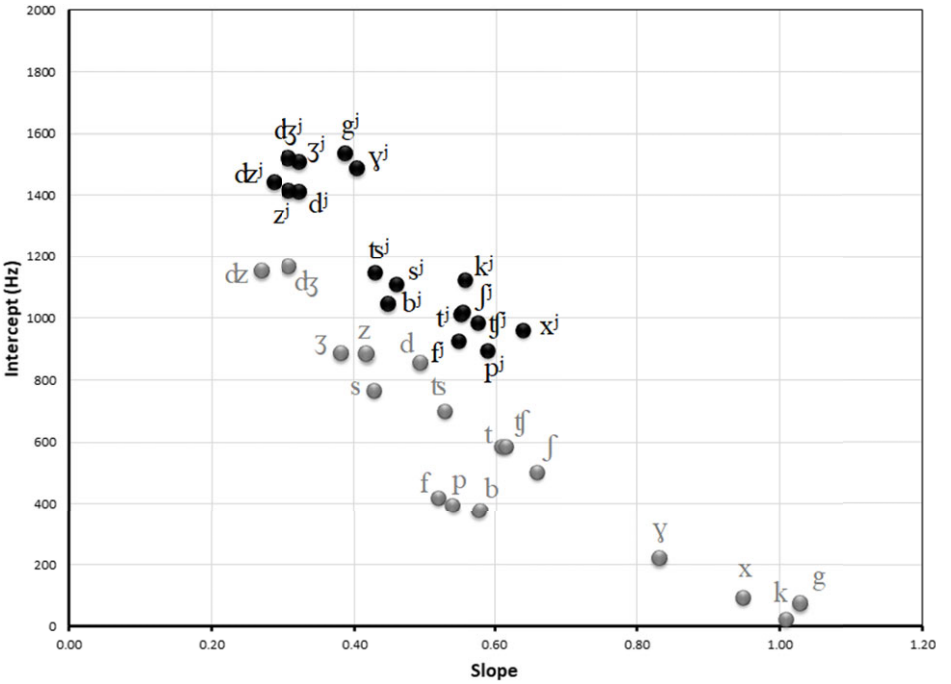
The consonants /k g/ in consonant clusters are only pronounced non-palatalized, even if there are palatalized consonants next to them (Girdenis 2001 [2000]: 411–413; LG 2006: 37), e.g. *žiñgsnis* [ˈʒʲɪŋʲ·ksʲnʲɪs] 'step', *vìrkdė* [ˈˈʊʲɪrʲgdʲeː] '(s/he, it, they) made smb. cry'. The consonants /kʲ gʲ xʲ ɣʲ/ form a separate palatalized subgroup of palatalized velar consonants because they are articulated not by raising the tongue back farther towards the hard palate but by raising the tongue middle towards the hard palate (for a comparison of the acoustic features of the velar consonants /k g/ and the palatalized velar consonants /kʲ gʲ/ see Indričāne & Urbanavičienė 2017: 33–72).

The articulation of the non-palatalized /l/ also differs sharply from that of /lʲ/, e.g. *Lùkas* [ˈlʊkʌs] 'Luke' (name) and *liùkas* [ˈlʲʊ̯kʌs] 'hatch', *plãnas* [ˈˈplɐːnʌs] 'plan' and *plýnas* [ˈˈpʲlʲiːnʌs] 'bare; smooth; open'. The consonant /l/ can have a strongly velarized articulation and the tongue blade creates a dental contact. The palatalized /lʲ/ is articulated with the front part of the tongue touching the alveolar ridge (see Figures 2 and 3, for an animated view see TARTIS).

The second formant of non-palatalized /l/ is lower than in the case of its palatalized counterpart /lʲ/, namely, in F2 stable part – male data [l] is 930 Hz, [lʲ] F2 – 1720 Hz; female data [l] F2 – 1210 Hz, [lʲ] F2 – 1860 Hz (Urbanavičienė et al. 2019: 208). Acoustical investigation of the palatalization of consonants has revealed that locus equations[6] (see Figure 4)



Note: The material for Figures 4–6 was read by six male speakers, aged 21–42 years. Each segment was repeated three times. There were 15 isolated prevocalic CVC sequences, i.e. about 270 tokens, for each consonant. Long CVC syllables were pronounced with a circumflex accent (because circumflex is the non-marked variant in the final syllable of words, including monosyllables).

Figure 4 Locus equations: Lithuanian non-palatalized (●) and palatalized (●) consonants (male data).

[6] Locus equations include two variables: F2 value at the onset of the vowel ($F2_{onset}$) and F2 value in the steady-state ($F2_{middle}$). The change of the two constant values, slope and y-intercept, depends on the place of articulation in consonants, but also on the effects of coarticulation (Sussman 1994).

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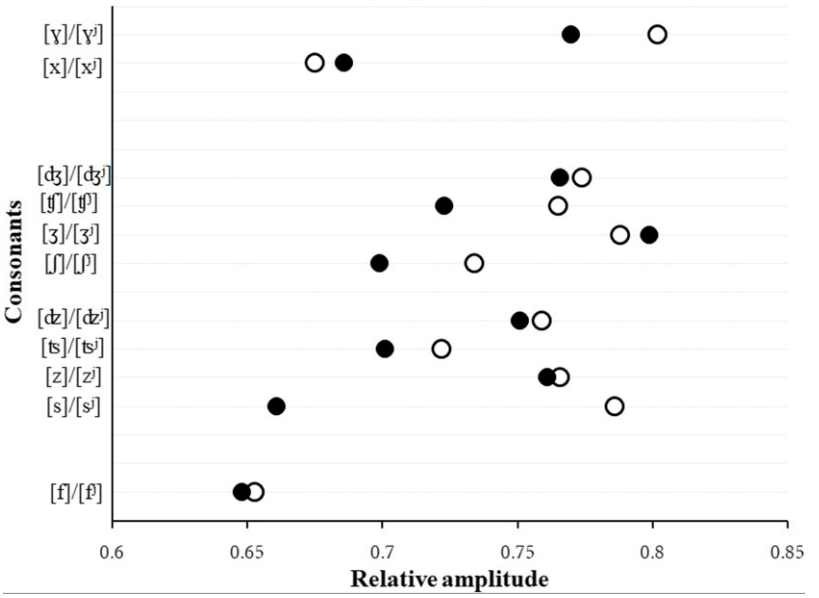

Figure 5 Relative amplitude of Lithuanian fricatives and affricates: non-palatalized (●) and palatalized (◯) consonants (male data, 270 tokens for each consonant).

conclusively show the difference between the palatalized and non-palatalized consonants (Ambrazevičius 2012: 15; Ambrazevičius & Leskauskaitė 2014: 263; Urbanavičienė et al. 2019: 279).

The F2 loci of palatalized consonants are compactly concentrated in the upper part of the coordinate plane, whereas the loci of non-palatalized consonants are less densely arranged in the lower part. This arrangement is determined by a general additional articulation (raising the body of the tongue towards the hard palate) characteristic of palatalized consonants, whereas non-palatalized consonants have no common articulatory component uniting them (Urbanavičienė 2019: 103–118). It was also noted that spectrum models of the palatalized consonants had more intensive spectral peaks or areas of energy concentration (Dereškevičiūtė 2013: 138). Palatalization also increases the relative amplitude[7] of the palatalized obstruents (see Figure 5).

In palatalized/non-palatalized pairs, apart from a couple of exceptions (i.e. [xʲ] and [x], [ʒʲ] and [ʒ]), the mean relative amplitude of the palatalized fricative or affricate is usually higher than that of the corresponding non-palatalized obstruent (Urbanavičienė et al. 2019: 232).

Voiceless and voiced consonants

Only obstruents contrast in voicing, i.e. /p/ – /b/, /pʲ/ – /bʲ/, /t/ – /d/, /tʲ/ – /dʲ/, /k/ – /g/, /kʲ/ – /gʲ/, /s/ – /z/, /sʲ/ – /zʲ/, /ʃ/ – /ʒ/, /ʃʲ/ – /ʒʲ/, /x/ – /ɣ/, /xʲ/ – /ɣʲ/, e.g. *pùvo* [ˈpʊʊoː] ‘(s/he, it, they) decayed’ : *bùvo* [ˈbʊʊoː] ‘(s/he, it, they) was/were’, *kãras* [ˀˈkɐːrʌs] ‘war’ :

[7] Relative amplitude is the difference between the amplitude of fricatives/affricates and the amplitude of the following vowel (Reetz & Jongman 2009: 248).

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gãras [ˀˈgɐːrʌs] ‘steam’, *šìlas* [ˈʃʲɪlʌs] ‘forest’ : *žìlas* [ˈʒʲɪlʌs] ‘grey’. The articulation of voiced and voiceless consonants is very similar (Pakerys 2003: 74): they are attributed to the same classes by both the place and the manner of articulation. Obstruents assimilate in voicing to a following obstruent and are voiceless word-finally (LG 2006: 44), e.g. *nèšti* [ˈnʲɛʃʲtʲɪ] ‘carry’ – *nè*[*ž*]*damas* [ˈnʲɛʒdʌmʌs] ‘when carrying’, *skrìsti* [ˈsʲkrʲɪsʲtʲɪ] ‘fly’ – *skrì*[*z*]*damas* [ˈsʲkrʲɪzdʌmʌs] ‘when flying’, *vẽža* [ˀˈʋʲæːʒʌ] ‘(s/he, it, they) carries/carry’ – *vè*[*š*]*ti* [ˈʋʲɛʃʲtʲɪ] ‘carry’, *láužia* [ˈˈlɐ·ʊʒʲɛ] ‘(s/he, it, they) break(s)’ – *láu*[*š*]*ti* [ˈˈlɐ·ʊʃʲtʲɪ] ‘break’, *daũg* [ˀˈdɒʊ·k] ‘many, much’ – *dúok* [ˈˈduɔk] ‘(you) give’ (IMPERATIVE, SG), *lýg* [ˈˈlʲiːk] ‘like; as if’ – *lìk* [ˈlʲɪk] ‘(you) stay’ (IMPERATIVE, SG). The approximants /j l lʲ m mʲ n nʲ r rʲ/ do not trigger voicing assimilation: they do not make a preceding voiceless consonant voiced and always remain voiced themselves (DLKG 2005: 33), e.g. *pùslapis* [ˈpʊslʌpʲɪs] ‘page’, *kaitrà* [kʌɪˈtrʌ] ‘heat’.

