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Prohlašuji, že jsem tuto bakalářskou diplomovou práci vypracovala samostatně pod vedením Mgr. Šárky Šimáčkové, Ph.D. a uvedla úplný seznam citované a použité literatury.

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ABSTRACT

The main aim of the thesis is to analyse sequences of two consecutive stop consonants in the Czech and English language in terms of the audibility of the first stop release. We focus on the speech of advanced Czech learners of English, however, we also examine productions of the native speakers of English and Czech. Based on existing literature and research we assume two facts. Firstly, the English native speakers will keep the first stop in the sequence of two stops unreleased. Secondly, the Czech native participants will release the first stop. However, the Czech language has not been studied well yet, thus, one of the objectives of this paper is to verify this phenomenon. We tried to find out whether the learners of English adopt L2 structures of the language in their utterances. To test our hypotheses we conducted an experiment. Meaningful stimuli were constructed to contain stop-stop sequences across the word and syllable boundary. Participants (English natives, Czech natives, advanced learners of the English) were recorded during the production of these stimuli and the recordings were analysed and discussed.

Key words: stop consonants, sequence of two stops, release, second language acquisition, syllable boundary, word boundary, place of articulation

ANOTACE

Hlavním cílem této práce bylo analyzovat pořadí dvou okluzív v českém a anglickém jazyce se zaměřením na slyšitelnost exploze první okluzívy. Zkoumanou skupinou jsou pokročilí studenti angličtiny, ale zkoumali jsme také rodilé mluvčí obou jazyků. Na základě literatury jsme dospěli k dvěma předpokladům. Zaprvé, rodilí mluvčí angličtiny nebudou realizovat explozi první okluzívy slyšitelně nebo vůbec. Zadruhé, čeští rodilí mluvčí budou realizovat explozi první okluzívy. Nicméně, tato oblast v českém jazyce nebyla ještě zkoumána, a proto jedním z cílů práce bylo tento předpoklad potvrdit. Snažili jsme se dojít k závěru, zda studenti angličtiny, jejichž prvním jazykem je čeština, si dokážou osvojit fonetické aspekty druhého jazyka. Abychom potvrdili naše hypotézy, byl proveden experiment. Sestrojili jsme smysluplné věty, které obsahovaly sekvenci svou okluzív přes hranici slabiky nebo přes hranici slova. Subjekty (rodilé mluvčí anglického jazyka, rodilé mluvčí českého jazyka, pokročilé studenti anglického jazyka) jsme při produkci stimulů nahráli a tyto nahrávky následně analyzovali.

Klíčová slova: okluzíva, pořadí dvou okluzív, exploze, osvojování si cizího jazyka, hranice slabiky, hranice slova, místo artikulace

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INTRODUCTION

One of the reasons non-native speakers struggle with accents is different phonetic structures of L1 which interfere with the acquisition of correct structures in L2. Also careful utterances of non-native speakers may contribute to increased suppression of such features since they treat every word as an individual unit. Cautious pronunciation of sequences of stop consonants belongs to this category because both stops involved would be audible and would have a loud release stage. However, while valid in some languages, it may not be applicable in others which overlap and connect these stops.

Stop consonants have three stages of production – an approach of articulators, a closure and a release. The general assumption about them is that the release stage will be present in all stops. However, the phonetic rules of the English language exact the suppression of this feature in sequences of stops (*September*, *fruitcake*) and so the first stop is unreleased.

The main aim of this work is to analyse stop sequences in the speech of advanced Czech learners of English in terms of the audibility of the first stop release. Their productions of stop sequences are compared to the productions of the native speakers of English. The assumption is that the English native speakers apply the mentioned phonetic rule, which states that the first stop is unreleased. Since this phenomenon has not been examined well yet in the Czech language, another objective is to study Czech speakers and their realizations. Thus, the outcome of this thesis is to verify and expand what is known about Czech speakers' realization of stop sequences and establishes the influence of L1 in the English pronunciation of Czech speakers.

In the first chapter, an introduction into this topic will be presented. The first part offers an overview of the characteristics and rules related to stop consonants and of the existing research and literature on this issue. Several studies of English stop sequences and overlaps have been carried out (e.g. Henderson and Repp 1982, Byrd and Tan 1996, Lisker 1999). Specifically, the sequence of two stops with the focus on the first stop release was the subject of the analysis of Henderson and Repp (1982), which serves as the basis for our study. The other papers on the English language, which are presented in the first chapter, had different goals, for example to study overlaps or articulatory gestures, and they are only used as a supportive literature. However, the problematic part is the Czech language. Only several Czech authors, who focused on Czech phonetics, mention this feature marginally and only few studies have looked into Czech stops and their sequences. But none of them specifically focused on consecutive stops or on the audibility of the release of the first stop. It is a reason for only research on similar issues and their findings to be introduced.

The second chapter introduces the methods and procedures. For this study we came up with suitable stimuli, which would fulfil our required conditions. As a result, we constructed meaningful sentences which consisted of word-internal and across word boundary sequences of stops, which are heterogrganic or homorganic, and are divided based on the labiality of the second stop. The whole preparation and explanation of choosing the given stimuli, as well as selecting the participants, the process of recording, and processing the data makes up the content of this chapter.

Lastly, we introduce the research findings and answer our research questions. The purpose of this study is to verify the hypothesis that the first stop in the sequence is being released by the Czech speakers of English due to the interference from the learners' first language. The hypothesis is based on the rule of Ladefoged (2001), which claims that a stop consonant preceding another stop will be unreleased and on the Czech phonetic literature, such as Hála (1948) or Palková (1994), which states that first stops are at least partially released.

1 STOP SEQUENCES IN ENGLISH AND CZECH

This chapter gives an overview of studies on stops (also called plosives) both in the Czech and English literatures.

1.1 Stop Consonants

Various languages have a different number of stop consonants because of various place of articulation. This study focuses on six voiced and voiceless oral stops which occur both in English and Czech /*p, t, k, b, d, g*/.

1.1.1 Stops in General

All stop consonants are produced by creating a closure in the vocal tract, which results in the building up of the pressure in the mouth, and then releasing this closure. This means a complete contact of active and passive articulators, which creates an obstruction resulting in the stopping of the airflow. Thus, from the articulatory point of view plosives are realized in three parts, which we call an approach, a closure and a release (Ladefoged 2001, 73). Other phoneticians offer slightly different descriptions, for example Machač and Skarnitzl mention only two stages – the closure/occlusion and the release/plosion stage (Machač and Skarnitzl 2009, 27). On the other hand, Roach describes four stages, where the first three correspond to Ladefoged's description and the additional one is called a post-release phase (Roach 2000, 32).

The first of these stages is the approach stage in which the articulatory organs form an obstruction as a foundation for the second stage (closure), where the obstruction created by the articulators stops the airstream and it cannot escape through a mouth. Once the articulators separate, the air that has accumulated behind the obstruction is released during the release stage (Gimson 2001, 150).

In English, three pairs of plosives can be distinguished according to the place of articulation. Bilabial stop consonants /*p, b*/ are produced with both lips pressed together to create the obstruction. Secondly, there are alveolar stops /*t, d*/ which are created when the tongue as the active articulator presses against the alveolar ridge. During the production of velar stops /*k, g*/, the back of the tongue creates the obstruction while pressing against the end of a hard palate and the beginning of a soft palate. Additionally, the Czech language also has a pair of palatal stops [c], [ɟ] (Šimek 2010, 16).

On the other hand, in fluent speech either the closure or the release part of a single stop unit may be missing. In his MA thesis, Šimek states that there is no release without the closure, but stops with the closure part do not necessarily have to have the release stage. Another tendency in Czech is no closure and no release stage at all, which tends to be more frequent in voiced stops. The cause of this feature can be traced to different vocal cords movements in voiced and voiceless stops due to maintaining of the voicing. Moreover, the stability of the closure and the release phase is influenced by the position of the stop, making it less stable in non-intervocalic position (Šimek 2010, 103-104, 112-113). As we have already stated in the case of the sequence of two stops there might be the closure and the release phase for both stops, or just one long closure stage without any realization of the explosion of the first stop. In addition, Šimek showed that there are three more types – 1) the first stop has the release but the second stop does not, or 2) the first stop has neither closure nor release stage, or 3) the whole sequence is without the closure and release phase (Šimek 2010, 113-114).

In English, Ladefoged (2001) states that in a sequence of two plosives the first one is not released, thus there is no release phase for the stop. "The gestures for consecutive stops overlap, so that stops are unexploded when they occur before another stop in words such as apt [æp˺t] and rubbed [rΛb˺d]" (Ladefoged 2001, 57). This also works when there is a homorganic stop across the word boundary (*ask Kim*), or at the end of a word before a pause (*It is a cat.*). A special case of unreleased first stop is a nasal release which occurs when the second stop is a nasal, such as in *sudden* (Ladefoged 2011, 60-61).

1.1.2 Stop-Stop Interactions

A sequence of consonant stops across a word or syllable boundary is not rare, but there are also less frequent sequences of two stop within a syllable, which appear in syllable coda clusters in English (*fact, act, apt, aptitude,*). The frequency of stop-stop sequences in English is increased by /*d*/ and /*t*/ at the end of the verbs in the past tense (e.g. *slept, kept, worked, cooked*). In Czech, stop-stop clusters usually occur at the syllable onset (*který, pták, dbát, tkát, dbělý, kdákat, tkanička*)

As stated above, in English the first stop in the sequence should be unreleased. In such cases, a waveform would only show one closure and one burst. Neither a spectrogram is useful in searching for two burst, although it shows more features at once. One of them, which is helpful in detecting various phonemes, is a formant structure. The formants have a different position and their movement is able to help us detect the change of consonants and vowels. For example, thanks to formants and their movement in the /*kt*/ sequence we are able to say that there is more than one phoneme. There is a movement towards the velar locus during the approach stage and afterwards they move to the alveolar position for /*t*/ (Olive, et al. 1993, 231-235).

However, even the formant structure does not have to be absolute. Not all speakers are thorough and their articulators do not move from the right place to the other place of articulation, such as in a situation when a speaker either does not make any velar closure, or "the tongue may be moving back while the lips are closing in anticipation of the /p/. Lip closing lowers F2, and since the lips are in the front of the vocal tract, their motion masks the effect of the backward tongue motion which would cause F2 to rise toward the velar pinch" (Olive, et al. 1993, 235). In careful speech, formant transitions of two successive stops do not generally carry much information about the preceding or the following stop (Repp 1983a, 420).

In addition to the formant movement and the release, voiced stops are specific in the fact that there may not be apparent discontinuity in the waveform during the burst which is actually apparent in a spectrogram. "This line is not prominent enough to be caused by a burst but is caused by a sudden shift in the spectrum" (Olive, et al. 1993, 237).

Moreover, the assimilation process concerns all consonants. In a stop-stop sequence it tends to have an effect on the voicing feature, specifically stops are inclined to have the same voicing feature. Either the first stop adopts the voicing from the second one or vice versa, such as /*kd*/ becomes /*kt*/ in *baked.* They also coalesce since they might have the same place of articulation. It can lead to lexicalized cases, for instance /*pb*/ becomes /*bb*/ and then /*b*/ in *cupboard* (Ripman 1947, 43).

1.2 Literature review

1.2.1 Stop-Stop Sequences in English

One well-known study of stop sequences in English by Henderson and Repp (1982) focused on the release of the first stop in nonhomorganic stop sequences. The authors argued that if the release is considered an articulatory term, articulators would have to separate after the first stop when each of the stops has a different place of articulation, thus the pressure, which was built up because of the obstacle, would be released. Otherwise, there would be inaccurate pronunciation caused by "incorrect or dual place of articulation" (1982: 72).

Specifically, Henderson and Repp were interested in the generalization which occurs in textbooks – in a sequence of two stops the first stop is commonly unreleased. Nevertheless, Repp's previous studies (1980) showed the presence of recognizable release bursts in such sequences, even though they were shorter and lower in their amplitude than the burst of the second stop (Repp 1983a, 420).

Henderson and Repp suggested that the variation between textbooks and Repp's results may be caused by a different approach to the release burst, specifically articulatory, auditory or acoustic. Firstly, if the release burst is interpreted as an articulatory term (loosening of articulators), they claim that the first stop cannot be unreleased if it has a different place of articulation than the second stop, as mentioned above. Secondly, from the acoustic perspective, the presence or absence of the release depends on the amplitude and duration of the release burst. Thirdly, when the perception was taken into account, it turned out that the release burst was mainly inaudible and thus the first stop may be referred to as unreleased. However, the resulting information is that releases need more detailed classification according to different criteria, which they broaden to five:

1) **Unreleased** – the obstruction is maintained (homorganic stops, or stops with a delayed release)
2) **Silently released** – from the acoustic point of view there is no explosion
3) **Inaudibly released** – the recording shows a release burst, but it is undetectable by ear
4) **Weakly released** – the explosion is detectable by ear
5) **Strongly released** – even stronger explosion than in 4 (with aspiration or voicing) (Henderson and Repp 1982, 80).

The conclusion was that "stops preceding a nonhomorganic stops in conversational speech are generally released inaudibly or silently, silent releases being particularly common when the following stop is labial" (80-81). On average 58% of the target sequences in Henderson and Repp contained a release burst of the first stop in the syllable boundary position and the first stop in the sequences across the word boundary was exploded in 81% cases on average, ranging from 63% to 100% for the subjects (75-76).

The role of the boundary type between the stops is of particular interest in this study of unreleased stops in the interlanguage of the Czech learners of English. In his paper on transferability and productivity of the rules of L1, Cebrian (2000) suggests that word integrity plays an important role in the utterances of non-native speakers. Non-native speakers treat every word as an individual unit and they are careful while speaking, which leads to the prevention of "the articulatory synchronization of sounds belonging to different words" (Cebrian 2000, 19). Thus, there are restrictions in the application of phonological rules in non-native speech, especially across word boundaries. Cebrian gives an example of a phrase *Swiss girl* which is pronounced as /swɪ**s** gɜːl/ instead of / swɪ**z** gɜːl/ by non-native speakers. Here, a non-native does not apply regressive voicing assimilation in the final obstruent and so it fails to comply with the rule of L1. However, across the syllable boundary, such as in (*blackboard*), there was an indication of regressive assimilation and Cebrian thus concluded that there is no constraint on synchronization in a single word unit (Cebrian 2000, 20).

