# The Role of Plosive Codas: Recognition and Perception by Lithuanian Learners of English


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**Abstract** This chapter investigates the role of voicing in English plosives in the coda position. Two tests were used to investigate this role from different perspectives: recognition and perception. Though vowel sounds are typically described according to three main factors (the front-back and high-low dimensions, and the lip aperture type), many languages, including English, distinguish a variable of duration. A direct correlation between vowel length and its phonological context has been reported in linguistic literature. The participants were 78 Lithuanian learners of English pursuing undergraduate degrees at a university in Lithuania. The recognition test aimed at addressing the phenomenon known as voicing effect in one-syllable CVC words with a plosive coda. English plosives, though perceived as voiced, are devoiced in final position. This might cause problems for Lithuanian learners of English since the correlation mark of the Lithuanian plosives is voicing. Using a variationist approach, the perception test aimed at checking the role of the English variety (British English or American English), the force of articulation, and the preceding phonological context on the perception of post-vocalic plosives. The findings indicate the Lithuanian learners' low awareness of vowel length dependence on its context, and different roles played by the studied variables.

**Keywords** Lithuanian learners · Voicing effect · Plosive codas · English varieties

## 1 Introduction

A large body of literature has investigated learner language from various perspectives and under different terms (Ellis, 1982). In the 1970s, in addition to distinguishing the target language (TL) from source languages, Nemser (1971) identified "the deviant linguistic system actually employed by the learner attempting to utilize the target language," which he named "an approximative system" (p. 115). Selinker (1972)

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coined a nowadays well-established term ‘interlanguage’ (IL) and defined it as “a separate linguistic system... which results from a learner’s attempted production of a TL norm” (p. 214). In Corder’s (1981) classification, IL falls under one of the classes of ‘idiosyncratic dialects’ or, due to its unstable nature, it could also be referred to as a ‘transitional dialect.’ The view that IL is systematic but to a certain degree defective has prevailed in the linguistic literature. Bialystok and Sharwood Smith (1985) define it as “the systematic language performance... by second-language learners who have not achieved sufficient levels of analysis of linguistic knowledge or control of processing to be identified completely with native speakers” (p. 116). The scope of IL is sometimes narrowed to encompass adult learners’ linguistic system only (Tarone, 2018). Irrespective of the scope, the development of IL is believed to happen through the lects: from basilect to acrolect; the higher in language proficiency the learner is, the nearer the learner’s IL is to the TL and the better the learner’s interpersonal understanding is (Davies, 1989; Wang & Wu, 2001). The key point is that, despite individual variables, learner language is systematic (to a varying degree, though) and allows some pattern detection.

Learners’ ultimate language learning goal does not always coincide with the one formally set for university language-related courses. Their goal is believed to be “that variety of the target language which enjoys the greatest prestige and which, therefore, represents the most worthwhile investment” (Valdman, 1989, p. 276). In pronunciation classes, students often display overt preference for one of the two main English varieties: British English (BrE) and American English (AmE). Interestingly, the learners’ expressed preference is sometimes found not to be in accordance with the variety they use (Bikelienė, 2015; Smakman, 2017). Also, acquiring the TL phonology is not a straightforward process as L1 transfer is more likely to happen for learners with lower phonological abilities (see Ellis, 2015). However, the focus of this chapter is not on correlations between learners’ phonological abilities and L1 transfer but rather on examining two distinct aspects of IL: the role of phonological context and English variety (BrE or AmE). Based on prior research (Rindal & Piercy, 2013; Smakman, 2017), European learners typically use a blend of BrE and AmE, with different varieties in the dominant position. The analysis of the role BrE and AmE play in Lithuanian learners’ perception of plosive codas is expected to add one more piece to the Lithuanian English puzzle.

Given some of the similarities between plosive codas in English and Lithuanian, we can hypothesise that Lithuanian learners are likely to be able to recognise vowel duration as a voicing cue. Yet, learners with different mother tongue backgrounds are known to struggle with voicing distinction, which might require reformulating the original hypothesis. Results can be expected to provide some insights into Lithuanian English and help to target Lithuanian English-tailored pronunciation teaching. The chapter starts with background information regarding theoretical constructs for the study of IL and characteristics of the phonological features under study, and then reports and discusses the findings and pedagogical implications of this investigation.