Featuring among the approximants are /ʊ ʋʲ/, which formally have voiceless fricative equivalents /f fʲ/; however, they do not form real functional pairs (Pakerys 2003: 74). At the end of a word, /ʊ ʋʲ/, similar to the approximant /j/, loses frication, becomes even more voiced and turns into the non-syllabic [ʊ̯], [ɪ̯], forming secondary diphthongs with the preceding vowels, e.g. *sudiẽu* [sʊˀˈdʲiɛʊ̯] ‘good-bye’, *jū́roj* [ˈˈjʊ̯ːrɔɪ̯] ‘in the sea’, *kėdẽj* [kʲeːˀˈdʲeːɪ̯] ‘on a chair’ (for the breakup of diphthongs into a vowel and /j/ or /ʊ/ before the vowels, see section ‘Diphthongs’ below). On the one hand, phonologically /j ʊ ʋʲ/ do pattern with sonorants in permitting a preceding voiceless obstruent, but on the other hand, with fricatives in a stricture between the speech organs (see TARTIS). In earlier grammars (e.g. Vaitkevičiūtė 1965: 70), the consonants /ʊ ʋʲ j/ were regarded as intermediate between fricative consonants and approximants. The current studies on the phonetics of Lithuanian treat them in two ways: either as fricative consonants /v vʲ/ (e.g. Balode & Holvoet 2001: 48; Ambrazevičius & Leskauskaitė 2014: 167; Pakerys 2014: 91) or as approximants /ʊ ʋʲ/ that undergo full (or partial) vocalization (Pakerys 2003: 75; LG 2006: 46; Girdenis 2014: 224; Kazlauskienė 2018: 50) and are generalized as phonemes. This Illustration presents the classical phonological classification of Lithuanian consonants, which assigns /ʊ ʋʲ/ to approximants. It should be noted that the contrast between approximants and voiced fricatives is also not sharply defined in other languages (e.g. Russian – Yanushevskaya & Bunčić 2015: 223; see also Johnson 2011: 122).

The voicing of obstruent consonants is evidenced by the duration of the release burst[8] – voiced stops have lower average statistical values compared to their voiceless counterparts with the same manner and place of the articulation (except for [b], [bʲ] and [p], [pʲ] in pronunciation of male, see Table 1). The duration of the release burst of voiceless plosives in Lithuanian is 26 ms (male), 33 ms (female) and that of voiced plosives is 23 ms (male; except for [b], [bʲ]), 15 ms (female); the duration of the release burst of voiceless affricates is 86 ms (male), 85 ms (female), voiced affricates – 67 ms (male), 60 ms (female).

The data for relative amplitude show (see Figure 5) that voiced fricatives and affricates typically have higher average statistical values compared to their voiceless counterparts:

[8] In this article DURATION OF THE RELEASE BURST instead of VOICE ONSET TIME (VOT) is used to characterize plosives and affricates (for more on the methodology for calculating the duration of the release burst see Urbanavičienė et al. 2019: 57). VOT is an important feature of plosive consonants in languages where the contrast between consonant voicing and voicelessness is created not only by the activity of the vocal cords but also by aspiration. VOT values of Lithuanian voiced plosive consonants are the same and VOT does not differentiate their place of articulation (Urbanavičienė et al. 2019: 239). Therefore, it is more appropriate to analyze the duration of the release burst rather than the VOT. Studies of VOT by other authors shows that the phonation of the Lithuanian voiced plosive consonants begins before the noise burst and is continual, while the VOT values are negative and not precisely defined (Ambrazevičius & Leskauskaitė 2014: 212).

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Table 1 Duration of the release burst of Lithuanian plosives and affricates (540 tokens for each consonant) (according to Urbanavičienė et al. 2019: 155).

Consonant		Male		Female	
		Statistical mean (ms)	Standard deviation (ms)	Statistical mean (ms)	Standard deviation (ms)
Plosives	[p]	20	8.4	24	18.9
	[pʲ]	19	8.0	24	14.7
	[b]	52	10.1	21	10.0
	[bʲ]	39	20.0	8	4.7
	[t]	18	3.1	20	10.7
	[tʲ]	24	8.7	29	13.1
	[d]	16	12.0	10	4.3
	[dʲ]	20	9.1	14	7.4
	[k]	36	10.7	52	14.3
	[kʲ]	40	9.5	47	17.0
	[g]	27	10.5	19	8.9
	[gʲ]	30	8.6	17	9.5
Affricates	[ts]	94	24.7	87	22.7
	[tsʲ]	92	16.4	84	26.9
	[dz]	74	26.7	66	13.4
	[dzʲ]	80	26.0	68	16.7
	[tʃ]	79	20.7	85	23.4
	[tʃʲ]	78	25.6	84	26.0
	[dʒ]	53	13.9	56	14.8
	[dʒʲ]	59	22.4	61	14.3

Note: The material for Table 1 was read by six male and six female speakers, aged 21–42 years. There were 15 isolated prevocalic CVC sequences for each consonant. Each segment was repeated three times. There were 270 tokens by male and 270 tokens by female speakers.

the relative amplitude of voiceless consonants is 0.620–0.790 dB; that of voiced consonants is 0.720–0.820 dB (Urbanavičienė & Indričāne 2016: 171; Urbanavičienė et al. 2019: 283–284).

The differences in the voicing of plosive consonants do not affect the energy distribution across the spectrum, meaning the allocation of the consonant to a particular model of the FFT spectrum – DIFFUSE FLAT/FALLING SPECTRUM vs. COMPACT SPECTRUM. Nor is the contrast in the consonants being voiced/voiceless evident in the frequency of the spectral peak of obstruent consonants, as the differences in the values of voiced obstruent consonants and their voiceless counterparts are rather variable (Urbanavičienė et al. 2019: 278–279).

Affricates

Lithuanian affricates are closer in duration to fricatives than to plosives – compare the duration of the release burst: [t] – 18 ms, [ts] – 94 ms; [d] – 16 ms, [dz] – 74 ms (see Table 1). The statistical mean and standard deviation of the frequencies of the spectral peak of affricates and the corresponding fricatives [s], [z], [ʃ], [ʒ] are also higher than those of the plosives [t], [d] (see Figure 6).

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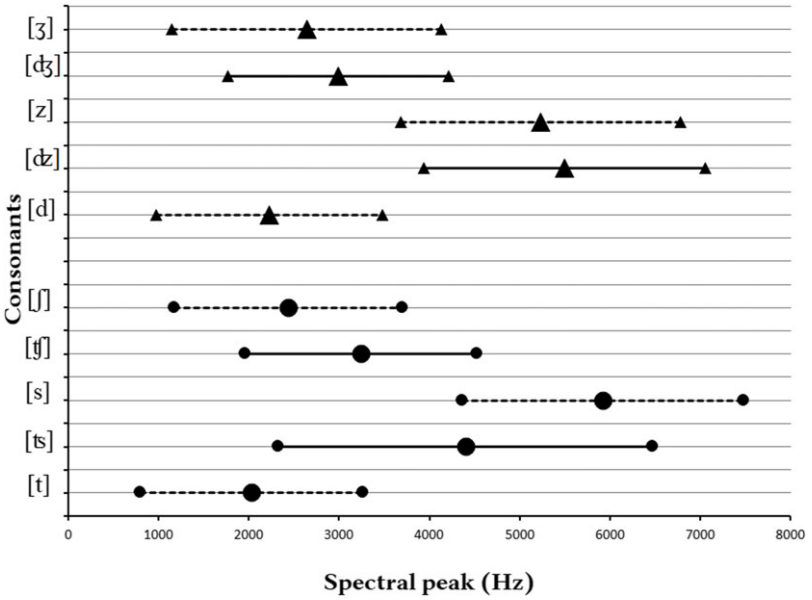

Figure 6 Spectral peaks of Lithuanian affricates, fricatives [s], [z], [ʃ], [ʒ] and plosives [t], [d]: voiceless (●) and voiced (▲) consonants (male data; ●, ▲ in the center indicates statistical mean; ●, ▲ on the left – statistical mean – standard deviation; ●, ▲ on the right – statistical mean + standard deviation).

The main language-specific patterns of assimilation

In the Lithuanian language, there is regressive (A←B) and progressive (A→B), as well as close (contact) and remote (distant), partial and total assimilation (Pakerys 2003: 178). Regressive close assimilation is most common. Cases of progressive and distant assimilation are found in dialects as well as in diachronic phonetic processes. Lithuanian (as well as e.g. North Slavic languages) is characterized by a particular sensitivity to the context of vowel realization, i.e. by accommodative pronunciation, where the realizations of sounds in adjacent positions overlap (Sawicka 2007: 83).

Adjacent sounds in Lithuanian assimilate as follows:

1. According to voicing, e.g. *võgti* [ˀˈʊoːktʲɪ] 'steal', *grįžk* [ˀˈgrʲiːʃk] '(you) come back' (IMPERATIVE, SG), *nèšdavo* [ˈnʲɛʒdʌʊoː] '(s/he, it, they) used to carry', *vìrkdė* [ˈˈʊɪrʲgdʲeː] '(s/he, it, they) made smb. cry', *išgirďo* [iʒʲˀˈgʲɪr·doː] '(s/he, it, they) heard'. The sonorants do not participate in this assimilation (see section 'Voiceless and voiced consonants' above). Assimilation according to activity of vocal cords is partial because consonants still differ in other features, i.e. no two identical consonants are obtained.
2. According to the place of articulation. This type of assimilation can be partial (e.g. *vabzdžių* [ʊʌbʲʒʲˀˈʤʲụː] 'insects' (GEN.PL)) or total (e.g. *pùsšimtis* [ˈpʊʃʲɪmʲtʲɪs] 'fifty', *ùžzvimbė* [ˈʊzʲʊʲɪmʲbʲeː] '(s/he, it, they) hummed'). In the case of total assimilation, when two identical consonants are obtained, additionally degemination takes place, i.e. one of two consonants is omitted. Fricative compounds (S–S type, two (post)alveolar fricatives) are not the same duration as in a similar word with a singleton, e.g. a morphological boundary (*pus-* + *-šimtis*) increases the duration of the compound by a factor of

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approximately 1.06, and can be interpreted as an open juncture (Strimaitienė & Girdenis 1978: 64).

3. According to palatalization, e.g. *viščiùkas* [ʊʲɪʃʲˈʧʲʊˌkʌs] ‘chicken’, *veñsti* [²ˈʊʲɛrʲ·sʲtʲɪ] ‘turn, overthrow, force’, *spjáuti* [¹ˈsʲpʲjæ·ʊtʲɪ] ‘spit’. This assimilation is partial because consonants are adjusted only by palatalization.