Moreover, in case of English spoken natively, the place of articulation of the second stops has been shown to be important because in some cases bursts are not particularly common. Phonetic textbooks also mention homorganic sequences as being unreleased (e.g. Catford 1977, Ladefoged 1993). Gimson (2001) marginally mentions homorganic sequences, concluding that only one closing stage and one release stage is present but with double duration of the closure stage (Gimson 2001, 152). In Zsiga's study of articulatory overlap the /*kk*/ sequence was released only in 7% of cases, but /*kt*/ in 27% cases (Zsiga 2000). This is in line with Henderson and Repp's (1982) classification of the release in articulatory terms: when the articulators do not have to move to another place of articulation (alveolar or velar in this case), it is highly probable that articulators do not open the obstruction, resulting in an unreleased sequence.

The place of articulation is an important factor also in heterogeneous sequences of stops. Special attention is paid to the second stop. In Henderson and Repp (1982) releases were predominantly missing when the second stop was labial, but they were mostly present with the alveolar second stop, and they were the most common with the velar second stop. The authors elaborated that when the second stop is labial, the speaker can close lips before the release of the previous nonhomorganic stop and thus the explosion of the first stop occurs during the closure stage of the labial stop. Reversely, „if the first stop is labial, although an alveolar or velar closure may be established before the lips are parted, the labial release, when it occurs, will generally produce a burst because there is no occlusion anterior to the lips" (Henderson and Repp 1982: 76). Velar and alveolar sequences both involve the tongue as an articulator and so there is a movement from one place of articulation to the other, and thus there is generally a release. Their results showed that the closure part of the second stop (in either alveolar-velar or velar-alveolar succession) starts when the first stop is released, but overlaps may appear. In such cases, the velar-alveolar sequences are more likely to be unreleased because the alveolar stop closure would silence the velar explosion. The effect of the place of articulation of the second stop relative to the first one is confirmed by later studies. Zsiga's (2000) data demonstrate that the release of the first stop is most common when the first stop is /*p*/ (an average of 32% released cases in /*pt*/ and in 40% of /*pk*/ sequences). However, when /*p*/ is the second stop (f.e. /*dp*/ or /*kp*/) it ranges from 5% to 20% released cases. The generalization is that released bursts occur when the first stop is in further forward position towards the second stop in English (Zsiga 2000, 78).

According to Henderson and Repp the influence of the place of articulation of the first stop is minor (Henderson and Repp 1982, 77). Later Repp elaborated on this conclusion. In a study of coarticulation in sequences of two nonhomorganic stops, Repp scrutinized the first stop release burst, which was present in all stimuli (Repp 1983a). In a perception experiment, he let his participant listeners hear only the VC portion of synthetized VCCV sequences and asked them to identify the second stop. It was evident from the results that the place of articulation of the second stop was present in the given stimuli and thus conveyed by the first stop release burst (Repp 1983a, 422). "That the coarticulatory cues were in fact contained in the C1 release burst, and not in the VC formant transitions, is evident from a comparison of the present results with those [in Repp 1983b] of a condition in which the natural VC portions (without release burst) were separated from the synthetic CV portions by a fixed silent interval" (Repp 1983a, 423). Besides, the results showed that the place of articulation of the first stop influenced the perception of the second stop. The acoustic analysis revealed that the place of articulation has an influence on the duration of the first stop closure, which was the longest for /*b*/. The duration of the explosion of the first stop also depended on the place of articulation and it was the shortest for /*b*/ again. Moreover, the former also occurs with the second stop, which means that the place of articulation of the second stop has an influence on the duration of its closure (Repp 1983a, 424-425). To sum up, "[t]he perception of C2 was influenced not only by the coarticulatory cues in the C1 release burst but also by the place of articulation of C1" (1983a: 423).

The common feature which appears during a succession of two stops is an overlap. Zsiga (2000) compared the gestural overlap in English and Russian by looking at the sequences of stop consonants and at the palatalization of consonants, which showed greater overlap in English thanks to different phonetic constrains. If the closure overlap is present then the closure duration is shorter and the releases occur less often. And reversely if there is no or little of the overlap then the closure duration is longer and releases occur more often. In her experiment, Zsiga used two measures – the duration ratio and the percent released. The duration ratio indicated that for 20% of the closure duration of the first stop there is an overlap present in English while Russian showed almost no overlap at the closure stage (Zsiga 2000, 77).

Moreover, Byrd and Tan (1996) and Zsiga (1994) included in their studies speech rate because some degree of gestural overlap could be related to tempo. With faster tempo the degree of the overlap could be increased. However, Zsiga's study did not confirm a "direct relationship between increased speaking rate and increased gestural overlap" (1994, 58). Nevertheless, she claims that even though the increased rate may not be the cause of the increased overlap, "overlap may increase with rate" (Zsiga 1994, 61). As a result, there is also an influence on the duration of the consonant closure, which is shorter with increased overlap. Byrd and Tan specifically focused on the quick utterances of stop sequences and determined that the rate of speaking is in direct connection with the shorter duration of consonants as well as with the increased temporal coarticulation. For example, they showed that there is no significant overlap in the sequence /*dg*/, because it is also overlapped in the slow speech. However, their study additionally indicated that it is a subjective feature, and several subject were exceptional, such as with faster tempo there was less of overlapped stimuli. Moreover, they examined the increased rate of individual consonants. Generally, consonants were shorter with the increased rate but some participants showed variability so it suggests that it is again a subjective matter. For example, the stop /*d*/, which extremely overlaps even at the normal speech rate, was shortened but some speakers applied it only in coda position instead of in both onset and coda (Byrd and Tan 1996, 272-276). "For most speakers, this shortening takes place regardless of the place and manner of the individual consonant or its syllabic affiliation" (Byrd and Tan 1996, 276).

1.2.2 Stop-Stop Sequences in Czech

Sequences of two consecutive stops in the Czech language have not been thoroughly researched yet. One recent study by Šimek (2010) gives a detailed description of Czech stops and their characteristics, however, stop-stop sequences are mentioned only marginally.

The purpose of Šimek's analysis was to make a description of the characteristics of Czech stops, in all environments, especially the temporal characteristics of stops, and also their realization. He focused on the neighbouring vowels and consonants, articulation tempo, gender of the speaker, and stops position within the vocal tract. For these purposes, Šimek used six subjects which spoke in a relatively spontaneous way.

Because of less coarticulation and deformation of stops in intervocalic position, we can determine several characteristics which are relevant for this study. For instance, acoustic features in consonant stops tend to differ according to the place of articulation. Alveolar stops /*t, d*/ compared to velar and bilabial stops are shorter in duration, specifically this duration goes as follows from the shortest to the longest: alveolar – velar – bilabial (Šimek 2010, 59). In addition, Šimek proved that the ratio of the closure duration to the explosion duration is connected to the place of articulation. The explosion stage is the shortest with labials and it is increased with velar stops (125).

Moreover, the results indicated that voiceless stops are longer in duration than voiced ones, and the duration of stops in general is shorter compared to literature he reviewed (f.e. Borovičková and Maláč 1967, Chlumský 1911 and 1928, or Machač 2006).

The surrounding phonemes also proved to have an influence. As mentioned above, stops in intervocalic positions have generally the longest duration. When a stop stands next to another stop, it has a similar duration as the average stops within a two-consonant group. However, the duration is also influenced by the articulation tempo, meaning it decreases in duration as the tempo increase (125).

In connection to the immediate succession of two stops, Šimek indicated that there are five different types of sequences:

- Both stops are released and have a closure and an explosion;
- Closures of stops overlap and only the second plosive has an explosion;
- The first stop closure and explosion is realized, the second one has neither
- The first stop has no closure and no explosion;
- The whole segment has no closure and no explosion.

The data suggest that the first possibility, both stops realized with a closure and an explosion, is the most common (36% cases), followed by the second option, where the first stop has no closure (34% cases) (113-114).

As already mentioned, the duration of stops in a sequence is influenced by the overlapping feature, thus Šimek indicated that the second plosive already begins during the closure stage of the first stop and from the acoustic signal we cannot state where one ends and begins. In addition, Šimek established that voiceless stops in the sequence are shorter compared to their realization in the intervocalic environment and specifically, the most substantial difference in the duration is with /*p*/, on the other hand, /*d*/ variation is almost insignificant (2010, 69).

Even though the Russian language has a different articulation than English, we can expect similarity between Czech and Russian, which are both Slavic languages. Thus, Zsiga's research on the English and Russian gestural overlaps and palatalization was studied in order to have a similar language research involved because we do not have any Czech studies on this topic. The results show that Russian speakers always keep the first stop in homorganic sequences unreleased. However, heterorganic sequences are often released in Russian, for example /*dk*/ is released in 100% of cases (compared to 30% in English). In Russian the presence of a labial (either in the first or the second stop position) is influential – with labial stops the sequence is unreleased in more cases than with alveolar and velar combinations (Zsiga 2000, 78).

1.3 Research Questions

This thesis focuses on the advanced students of English (level C1 in CEFR) whose first language is Czech. It studies the productions of stop-stop sequences in their utterances and compares them with the productions by native speakers of English and also to the productions by native speakers of Czech. The main research question is as follows:

Q1: Do advanced learners of English overcome L1 influence and adopt L2 realization of stop sequences?

The main research question contains the assumption that the realization of the first stop as released is due to the interference from the learners' first language.

Based on the Šimek's study of Czech and Zsiga's findings for homorganic sequences in Russian, we ask the following complementary research questions about the Czech language:

Q2: a) What portion of first stops has no audible release in stop-stop sequences when Czech speakers read short familiar sentences?

b) Will homorganic sequences yield more unreleased stops?

c) Will the place of articulation of the second stop in nonhomorganic sequences have an influence on the probability of no audible release?

Based on Cebrian's concept of word integrity in non-native speech, we formulated an additional research question:

Q3: Will there be more releases across syllable boundary than across word boundary in the speech of the learners of English compared to native speakers?

2 METHODOLOGY

2.1 Participants

A total of 16 subjects split into three groups participated in the study. Group 1 included 6 advanced learners of English, all students of English from Palacký University who have achieved C1 level (CEFR). Group 2 included 6 native speakers of Czech with only basic knowledge of English. All were students at Palacký University, none of them majoring in philology. Group 3 was a control group of 4 native speakers of English, two British and two American English speakers. The purpose of the control group was to confirm the validity of the stimuli, i.e. that the elicited data are in line with the findings discussed in the literature overview. All subjects participated in the study voluntarily and without previous knowledge of the research purpose.

2.2 Stimuli

The crucial part of the study was to get an adequate number of stimuli which contained the sequence of stop consonants. The stimuli included 72 nonhomorganic stop-stop sequences for each language. The selection of the stimuli was determined by the combination of two factors – the position of the sequence with respect to the word or syllable boundary and with respect to the place of articulation of the second stop. According to the former factor, the stimuli split between stop-stop sequences across the word boundary (***eat c**ake*) and sequences spanning a syllable boundary within a word (*goo**db**ye*). Regarding the place of articulation, we considered labiality of the second stop so the stimuli split between labial (*goo**db**ye*) and non-labial (*frui**tc**ake*) stop sequences. Moreover, we added another 18 homorganic stimuli for each language, six for each place of articulation (*bla**ck c**olour, sho**t T**im, ro**b B**ill)*. In total, we have 90 sequences, consisting of five different categories with 18 sentences in each:

A. 18 sequences of the type [nonhomorganic][word internal][+labial]
B. 18 sequences of the type [nonhomorganic][word internal][-labial]
C. 18 sequences of the type [nonhomorganic][across word boundary][+labial]
D. 18 sequences of the type [nonhomorganic][across word boundary][-labial]
E. 18 sequences of the type [homorganic][across word boundary]

We constructed meaningful sentences containing the stop-stop sequences described above. Each sentence contained on average 8 syllables in Czech and 7 in English and the full list of the sentences is given in the Appendix A and Appendix B.

Later on during the analysis we realized that 6 of the English stimuli were unsuitable because they contained a stop-stop sequence following a sonorant. These stimuli were excluded from the analysis and replaced with parallel sequences contained in the remaining sentences. The number of stop-stop sequences in categories A-E was preserved in English. In the Czech set one stimulus was eliminated from the category D because it did not follow the given criteria and it could not be replaced.

2.3 Data Collection

Before recording, the participants were given time to familiarize themselves with the stimuli sentences. The purpose was to reduce stammering and to produce sentences in a conversational and natural tempo.

The recording took place in a soundproof studio to reduce other intrusive noises. The subjects were told to read the stimulus sentence one at a time at their natural speech rate from a PowerPoint presentation, which contained each stimulus twice in random order. We used Zoom H4n Handy Mobile 4-Track Recorder, and the result of each session was a WAV format recording. To analyse the data, we used the application Praat version 5.3.25.

2.4 Segmentation

There are two segmentations done in our study – firstly, the beginning and end of each sentence was determined and secondly the beginning and the end of the closure stage was marked. Based on the auditory inspection and on the visual inspection of a waveform and a spectrogram, all the acoustic data were manually segmented. The place of the boundaries was set into a zero crossing.

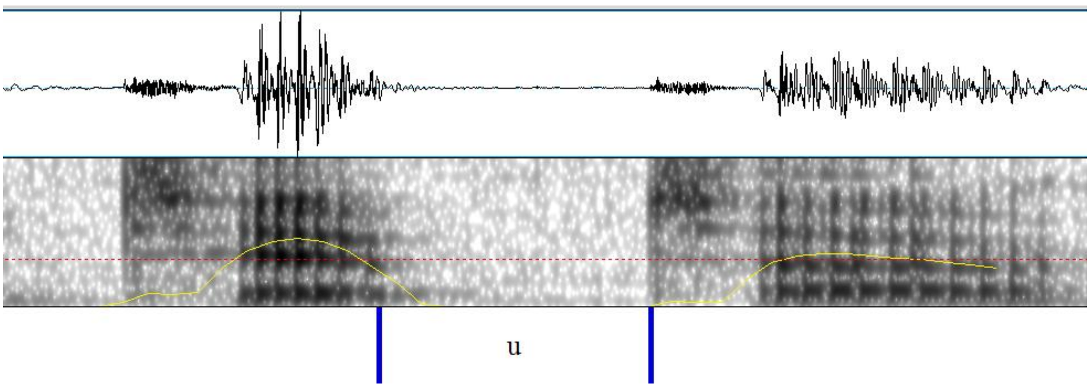
When the stimulus sentence has an initial or final stop, the beginning of the interval is placed in the moment of release, nevertheless the end of the interval is put in the end of the closure stage, thus in the moment of release, excluding the release burst. However, some of the participants had a tendency to weaken their articulation of the stop and to close the sentence with a fricative instead of a stop. Those fricatives are included inside the interval.