## 2 Literature Review

Even though this chapter does not overtly address the question of transfer, this section briefly describes prior research on L1 transfer and markedness theory and then compares the phonological features of plosive consonants and the vowels preceding them in English and Lithuanian in order to provide the necessary background for the analysis of the effects of voicing on the preceding phonological context of post-vocalic plosives in Lithuanian accented English.

### *2.1 L1 Transfer and Markedness Theory*

In IL studies, it is impossible to disregard the influence of the native language phonological system (see Ellis, 2015; Wang & Wu, 2001). Attempts at analysing IL concentrate around two pivotal concepts: L1 transfer and markedness theory. L1 transfer—that is, the incorporation of learners' L1 structures into the TL system—is believed to play a crucial role in the acquisition of learners' TL at all stages and all aspects of IL development (see Ellis, 2015). Findings from investigations of markedness theory, however, are not univocal. While White (1987) proposed the idea that "learners do not necessarily make a distinction between marked and unmarked structures" (p. 278), Ellis (2015) argues that marked features cause difficulties for language learners. For example, as Eckman (1977) shows, German learners of English face problems with English marked usage of voiced codas in a word-final position, whereas unmarked (or less marked) voiceless word-final consonants do not pose difficulties for English learners of German.

Correlations between a vowel's duration and its context have been reported in a number of previous studies. The findings indicate two opposing points of view. On the one hand, due to its widespread nature, vowel duration is seen as universal and unmarked (Embarki, 2016; Yoneyama & Kitahara, 2014) or 'automatic' (Ko, 2007). To support the idea of universality, Embarki (2016) reports a positive correlation of vowel duration and post-vocalic consonant voicing in male speakers' production from four Arab countries. He makes an observation of a two-fold effect: vowel lengthening before a lenis consonant and shortening before a fortis consonant. The correlation is not limited to adult speakers. Yoneyama and Kitahara (2014) conclude the existence of the universal basis of the correlation based on the analysis of Japanese infant and adult speech corpora as well as Japanese L2 learners' data. Ko's (2007) study pinpoints the age of two as the age by which children (speakers of American English) master the control of vowel length and voicing correlation. On the other hand, a number of linguists report exceptions and suggest the phenomenon of vowel length and post-vocalic consonant voicing to be of language-specific rather than universal nature (Gandour et al., 1980; Mitleb, 1984). For example, Mitleb (1984), contrary to Embarki (2016), does not observe the correlation in Arab speakers' data. Similarly,

Gandour et al.'s (1980) comparison of 'normal' and laryngectomised males' production yielded no significant differences and was seen as a proof of a phenomenon being governed by English.

## 2.2 *Plosive Consonants in English and Lithuanian*

Both Lithuanian and English are equipped with plosive consonants and distinguish between voiced and voiceless sounds. Lithuanian learners of English, therefore, do not expect to have any problems in perceiving or producing English plosive stops. However, contrary to learners' expectations, the similarity of these sounds in the two languages (i.e., their L1 and TL) could have a negative effect on the correct acquisition of the TL (Ellis, 2015). It is believed that when learners do not find any equivalent of a TL sound in their L1 repertoire, they are more likely to learn its set of features than when the TL and L1 sounds share some (but not all) of their features (see Flege, 1987). In other words, the similarity of sounds in both languages can lead to creating a false sense of security and to transferring L1 features to the TL. For example, Lithuanian learners of English, even at the university level, often fail to aspirate English plosives in a word-initial position due to the wrong assumption that plosive sounds have all the same properties in both languages.

Indeed, with respect to voicing considerations, plosives in English and Lithuanian have some important similarities as well as differences. Just like in English, Lithuanian plosive consonants form a voicing correlation—/p/:/b/, /t/:/d/, and /k/:/g/—(Girdenis, 2014) and differ in one distinctive feature (voicing) (Pakerys, 1995). Lithuanian stops in a word-final position are usually unvoiced as a result of the *Law of Neutralization* of a phonemic contrast, e.g., visa/d/a—visa/t/ (Engl. always) (Pakerys, 1995). The law is, however, often violated due to its zero realisation in orthography and a scarcity of such words. In English, word-final lenis plosives, /b, d, g/, are voiceless, and word-final fortis plosives, /p, t, k/, "may have no audible release" (Cruttenden, 2014, p. 164)—that is, the fortis plosives lose their aspiration in final position. Lithuanian /p/, /t/, and /k/, on the contrary, can be aspirated solely in a word-final position (Aprijaskytė-Valdšteinienė, 1960; Pakerys, 1995). An aspirated Lithuanian plosive in final position, however, can easily alternate with an unaspirated allophone without any changes in meaning (Girdenis, 2014).