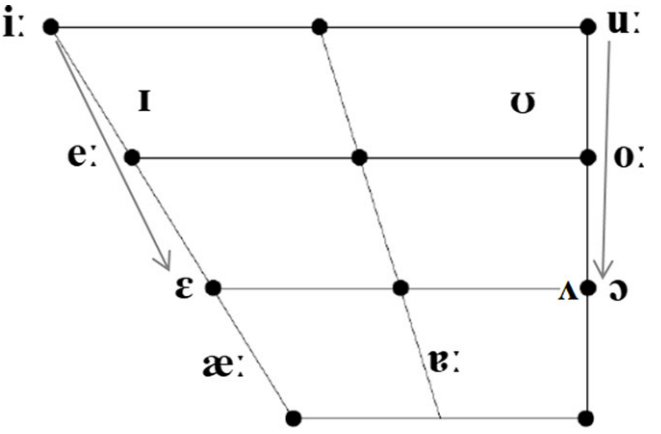
Consonants can be combined according to several features at the same time, i.e. according to voicing and the place of articulation (e.g. *užsãkymas* [ʊ²ˈsɐːkʲiːmʌs] ‘order’, *pùsžalis* [ˈpʊʒʌlʲɪs] ‘half-baked, half-raw’), according to the place of articulation and palatalization (e.g. *anksčiaũ* [ʌŋʲkʃʲ²ˈʧʲɛʊ·] ‘earlier’, *pãvyzdžio* [²ˈpɐːʊʲiːʒʲʤʲoː] ‘example’ (GEN.SG)), and according to the activity of the vocal cords and the place of articulation and palatalization (e.g. *mèzgčiau* [ˈmʲɛkʃʲʧʲɛʊ] ‘(I) would knit’, *pùsžiemis* [ˈpʊʒʲiɛmʲɪs] ‘semi-winter’, *ùžsienis* [ˈʊsʲiɛnʲɪs] ‘foreign countries’).

At morpheme boundaries the consonants are also assimilated. There are productive alternations that exist for all types of assimilation: one morphologically related form shows the alternation and the other does not, e.g. assimilation of voicing (*sė́sti* [¹ˈsʲeːsʲtʲɪ] ‘to sit’– *sė́*[*z*]*davo* [¹ˈsʲeːzdʌʊoː] ‘(s/he, it, they) used to sit’, *dė̀*[*k*]*ti* [ˈdʲɛktʲɪ] ‘burn’ – *dẽga* [²ˈdʲæːgʌ] ‘it burns’); assimilation of palatalization (*laisviaũ* [lʌɪ²ˈsʲʊʲɛʊ·] ‘more freely’ – *laisvaĩ* [lʌɪ²ˈsʊʌɪ·] ‘freely’, *geriaũ* [gʲɛ²ˈrʲɛʊ·] ‘better’ – *geraĩ* [gʲɛ²ˈrʌɪ·] ‘good’).

Due to the interaction with the adjacent velar and palatalized velar consonants /k kʲ g gʲ/, the nasal sonorants /n nʲ/ become velar; velar allophones [ŋ ŋʲ] are articulated, e.g. *sniñga* [²ˈsʲnʲɪŋ·gʌ] ‘it snows’, *añka* [²ˈʌŋ·kʌ] ‘(s/he, it, they) goes/go blind’ (Pakerys 2003: 86–87; LG 2006: 4–45; Kazlauskienė 2018: 58–61).

Geminates arising across morpheme or word boundaries degeminate in Lithuanian, e.g. *pùsseserė* (< *pus-* + *seserė*) [ˈpʊsʲɛsʲɛrʲeː] ‘cousin’ (F), *iššóko* (< *iš-* + *šoko*) [ɪˈˈʃoːkoː] ‘(s/he, it, they) jumped out’, *užsùko* (< *už-* + *suko*) [ʊˈsʊkoː] ‘(s/he, it, they) twisted; turned; turned off; screwed up’. Degemination occurs at the junction of the prefix and the root or two stems; also, by adding a clitic to an independent word. At the junction of two independent words, both single consonant (if the words are closely related) or two consonants (in one or more features) can be pronounced (Pakerys 2003: 175).

Vowels



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/ɪ/	[ˈdʲɪdʲɪs]	*dìdis*	‘great’	/eː/	[¹ˈgʲeːlʲeː]	*gélė*	‘(s/he, it, they) ached; stung’
/e/	[ˈmʲetrʌs]	*mètras*	‘metre’	/æː/	[²ˈkʲæːsʲtʲɪ] [²ˈnʲæːʃʌ]	*kę̃sti* *nẽša*	‘suffer; endure’ ‘(s/he, it, they) carries/carry’
/ɛ/	[ˈpʲɛʃʲtʲɪ]	*pèšti*	‘pluck’	/ɐː/	[²ˈgrɐːʃtɐː] [²ˈkɐːsʌ]	*grą̃žtą* *kãsa*	‘drill’ (ACC.SG) ‘(s/he, it, they) digs’
/ʌ/	[ˈkʌsʲtʲɪ]	*kàsti*	‘dig’	/oː/	[¹ˈstoːgoː]	*stógo*	‘roof’ (GEN.SG)
/ɔ/	[ˈxɔrʌs]	*chòras*	‘chorus’	/uː/	[²ˈpuːstuː]	*pũstų*	‘(s/he, it, they) would blow’
/ʊ/	[ˈlʊpʌ]	*lùpa*	‘(s/he, it, they) peel(s)’	/iɛ/	[²ˈkʲiɛkʲɪs]	*kiẽkis*	‘amount’
/iː/	[²ˈdʲiːdʲiː]	*dỹdį*	‘size; quantity’ (ACC.SG)	/uɔ/	[¹ˈpuɔdʌs]	*púodas*	‘pot’

The latest linguistic studies on Lithuanian (LG 2006: 28; Girdenis 2009: 213–242; 2014: 113, 201–214; Kazlauskienė 2018: 40) suggest that the vowel system of Standard Lithuanian consists of the following vowel phonemes of uniform (or non-gliding) and gliding (non-uniform) articulation: the short monophthongs /ɪ ɛ ʌ ɔ ʊ/, the long monophthongs /iː eː æː ɐː oː uː/ and the gliding diphthongs /iɛ uɔ/[9] which are characterized by the closeness of the articulation of the components and thus differ from other Lithuanian diphthongs /ʌɪ ɒʊ ɛɪ ʊɪ ɛʊ ɔɪ ɔʊ/ (see the vowel chart above, where arrows indicate variable articulation of /iɛ uɔ/). In the phonological system of Standard Lithuanian, the /iɛ uɔ/ function as independent long vowels consisting of stable sounds, i.e. the vowel and a glide component, which is pronounced differently depending on the prosodic features and co-articulation with the first component and the adjacent consonant. The diphthongs /iɛ uɔ/ glide in the direction of increasing back and open articulation, but it is complicated to divide it into two separate components, therefore the entire diphthong is considered to be the syllable center. This is one of many reasons to regard /iɛ uɔ/ as members of the phonological system of vowels rather than diphthongs. Additionally, similar to long vowels, /iɛ uɔ/ participate in the same morpho-phonological alternations and before vowels they are not broken up into two syllables as diphthongs are (see Tables 2 and 3).

The Lithuanian short phoneme /ɔ/ is to be regarded as marginal because [ɔ] is mainly used in words of foreign origin and some proper nouns. The short optional phoneme /e/ is also to be regarded as marginal. Instead of the optional close mid-high vowel [e] used only in borrowed words, usually the simple short [ɛ] is articulated. Moreover, speakers of Standard Lithuanian cannot pronounce the short /e/ as a separate sound in isolation (Jaroslavienė 2015; Jaroslavienė et al. 2019). In Aleksas Girdenis’ opinion, the short sound [e] ‘should not be considered a true (even if marginal) phoneme since its purpose is not distinctive. Nor do its optional usage and special expressive nuance allow us to treat it as a normal phoneme. In the

[9] According to their function in the syllable, the diphthongs /iɛ uɔ/ and /ʌɪ ɒʊ ɛɪ ʊɪ ɛʊ ɔɪ ɔʊ/ (as well as the diphthongoid sequences /ʌl ɛl ɪl ʊl ʌm ɛm ɪm ʊm ʌn ɛn ɪn ʊn ʌr ɛr ɪr ʊr/) are functionally equivalent to long vowels in contrasting in their distinctions in pitch accents (LG 2006: 25; see section ‘Prosodic system’ below).

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Table 2 Quantitative oppositions of the Lithuanian vowels.

Long vowels	Short vowels
[iː]	[ɪ]
pỹks [ˀˡpʲiːks] '(s/he, it, they) will be angry'	*pìgs* [ˈpʲɪks] '(s/he, it, they) will become cheap'
rýto [ˈˡrʲiːtoː] 'morning' (GEN.SG)	*rìto* [ˈrʲɪtoː] '(s/he, it, they) rolled'
palĩs [pʌˀˡlʲiːs] '(s/he, it, they) will creep under'	*palìs* [pʌˈlʲɪs] 'it will rain'
bróliį [ˈˡbroːlʲiː] 'brother' (ACC.SG)	*bróli* [ˈˡbroːlʲɪ] 'brother' (VOC.SG)
[uː]	[ʊ]
skũ̃s [ˀˡskuːs] '(s/he, it, they) will report on'	*skùs* [ˈskʊs] '(s/he, it, they) will peel; shave'
pũ̃sto [ˀˡpuːstoː] 'puffed' (GEN.SG.M)	*pùsto* [ˈpʊstoː] 'there is a blizzard'
vaikų̃ [vʌɪˀˡkuː] 'children' (GEN.PL)	*vaikù* [vʌɪˈkʊ] 'child' (INSTR.SG)
ramių̃ [rʌˀˡmʲụː] 'calm' (GEN.PL.M)	*ramiù* [rʌˈmʲụ] 'calm' (INSTR.SG.M)
šáukštų [ˈˡʃɐˑʊkʃtuː] 'spoon' (GEN.PL)	*šáukštu* [ˈˡʃɐˑʊkʃtʊ] 'spoon' (INSTR.SG)
[æː]	[ɛ]
trę̃šti [ˀˡtʲrʲæːʃtʲɪ] 'fertilize'	*trèšti* [ˈtʲrʲɛʃtʲɪ] 'rot'
sáulę [ˈˡsɐˑʊlʲæː] 'the sun' (ACC.SG)	*sáule* [ˈˡsɐˑʊlʲɛ] 'the sun' (INSTR.SG)
[ɐː]	[ʌ]
ką̃sti [ˈˡkɐːsʲtʲɪ] 'bite'	*kàsti* [ˈkʌsʲtʲɪ] 'dig'
šlúotą [ˈˡʃluɔtɐː] 'broom' (ACC.SG)	*šlúota* [ˈˡʃluɔtʌ] 'broom' (INSTR.SG)
[iɛ]	[ɪ]
šviẽs [ˀˡʃvʊʲiɛs] '(s/he, it, they) will shine'	*švìs* [ˈʃvʊʲɪs] '(s/he, it, they) will dawn'
kíẽto [ˈˡkʲiɛtoː] 'hard' (GEN.SG.M)	*kìto* [ˈkʲɪtoː] 'another (GEN.SG); (s/he, it, they) was changing'

Table 3 Qualitative oppositions of the Lithuanian vowels.