Concerning the second segmentation, the target sequence of the two consecutive stops was marked as one interval. The beginning of the interval was placed on the extremity of the approach phase, excluding the formant transitions. The end of the interval was marked on the extremity of the closure and the release phase of the sequence. The moment of release of the second stop is not included in this interval. In the case of a multiple release of the second stop, the first of those releases was determinative and the interval was again placed in the moment of its release.

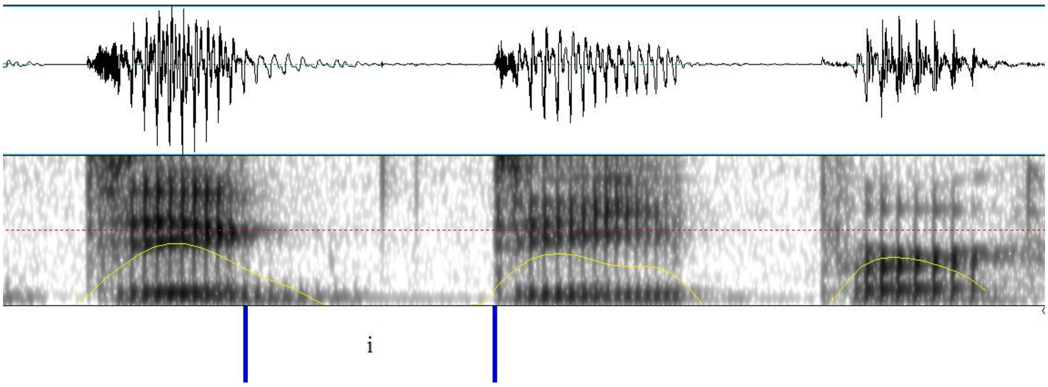
2.4.1 Types of releases

As already shown in the study of Henderson and Repp (1982), a simple *released* and *unreleased* distinction is not possible. Since we do not analyse the intensity and quality of the release, we used just four categories – *unreleased (u), inaudible (i), weak (w), released (r*). The categorization of releases is based on the perceptual assessment as well as on the visual inspection of the waveform and the spectrogram.

The *unreleased (u)* category has the closure maintained, without any visible or audible disruption, and the release occurs only with the second consonant stop (Picture 1). Thus, there is only one closure and one release for two speech sounds. The category *inaudible (i)* is shown in Picture 2. These are cases of no audible releases which are visible either in the waveform or in the spectrogram.

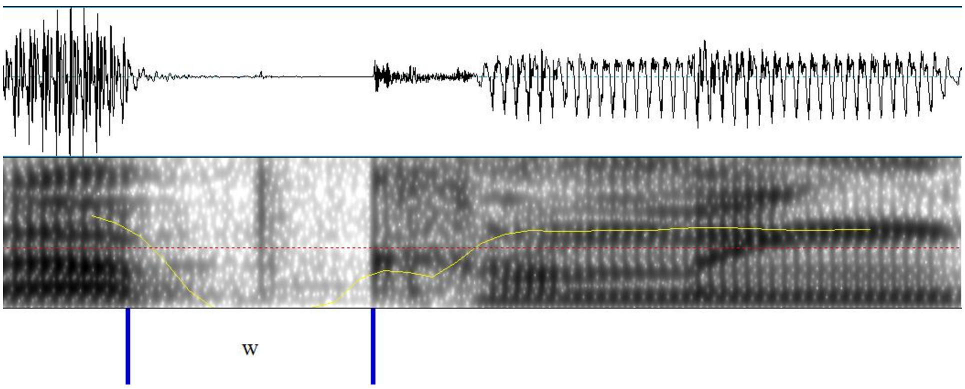


Picture 1: An example of *unreleased* category – the first stop in a word ***tiptoe*** is unreleased.

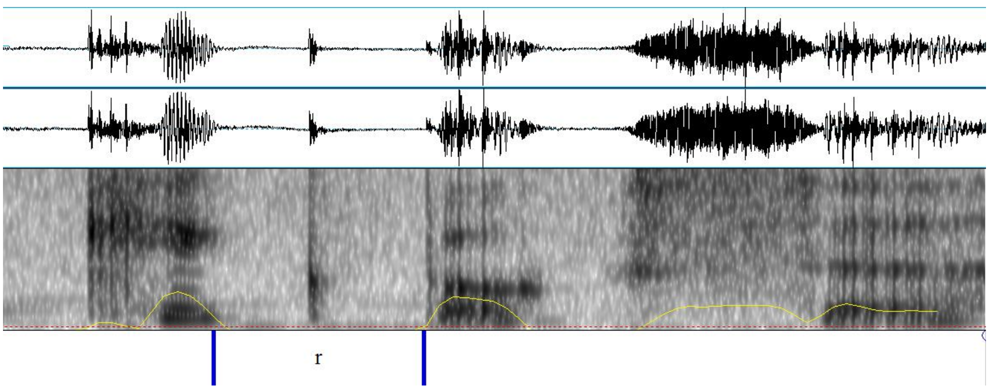


Picture 2: An example of *inaudible* category – the first stop in ***dig deeper***.

The difference between *released (r)* and *weak (w)* is in the intensity. Even though, the release burst is detectable by ear in both cases, it is clearly weaker in the category *weak* (Picture 3) than in *released* (Picture 4). It is supported by acoustic features.



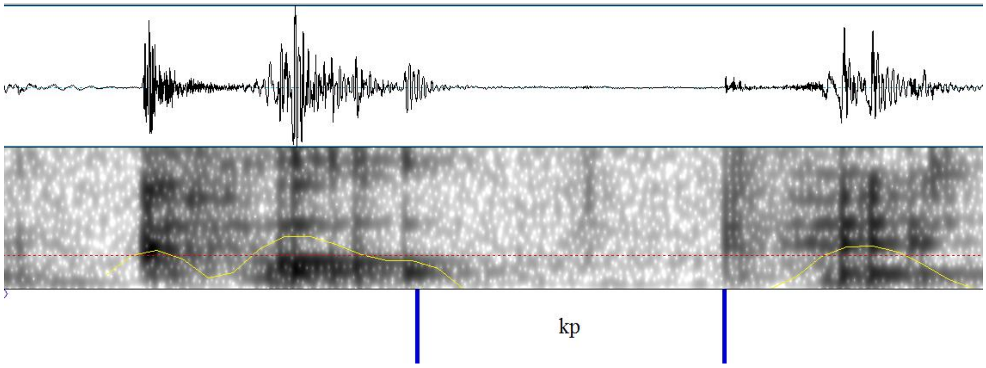
Picture 3: An example of *weak* category – the first stop in a word ***upcoming***.



Picture 4: An example of *release* category – the first stop in a word ***kickboxer***.

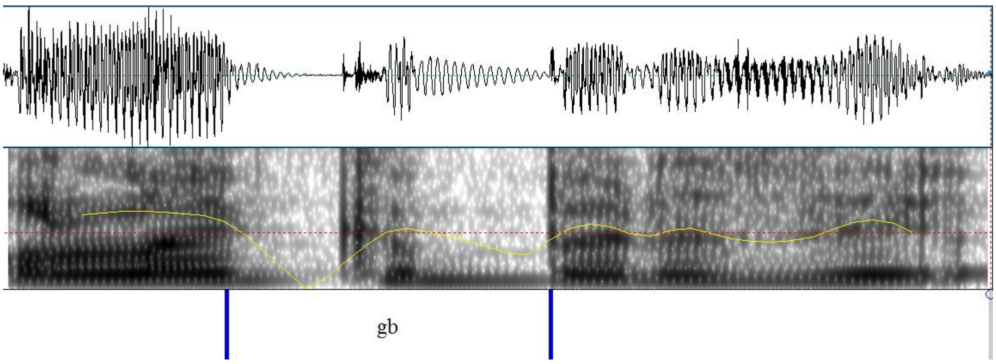
2.4.2 *Specific cases*

In the process of segmentation, several specific realizations had to be taken into account. One of these is preglottalization of stops which occurred in the speech of native speakers of both languages. Picture 5 shows a realization of a word *cockpit* by one of the English native speakers. After the vowel /*o*/ there is a glottal stop which was excluded from the closure part and thus from the interval.



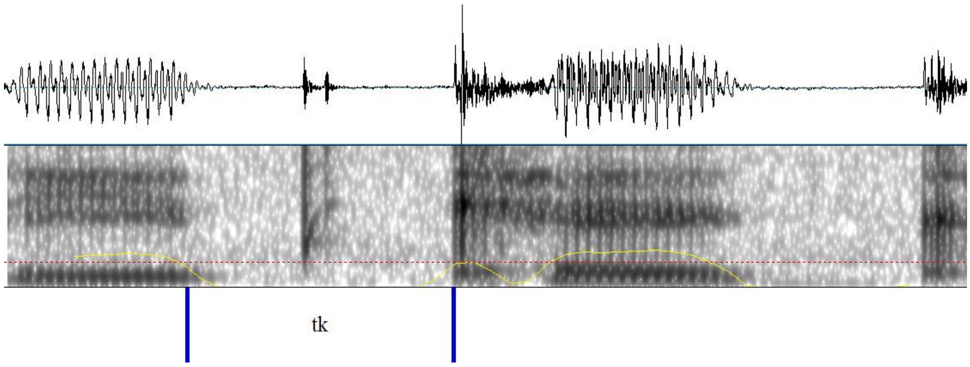
Picture 5: An example of glottalization in a word ***cockpit***.

In the Czech data a schwa sometimes appeared with the release of the first stop and sometimes it was long enough for another syllable to be perceived. It is “a short epenthetic schwa-like sound” (Machač and Skarnitzl 2009, 116) which emerges especially between two voiced plosives. Palková (1994) expands it and explains that it may happen also with voiceless stops, where transitional waves appear between plosives and thus the actual realization of *odpor* (resistance) is /otəpor/ (Palková 1994, 236). Since the schwa appears together with the release those cases were labelled as *released*.



Picture 6: An example of a schwa in ***Oleg brzy***.

Moreover, the common feature present is a multiple release. Often there is the release and a click sound but there are cases of two separate releases as shown in the Picture 7 as well. Nevertheless, this is not a crucial determinative attribute and those cases are marked as *released* (or *weak*) since they fulfil the requirement of being visible and audible.



Picture 7: An example of a multiple release in ***eat cake***.

3 RESULTS

3.1 General Data Overview

In this subchapter we focus on the general data, which provide an overview of releases in the stop-stop sequences we received irrespective of the Place or the Boundary variables. It means that these results are not based on the statistical analysis, but on the original data from the Pratt application. As mentioned above, during the annotation of stimuli we differentiated four categories of releases – *unreleased, inaudible, weak, released* – and the findings presented below are based on their average usage. To expand, we constructed a table of realizations of individual participants, which stated how many *unreleased/inaudible/weak/released* stimuli each participant produced. From that we can state an average individual or group realizations of the first stop release.

In the Figure 1 we can see that the most represented category in the utterances of the learners of English is actually the unreleased category (42%), followed by the released category (41%). The unreleased realizations of the stimuli dominate in the case of the English native speaking participants as well, but there is a clear difference in the percentage of the representation (over 70%), as visible in Figure 2. More than ¾ of the stimuli were unreleased by native English speakers. Moreover, when the English native speakers release the first stop, they prefer the released realization instead of the weak one (more in Appendix C). On the other hand, Czechs make the first stop released (58%) rather than unreleased and weak releases are more frequent than inaudible (Figure 3). Regarding audible releases, thus combining the released and the weak category together, Czech natives released the first stop in 66% of cases. However, those are the average data for the whole group while there are great differences in individual cases (Appendix D).

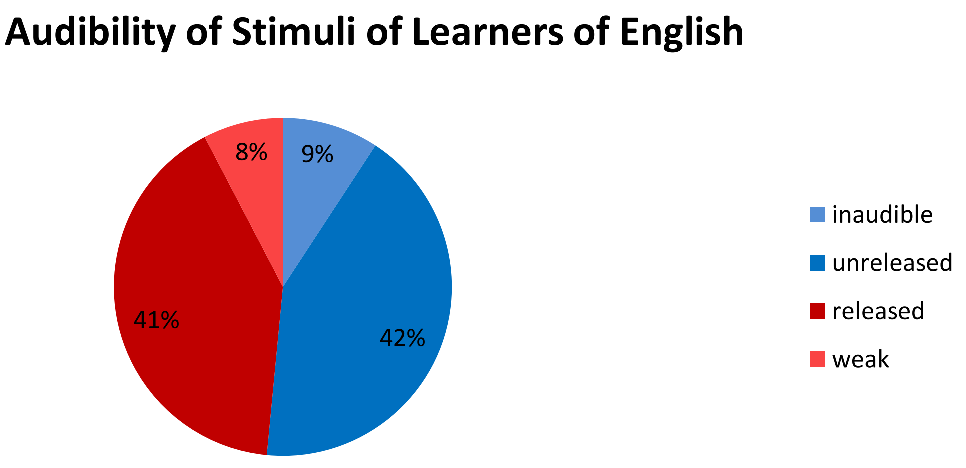


Figure 1: The average realization of the stimuli by the whole group.

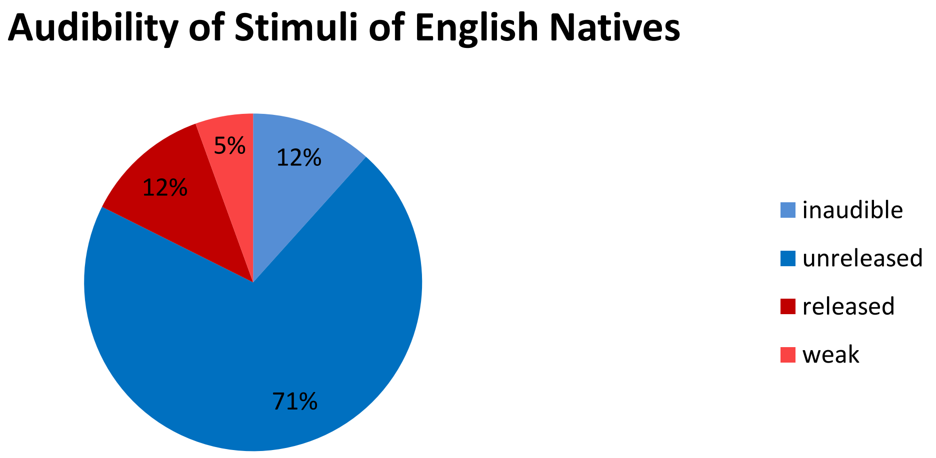


Figure 2: The average realization of the stimuli by the whole group.