According to the place of articulation, /p/ and /b/ are bilabial in both languages. The articulation of /t/ and /d/, however, differs. While in English this pair of plosives is produced with the tip of the tongue touching the alveolar ridge, in the Lithuanian language the tongue should touch not only the alveolar ridge but the teeth as well. Therefore, the consonants /t/ and /d/ are classed as alveolar in English, and dental (Kazlauskienė, 2018; Urbanavičienė, 2019; Urbanavičienė et al., 2019), apical dental (Girdenis, 2014) or dental/alveolar (Kushnir, 2016) in Lithuanian. /k, g/ in English are labelled as velar. In Lithuanian, /k, g/ are categorised as non-apical (Girdenis, 2014), velar (Kazlauskienė, 2018; Urbanavičienė et al., 2019) or guttural (Bacevičiūtė, 2009) plosives. A slight difference in articulation, though not sufficient to cause recognition

problems, should be noticed. In the production of the Lithuanian velar plosives, the tongue should be pressed to the back of the hard palate—that is, they are pronounced between the back of the tongue and the soft palate and not with the tongue pressed to the soft palate like in English.

### *2.3 Vowel Duration in Preceding Post-Vocalic Consonants*

Both English and Lithuanian speakers differentiate vowels according to the length dimension and perceive them as longer in stressed syllables (Lunden, 2017; Pakerys, 1995). In English, the length difference, however, is believed to be not stress-related but rather depend on "vowel-intrinsic durational characteristics" (Ciszewski, 2012, p. 223). The analysis of one-syllable words highlights one more factor affecting vowel length: the voicing of a post-vocalic consonant. The existence of such a correlation has been attested in native English (see Cho, 2016, for AmE, BrE, and New Zealand English; Holt et al., 2016, for African American; Tanner et al., 2019, for BrE and North AmE; Tauberer & Evanini, 2009, for BrE dialects) and English IL (see Bikelienė & Vaitkevičiūtė, 2018, for Lithuanian English; Chung, 2019, Park et al., 2019, for Korean English; Reinisch & Penney, 2019, for German English; Skarnitzl & Šturm, 2016, for Czech English), as well as in a number of other languages such as in Brazilian Portuguese (Alves & Brisolara, 2020), Georgian (Beguš, 2017), German (Zihlmann, 2020), Hindi (Sanker, 2019), Lithuanian (Campos-Astorkiza, 2012), Nepali (Schwarz, 2018), Arabic (Fathi & Qassim, 2020), Italian and Polish (Coretta, 2019).

There is no unanimous agreement on the treatment of the voicing effect in the linguistic literature. Is it articulatory motivated or speaker controllable (cf. Ciszewski, 2012)? In what way are the preceding vowels affected by a post-vocalic consonant? This uncertainty is well attested in the existent terminology. 'Pre-fortis clipping' (Wells, 1990) or 'shortening' (Cruttenden, 2014) suggest a shortening rule. 'Vowel-length effect' (Ko, 2007), 'post-vocalic consonant voicing effect' (Tauberer & Evanini, 2009), 'consonantal voicing effect' (Beller-Marino, 2014), and 'voicing effect' (Yoneyama & Kitahara, 2014), on the other hand, are not overtly specific and may include studies reporting a lengthening rule (Gandour et al., 1980; Scheer, 2017; Tauberer & Evanini, 2009). Since this chapter is of a descriptive nature, one of the non-directional terms, the 'voicing effect' will be used.

## 3 The Study

The main goal of this study was to gain some insights into the understanding of one aspect of Lithuanian English by checking whether Lithuanian learners of English are aware of the correlation between the voicing of plosive codas and the length of the preceding vowel. Specifically, the following research questions guided this research:

- Do Lithuanian learners of English acknowledge the existence of a different vowel length concept based on the voicing of plosive codas?
- Do the preceding vowel quality, the place of coda articulation, and the English language variety (BrE and AmE) play a role in the perception of plosive codas?