Backness	
Front vowels	Back vowels
[eː]	[oː]
gražẽs [grʌˀˡʒʲeːs] '(s/he, it, they) will get more beautiful'	*gražiõs* [grʌˀˡʒʲọːs] 'beautiful' (GEN.SG.F)
[ɪ]	[ʊ]
kelì [kʲɛˈlʲɪ] '(you) are lifting' (SG)	*keliù* [kʲɛˈlʲụ] '(I) am lifting'
[iɛ]	[uɔ]
nẽšiesi [ˈnʲɛʃʲiɛsʲɪ] '(you) will carry' (SG)	*nẽšiuosi* [ˈnʲɛʃʲụɔsʲɪ] '(I) shall carry'

Height		
High vowels	Mid vowels	Low vowels
[iː]		[æː]
tį̃sk [ˀˡtʲiːsk] '(you) drag' (IMPERATIVE, SG)		*tę̃sk* [ˀˡtʲæːsk] '(you) continue' (IMPERATIVE, SG)
[iː]	[eː]	
plýšo [ˈˡpʲlʲiːʃoː] '(s/he, it, they) *tore*'	*plė́šo* [ˈˡpʲlʲeːʃoː] '(s/he, it, they) is/are tearing'	
[uː]	[oː]	[ɐː]
šũ̃kių [ˀˡʃuːkʲụː] 'slogan; call' (GEN.PL)	*šõkių* [ˀˡʃoːkʲụː] 'dances' (GEN.PL)	*šākių* [ˀˡʃɐːkʲụː] 'pitchforks' (GEN.PL)

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Table 3 Continued.

Height		
High vowels	Mid vowels	Low vowels
[uː]	[oː]	
namų̃ [nʌ$^{2|}$muː] 'houses' (GEN.PL)	*namō* [nʌ$^{2|}$moː] 'home' (ADV)	
[iː]	[eː]	[æː]
senẽlį [sʲɛ$^{2|}$nʲæːlʲiː] 'grandfather' (ACC.SG)	*senẽlė* [sʲɛ$^{2|}$nʲæːlʲeː] 'grandmother'	*senẽlę* [sʲɛ$^{2|}$nʲæːlʲæː] 'grandmother' (ACC.SG)
[uː]	[oː]	[ɐː]
výrų [$^{1|}$ʊʲiːruː] 'men' (GEN.PL)	*výro* [$^{1|}$ʊʲiːroː] 'man' (GEN.SG)	*výrą* [$^{1|}$ʊʲiːrɐː] 'man' (ACC.SG)

best case, it is only a phoneme of certain urban sociolects' (Girdenis 2014: 202). However, the sounds [e] and [ɛ] are not functionally identical; the accented vowel in borrowed words does not become longer, whereas the accented Lithuanian one does (see examples under the vowel chart).

Quantitative and qualitative oppositions testify to the independent phonemic status of vowel quality and quantity, although quantitative oppositions are also accompanied by qualitative differences; the meaning of a word depends on the quantity (duration) and the quality of vowels (see Tables 2 and 3). Quantitative oppositions are preserved in both accented and unaccented positions of a word.

The length of Lithuanian vowels can be positional (when vowels become longer under stress, e.g. *rẽtas* [$^{2|}$rʲæːtʌs] 'rare' : *retàs* [rʲɛ$^{|}$tʌs] 'rare' (ACC.PL.F), *rãktas* [$^{2|}$rɐːktʌs] 'key' : *raktù* [rʌk$^{|}$tʊ] 'key' (INSTR.SG), or inherited or historical (when vowels are long in both the accented and unaccented positions), e.g. *gėlẽ* [gʲeː$^{2|}$lʲeː] 'flower', *gélė* [$^{1|}$gʲeːlʲeː] '(s/he, it, they) ached; stung', *ródo* [$^{1|}$roːdoː] '(s/he, it, they) show(s)', *namõ* [nʌ$^{2|}$moː] 'home' (ADV); *drį̃sti* (< Proto-Lith.[10] **drinsti*) [$^{2|}$dʲrʲiːsʲtʲɪ] 'dare', *drą̃są* (< Proto-Lith. **dransan*) [$^{2|}$drɐːsɐː] 'courage' (ACC.SG), *lū̃pų* (< Proto-Lith. **lūpun*) [$^{1|}$luːpuː] 'lips' (GEN.PL), *skų́sti* (< Proto-Lith. **skunsti*) [$^{1|}$skuːsʲtʲɪ] 'report on', *skę̃sta* (< Proto-Lith. **skensta*) [$^{2|}$sʲkʲæːstʌ] '(s/he, it, they) sink(s)' (see e.g. Kazlauskienė 2018: 40–41). The origins of the inherited and historical lengths of vowels differ; the former are inherited as long, and are most often denoted by long vowels, whereas the latter arose from nasal vowels and are denoted in the orthography by nasal letters, although it can be said that today no nasality is preserved.

Long vowels are more peripheral in the vowel space. The latest instrumental investigations show (e.g. Grigorjevs & Jaroslavienė 2015b: 79; Jaroslavienė et al. 2019) that [ɛ ʌ] of Standard Lithuanian are the longest of the short vowels, whereas [æː ɐː] are the longest of the long vowels; the short [ɪ ʊ] are the shortest of the short vowels, and [iː uː] are the shortest of the long vowels. In terms of duration, other vowels ([ɔ] of the short vowels and [eː oː] of the long vowels) occupy the intermediate position: they are shorter than the corresponding short and long low vowels but longer than the corresponding high vowels. The duration ratio of short and long vowels pronounced in isolation is about two to one (see Table 4). Such regularities essentially conform to tendencies established by earlier researchers (see Pakerys 1982: 43–48).

Lithuanian long and short vowels differ greatly in their quality (see LG 2006, Grigorjevs & Jaroslavienė 2015a, Jaroslavienė 2017, Jaroslavienė et al. 2019). Qualitative variations of vowels depend on the adjacent sounds and other factors (see Ledichova 2020; also variation of sounds in Lithuanian dialects in Bakšienė & Čepaitienė 2017).

[10] Proto-Lithuanian (see Balode & Holvoet 2001: 53).

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Table 4 Duration of the Lithuanian long and short vowels in CVC sequences (according to Jaroslavienė et al. 2019: 142).

Vowel	Male		Female	
	Statistical mean ± standard deviation (ms)	Duration ratio	Statistical mean ± standard deviation (ms)	Duration ratio
[iː]	350±38	2.11 : 1	352±40	2.06 : 1
[ɪ]	166±18		171±25	
[eː]	414±55		370±44	
[æː]	422±42	1.99 : 1	397±79	1.99 : 1
[ɛ]	212±16		199±29	
[ɐː]	451±38	2.16 : 1	406±76	2.06 : 1
[ʌ]	209±12		197±17	
[oː]	399±37	2.16 : 1	393±49	2.14 : 1
[ɔ]	185±22		184±13	
[uː]	368±43	2.22 : 1	362±49	2.07 : 1
[ʊ]	166±23		175±14	
	Long : short vowels 401 ms : 188 ms	2.09 : 1	Long : short vowels 380 ms : 185 ms	2.05 : 1

Note: The material for Table 4 was read by six male and six female speakers, aged 21–42 years. There were 23 isolated CVC sequences for each vowel, which was repeated three times. There were 414 tokens by male and 414 tokens by female speakers. Mean value was calculated as the average of all realizations of the sound.

Classification and spectral characteristics of vowels

According to the backness of articulation (see Figure 7), FRONT vowels (long phonemes /iː iɛ eː æː/ and short phonemes /ɪ ɛ/) and BACK (long phonemes /uː uɔ oː ɐː/ and short phonemes /ʊ ɔ ʌ/) are distinguished in Lithuanian linguistics. According to the formant data, the Lithuanian short [ʌ], especially when pronounced by females, seems to be close to the schwa-like vowel, as its F2 exceeds the threshold of 1500 Hz; however, the calculated data for the male voice (see Table 5 and Figure 7) show a much lower F2 for [ʌ], closer to the back vowels; moreover, this vowel has highly variable F2 values (the male voice is approximately 1100 Hz to 1450 Hz, see Figure 7). In Lithuanian linguistics, it is customary to consider the vowel [ʌ] as a back vowel, taking into account phonological criteria: short /ʌ/ functions as a back vowel – non-palatalized consonants are used before it as before other back vowels. The latest textbooks on the phonetics and phonology of the Standard Language treat the short /ʌ/ as a back vowel (see Kazlauskienė 2018: 34–35; see also Pakerys 2003, Girdenis 2014, Grigorjevs & Jaroslavienė 2015b, Jaroslavienė 2017). In the Lithuanian language, the back vowels [uː uɔ oː ʊ ɔ] that follow palatalized consonants become slightly advanced[11] (e.g. *gerù* [gʲɛˈrʊ] 'good' (INSTR.SG.M) : *geriù* [gʲɛˈrʲʊ̟] '(I) am drinking'), and [ɐː ʌ] become completely front (e.g. *galià* [gʌˈlʲɛ] 'power' : *galè* [gʌˈlʲɛ] 'at the end', *žãlią* [ˀʒɐːlʲæː] 'green' (ACC.SG) : *žõlę* [ˀʒoːlʲæː] 'grass' (ACC.SG)) and therefore are transcribed as corresponding front vowels [æː ɛ] (see e.g. Girdenis 2014, Kazlauskienė 2018).

According to the distance between the tongue and the palate, the following vowels are distinguished in Lithuanian linguistics as HIGH (i.e. close long /iː uː/ and short /ɪ ʊ/), MID (long /eː oː/ and short /ɔ/) and LOW (open long /ɐː æː/ and short /ʌ ɛ/) vowels (see Figure 7 and the vowel chart). As mentioned, /iɛ uɔ/ are regarded as vowels of gliding articulation.

[11] When [uː ʊɔ oː ʊ ɔ] become advanced, they are not central vowels; in articulating them, the tongue first moves forward and later withdraws to the back of the mouth (see TARTIS).

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Table 5 Values of F1 and F2 for Standard Lithuanian long and short vowels (male data; according to Girdenis 2014: 238).

Long vowel	F1 (Hz)	F2 (Hz)	Short vowel	F1 (Hz)	F2 (Hz)
[iː]	250	2400	[ɪ]	400	1900
[eː]	450	2100			
[æː]	750	1600	[ɛ]	550	1700
[ɐː]	900	1200	[ʌ]	750	1300
[oː]	550	800	[ɔ]	600	1100
[uː]	300	600	[ʊ]	450	900

Note: The values of F1 have been rounded to the nearest 50 Hz and the values of F2 have been rounded to the nearest 100 Hz.