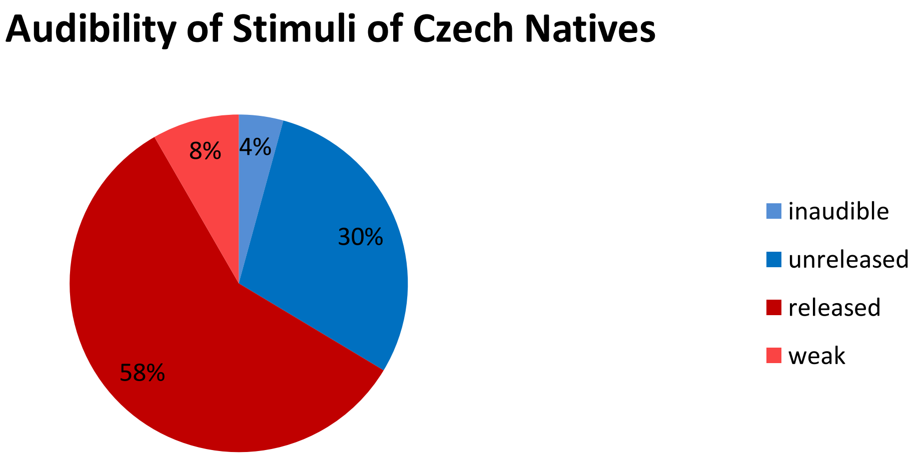


Figure 3: The average realization of the stimuli by the whole group.

Although the data for the English native speakers do not vary significantly, the data about the learners cannot be generalized. Below, we offer two opposing participants from this group to demonstrate the variability of the realization (Figure 4 and Figure 5). There we can see that one of the students actually make the first stop unreleased while the second student rather makes it released (more in Appendix E).

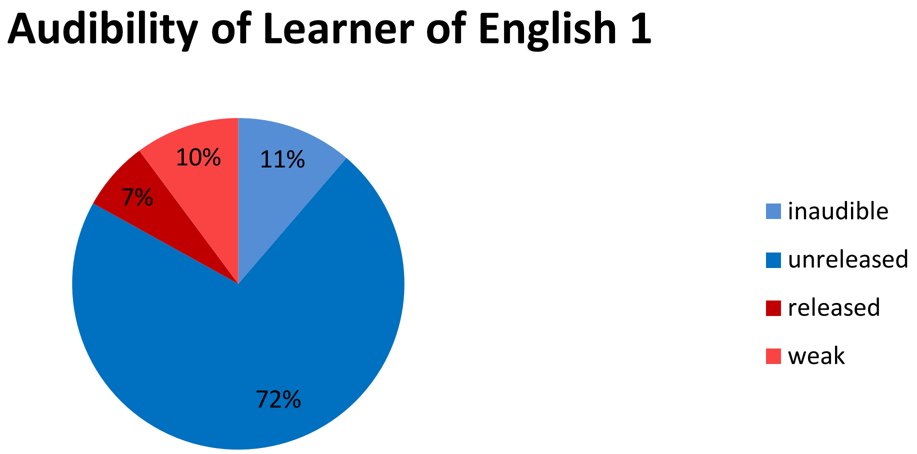


Figure 4: The realization of the set of the stimuli by one of the learners of English participants.

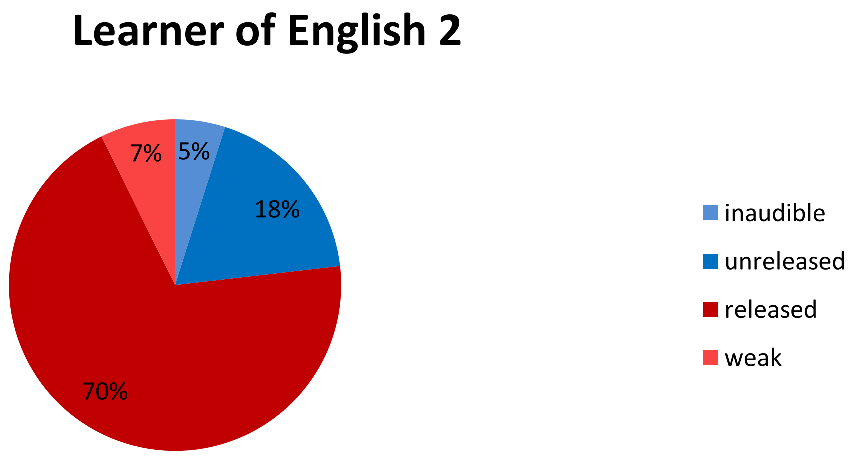


Figure 5: A different realization of the same set of the stimuli by another participant from the group of learners of English.

3.2 Statistical Data Overview

We observed proportion of unreleased and released first stops depending on three variables – Group, Place and Boundary. To obtain the final results we used two-way and three-way repeated measures ANOVA in the statistical software Statistica 12. The between subject variable focused on the Group variable (English natives – en-en, Czech natives – cz-cz, Czech learners – cz-en) and within subject variables were the Place and the Boundary variable. The original intention was to focus on the second stop which was either labial or non-labial or homorganic. However, due to the inclusion of homorganic stimuli into the Place variable we decided to modify the aiming and we chose *fronter-backer-homorganic* variability. Thus, we interpret two sets of data below and we divide this subchapter according to the Place variable. Firstly, we focus on the labial and non-labial second stop influence, then we continue with the fronter and backer second stops, and conclude with the homorganic, fronter, backer division.

In addition to statistical analysis, we also interpret Post hoc Tukey HSD tests which revealed significant differences between variables. Only relevant differences are mentioned in the text, but we include the table in the appendix for reference on the other significances (Appendix F).

3.2.1 Labial – Non-labial Place Variable

EFFECT	**Degrees of Freedom**	**F**	**p**
Group	2	7,44	0,007
Boundary	1	14,68	0,002
Boundary*Group	2	0,75	0,491
Place	1	24,08	0,000
Place*Group	2	1,41	0,28
Boundary*Place	1	7,15	0,019
Boundary*Place*Group	2	5,45	0,019

Table 1: The ANOVA results on variables *Group – Place – Boundary*, where the *Place* is represented by labial and non-labial second stops.

Significant main effects of the Group, Boundary and Place variable were found in this study as visible in Table 1. Firstly, the results show that there is a significant main effect among the stop-stop sequences within the Group variable [F(2, 13) = 7,4383, p < 0,01]. The smallest proportion of unreleased sequences is in Czech (32%) while the English natives unreleased the first stops the most (81%). The learners of English produced unreleased stop-stop sequences in 51% of cases. However, the Group variable is not influential in the interaction with the Boundary or the Place.

Moreover, there is a significant main effect in the Place variable (labial, non-labial). The main effect is F(1, 13) = 24,076, p < 0,001, which results into a significant influence of the labiality of the second stop. Our data show that when the second stop is labial, the release is predominantly missing since the numbers indicate that the unreleased category was more common (63%) than in non-labial sequences (47%) for the second labial stops.

Concerning the Boundary variable [F(1, 13) = 14,680, p < 0,01] there are more unreleased cases across the word boundary (61%) while the stimuli across the syllable boundary are unreleased less – just in 49% of cases.

The interaction between the Boundary and the Place is also significant F(1, 13) = 7,1547, p < 0,05. Universally, more unreleased sequences are produced across the word boundary stimuli with the second stop labial. On the other hand, non-labial stimuli with the sequence across syllable boundary are unreleased the least (39%) (see Appendix G).

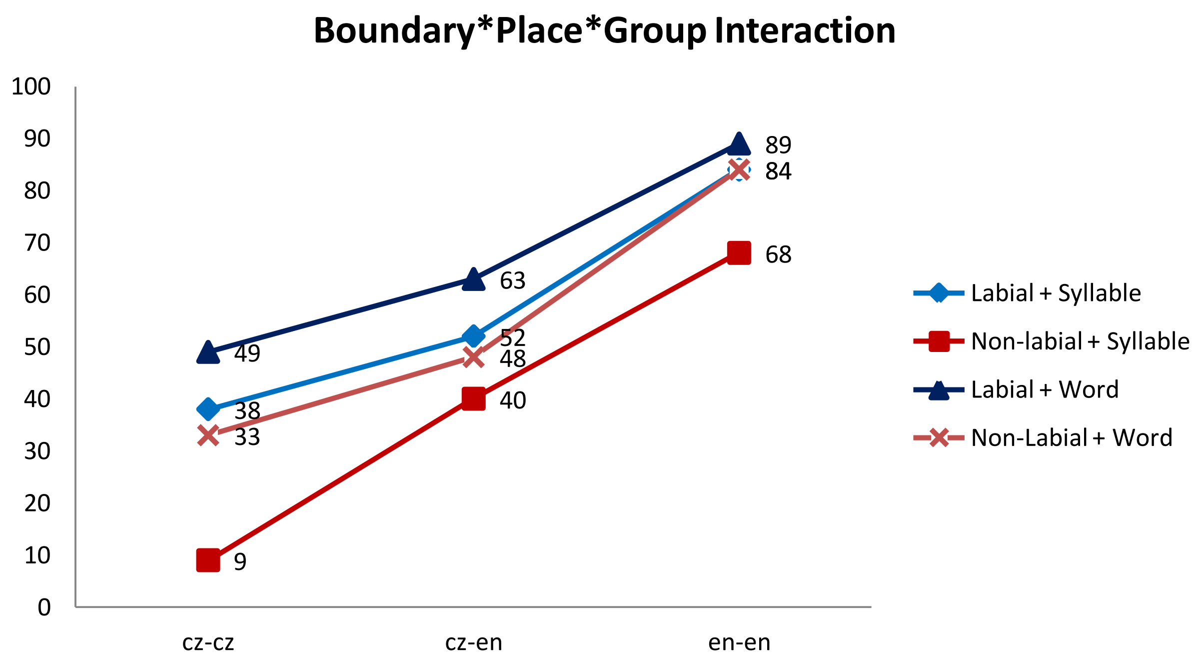


Figure 6: The data from the *Boundary – Group – Place* interactions show a movement across the variables.

However, there is also another substantial interaction of the Boundary and the Place with the Group variable. The overall results are demonstrated in the Figure 6. The Czech language has the lowest percentage of unreleased sequences in all categories. Specifically, non-labial sequences have are released often – both across the word (33%) and syllable (9%) boundary in Czech. The labial sequence which is across the word boundary is the combination with the most unreleased first stops (49%). Even though the specific percentage is different, the tendency is the same in utterances of the learners of English and the English natives. The across word boundary labial stimuli are produced rather as unreleased. As Figure 6 suggests, there is an indication of an acceptance of the L2 features among the learners of English. Even though the numbers do not reach the native English, there is a raise, especially in non-labial syllabic sequences from 9% to 40%.

The post-hoc Tukey HSD test was conducted to discover which variables varied significantly. Firstly, the syllabic non-labial stimuli differ significantly from the syllabic labial stimuli in all three groups. It was proven significant in the Czech language ($p<0,001$), while the other two followed with $p<0,05$. When non-labiality is taken into account, the difference between the syllable and word boundary is significant for both the Czech native participants ($p<0,001$) and for the English native participants ($p<0,05$), whereas the significant difference for the learners of English can be found when the syllabic labial and the word labial conditions are compared ($p<0,05$). The common significance for the Czech speakers and the learners occur when the labial variable and the non-labial variable were compared for the word boundary (both $p<0,01$).

3.2.2 Fronter – Backer Place Variable

EFFECT	**Degrees of Freedom**	**F**	**p**
Group	2	1,309	0,003
Boundary	1	0,003	0,565
Boundary*Group	2	0,014	0,251
Place	1	0,557	0,001
Place*Group	2	0,015	0,6
Boundary*Place	1	0,027	0,022
Boundary*Place*Group	2	0,012	0,089

Table 2: The ANOVA results on variables *Group – Place – Boundary*, where the *Place* of the second stop is considered either fronter or backer.

In Table 2 we can see that there is a main effect concerning the Group variable F(2, 13) = 9,4554, p < 0,01. The Czech speakers produce unreleased sequences in 24% of cases, whereas the English natives in 76%, and the learners apply the rule in 43% of cases.

The fronter – backer Place variable proved to be of great significance as well. The realization of unreleased stop-stop sequences with the fronter second stop was in this case around 57% while the backer second stop was unreleased only in 38% of cases [F(1, 13) = 20,179, p < 0,001]. This finding is valid for all groups involved.

The significant interaction of this part is between the Boundary and the Place with the effect F(1, 13) = 6,7929, p < 0,05. In general, the first stop is rather unreleased when the second stop is fronter. Specifically, the first stop is unreleased in 54% of cases when across the syllable boundary and in 60% when across the word boundary. Concerning the backer second stop, the first stop is unreleased in almost 40% of cases which are across the syllable boundary, and across the word boundary in 37% of cases (Figure 7).

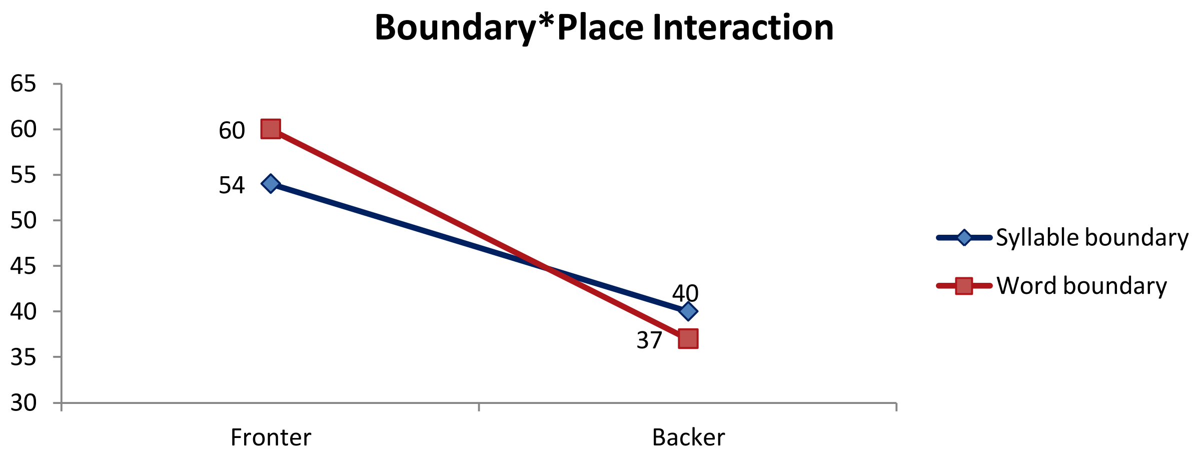


Figure 7: Mean values within the *Boundary – Place* interaction across all groups.