## 4 Methods

### *4.1 Participants*

The participants were 78 first-year students ($F = 72$; $M = 6$; aged 18–19), majoring in English and another language (French/Norwegian/Russian/Spanish), from the Faculty of Philology at Vilnius University in Lithuania. All the students were native speakers of Lithuanian with a B1-B2 level of English (according to the State level Matura English Examination) (Nacionalinis egzaminų centras, n.d.). The participants were starting their introductory course of English phonetics and had no theoretical knowledge related to the voicing effect.

### *4.2 Data Collection and Analysis*

Two tests were designed for this study: a recognition test and a perception test. For ecological validity, the data was obtained in an everyday classroom environment using standard classroom procedures. The students were informed that the tests would not be graded and the results would be used for research purposes to eliminate any possible influence of a stress factor.

During the English phonetics course, students mainly focused on the standard or a neutral type of accent for British English with minor attention paid to General American English. There is no consistency in terminology regarding the former. It can appear under the terms of non-regional pronunciation (NRP) (Collins & Mees, 2013), General British (GB) (Cruttenden, 2014), Standard Southern British (SSB) (Lindsey, 2019) or Standard Southern British English Pronunciation (SSBE) (Knight, 2012). For the tests, *Cambridge English Pronouncing Dictionary 18th edition* and *Cambridge Dictionary Online* were used; thus, the chapter follows their tradition and refers to the two main standard varieties as British English (BrE) and American English (AmE).

Test 1: Recognition of vowels. The students were provided with 28 minimal pairs of CVC words with a plosive consonant in the coda position (see minimal pairs in Appendix). All the minimal pairs were provided in an orthographic form arranged randomly. The minimal pair *hark—Hag* was supplemented with a transcription for the element *Hag* due to its irregular pronunciation. The task asked for a decision whether the vowels of each minimal pair in the BrE variety were of the same length

or different. In the case of the latter, the students were requested to indicate the word with a longer vowel.

Test 2: Perception of plosive codas. The students' perception of the voicing plosive in the coda position was tested with an auditory test. The recordings of one-syllable CVC minimal pair words (where possible) in BrE and AmE were played in random order. It is important to note that the minimal pairs were formed based on BrE. For each phonological context (/? ɪ _ /, /? e _ /, /? ʌ _ /, /? ɒ _ /, /? ɑ: _ /, /? ɔ: _ /, /? ɜ: _ /, /? æ _ /, /? i: _ /, /and /? u: _ /), there were six words in two varieties per line, that is, 12 sounds to be inserted in the table. Since there were no minimal pairs for the /? ʊ _ / context, the students listened to the recordings of three individual words in the two varieties under consideration.

For analysis purposes, BrE target vowels are referred to by the lexical set keywords proposed by Wells (1982): /ɪ/ = KIT, /e/ = DRESS, /æ/ = TRAP, /ʌ/ = STRUT, /ʊ/ = FOOT, /ɑ:/ = BATH (together with START), /ɒ/ = CLOTH, /ɜ:/ = NURSE, /i:/ = FLEECE, /ɔ:/ = THOUGHT (together with FORCE), and /u:/ = GOOSE. The research methodology was based on a variationist approach Level II (two linguistic factors) and Level I (linguistic and social factors) (Hazen, 2017). The relationship between the force of articulation of the coda plosive, the features of the preconsonantal vowel, the variety of English, and the voicing effect are presented with the help of descriptive statistics. Test 2 results were evaluated with the Wilcoxon non-parametric test at the 0.05 significance level.

## 5 Results

### *5.1 Test 1: Recognition of Vowels*

The results of the recognition test indicate participants' general tendency (73%) to perceive vowels in any given minimal pair as having the same length regardless of the following consonant. Even though Lithuanian vowels can be short and long depending on the following consonant (Campos-Astorkiza, 2012) and the same letter can be rendered as a short (e.g., *mes* Engl. *will throw*) and long vowel (e.g., *mes* Engl. *we*), the large majority of the learners did not seem to believe that a vowel phoneme in English could be of two different lengths. The results, however, are promising since, when the learners recognised a durational difference, they indicated a longer sound preceding a lenis than a fortis plosive nearly five times more often (552 and 111 cases, respectively).