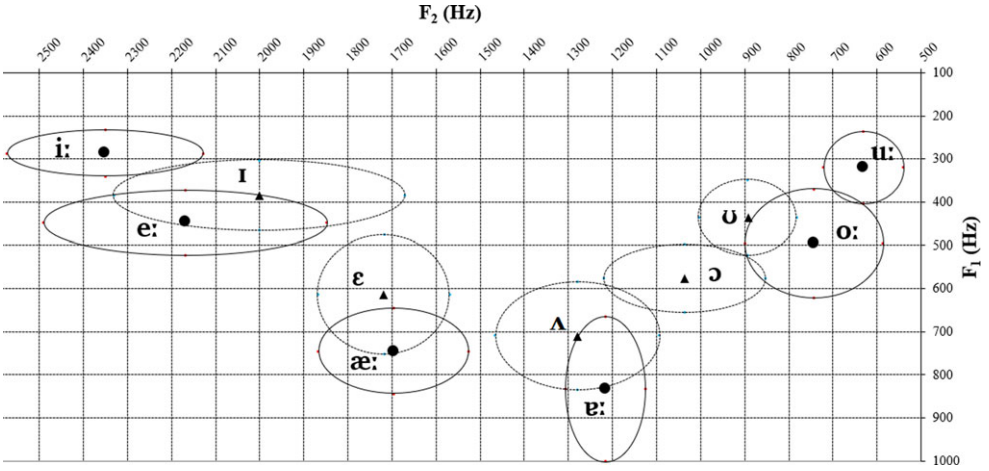
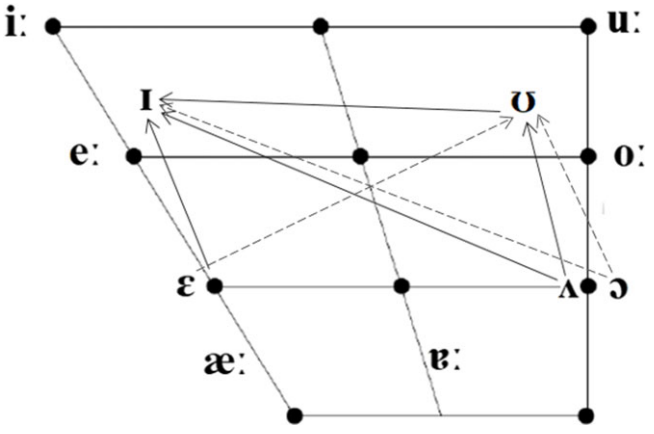


Figure 7 Mean values of the Lithuanian vowels in the acoustic F2/F1 (Hz) plane. The ellipses explain 99.72% of the data according to the calculated standard deviation (male data, 33 tokens for each vowel; circles represent long vowels, triangles represent short vowels).

The results of the present paper confirm the general tendency that the qualitative characteristics of the Lithuanian long and corresponding short vowels differ to a great extent (see Figure 7). According to the movement of the lips, Lithuanian vowels are divided into rounded or labial (/uː oː ʊ ɔ/) and unrounded or non-labial (/iː eː æː ɐː ɪ ɛ ʌ/).

Diphthongs



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The Lithuanian language has a rich inventory of diphthongal sounds: DIPHTHONGS and VR-TYPE (vowel + sonorant) DIPHTHONGOID SEQUENCES (see the diphthongs chart above, where arrows indicate variable articulation of diphthongs and dashed arrows indicate marginal diphthongs). Diphthongs are considered to be /ʌɪ ɒʊ ɛɪ ʊɪ/ and the marginal /ɛʊ ɔɪ ɔʊ/;[12] VR-type diphthongoid sequences are the following: /ʌl ɛl ɪl ʊl ʌm ɛm ɪm ʊm ʌn ɛn ɪn ʊn ʌr ɛr ɪr ʊr/, e.g. *vaĩkas* [ˀˈvʌɪ·kʌs] 'child', *vaikaĩ* [vʌɪˀˈkʌɪ·] 'children', *láuk* [ˈˈlɐ·ʊk] '(you) wait' (IMPERATIVE, SG), *laũk* [ˀˈlɒʊ·k][13] 'get away!; out' (ADV), *laukè* [lɒʊˈkʲɛ] 'outside', *reĩkia* [ˀˈrʲɛɪ·kʲɛ] 'it is necessary', *muĩlas* [ˀˈmʊɪ·lʌs] 'soap', *terapeũtas* [tʲɛrʌˀˈpʲɛʊ·tʌs] 'therapist', *boikòtas* [bɔɪˈkɔtʌs] 'boycott', *klòunas* [ˈˈklɔʊnʌs] 'clown', *káltas* [ˈˈkɐ·ltʌs] 'chisel', *kaĨtas* [ˀˈkʌl·tʌs] 'guilty', *kaltàs* [kʌlˈtʌs] 'guilty' (ACC.PL.F), *délnas* [ˈˈdʲæ·lnʌs] 'palm', *peñktas* [ˀˈpʲɛŋ·ktʌs] 'the fifth', *kerpa* [ˀˈkʲɛr·pʌ] '(s/he, it, they) cut(s)', *gìnti* [ˈˈgʲɪnʲtʲɪ] 'defend', *pìrmas* [ˈˈpʲɪrmʌs] 'the first', *kùrmis* [ˈˈkʊrʲmʲɪs] 'mole', *vìrti* [ˈˈʋʲɪrʲtʲɪ] 'boil', etc. Two adjacent sounds are united into a diphthong by the fact that they form the base of a long syllable and have a common accent as well as form the basis for the distinction in syllable tonemes (LG 2006: 25; see also next section, 'Prosodic system'). Diphthongs and VR-type diphthongoid sequences occur only before consonants and a juncture, whereas before vowels they are broken up into two syllables or a vowel and /j/ or /ʋ/, e.g. *kìlti* [ˈˈkʲɪlʲtʲɪ] 'rise' : *kìlo* [ˈkʲɪlɔː] '(s/he, it, they) rose', *kùrti* [ˈˈkʊrʲtʲɪ] 'create' : *kùria* [ˈkʊrʲɛ] '(s/he, it, they) create(s)', *gìnti* [ˈˈgʲɪnʲtʲɪ] 'defend, drive' : *ginù* [gʲɪˈnʊ] '(I) defend, drive', *gùiti* [ˈˈgʊɪtʲɪ] 'drive; scold' : *gujù* [gʊˈjʊ] '(I) am driving, scolding'. Both elements of diphthongs and VR-type diphthongoid sequences can be interchanged: *laũkas* [ˀˈlɒʊ·kʌs] 'field': *laĩkas* [ˀˈlʌɪ·kʌs] 'time' : *lañkas* [ˀˈlʌŋ·kʌs] 'bow', *kaĩsti* [ˀˈkʌɪ·sʲtʲɪ] 'become heated': *kuĩsti* [ˀˈkʊɪ·sʲtʲɪ] 'rummage' : *keĩsti* [ˀˈkʲɛɪ·sʲtʲɪ] 'change', *veĩsti* [ˀˈʋʲɛɪ·sʲtʲɪ] 'breed' : *veřsti* [ˀˈʋʲɛrʲ·sʲtʲɪ] 'turn over; force', etc.

Vowel elements of unaccented diphthongs are short. Qualitative features of elements that were lengthened due to the accent become more pronounced; these accented elements qualitatively can also be close to the long vowels (see section 'Prosodic system' below).

Long vowels or diphthongs followed by a tautosyllabic sonorant consonant are limited to word-final position or the first element in a compound, i.e. morphologically complex forms, e.g. *vẽl* [ˀˈʋʲeːl] 'again', *kõrtos* [ˀˈkoːrtoːs] 'cards', *žemỹn* [ʒʲɛˀˈmʲiːn] 'downwards', *sū́rmaišis* [ˈˈsuːrmʌɪʃʲɪs] 'cheese-bag', *laũmžirgis* [ˀˈlɒʊ·mʲʒʲɪrʲgʲɪs] 'dragon-fly', *rainmañgis* [rʌɪnˀˈmʌrʲ·gʲɪs] 'variegated in streaks'.

Prosodic system

Stress

Stress in the Lithuanian language is FREE, i.e. it can occur on any syllable of a word: the ultimate, the penultimate, the first and any other. Alongside its universal CULMINATIVE function, which is fulfilled by stresses of all types, this type of stress primarily performs a DISTINCTIVE function because the place of a word stress can distinguish lexical and grammatical meanings of words, as seen in the minimal pairs *kìlimas* [ˈkʲɪlʲɪmʌs] 'carpet' : *kilìmas* [kʲɪˈlʲɪmʌs] 'rise' (NOUN), *gìria* [ˈgʲɪrʲɛ] '(s/he, it, they) praise(s)' : *girià* [gʲɪˈrʲɛ] 'forest', *kìtas* [ˈkʲɪtʲɐs] 'another' : *kitàs* [kʲɪˈtʌs] 'others' (ACC.PL.F), *nèši* [ˈnʲɛʃʲɪ] '(you) will carry' (SG) : *nešì* [nʲɛˈʃʲɪ] '(you) are carrying' (SG), etc. (Balode & Holvoet 2001: 49; Pakerys 2003: 217–218; LG 2006: 53–54; Girdenis 2014: 272–273; Stundžia 2014b: 12).

[12] The most frequent are [ɛɪ ʌɪ ɒʊ]. The diphthong [ʊɪ] is comparatively rare, and the marginal [ɛʊ ɔɪ ɔʊ] are found only in words borrowed from other languages (Stundžia 2014b: 10).

[13] The first component of circumflex and unstressed diphthong [ɒʊ] is strongly labialized and marked [ɒ].

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In longer words with at least three syllables, alongside the PRIMARY stress, one or several SECONDARY stresses can be optionally realized, e.g. *mókytojo* [ˈˈmoːkʲiːˌtoːjoː] 'teacher's', *pùskepalis* [ˈpʊsʲkʲɛˌpʌlʲɪs] 'half a loaf', *pasidarýdavo* [pʌˌsʲɪdʌˈˈrʲiːdʌˌʊoː] '(s/he, it, they) used to make something for oneself, used to become'. Secondary stresses are most often found in long words of foreign origin made of several clearly perceived components, e.g. *aerohidroterãpija* [ˌʌɛrɔˌɣʲɪdrɔtʲɛ²ˈrɛːpʲɪjɛ] 'airhydrotherapy' (Pakerys 2003: 218; LG 2006: 54; Girdenis 2014: 280–282).