To expand further, post-hoc Tukey HSD test showed several conditions which varied significantly. In the Czech language there is a significant difference between the fronter and backer second stop across the syllable boundary (p<0,01). When the word boundary is taken into account, the difference between fronter and backer second stops is significant for Czechs as well (p<0,001). The later is the same for the learners of English (p<0,001).

3.2.3 Homorganic – Fronter – Backer Place Variable

In this part we will focus on an additional characteristic involved – homorganicity. The stimuli were constructed to involve also this separate category, which included 18 sequences of homorganic stops across the word boundary. Due to the homorganic nature of the stimuli, there is no Boundary variable since they are rare.

As Table 3 demonstrates, the Place alone shows great significance with the main effect $F(2, 26) = 30,509$, $p < 0,001$. Here, the smaller proportion of unreleased first stops occurs when the second stop is backer than the first one (37%). When they are fronter the mean value is around 60%, and for homorganic sequences it is around 78%.

EFFECT	**Degrees of Freedom**	**F**	**P**
Group	2	0,833	0,005
Place	2	0,661	0,000
Place*Group	4	0,018	0,507

Table 3: The ANOVA results on variables *Group – Place*, where the Place of the second stop is considered either fronter or backer or homorganic.

Also there is a significant main effect of the Group variable $F(2, 13) = 8,1726$, $p < 0,01$. The smallest proportion of unreleased first stops occur in the Czech group of participants, the first stops are unreleased only in 37% of cases while the English native group unreleased them in 85% of cases. The learners of English ended up in the middle with 53% of cases of unreleased first stops.

As we can see in Table 3, there is no significant interaction between the Group and the Place with the effect $F(4, 26) = 0,84978$, $p > 0,1$. However, the prevalent tendency is that the first stops are more released when the second stop is backer than the first one. Homorganic sequences are in general unreleased in native English (99%), but it is not a natural fact for the native Czech speakers. Only in 58% of cases the first stops are unreleased in the Czech language, however, there is a visible raise in the utterances of learners of English (78%).

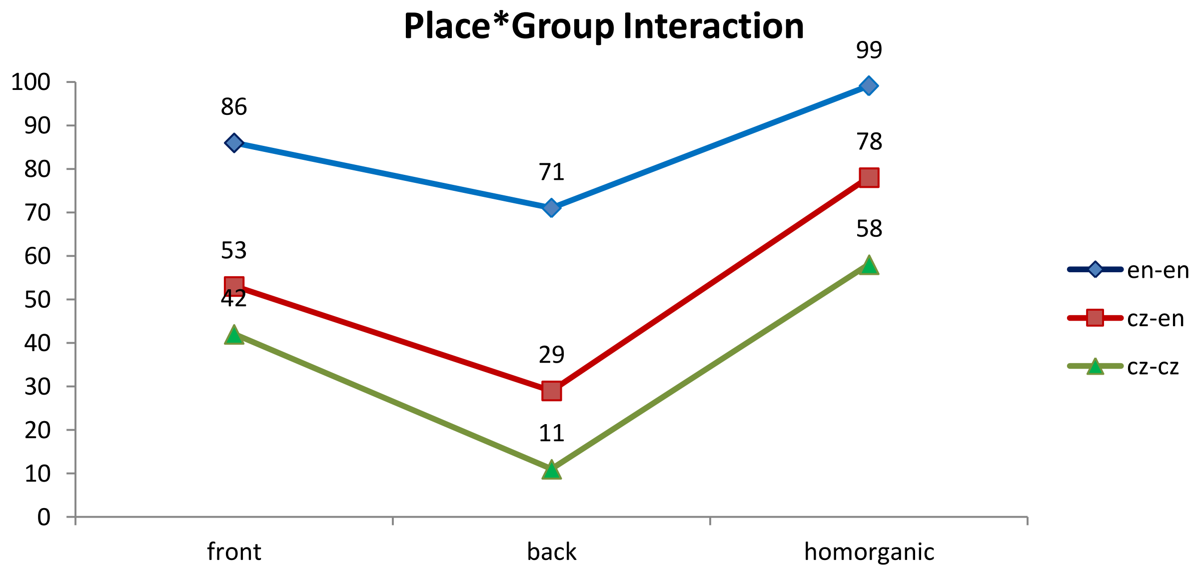


Figure 8: Mean values for the unreleased sequences across word boundary, where the Place is represented by fronter – backer – homorganic variables.

To elaborate homorganic stop-stop sequences further, we also present an individual breakdown of those sequences. In Figure 9 we can see that English native speakers have a tendency not to release homorganic sequences, only the first native English participant released couple of stimuli. The Czech participants vary from 12% to 94% of unreleased sequences. Only one advanced learner of English produced all stimuli as unreleased, and another three participants from the same group unreleased those stimuli in over 90% of cases. One participant among the Czech learners produced unreleased sentences just in 29% of cases, and the last one in 53%.

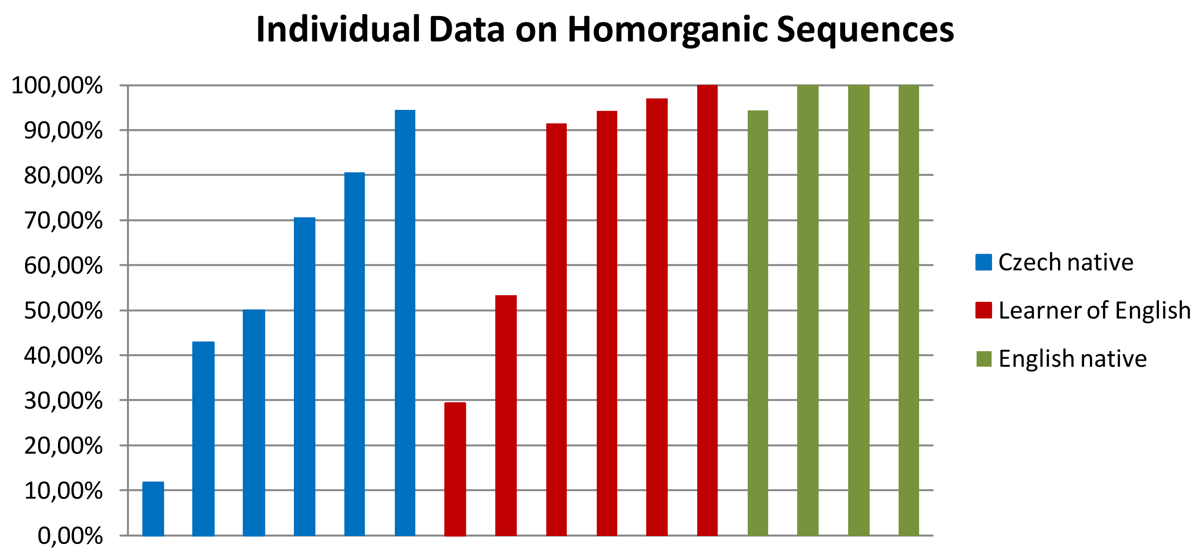


Figure 9: Those data show percentage of unreleased sequences of homorganic stimuli across all groups.

Post hoc Tukey HSD test revealed that there was a significant difference between backer and homorganic second stops for the Czech native speakers ($p<0,001$) and for the learners of English ($p<0,001$). Moreover, in the Czech language the difference between backer and fronter second stops is significant ($p<0,05$).

4 DISCUSSION

In this section, we will try to answer the research questions stated in the beginning. The main question concerns the learners of English and the relation between the phonetic rules of L1 and L2. For clarity, we state the questions again:

Q1: Do advanced learners of English overcome L1 influence and adopt L2 realization of stop sequences?

Q2: a) What portion of first stops has no audible release in stop-stop sequences when Czech speakers read short familiar sentences?
b) Will homorganic sequences yield more unreleased stops?
c) Will the place of articulation of the second stop in nonhomorganic sequences have an influence on the probability of no audible release?

Q3: Will there be more releases across syllable boundary than across word boundary in the speech of the learners of English compared to native speakers?

4.1 Question 1

Based on the literature review, we hypothesised that Czech speakers would release the first stop in the stop-stop sequence while the native speakers of English would keep them unreleased. Thus, a part of the study was to scrutinize the realizations of the native speakers to verify this hypothesis.

In general, the results showed that the Czech participants release the first stop more than the English natives. Even though we mentioned that the audibility of the first stop is subjective, all Czechs have over 50% of the stimuli sentences realized audibly (see Appendix E). This fact contrasts with the English natives who realized the first stop mainly inaudibly – without a release. Specifically, they produced over 2/3 of the stimuli as unreleased and no significant variations appeared between them individually, with the exception of one speaker who suppressed the released category more than the others (see Appendix C). From those data we draw a conclusion which supports the original hypothesis that the English native speakers do not release the first stop in the sequence while the Czech native speakers release it.

The statistical analysis proved a significant main effect of the category Group which allows us to bear out that advanced learners of English adapt to L2 rules. The data show that the learners of English do not demonstrate a high percentage of released first stops as the group of Czech natives, but they also do not reach the same figures of unreleased first stops as the group of English native speakers. And thus, they are placed in between those two native groups in both labial – non-labial and fronter – backer categories. Considering all the variables involved, we can notice the same increasing pattern (the smallest proportion of unreleased first stops belong to Czech natives, followed by the advanced learner, and then the English natives). Nevertheless, we point out the statistical data on the homorganic variable which also demonstrate an increasing tendency, however, there is not a significant interaction with the Group and the Boundary. A possible explanation might be that these participants prefer their L1 tendency here, which means they rather release the first stop in the homorganic stop-stop sequence. We can claim this because there is no significant difference between the Czech natives and the learners concerning the homorganic variable.

Even though all the learners have C1 level of English, the results concerning them individually demonstrated a great variance (see Appendix E). We present these individual cases in particularly because of the two advanced learners who reached similar figures as the native speakers. It may be suggested that a stay abroad, often communication with the native speakers of English or not dubbed movies could influence the results. According to an additional interview, we can discard the option of the stay abroad because only one of the participants spent several months in an English speaking country but the others spent just inconsiderable time abroad. Surprisingly, the learner of English 1, which produced the first stops as unreleased and thus became the most English native like participant, has not spent any time aboard. Only half of the participants admitted communication with native speakers of English but all of them claimed that they watch movies rather in the original language (in this case English) than the dubbed version. This observation suggests that only “second hand” contact (not direct communication) with L2 has a substantial influence on the realization.

To sum up, the advanced learners of English overcome L1 influence and adopt L2 realizations of stop sequences only partially, mainly in heterorganic sequences.

4.2 Question 2

4.2.1 Portion of Unreleased First Stops in Stop-Stop Sequences

The results of the Czech part of the study demonstrated that the speakers of the Czech language make the first stop in the stop-stop sequence released most of the time. It means that we supported Palková (1994) and Hála (1948) who claim that in a sequence of two stops the first stop is at least partially released.

On the average, over two-thirds of the stimuli sentences were produced as released or weak. These findings correspond with Šimek's study and his conclusion that the most common realization of the sequence of two stops is when both stops are released. The statistical analysis shows that the most released were the word internal non-labial sequences, followed by across word boundary non-labial sequences. Since the labial sequences follow the same pattern, which means the syllabic sequences are more released than the ones across the word boundary, we can conclude two facts. In Czech, sequences of two nonhomorganic stops placed across the word boundary are generally less released than the word internal sequences. Secondly, the labial stop sequences have a smaller proportion of released first stops than the non-labial sequences in Czech utterances. Post hoc Tukey HSD test revealed a great difference between labial and non-labial syllabic sequences ($p < 0,001$), as well as between the labial and non-labial sequence which is across the word boundary ($p < 0,01$).

Concerning the fronter-backer place of articulation, there are smaller proportions of unreleased first stops when the second stop is backer for both boundaries. Here, post hoc Tukey HSD test indicated that the significant difference is between fronter and backer second stop when the syllabic boundary is taken into account ($p < 0,01$). The same results were obtained about the word boundary ($p < 0,001$).

The results actually correspond to the Russian language. As we mentioned above, Zsiga suggests that heterorganic stop-stop sequences are mostly released in Russian and there is also a uniformity about the second labial stop, whose presence often means that the sequence is rather unreleased.

Even though English has the same developments concerning the labiality and fronter-backer place of articulation, there are completely different figures. Not even one-fifth of the nonhomorganic stop-stop sequences are released by the English natives compared to two-thirds of released first stops in Czech.

4.2.2 Homorganic Sequences Realization

Although the results concerning the interaction between Place and Group variables were not proven significant, we can see that homorganic sequences are the most unreleased among all three groups of participants (see Figure 8, p. 27). However, we cannot support the similarity of Czech with the Russian language, whose speakers keep the first stop unreleased in 100% of cases, or with three English speaking participants who kept them unreleased in 100% of cases as well.

The statistical data indicate that a little over 50% of the Czech homorganic stimuli were unreleased. When the first stop was fronter than the second one, it was also kept unreleased but only in 40% of cases and thus it did not reach even half. Regarding the backer first stops in Czech, they are unreleased in about 10% of cases. Thus, we can answer our question positively that homorganic sequences actually do yield more unreleased stops than the other categories (fronter, backer).

4.2.3 The Influence of the Place of Articulation of the Second Stop

With regard to the place of articulation, the results of this experiment are more complex due to two sets of data (labiality and the front-back category).

We already suggested that the sequences with the labial second stop tend to be more unreleased than the non-labial sequences. The interaction between the Boundary variable and the Place variable supports this fact. Moreover, these findings correspond with the studies on the English language (Henderson and Repp 1982 and Zsiga 2000) so we can conclude that the Czech and English speakers regard the labiality of the second stop in the same way. However, our study proved that when considering all three variables (Place, Boundary, Group) English native participants produced a higher percentage of unreleased sequences than the Czech natives and the learners of English. Thus, we should point out that even though there is the same tendency, the English language is more prone to keep the first stop unreleased in such cases (38% and 49% in Czech language versus 84% and 89% in English – for more see Figure 6, p.23).