The comparison of plosive pairs (Table 1) indicates that in the case of the bilabial plosive codas (/p/ and /b/), no vowel length difference was observed in 80 percent of the cases ($M = 62.64$, $SD = 14.31$), with a range from 50 to 100 percent. It was followed by velar (/k/ and /g/) and alveolar (/t/ and /d/) plosive codas, with mean percentage 70 ($M = 54.67$, $SD = 13.85$) and 67 ($M = 52.18$, $SD = 11.44$), respectively.

**Table 1** Vowel length recognition in word pairs with plosive codas (percentage)

| | Same Length | | | Longer before Fortis | | | Longer before Lenis | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bilabial | Alveolar | Velar | Bilabial | Alveolar | Velar | Bilabial | Alveolar | Velar |
| /ʔ ɪ _ / | 92 | 90 | 92 | 0 | 1 | 0 | 8 | 9 | 8 |
| /ʔ e _ / | 89 | 62 | 81 | 9 | 5 | 3 | 3 | 33 | 17 |
| /ʔ ʌ _ / | 87 | 82 | 94 | 1 | 3 | 1 | 12 | 15 | 5 |
| /ʔ ɒ _ / | 67 | 47 | 58 | 3 | 5 | 3 | 31 | 47 | 40 |
| /ʔ ɑː _ / | 64 | 60 | 46 | 4 | 1 | 9 | 32 | 39 | 45 |
| /ʔ ɔː _ / | 100 | 59 | 58 | 0 | 17 | 9 | 0 | 24 | 33 |
| /ʔ ɜː _ / | 100 | 73 | 77 | 0 | 1 | 0 | 0 | 26 | 23 |
| /ʔ æ _ / | 56 | 46 | 50 | 4 | 5 | 15 | 40 | 49 | 35 |
| /ʔ iː _ / | 78 | 77 | 76 | 4 | 0 | 6 | 18 | 23 | 18 |
| /ʔ ʊ _ / | 100 | 82 | NA | 0 | 0 | NA | 0 | 18 | NA |
| /ʔ uː _ / | 50 | 58 | NA | 33 | 0 | NA | 17 | 42 | NA |
| Total | 80 | 67 | 70 | 5 | 4 | 5 | 15 | 30 | 25 |

Both alveolar and velar plosive codas proved to be more context-related. For the former, two instances were observed, where the percentage for the same length was below 50. The LOT vowel was reported as being of the same length with the same frequency as being longer before a lenis member of the pair (47 percent of cases). The TRAP vowel was marked as being of the same length in both minimal pair words in approximately the same number as in LOT words (46 percent of cases). In the minimal pair words ending in /k/ or /g/, only BATH vowel was marked as being of the same length in less than half of the cases (46 percent). Such results indicate the need for students to be exposed to finer features of the BrE sounds.

### 5.1.1 The Influence of Plosive Codas on Vowels According to the Front/Back Dimension

As Fig. 1 shows, the highest mean percentage for correct length recognition (28%) ($M = 26.09$, $SD = 8.12$) can be observed when a plosive coda follows one of the back vowels (e.g., as in /ʔ uː _ /, /ʔ ʊ _ /, /ʔ ɔː _ /, /ʔ ɒ _ /, and /ʔ ɑː _ /). In such a phonological context, the learners failed to notice any difference in length in 65 percent of their choices. The lowest mean percentage for correct length recognition was when a plosive is preceded by a central vowel /ɜː/ or /ʌ/ (14 percent of answers choosing lenis, $M = 10.5$, $SD = 7.79$, while 86 percent indicating no difference). The results for front vowels (FLEECE, KIT, DRESS, and TRAP) show 22 percent of correct answers ($M = 16.83$, $SD = 11.36$).