The Lithuanian syllable nucleus, which can consist of vowels, diphthongs and VR-type diphthongoid sequences, can be accentuated with respect to other syllables by a complex of several prosodic features. The most prominent and stable feature of stressed syllables is the longer duration of the center of the syllable, while accented vowels also have more prominent qualitative features. The features of f0 and intensity may vary depending on the intonation of the phrase. The unaccented syllables are always less distinctly articulated quantitatively and qualitatively (see Figures 8 and 9, and Table 6).[14]

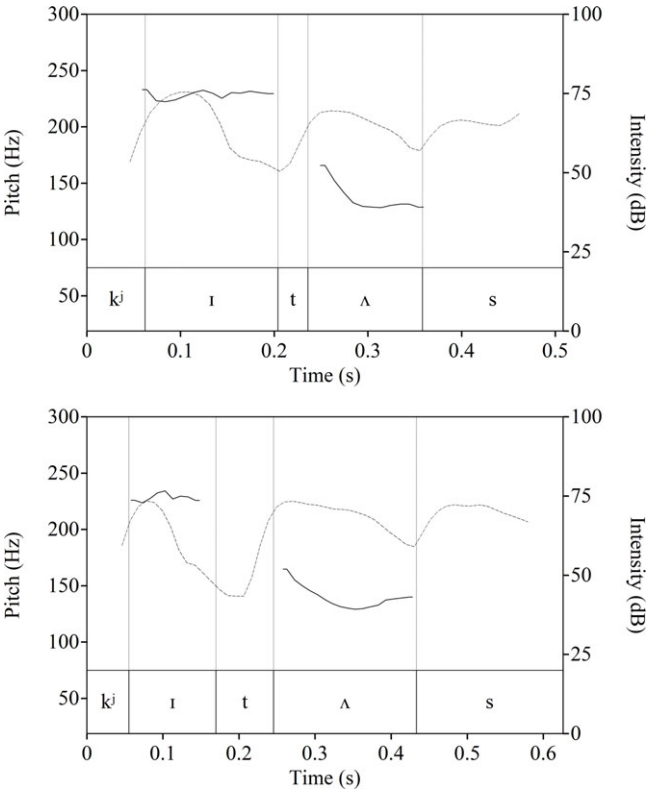

Figure 8 Pitch (solid line) and intensity (dashed line) traces of stressed and unstressed short vowels in Lithuanian [ˈkʲɪtʌs] (top panel) vs. [kʲɪˈtʌs] (bottom panel) (female data).

[14] The figures and tables in the prosody section are based on audio recordings of this Illustration, analyzed with the computer program *Praat* (see Boersma & Weenink 2018; for information on the recordings and speaker, see the beginning of the article). More quantitative data based on the previous research on the prosody of the Standard Lithuanian language are given in the text, discussing the prosodic features of stress and pitch accents.

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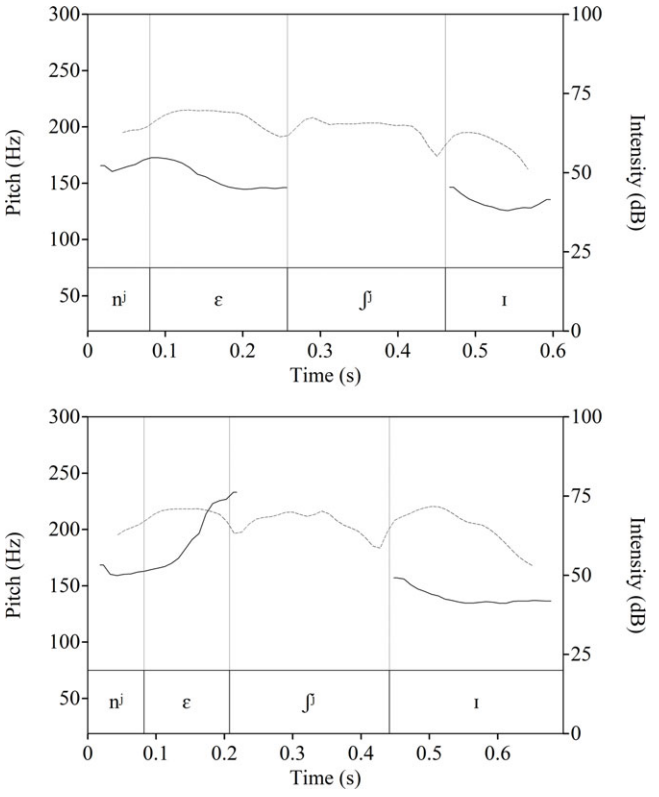

Figure 9 Pitch (solid line) and intensity (dashed line) traces of stressed and unstressed short vowels in Lithuanian [ˈnʲɛʃʲɪ] (top panel) vs. [nʲɛˈʃʲɪ] (bottom panel) (female data).

Table 6 Prosodic features of stressed and unstressed Lithuanian short vowels (female data). The investigated vowel is given in angle brackets < >.

Vowel	Absolute duration (ms)	Proportional duration in word	Pitch (Hz)	Intensity (dB)	Formants F1 (Hz)	F2 (Hz)	F3 (Hz)
[ɪ] - [ˈkʲ<ɪ>tʌs]	99	0.597	217	73	412	2130	2729
[ɪ] - [kʲ<ɪ>ˈtʌs]	44	0.069	227	72	423	1943	2574
[ʌ] - [kʲɪˈt<ʌ>s]	165	0.259	141	71	745	1488	2467
[ʌ] - [ˈkʲɪt<ʌ>s]	108	0.181	137	68	594	1492	2480
[ɛ] - [gʲɪˈrʲ<ɛ>]	213	0.397	135	66	664	1885	2535
[ɛ] - [ˈgʲɪrʲ<ɛ>]	157	0.296	137	68	600	1856	2451

Note: Proportional duration is calculated by dividing the vowel duration of the subject by the total word duration. The values of pitch, intensity and formants of the vowels were calculated by averaging all the values of the middle part of the sound (three tokens).

The prosody of Standard Lithuanian was systematically studied by experimental methods at the end of the 20th century (Pakerys 1982).[15] Based on the data from this study, it can be

[15] The study was conducted with the recordings of 14 speakers (radio announcers, actors, students of Lithuanian from a dialect close to Standard language, aged 25–50, five females and nine males), the

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stated that the short stressed vowels are about 1.16 times longer, slightly higher in pitch and by 1.8 dB more intense than the corresponding unstressed vowels in analogical positions. The nuclei of the long syllables are even longer, higher and more intense in a stressed position (Pakerys 1982: 111–133, 193–196).

Pitch accent (toneme)

In Standard Lithuanian, stressed long syllables consisting of the same phonemes are pronounced differently; they are distinguished by a prosodic element of a syllable. The pitch accent, often referred to as TONEME, is defined as a certain modulation of the long stressed syllable, particularly its pitch, intensity and quantity (and in some cases quality as well), performing a distinctive function (Pakerys 1982: 147; 2003: 219, 222; LG 2006: 55; Girdenis 2014: 287–291, 298; Stundžia 2014a: 24–27; Rinkevičius 2015: 18–19, 21–23; Bakšienė 2016: 44–45).

Since one of the most significant elements in the realization of Lithuanian pitch accents is pitch modulation, in some literature this prosodic element is simply called TONE and Lithuanian is attributed to the group of TONAL languages (see e.g. Martinet 1970: 364, 378; Fromkin, Rodman & Hyams 2007: 243; Radford et al. 2009: 43–44; Girdenis 2014: 291; Rinkevičius 2015: 17–18; Švageris 2015: 10; Kardelis 2017: 6–8). However, it should be emphasized that Lithuanian pitch accents are differentiated by a whole complex of prosodic features (see further); neither the pitch parameters nor changes in the features of a syllable pitch perform any independent distinctive function as they do in real tonal languages. Therefore, in the Lithuanian phonological tradition, which follows the tradition of the Prague Phonological School, Lithuanian is not typically considered a tonal language; instead, it is identified as a PITCH ACCENT language. In Lithuanian, like in Latvian, Norwegian, Swedish, Slovenian, and Serbo-Croatian, pitch features are associated with accentuation – only the pitch accents, or tonemes, of stressed long syllables essentially contrast (Girdenis 2014: 307; Bakšienė 2016: 41–44; see also Jakobson 1962: 122).

Two phonological pitch accents exist in Standard Lithuanian and all its dialects, namely THE ACUTE ACCENT (labelled here with a superscript [1]) and THE CIRCUMFLEX ACCENT (labelled with superscript [2]), which contrast in stressed long syllables, those containing long vowels, diphthongs and VR-type diphthongoid sequences, e.g. *kóšė* [ˈˈkoːʃʲeː] ‘(s/he, it, they) strained’ : *kõšė* [ˀˈkoːʃʲeː] ‘porridge’, *káltas* [ˈˈkɐ·ltʌs] ‘chisel’ : *kal̃tas* [ˀˈkʌl·tʌs] ‘guilty’, *kùrpė* [ˈˈkʊrʲpʲeː] ‘sabot’ : *kuřpė* [ˀˈkʊrʲ·pʲeː] ‘(s/he, it, they) mended smth. poorly’.

The problem of marking Lithuanian pitch accents with IPA symbols should be discussed separately. In Lithuanian, it is common to show the accentuation of a vowel with the acute accent symbol (ˊ) and the circumflex accent (˜), e.g. *výras* ‘man’, *kãla* ‘(s/he, it, they) hammer(s)’, *sáulė* ‘the sun’, *vaĩkas* ‘child’, *gérti* ‘drink’, *kařtas* ‘time’, etc. (Stundžia 2014b: 9). However, the first diacritic represents high tone in the IPA system, and the second diacritic indicates a nasalized sound (see IPA 2015). The rise of the pitch contour in the IPA system is marked with the diacritic [ˇ], and its fall is signalled by [ˆ]. The same symbols could be suggested for marking the Lithuanian accents having written the diacritic of the main stress before the stressed syllable, e.g. *výras* [ˈʊi̯ˆːrʌs], *kãla* [ˈkɐ̆ːlʌ], *sáulė* [ˈsɐ̂·ʊlʲeː], *vaĩkas* [ˈʊʌ̆·kʌs], *gérti* [ˈgʲɐ̂·rʲtʲɪ], *kařtas* [ˈkʌ̆ř·tʌs]. However, pitch features are not the only ones in which Lithuanian accents differ. Moreover, the acute accent is not always used to note the falling pitch contour, and the circumflex accent is not always used to note the rising pitch contour; contours of both accents can be very different (for more about this see Pakerys 1982: 163–173). In languages such as Norwegian with prosodic units similar

data for each position is calculated from approximately 30 tokens. The perception of pitch accents was also investigated by the method of feature substitution (experimentally changing the duration, f0 and intensity of the segments) (Pakerys 1982: 31–42).

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to those of Lithuanian, tonemes are marked by numbers placed before a stressed syllable and what those numbers symbolize is explained separately (Kristoffersen 2007: 11). Asta Kazlauskienė (2018: 8, 19) also suggests marking the accents of the Lithuanian language in the same way as in Norwegian. It has been decided to apply an analogous system in this Illustration: the raised number [1] signals the acute accent before a stressed syllable, the raised number [2] marks the circumflex accent (see their prosodic features below), e.g. *výras* [ˈˡˈʊʲiːrʌs], *kãla* [ˈ²ˈkɐːlʌ], *sáulė* [ˈˡˈsɐˑʊlʲeː], *vaĩkas* [ˈ²ˈʊʌɪˑkʌs], *gérti* [ˈˡˈgʲæˑrʲtʲɪ], *kařtas* [ˈ²ˈkʌrˑtʌs].