Considering the fronter and backer place of articulation, the data again show significant interactions. In general, substantially more unreleased first stops in the stop-stop sequences appear when the second stop is fronter than when the second stop is backer. Again, these findings correspond with another research, specifically Zsiga's (2000) study which states that the backer position of the second stops the higher probability of release.

To sum up, irrespective of which category of the place of articulation of the second stop we examine, they both proved to be significant.

4.3 Question 3

Based on Cebrian's (2000) study, we raised the question whether the learners of English can be influenced by their carefulness while speaking because the outcome could disrupt word integrity. In such a scenario, the speakers could treat each word as an individual unit and it could result into releasing the final stop in a word (the first stop in a sequence) more than in connected speech. Thus, speakers would suppress some rules which would native speaker normally produce. Based on this, we wanted to look into the boundaries and find out whether the learners release the first stop more on the word boundary than on the syllable boundary.

Results indicated that the Boundary variable is significant for the labial – non-labial place of articulation of the second stop, but it was not proven significant for the fronter – backer place of articulation. And even though there is a main effect of the Group variable, there is no significant interaction between the Boundary and the Group in neither of the Place variable categories. Thus, we did not prove the hypothesis that the learners of English respect boundaries more than the native speakers.

However, the statistical analysis showed that the first stops on the word boundary have actually smaller proportions of released first stops compared to the syllable boundary. Thus, we received completely different result than it was expected. Over 61% of the unreleased stimuli were produced on the word boundary by the participants, while only 49% of syllable boundary cases were unreleased (Appendix G).

CONCLUSION

This thesis tried to expand the knowledge about non-native speakers and their acquisition of the correct structures of L2. The aim of this study was to analyse the stop-stop sequences in the English and Czech language with respect to the audibility of the release of the first stop. After the introduction into stop consonants and their sequences, we had to firstly confirm the hypothesis that the first stop is mainly released in the Czech language, while English participants keep the first stops mainly unreleased. Then we focused on the advanced learners of English whose L1 is Czech. The main objective was to examine whether the learners apply the English structures by unreleasing the first stop when two consecutive stops appear or whether they keep their English utterances released.

The analysis of the obtained data confirmed our findings from the literature that the English native participants mostly keep the first stop in nonhomorganic sequences unreleased and also the first stop in the sequence of two homorganic stops is always unreleased in English.

Based on the results concerning Czech, we reasoned that Czech speakers have bigger proportion of released first stops across the syllable boundary compared to the word boundary sequences which were kept more unreleased. Regarding the place of articulation, the first of the two consecutive stops is less released when the second stop is a labial, and thus we confirmed our expectations based on the literature overview. In the fronter – backer category of the place of articulation we could see that there are also significant main effects and interactions. Here, a bigger proportion of unreleased first stops appeared when the second stop was fronter. Next, the question concerning Czech homorganic stops was raised as a comparison with fronter and backer second stops, which proved that homorganic stops do increase the probability of the first stop being unreleased. However, we cannot claim that the first stop in the homorganic stop-stop sequences is always or mainly unreleased as in English. Not regarding the variability among Czech speakers, the statistics showed that only around 60% of first stops are unreleased in homorganic sequences. To sum up, according to the statistical data which included all variables, we concluded that the Czech participants mostly release the first stops and the English participants do not.

The main research question focused on the learners of English and whether they adopt L2 structures so they overcome the L1 inherent influence. The statistical analysis indicated that even though the utterances of the learners are not alike the utterances of the English native participants, they do significantly adapt to L2 structures. It means that they vary from the Czech speaking participants significantly.

The last question focused on word integrity. Surprisingly, we established that the first stop in the syllable boundary sequences has a bigger proportion of released first stops than the one on the word boundary. Regardless of this fact, we did not prove any significant difference between the learners of English and the English native speakers.

Since this study was focused on a limited number of participants and because we also found great differences among the individual participants within groups, the resulting numbers and percentages should not be generalized and viewed as definitive regarding the study of the first stops release in the English and Czech languages.

RÉSUMÉ

Jedním z důvodů, proč nerodilí mluvčí mají problémy při osvojování si cizího jazyka, a tedy mluví s akcentem, jsou odlišné fonetické aspekty obou jazyků. K potlačování některých aspektů může přispívat i opatrné vyslovování, kdy mluvčí zachází s každým slovem jako s individuální jednotkou. Opatrná výslovnost sekvence dvou okluzív patří do této kategorie, protože obě okluzívy by byly vysloveny zřetelně a obě by měly dlouhou explozivní fázi. Ačkoliv tento fakt může být platný v některých jazycích, není relevantní v jazycích, které okluzívy spojují a dochází k jejich překrývání.

Hlavním cílem této práce bylo analyzovat pořadí dvou okluzív se zaměřením na slyšitelnost exploze (explozivní fáze) první okluzívy u pokročilých studentů angličtiny, jejichž mateřský jazyk je čeština. Jejich výslovnost je porovnána s rodilými mluvčími angličtiny. Zde jsme vycházeli z předpokladu, že anglický jazyk patří právě do skupiny jazyků, které okluzívy spojují a překrývají, a tudíž by první okluzíva neměla být vypuštěna. Na základě prostudované literatury očekáváme, že čeština bude naopak první okluzívy alespoň částečně vypouštět, a jelikož český jazyk v tomto ohledu nebyl důkladně prostudován, rozhodli jsme se pro zkoumání i samotného českého jazyka, abychom měli výchozí data k porovnání. Výsledkem této práce je potvrzení a rozšíření dostupných informací o českém jazyce a následně zjištění vlivu mateřského jazyka na výslovnost dvou okluzív pokročilých českých studentů angličtiny.

V první kapitole se zabýváme úvodem do tématu, tedy poskytujeme přehled existující literatury, výzkumů, vlastností a pravidel, které se týkají okluzív. Několik studií anglických okluzív a sekvence anglických okluzív již bylo provedeno (např. Henderson and Repp 1982, Byrd and Tan 1996, Lisker 1999). Konkrétně studie Hendersonna a Reppa (1982) byla základem pro tuto práci. Ostatní výzkumy týkající se anglického jazyka, které jsou prezentovány, se zabývaly odlišnou oblastí pořadí dvou okluzív, a proto jsou využívány pouze jako sekundární a doplňující literatura. Jak jsme již zmínili, čeština nebyla v tomto ohledu velmi prozkoumána. Pouze několik autorů zabývajících se českou fonetikou zmiňuje pořadí dvou okluzív okrajově.

Druhá kapitola se zabývá metodologií. V rámci naší studie jsme sestavili věty, které obsahovaly sekvenci dvou explozív. Ty se vyskytovaly na hranici slabiky (*hudba*) nebo na hranici slova (*Marek kouří*) a okluzívy měly buď stejné místo artikulace, nebo odlišné. Následně byly stimuly rozdělené podle labiality druhé okluzívy (labiální, nelabiální).

Účastníky výzkumu byly rodilí mluvčí angličtiny i češtiny a čeští studenti angličtiny. Úkolem bylo nahrát je při čtení stimulů. Nahrávky byly následně analyzovány.

Na základě získaných dat jsme potvrdili naši hypotézu týkající se anglických rodilých mluvčích a to, že ve většině případů skutečně nevypouští první okluzívu v sekvenci dvou okluzív. Výsledkem studia českých rodilých mluvčích bylo zjištění, že více vypouští první okluzívu, která je na hranici slabiky než na hranici slova. Nadále jsme zjistili, že explozivní fáze první okluzívy bývá méně častá, když druhá okluzíva je *labiální* nebo podle druhého testu *přednější* než druhá okluzíva (pro lepší porovnání okluzív se stejným místem artikulace jsme zvolili proměnné *přední – zadní – homorganická* druhá okluzíva, namísto labiální). Zaměřili jsme se také na okluzívy, které měly stejné místo artikulace. Ačkoliv můžeme tvrdit, že stejné místo artikulace zvyšuje pravděpodobnost nevypuštění první okluzívy v českém jazyce oproti přednější nebo zadnější okluzívě, pouze 60 % stimulů nemělo explozivní fázi u první okluzívy. Tyto výsledky se signifikantně liší od anglického jazyka, který nevypouští první okluzívu v těchto případech.

Naše hlavní otázka se zaměřovala na studenty anglického jazyka a jejich realizaci explozivní fáze v pořadí dvou okluzív, tedy zda potlačí aspekty jejich mateřského jazyka a přivlastní si aspekty anglického jazyka. Statistická data ukázala, že studenti se při realizaci explozivní fáze v jejich promluvě přibližují výsledkům rodilých mluvčích angličtiny, nicméně nedosahují stejných výsledků. Proto tvrdíme, že si studenti přivlastňují aspekty anglického jazyka pouze částečně.

Na základě Cebrianovi studie (2000) jsme se v poslední části snažili odpovědět, zda studenti anglického jazyka mluví opatrně, čímž narušují slovní integritu a zachází se slovem jako s individuální jednotkou, a tudíž realizují explozivní fázi u první okluzívy především na hranici slova. Ale jelikož zde neexistovala signifikantní interakce, tuto hypotézu jsme nepotvrdili. Nicméně jsme zjistili, že více vypuštěných explozív bylo všemi mluvčími realizováno hlavně na vnitřní slabičné hranici, nikoliv na hranici dvou slov.

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APPENDIX A

English Stimuli

Word Internal – Labial

1. His **workplace** is great.
2. A pilot sits in a **cockpit**.
3. She likes to jog on **footpaths**.
4. It’s a **blackbird** on my porch.
5. It’s a good **output**.
6. John has a knife in his **backpack**.
7. I don’t like saying **goodbye**.
8. **Childbirth** was hard for her.
9. Tom didn’t use a **logbook**.
10. I like that **redbird**.
11. Kim always drinks **redbull**.
12. My **grandfather** won the jackpot.
13. There were **footprints** in the snow.
14. Jim is wearing his favourite **sweatpants**.
15. My sister uses **cookbooks**.
16. Animals **stockpile** food for the winter.
17. His brother is a **kickboxer**.
18. His leg broke during a **football** match.

Word Internal – Non-labial

1. I will be in London in **September**.
2. You can choose between those **cocktails**.
3. That **upcoming** party will be great.
4. I love your **nightclub**.
5. Mom has a **desktop** computer.
6. Joseph cut the **fruitcake.**
7. My grandfather drinks a **nightcap** every day.

8. **Abductors** should be punished severely.
9. Every generation has a **subgeneration**.
10. He gave an order to open the **floodgates**.
11. A graduation is just a **subgoal**.
12. Jane works in a Paris **subdivision**.
13. He visited **Bagdad** three years ago.
14. After his **abdication** he died.
15. I hurt my **tiptoe**.
16. Jane loves **pumpkin** pie.
17. He is wearing a red **necktie**.
18. He broke Gary´s **laptop**.

Homorganic

1. I like blac**k c**olour.
2. You should as**k K**im.
3. They often bu**g c**riminals.
4. Log Gaby in and go home.
5. He sent me a good-luc**k c**ard.
6. He bro**ke G**ary´s laptop.
7. I must sla**p P**eter on the back.
8. His idea is to ro**b B**ill of his money.
9. Jaco**b b**ought a new TV.
10. I want to hel**p P**eter with it.
11. A cra**b b**oat spends months out at sea.
12. Slee**p p**eacefully tonight.
13. You must ea**t t**omatoes.
14. The police sho**t T**im on the street.
15. John hi**d D**ana’s diary.
16. We playe**d d**arts yesterday.
17. I visi**t T**om every day.
18. John let Ka**te d**rive his car.

Word Boundary - Labial

1. I always gree**t p**eople at the front door.
2. He me**t P**am at the restaurant.
3. They spea**k P**ortuguese very well.
4. I di**d b**usiness with Bill Gates.
5. His le**g b**roke during a football match.
6. You loo**k b**eautiful.
7. There is a repea**t p**attern.
8. They mistoo**k P**atrick for John.
9. I will coo**k p**asta tonight.
10. Lilly pu**t p**ictures online.
11. He spo**ke b**riefly and wisely.
12. They wo**ke B**en early.
13. I need a wor**k p**ermit.
14. I have me**t P**aul several times.
15. Harry pai**d b**y check.
16. I fe**d B**arbara´s dog.
17. They suppor**t p**eople in need.
18. That do**g b**it Kate.

Word Boundary – Non-labial

1. She said slee**p t**ight.
2. John le**t K**ate drive his car.
3. I would like to be a ca**b d**river.
4. Ro**b g**ave me a present.
5. My grandma ha**d g**oats on her farm.
6. Just di**g d**eeper.
7. That dog bi**t K**ate.
8. Mike is one of our value**d c**ustomers.
9. You loo**k t**ired.
10. You have to trea**t k**ids gently.
11. Please, kee**p c**alm and continue.
12. You have to si**t c**almly.

13. Jack cannot ea**t c**ake.
14. We have to ta**ke T**im to school.
15. You have to spea**k t**actfully.
16. Jane has a deskto**p c**omputer.
17. I usually don’t si**p c**offee.
18. It is difficult to kee**p t**rack

APPENDIX B

Czech Stimuli

Word Internal – Labial

1. Jan tu **skladbu** zahrál krásně.
2. **Rugby** hraje dobře.
3. Jana píše **odborné** články.
4. Hanu bolel **podbřišek**.
5. Na **chodbě** byla zima.
6. Během zkouškového piji **redbull**.
7. Náš **odpad** neodtékal.
8. Povinná **četba** mě nebaví.
9. **Hudba** mě uklidňuje.
10. V sešitě chyběl **nadpis**.
11. **Odbila** půlnoc.
12. Jana má **odpor** k pavoukům.
13. **Odpal** tu raketu.
14. **Setba** už proběhla.
15. Naše **svatba** bude v červnu.
16. **Odbavení** zavazadel je vlevo.
17. **Sadba** brambor je připravená.
18. V divadle dávají hru **Ženitba** .

Word Internal – Non-labial

1. Honza se ptal na **Magdu**.
2. Bylo to **trpké** období.
3. Je to **obdobná** situace.
4. Ráda čtu knížky **Edgara** Alana Poea.
5. Nechceme žít v **Bagdádu**.
6. V jídle byla **skořápka**.
7. **Aktovku** už nenosím.