The analysis of plosive pairs according to the place of articulation highlights a general tendency for bilabial plosive codas (/b/ and /p/) to trigger the lowest number

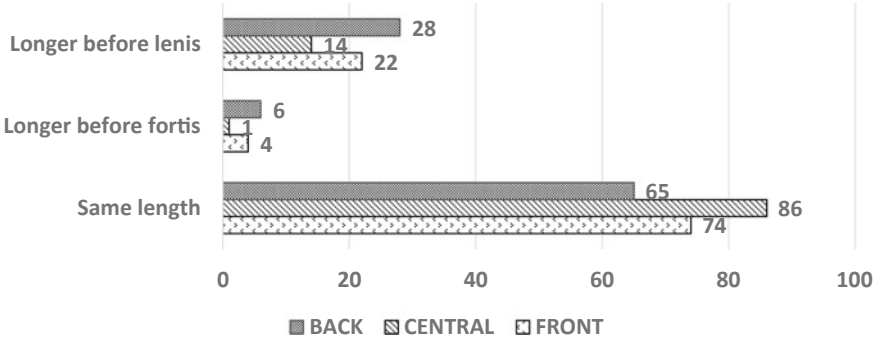


**Fig. 1** Vowel length recognition according to front/back dimension in word pairs with plosive codas (percentage)

of correct answers preceded by all the vowel groups, front (17 percent), central (6 percent), and back (16 percent). Interestingly, the back vowels are relatively the easiest to recognise when followed by both velar and alveolar plosives (39 and 34 percent, respectively). For the central vowels, the durational accuracy rate was three and a half times higher when they were followed by the alveolar and more than twice higher by the velar than by the bilabial consonant.

### 5.1.2 The Influence of Plosive Codas on Vowels According to the Close/Open Dimension

The highest mean percentage accuracy (33) was observed when a plosive coda followed a (mid)open vowel (/æ/, /ʌ/, /ɒ/, /ɑː/) ($M = 25.25$, $SD = 11.2$), followed by a (mid)close vowel (/iː/, /ɪ/, /uː/, /ʊ/) (16 percent) ($M = 13.89$, $SD = 8.33$) and a mid vowel (/e/, /ɜː/, /ɔː/) (14 percent) ($M = 13.78$, $SD = 10.62$) (Table 2).

As Table 2 also shows, the easiest phonological context for the learners appeared to be a (mid)open vowel followed by an alveolar plosive (38 percent of correct answers) as in *hat*. Nearly every third correct answer was when a (mid)open vowel was followed by a velar (as in *duck*) or a bilabial plosive (as in *cop*) (31 and 29 percent, respectively). The most controversial results can be witnessed in the

**Table 2** Vowel length recognition according to close/open dimension in word pairs with plosive codas (percentage)

| | Same length | | | Longer before fortis | | | Longer before lenis | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bilabial | Alveolar | Velar | Bilabial | Alveolar | Velar | Bilabial | Alveolar | Velar |
| (MID)CLOSE | 80 | 77 | 84 | 9 | 0.3 | 3 | 11 | 23 | 13 |
| MID | 96 | 65 | 72 | 3 | 7 | 4 | 1 | 28 | 24 |
| (MID)OPEN | 69 | 59 | 62 | 3 | 4 | 7 | 29 | 38 | 31 |

**Table 3** Vowel length recognition according to short/long dimension in word pairs with plosive codas (percentage)

| | Same length | | | Longer before fortis | | | Longer before lenis | | |
|---|---|---|---|---|---|---|---|---|---|
| | Bilabial | Alveolar | Velar | Bilabial | Alveolar | Velar | Bilabial | Alveolar | Velar |
| SHORT | 82 | 67 | 75 | 3 | 3 | 4 | 15 | 29 | 21 |
| LONG | 79 | 65 | 64 | 8 | 4 | 6 | 13 | 31 | 30 |

phonological context with a mid vowel. While the accuracy rate is relatively high for alveolar (28 percent) and velar plosives (24 percent), only one percent of correct answers was observed when such a vowel was followed by the bilabial plosive.

### 5.1.3 The Influence of Plosive Codas on the Preceding Vowel According to the Short/Long Dimension

The rate of correct answers is only insignificantly higher when a plosive is preceded by a short vowel ($M = 17.94$, $SD = 12.38$) than by a long vowel ($M = 22.08$, $SD = 7.59$) (22 and 25 percent, respectively). As with the other dimensions, the lowest accuracy rate was with bilabial plosive codas: 13 percent after a long and 15 percent after a short vowel (Table 3).

The recognition of correct vowel length for short and long vowels before an alveolar plosive differs only by two percent (29 and 31 percent, respectively). The Lithuanian learners showed the biggest differences in recognizing the longer sound when it was followed by a velar plosive: 21 percent following a short and 30 percent following a long vowel.