In Lithuanian, an accent opposition does not exist in unstressed syllables or in stressed syllables containing a short vowel in an open syllable or a short vowel with obstruent coda (Balode & Holvoet 2001: 50–51; LG 2006: 57–58; Petit 2010: 53–55, 60–63; Stundžia 2014b: 12). Such a pattern of pitch accent distribution is typical of many world languages that have lexical tone oppositions (Gordon 2002: 9–22). At the beginning of the 21st century, Lithuanian linguistics is of the opinion that in the Standard language, a systematic contrast of pitch accents exists only in the syllables containing a diphthong or sonorant coda, while in the monophthongal syllables the contrast of pitch accents is not systemic, the opposition of the pitch accents is often levelled. The signs of levelling of pitch accents are most pronounced in the speech of speakers of major cities, including Vilnius (for a review of the discussion, see Bakšienė 2016: 46–50).

The functional features of accents are very important in Lithuanian. At the morphological level, the accent is defined as a stable characteristic of a morpheme (Girdenis 2014: 298; see also Hjelmslev 1936–37: 8; Kuryłowicz 1987: 71; van der Hulst 2010: 451). Each morpheme that can receive a stress and which contains a long rime, i.e. contains a long vowel or a diphthong or a coda sonorant, is acute or circumflex by nature. Accentual features of morphemes, including accents, as well as their combinations, determined the formation of the complicated Lithuanian accentuation system (Petit 2010: 64–70; Stundžia 2014b: 12–16; Rinkevičius 2015: 79–83; see also Saussure 2012a [1922]: 47–72, 2012b [1922]: 73–87).

The prosodic features of the pitch accent are concentrated in the sonorant portion of the syllable rime, i.e. the vowel, diphthong or VR-type diphthongoid sequence, if present. Experimental research has established that Lithuanian accents are differentiated by a whole complex of prosodic features – the features of pitch, intensity, duration and quality, and the significance of their combinations depends to a great extent on the structure of the stressed long syllable. Hence, Lithuanian pitch accents have several allotones.

Accents of syllables whose nucleus consists of long non-gliding (uniform) and gliding (non-uniform) vowels differ in terms of f0 characteristics and duration, and characteristics of intensity and vowel quality are less significant (see Figures 10 and 11, and Table 7), e.g. *lópo* [ˈˡˈloːpoː] '(s/he, it, they) patch(es)' : *lõpo* [ˈ²ˈloːpoː] 'patch' (GEN.SG), *skýrei* [ˈˡˈsʲkʲiːrʲɛɪ] '(you) devoted' (SG) : *skỹriai* [ˈ²ˈsʲkʲiːrʲɛɪ] 'chapters; sections', *palíesiu* [pʌˈˡˈlʲiɛsʲʊ̯] '(I) shall spill' : *paliẽsiu* [pʌˈ²ˈlʲiɛsʲʊ̯] '(I) shall touch'.

According to earlier research, the vowels in circumflex syllables of Standard Lithuanian are longer than the acute ones by a ratio of approximately 1.12 : 1. The average f0 level of the circumflex syllables is slightly higher than that of the acute ones; the difference in peak f0 is not significant. The intensity indices are even less reliable in differentiating the pitch accents; circumflex vowels are usually several tenths of a decibel more intense than acute ones (Pakerys 1982: 157, 175, 178).

In syllables containing diphthongs and VR-type diphthongoid sequences with the first elements [ɐˑ/ʌ æˑ/ɛ], accents are most clearly differentiated by the quantitative (when accentuated, they are prolonged to half-long ones) and qualitative features of the elements (the first components of acute diphthongs are much more compact); however, the f0 is also a significant feature (see Figures 12 and 13, and Table 7), e.g. *šáuk* [ˈˡˈʃɐˑʊk] '(you) shoot' (IMPERATIVE, SG) : *šaũk* [ˈ²ˈʃɒʊˑk] '(you) shout' (IMPERATIVE, SG), *láido* [ˈˡˈlɐˑɪdoː] '(s/he, it, they) is/are hurling; flinging' : *laĩdo* [ˈ²ˈlʌɪˑdoː] 'wire' (GEN.SG), *kártas* [ˈˡˈkɐˑrtʌs] 'hung' : *kařtas*

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[ˀˈkʌrˑtʌs] ‘time’, *vérsiu* [ˈˈʊʲæˑrʲsʲʊ̟] ‘(I) shall put through; string’ : *veřsiu* [ˀˈʊʲɛrʲˑsʲʊ̟] ‘(I) shall throw down; turn over; make; translate’.

According to previous studies, the first components [ɐˑ/ʌ æˑ/ɛ] of the acute diphthongs are on average 1.52 times longer than the corresponding circumflex diphthongs and 1.35 times longer than the corresponding short stressed vowels, but significantly shorter than the corresponding acute long vowels; therefore, they are to be considered half-long ones. The second components of the circumflex diphthongs are on average 1.39 times longer than the corresponding components of acute diphthongs, so they lengthen slightly less due to the effect of the pich accent. Qualitative features of the components are also important. It was established that the components [ɐˑ/ʌ æˑ/ɛ] of acute diphthongs are more compact and more peripheral in the vowel space than the circumflex; the spectral structure of the corresponding sonorants is also unequal. The parameters of the f0 and intensity are to be considered only as ancillary features in the differentiation of pitch acents (Pakerys 1982: 160, 181).

In those syllables where the nucleus consists of VR-type diphthongoid sequences with the components [ɪ ʊ], accents are differentiated by means of pitch features. Their first components, even if emphasized, do not become half-long but remain short (see Figures 14 and 15, and Table 7), e.g. *kùrtas* [ˈˈkʊrtʌs] ‘created’ : *kuřtas* [ˀˈkʊrˑtʌs] ‘deaf’, *vìrto* [ˈˈʊʲɪrtoː] ‘boiled’ (PAST PART.GEN.SG.M) : *vířto* [ˀˈʊʲɪrˑtoː] ‘(s/he, it, they) turned into’ (for more about it see Pakerys 1982: 156–182; 2003: 220–221; LG 2006: 56; Bakšienė 2016: 46–50).

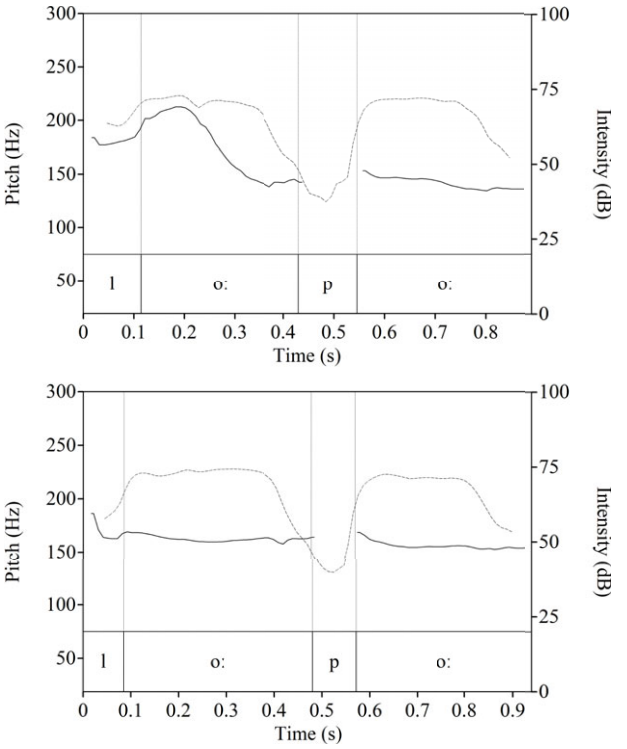

Figure 10 Pitch (solid line) and intensity (dashed line) traces of acute and circumflex long monophthongs in Lithuanian [ˈˈloːpoː] (top panel) vs. [ˀˈloːpoː] (bottom panel) (female data).

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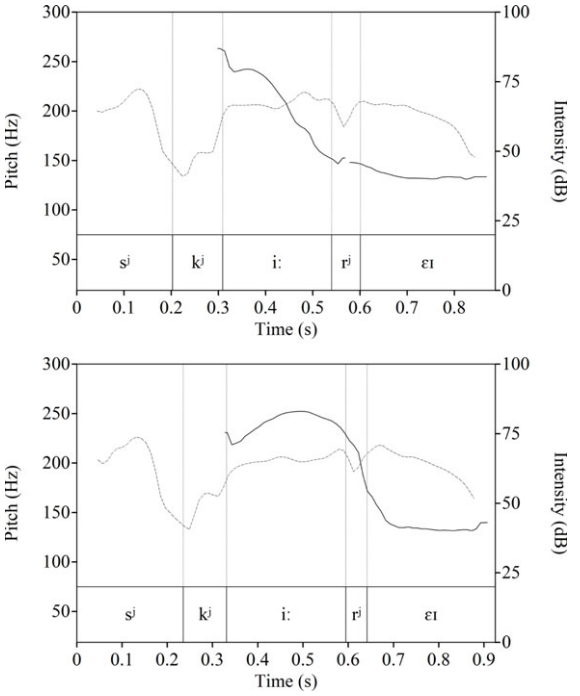

Figure 11 Pitch (solid line) and intensity (dashed line) traces of acute and circumflex long monophthongs in Lithuanian [ˈsʲkʲiːrʲɛɪ] (top panel) vs. [ˀˈsʲkʲiːrʲɛɪ] (bottom panel) (female data).

Table 7 Prosodic features of Lithuanian acute and circumflex vowels, diphthongs and VR-type diphthongoid sequences (female data).