8. **Šipka** směřovala doprava.
9. Měla to být **zkratka**.
10. **Obdržela** oznámení od policie.
11. V kině jím **popkorn**.
12. Moje teta pracuje v **optice**.
13. Nemám ráda **doktory**.
14. Chemické **látky** spolu zareagovaly.
15. Maliny **kupte** až zítra.
16. Tvoje **matka** je na zahradě.
17. Jan od dětství **koktá**.
18. Na chalupě **topte** uhlím.

Homorganic

1. Rakovina je důslede**k k**ouření.
2. Chce se naučit jazy**k K**eltů.
3. Gynekolo**g K**ovář je velmi dobrý doktor.
4. Ole**g g**alantně otevřel dveře.
5. Mare**k k**ouří jen doutníky.
6. Vážil několik stove**k g**ramů.
7. Stro**p p**opraskal při zemětřesení.
8. Obehnali příko**p p**áskou.
9. Jaku**b b**ěžel jako o život.
10. Užívám siru**p p**roti kašli.
11. So**b b**ěžel přes mýtinu.
12. Kra**b b**yl uvařen.
13. Musím si napsa**t t**ahák.
14. Během nemoci musíš pí**t t**eplý čaj.
15. Petr rá**d d**ostává dárky.
16. Překla**d d**o čínštiny je těžký**.**
17. Nera**d d**ělal z lidí otroky.
18. Musíš pí**t t**ři litry vody.

Word Boundary - Labial

1. Chtěl mi nabídnou**t p**omoc.
2. Doutní**k p**atří mezi tabákové výrobky.
3. Ten překla**d b**yl velmi náročný.
4. Ole**g b**rzy odešel.
5. Známý geolo**g b**yl v televizi.
6. Pí**t p**ivo je zdravé.
7. Ten seši**t b**yl Markův.
8. Vojá**k b**ránil svou vlast.
9. Gro**g p**iji jen v zimě.
10. Číšní**k p**řinesl můj čaj.
11. Vla**k p**řijel pozdě.
12. Sna**d p**řiletí zítra.
13. Chtějí vybudovat skla**d b**ot.
14. Už nechci trpě**t b**olestmi hlavy.
15. Po operaci měl oto**k p**lic.
16. Musíš zastavi**t p**lyn.
17. Češi pijí napřikla**d p**ivo.
18. Chtěl bych vidě**t P**aříž.

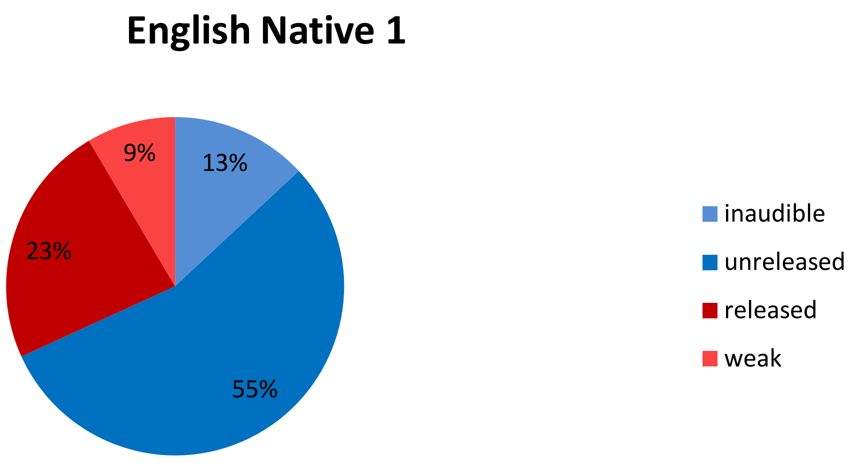
Word Boundary – Non-labial

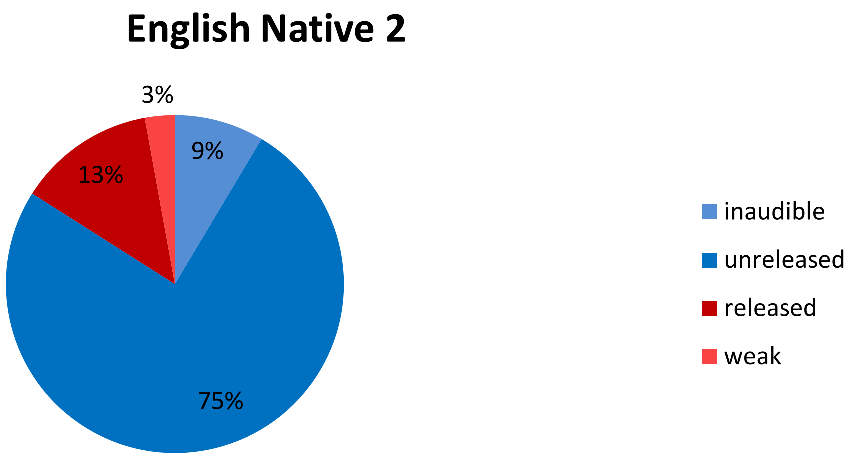
1. Fili**p t**ančil s Veronikou.
2. Výko**p k**opali dělníci z Prahy.
3. Výslede**k t**estu byl neurčitý.
4. Náku**p d**ovez domů.
5. Jaku**b g**alantně otevřel dveře Alici.
6. Skla**d g**olfového vybavení vyhořel.
7. Gynekolo**g d**opoledne neordinoval.
8. Musím si sbali**t k**artáček.
9. Gro**g d**opil najednou.
10. On sli**b d**održel.
11. Čá**p k**roužil nad rybníkem.

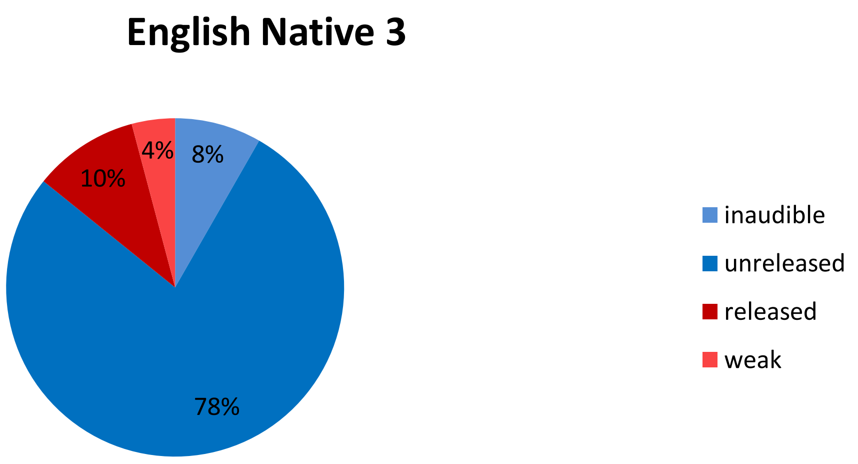
12. Chci tatarku a keču**p t**aky.
13. Deštní**k t**rčel ve vzduchu.
14. Stro**p t**ělocvičny se propadal.
15. Já nemám rá**d g**yros.
16. Klu**b K**abaret sídlí v Praze.
17. Ku**p k**rmení pro křečky.

APPENDIX C

English Native's Audibility of Release Pie Charts



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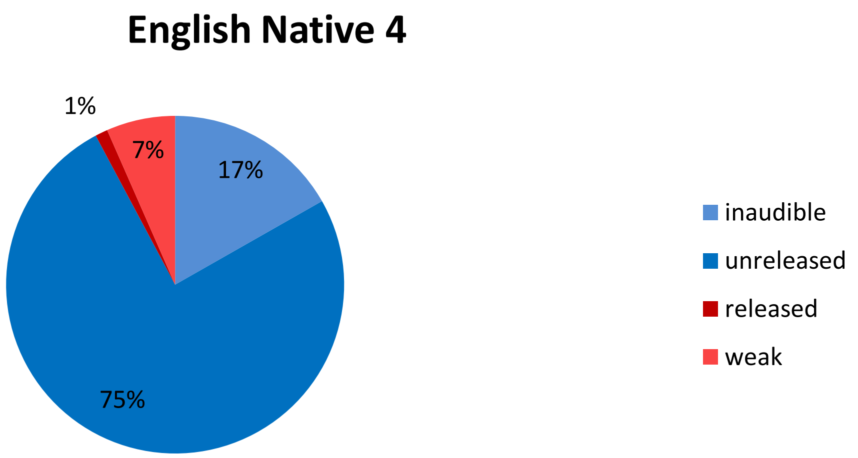
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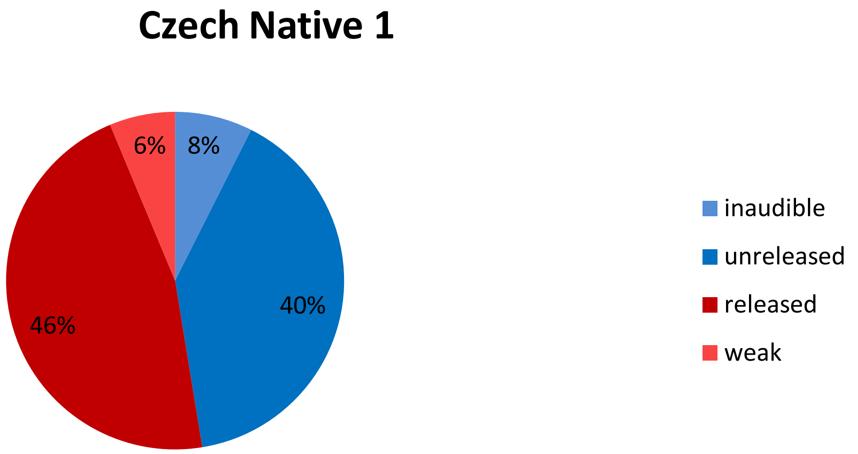
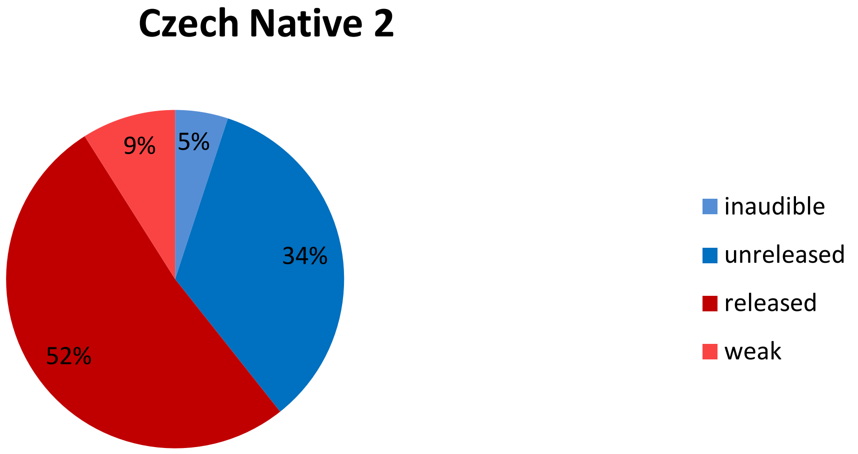
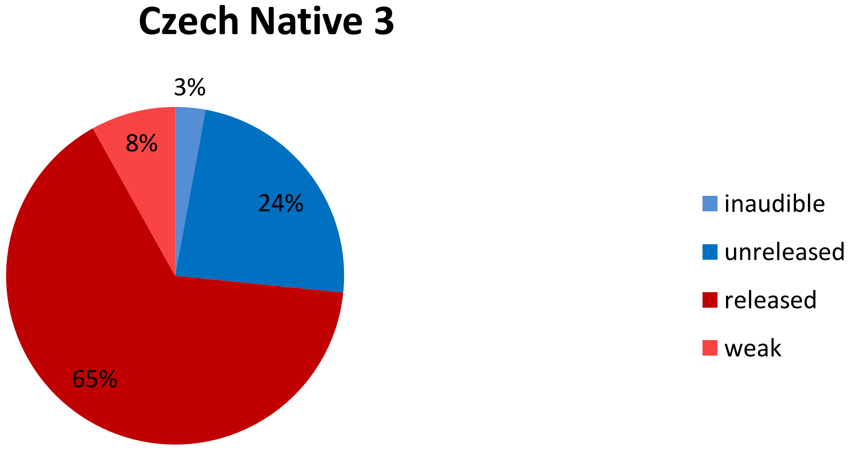
released
weak