## *5.2 Test 2: Perception of Plosive Codas*

The results of Test 2 show the Lithuanian learners' ability to better discriminate the coda voicing in AmE than in BrE. In 89 and 84 percent of instances, respectively, the correct voicing was indicated even if the coda itself was marked incorrectly. The difference is statistically significant at $p < 0.05$ ($z = 2.1028$, $p = 0.03572$). The analysis of the students' perception of fortis and lenis codas separately, however, yielded different results. No statistically significant differences were observed in either the comparison of fortis and lenis codas separately in both BrE and AmE ($W = 16$, the critical value is 8, $p > 0.05$ for fortis codas; $W = 12.5$, the critical value is 10, $p > 0.05$ for lenis codas), or between fortis and lenis codas in each variety separately ($W = 26.5$, the critical value is 10, $p > 0.05$ for BrE; $W = 30$, the critical value is 10, $p > 0.05$ for AmE).

The comparison of the perception of correct coda voicing in different phonological contexts indicates two cases when learners found BrE more complicated than AmE.

When the coda was preceded by a FOOT vowel, as in /p ʊ _/, in BrE, the students tended to hear a fortis consonant /t/ instead of a lenis consonant /d/. This mistake was made in 82 percent of all the cases. Interestingly, in AmE, this happened in only 14 percent of all the cases. The other problematic phonological context in BrE was when a lenis consonant (/b/, /d/ or /g/) followed a KIT vowel, as in *rib*, *kid*, and *pig*. The error rate was 44 percent in BrE while in AmE it was only 8 percent. Neither of the analysed contexts posed problems when the coda was fortis as in *rip*, *hat*, *cop*. The error rate varied from 2 to 34 percent for BrE and from 3 to 20 percent for AmE.

Interestingly, the results for students' perception of correct coda indicate the same tendency irrespective of the English variety under consideration. The Lithuanian students more often tended to perceive correctly fortis than lenis plosive codas: 82 and 70 percent in BrE, and 83 and 75 in AmE. The differences, however, are not statistically significant: $W = 13$, the critical value is 10, $p > 0.05$ for BrE; $W = 17$, the critical value is 10, $p > 0.05$ for AmE.

According to the front-back dimension of the preceding vowel, no significant differences were observed in the students' perception of correct plosive codas. In both varieties, when the central vowel was followed by a plosive, as in /ʔ ɜː _ / or /ʔ ʌ _ /, the accuracy rate was nearly identical regardless of the coda voicing (78 and 82 percent for BrE, and 85 and 84 in AmE, respectively). In the case of back vowels, in both varieties, the difference in the accuracy rate was nearly identical (83 vs. 66 and 84 vs. 66 percent). In BrE, when the plosive coda was preceded by a front vowel, students perceived the correct coda with almost the same accuracy as in the case of a back vowel. In AmE, however, fortis and lenis consonants were perceived with the accuracy of 80 and 81 percent.

In sum, the phonological context, according to the high/low and short/long dimensions of the preceding vowel, proved to have no influence on the perception of the correct coda. The only exception was observed in the case of (mid)high vowels in BrE, where the accuracy rate for the perception of lenis codas was only 48 percent.

## 6 Discussion

The findings of the recognition test provide strong evidence indicating that Lithuanian learners of English face difficulties using vowel duration as a cue to the voicing of the following consonant. These findings contradict the results reported in Bikelienė and Vaitkevičūtė (2018) regarding the production of checked unrounded vowels in CVC words with fortis and lenis codas. According to Campos-Astorkiza (2012), Lithuanian speakers should be familiar with vowel duration as a cue to voicing a following consonant from their native language. Arguably, native language knowledge is used automatically and, thus, should be more likely to manifest itself in tasks that do not require conscious efforts to implement. The recognition test, however, revealed that the learners had problems transferring their L1 features to English. The findings of the recognition test are in line with other studies on voicing effect in learner English with different mother tongue backgrounds (e.g., Reinisch & Penney,

2019) that show the difficulty to use the vowel length cue. Though both English and Lithuanian devoice final consonants, the ratio between fortis and lenis plosive codas is in sharp contrast in the two languages. Due to the Lithuanian language morphemic structure, word final plosives are mainly restricted to fortis consonants potentially making Lithuanian learners to treat word final lenis plosives as *new* and *difficult* (Reinisch & Penney, 2019) and, according to the Markedness Differential Hypothesis (Eckman, 1977), likely also causing problems in distinguishing coda voicing in English.