Vowel	Absolute duration (ms)	Proportional duration in word	Pitch (Hz)	Intensity (dB)	Formants F1 (Hz)	Formants F2 (Hz)	Formants F3 (Hz)
[oː] - [ˈlo:po:]	258	0.292	194	74	524	864	3103
[oː] - [ˀˈlo:po:]	343	0.372	155	73	502	792	3154
[iː] - [ˈsʲkʲiːrʲɛɪ]	253	0.295	181	66	363	2503	3437
[iː] - [ˀˈsʲkʲiːrʲɛɪ]	271	0.307	230	64	353	2742	3577
[ɐˑ] - [ˈʃɐˑʊk]	180	0.298	195	74	820	1223	2357
[ɒ] - [ˀˈʃɒʊˑk]	113	0.155	172	76	743	1182	2687
[ʊ] - [ˈʃɐˑʊk]	112	0.185	143	66	606	961	2385
[ʊˑ] - [ˀˈʃɒʊˑk]	198	0.272	163	73	538	892	2933
[æˑ] - [ˈʊʲæˑrʲsʲu̯]	196	0.282	186	69	744	1976	2610
[ɛ] - [ˀˈʊʲɛrʲˑsʲu̯]	157	0.232	172	70	553	1983	2649
[rʲ] - [ˈʊʲæˑrʲsʲu̯]	74	0.106	151	61	559	1821	2715
[rʲˑ] - [ˀˈʊʲɛrʲˑsʲu̯]	84	0.125	174	62	485	1859	2769
[ʊ] - [ˈkʊrtʌs]	126	0.170	204	73	450	902	2336
[ʊ] - [ˀˈkʊrˑtʌs]	123	0.165	213	72	444	984	2312
[r] - [ˈkʊrtʌs]	91	0.123	172	62	494	1377	2128
[rˑ] - [ˀˈkʊrˑtʌs]	136	0.182	227	63	476	1346	2140
[ɪ] - [ˈʊʲɪrto:]	184	0.232	183	70	463	1899	2447
[ɪ] - [ˀˈʊʲɪrˑto:]	156	0.207	185	70	473	1773	2399
[r] - [ˈʊɪrto:]	117	0.148	155	56	535	1492	2364
[rˑ] - [ˀˈʊɪrˑto:]	150	0.199	189	58	498	1478	2324

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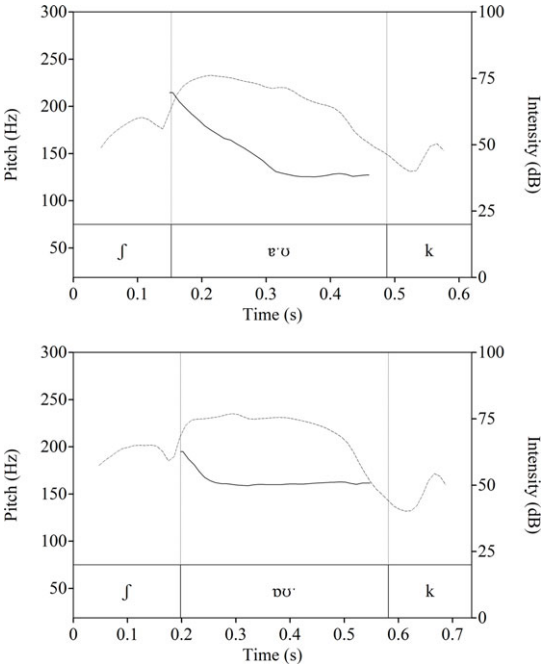

Figure 12 Pitch (solid line) and intensity (dashed line) traces of acute and circumflex diphthongs with [ɐˑ/ɒ] in Lithuanian [ˈ¹ʃɐˑʊk] (top panel) vs. [ˈ²ʃɒʊˑk] (bottom panel) (female data).

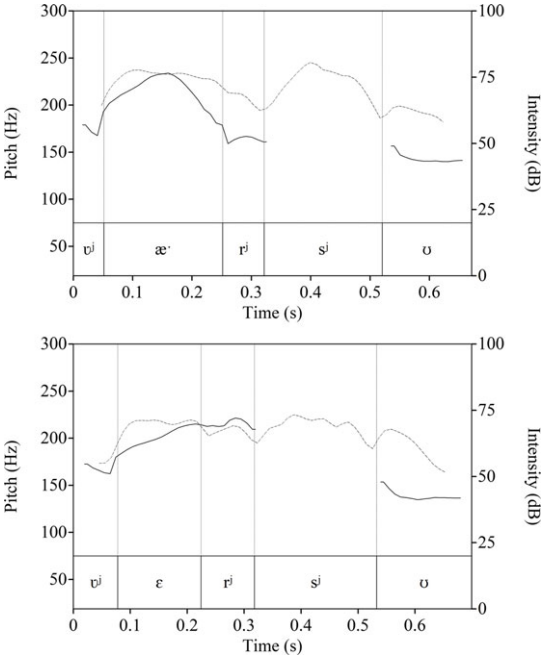

Figure 13 Pitch (solid line) and intensity (dashed line) traces of acute and circumflex VR-type diphthongoid sequences with [æˑ/ɛ] in Lithuanian [ˈ¹ʊʲæˑrʲsʲu̯] (top panel) vs. [ˈ²ʊʲɛrʲˑsʲu̯] (bottom panel) (female data).

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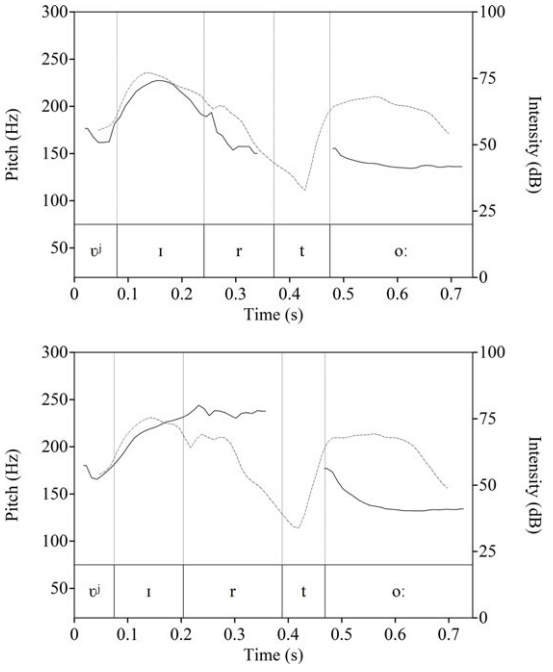

Figure 14 Pitch (solid line) and intensity (dashed line) traces of acute and circumflex VR-type diphthongoid sequences with [ɪ] in Lithuanian [ˈʊʲɪrtoː] (top panel) vs. [ˈʊʲɪrˑtoː] (bottom panel) (female data).

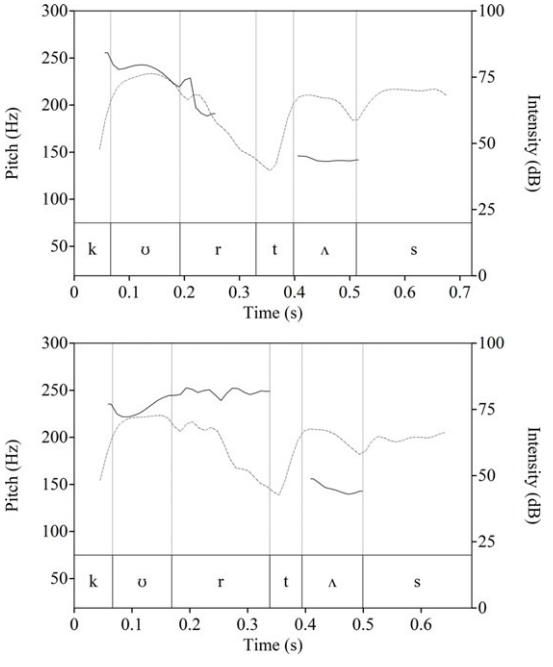

Figure 15 Pitch (solid line) and intensity (dashed line) traces of acute and circumflex VR-type diphthongoid sequences with [ʊ] in Lithuanian [ˈkʊrtʌs] (top panel) vs. [ˈkʊrˑtʌs] (bottom panel) (female data).

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According to previous studies, the components [ɪ ʊ] for acute diphthongs are only 1.06 times longer than the corresponding short vowels. The ratio of the respective acute and circumflex components [ɪ ʊ] is 1.16 : 1; therefore, the lengthening of the acute components [ɪ ʊ] is insignificant. The lengthening of the circumflex diphthongs' second components in this group is similar to those discussed previously – they are approximately 1.3 times longer than the corresponding acute diphthongs' second components. The pitch and intensity parameters of the acute diphthongs are usually lower than those of the corresponding circumflexes (Pakerys 1982: 160, 175, 178).

Transcription of the recorded passage

ˈˌvʲiɛnɐ: ˈˈdʲiɛnɐ: | ˈˌʃæ·ʊrʲeːs ˈˌvʲeːjǫɪ | ɪr‿ˈˌsɐ·ʊlʲɛɪ | bʲɛsʲɪˈˈgʲɪnʲ·ʧʲɪjɛnt | kʊˈrʲɪs ɪʃ‿ˈˈjuː sʲtʲɪˈpʲrʲɛsʲnʲɪs | pʌsʲɪˈˌroːdʲeː kʲɛˈˌlʲæ·ʊtoːjɛs | ˈˈvʲɪlʲ·kʲɪnʲtʲɪs ʌpʲsʲɛʊˈstʊ ‖ ʃɛʊˈˈrʲiːs ɪr‿ˈˌsɐ·ʊlʲeː sʊˈsʲɪtʌrʲeː | kʌt‿sʲtʲɪpʲrʲɛˈsʲnʲǫ | ˈbʊs ˈˈlʌɪ·koːmʌs ˈtʌs | kʊˈrʲɪs pʲrʲɪˈˈvʲɛr·s kʲɛˈˌlʲæ·ʊtoːjæː | nʊsʲɪˈmʲɛsʲtʲɪ ʌpʲˈˈsɛʊ·stɐː ‖ ʃɛʊˈˈrʲiːs ˈˈpuːteː ˈˈtʌɪ·p sʲtʲɪˈˈpʲrʲɛɪ· | kʌɪp‿ˈtʲɪk ˈpʌjeːgʲeː ‖ bʲɛt‿ˈˈkuɔ sʲtʲɪˈˈpʲrʲɛʊ· jɪˈˈsʌɪ· ˈˈpuːteː | ˈˈtuɔ tʲvʲɪrʲˈˈʧʲɛʊ· kʲɛˈˌlʲæ·ʊtoːjɛs | ˈˈgɒʊ·bdʌʊoːsʲɪ ʌpʲˈˈsɛʊ·stɐː ‖ gʌˈˌlʲæ·ʊsʲɛɪ ʃɛʊˈˈrʲiːs | pʌˈsʲɪdʌvʲeː ‖ tʌˈdʌ ˈˌsɐ·ʊlʲeː prʌˈˌdʲeːjǫː ˈˈkʌɪ·tʲɪnʲtʲɪ | ɪr‿kʲɛˈˌlʲæ·ʊtoːjɛs tuɔj‿ˈpʌt | nʊsʲɪˈˈvʲɪlˈkoː ʌpʲˈˈsɛʊ·stɐː ‖ ˈtʌt ʃɛʊˈˈrʲiːs | tʊˈˌrʲeːjǫː pʲrʲɪpʌˈˌʒʲɪnʲtʲɪ | kʌt‿ˈˌsɐ·ʊlʲeː | sʲtʲɪˈpʲrʲɛsʲnʲeː ʊʒ‿ˈˈjiː ‖

Orthographic version

Vieną dieną, Šiaurės vėjui ir Saulei besiginčijant, kuris iš jų stipresnis, pasirodė keliautojas, vilkintis apsiaustu. Šiaurys ir Saulė susitarė, kad stipresniu bus laikomas tas, kuris privers keliautoją nusimesti apsiaustą. Šiaurys pūtė taip stipriai, kaip tik pajėgė. Bet kuo stipriau jisai pūtė, tuo tvirčiau keliautojas gaubdavosi apsiaustą. Galiausiai Šiaurys pasidavė. Tada Saulė pradėjo kaitinti, ir keliautojas tuoj pat nusivilko apsiaustą. Tad Šiaurys turėjo pripažinti, kad Saulė stipresnė už jį.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S0025100323000105.

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