The perception test suggested a slight tendency (even though statistically insignificant) for Lithuanian learners of English to accurately perceive fortis English plosives more often than their lenis counterparts. This finding is in line with Reinisch and Penney's (2019) argument indicating that fortis consonants were *easier* for learners. Interestingly, the same tendency was partially observed for the recognition test: When learners recognised vowel durational difference, nearly five times more often they correctly indicated a vowel to be longer before a lenis than a fortis plosive. The results suggest that Lithuanian learners are able, to a certain extent, to transfer L1 knowledge regarding the phenomenon of voicing effect (Campos-Astorkiza, 2012) to TL. The statistically insignificant difference between correctly and incorrectly perceived plosive codas for the perception test and overall low numbers of correct answers for the recognition test, on the other hand, point towards the need of explicit instruction, as understanding phonetic features is important for phonetic accuracy and may have an impact on intelligibility (Levis, 2018). To make a stronger claim on Lithuanian learners' understanding of vowel duration as a cue to coda voicing, the tests could be repeated on other student groups and at different times of their studies, that is pre- and post-introduction to the phenomenon in English.

Finally, the analysis of a phonological context indicates the results to be not homogeneous: bilabial plosive codas are more likely to be problematic for Lithuanian learners of English than alveolar or velar plosives. Also, the examination of the role of the English variety variable for vowel length-coda voicing correlation seems to support a blended-variety idea (cf. Rindal & Piercy, 2013; Smakman, 2017). The evidence suggests that while AmE seems an 'easier' variety to hear voicing, no significant differences between BrE and AmE were observed in perceiving the correct coda sounds.

## 7 Implications

This chapter attempted to describe some voicing effect-related features in Lithuanian learner English phonology. Vocalic duration is known to be not the only and sometimes even not the most crucial factor affecting voicing decisions (Nittrouer, 2004); thus, a more detailed study would benefit a better understanding of the phenomenon. It would be reasonable alongside recognition and perception to perform a thorough articulatory analysis of Lithuanian learners' production of fortis/lenis plosive codas

in different phonological environments. It could be hypothesised that raised awareness of vowel duration as a cue for voicing could be an important factor in enhancing listening accuracy.

To eliminate the familiarity effect, the tests could be replicated with non-existent words. This could contribute to the establishment of the place of Lithuanian English in the IL continuum across different learner populations. A better understanding of the differences between Lithuanian English and native English phonology could help the enhancement of teaching and the design of teaching materials oriented at learners with a particular mother tongue.

## 8 Conclusions

It has been previously reported that learners' ability to produce sounds follow their ability to recognise them (Ellis, 2015). Based on this claim, the chapter set out to investigate any potential differences in the recognition and perception of the voicing effect in Lithuanian English concentrating on the role played by the preceding vowel quality, the place of articulation of the final consonant, and the English language variety (BrE and AmE) in the perception of plosive codas. Though the voicing effect is sometimes referred to as universal, the results of the analysis are in accordance with a large body of IL studies, which indicate low awareness of the link between the coda voicing and vowel length irrespective of the force of articulation of the final consonant.

The results of the study signal that perception of the coda in the listening task precedes the recognition of the phenomenon of voicing effect on the preconsonantal vowel. The findings are not surprising since the perception test required the students' listening skills, which were relatively good, while the recognition test implied at least passive knowledge of the linguistic phenomenon of voicing effect, which requires explicit teaching in the general perception of voicing only. The comparison of the perception of fortis and lenis plosive codas was indicative of an insignificantly better perception of fortis consonants. The preceding phonological context had no important effect on the learners' perception.

## Appendix

### Minimal pairs

*rip – rib, cob – cop, beep – Beeb, dead – debt, cart – card, had – hat, moot – mood, duck – dug, baulk – Borg, league – leek, Depp – deb, carb – carp, loop – lube, mud – mutt, caught – cord, heed – heat, pig – pick, block – blog, berg – berk, pub – pup, cab – cap, kit – kid, nod – not, Birt – bird, pud – put, peg – peck, hark – Hag /hɑ:g/, hag – hack.*

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