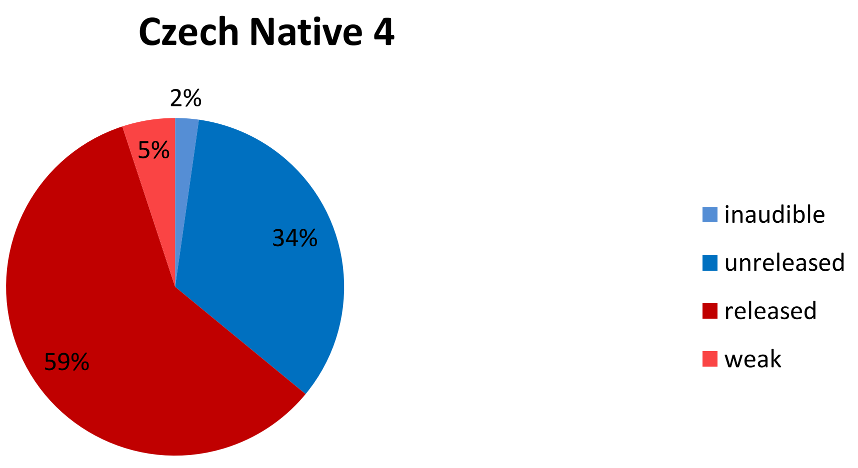
APPENDIX D

Czech Natives's Audibility of Release Pie Charts





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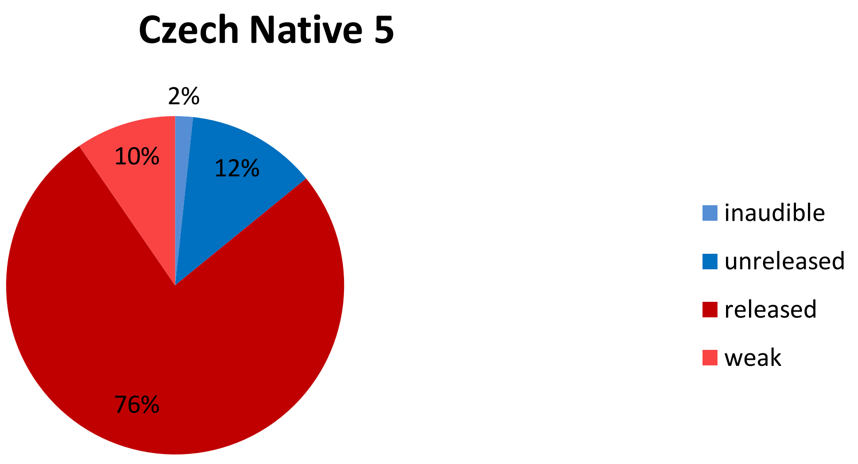
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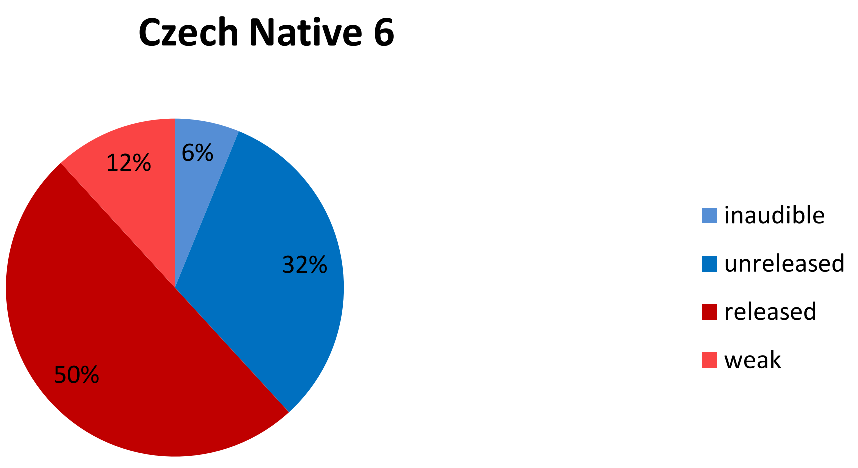
unreleased
released
weak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released
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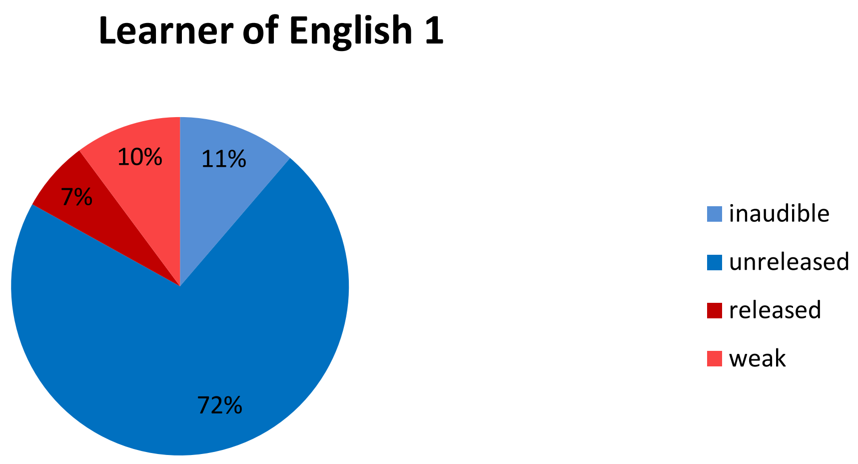
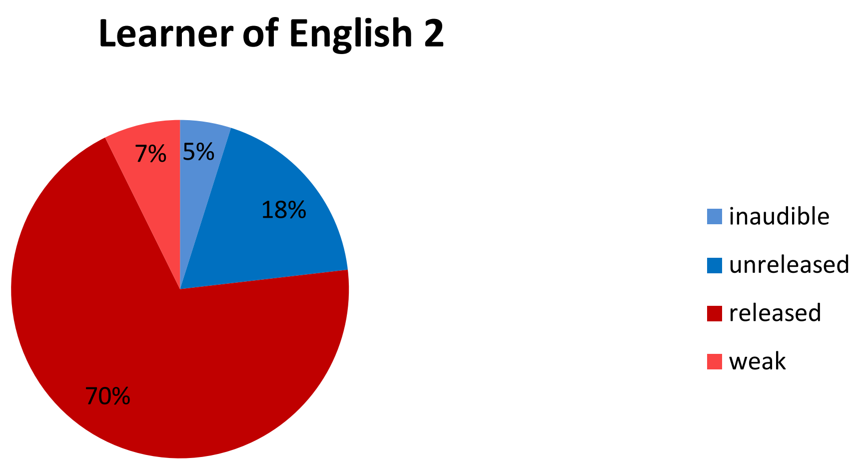
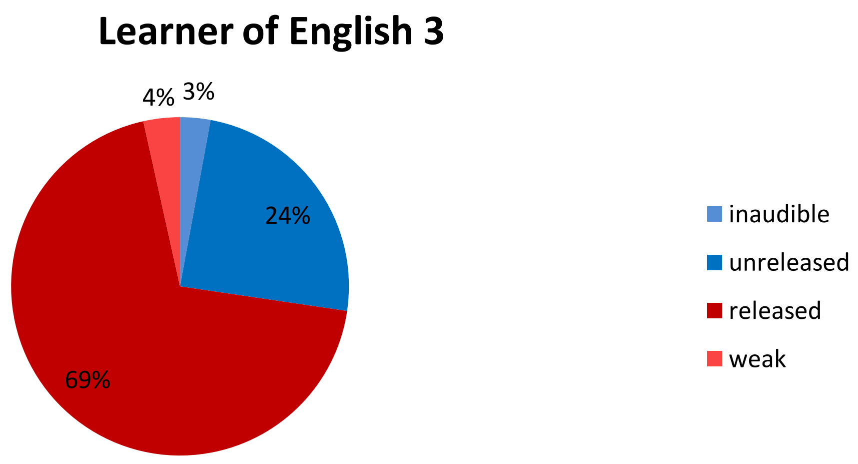
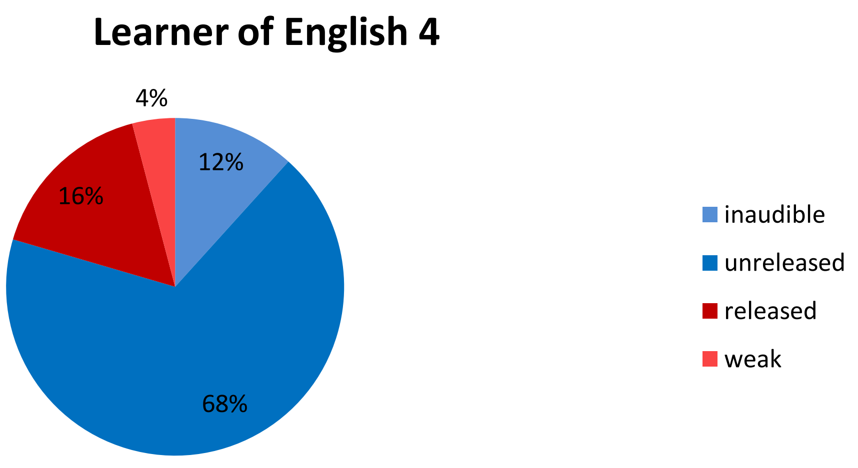
APPENDIX E

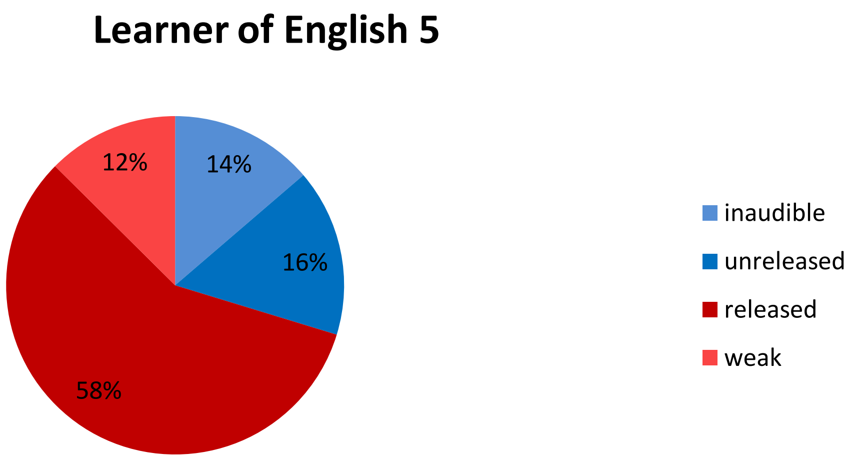
English Learner's Audibility of Release Pie Charts

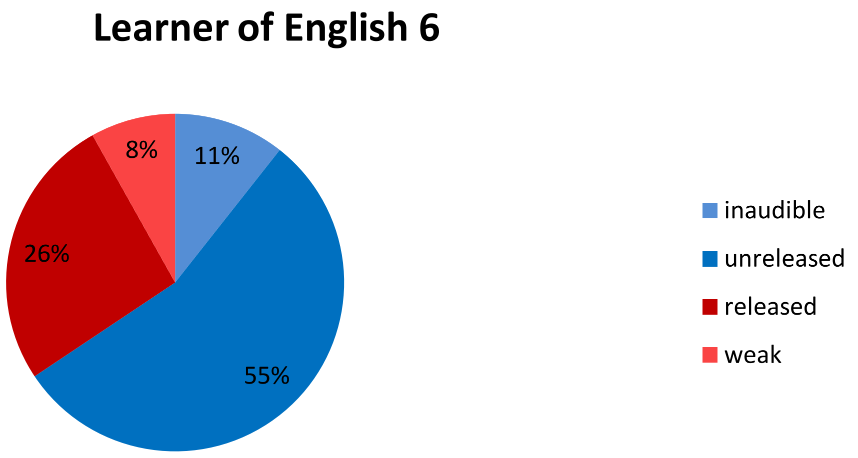







Learner of English 4
4%
12%
16%
68%
inaudible
unreleased
released
weak


Learner of English 5
12%
14%
16%
58%
inaudible
unreleased
released
weak


Learner of English 6
8%
11%
26%
55%
inaudible
unreleased
released
weak

APPENDIX F

Post Hoc Tukey HSD Tests

Boundary (syllable, word), Place (Labial, Non-labial)

Tukey HSD test; variable DV_1 (cdur)Approximate Probabilities for Post Hoc TestsError: Between; Within; Pooled MSE = ,07891, df = 13,421

Cell No.	folder	BOUNDARY	PLACE	{1} (,38481)	{2} (,08661)	{3} (,49210)	{4} (,33124)	{5} (,51772)	{6} (,40415)	{7} (,63156)	{8} (,47496)	{9} (,84350)	{10} (,68250)	{11} (,89027)	{12} (,83977)
1	cz-cz	1	1		0,000183	0,070100	0,768244	0,999037	1,000000	0,910203	0,999975	0,396578	0,866159	0,282436	0,406728
2	cz-cz	1	2	0,000183		0,000182	0,000207	0,336371	0,711304	0,119545	0,465867	0,031061	0,134400	0,020061	0,032157
3	cz-cz	2	1	0,070100	0,000182		0,003415	1,000000	0,999980	0,998535	1,000000	0,722266	0,992431	0,576278	0,733438
4	cz-cz	2	2	0,768244	0,000207	0,003415		0,985051	0,999997	0,768248	0,998102	0,268062	0,722709	0,183911	0,275870
5	cz-en	1	1	0,999037	0,336371	1,000000	0,985051		0,049106	0,048361	0,923163	0,796114	0,997652	0,657021	0,806151
6	cz-en	1	2	1,000000	0,711304	0,999980	0,999997	0,049106		0,000260	0,440046	0,450794	0,905692	0,326407	0,461648
7	cz-en	2	1	0,910203	0,119545	0,998535	0,768248	0,048361	0,000260		0,004305	0,983176	1,000000	0,937807	0,985192
8	cz-en	2	2	0,999975	0,465867	1,000000	0,998102	0,923163	0,440046	0,004305		0,669567	0,985537	0,522731	0,681166
9	en	1	1	0,396578	0,031061	0,722266	0,268062	0,796114	0,450794	0,983176	0,669567		0,017640	0,961199	1,000000
10	en	1	2	0,866159	0,134400	0,992431	0,722709	0,997652	0,905692	1,000000	0,985537	0,017640		0,002142	0,020994
11	en	2	1	0,282436	0,020061	0,576278	0,183911	0,657021	0,326407	0,937807	0,522731	0,961199	0,002142		0,937801
12	en	2	2	0,406728	0,032157	0,733438	0,275870	0,806151	0,461648	0,985192	0,681166	1,000000	0,020994	0,937801	

Boundary (syllable, word), Place (Fronter, Backer)

Tukey HSD test; variable DV_1 (cdur)Approximate Probabilities for Post Hoc TestsError: Between; Within; Pooled MSE = ,07124, df = 13,751

Cell No.	folder	BOUNDARY	PLACE	{1} (,31364)	{2} (,12092)	{3} (,41643)	{4} (,11141)	{5} (,48952)	{6} (,41300)	{7} (,53061)	{8} (,28641)	{9} (,82997)	{10} (,65538)	{11} (,85522)	{12} (,70872)
1	cz-cz	1	1		0,005323	0,274677	0,003529	0,986003	0,999897	0,942957	1,000000	0,207209	0,697164	0,165794	0,520490
2	cz-cz	1	2	0,005323		0,000230	1,000000	0,466212	0,745548	0,334575	0,991123	0,033201	0,176678	0,025817	0,108242
3	cz-cz	2	1	0,274677	0,000230		0,000212	0,999995	1,000000	0,999619	0,998781	0,461770	0,947953	0,386803	0,843431
4	cz-cz	2	2	0,003529	1,000000	0,000212		0,433650	0,711928	0,307939	0,986511	0,030208	0,162262	0,023484	0,098934
5	cz-en	1	1	0,986003	0,466212	0,999995	0,433650		0,634150	0,987058	0,003398	0,701387	0,996264	0,617950	0,970082
6	cz-en	1	2	0,999897	0,745548	1,000000	0,711928	0,634150		0,151693	0,103335	0,451188	0,943229	0,377192	0,834547
7	cz-en	2	1	0,942957	0,334575	0,999619	0,307939	0,987058	0,151693		0,000706	0,824888	0,999691	0,751578	0,993391
8	cz-en	2	2	1,000000	0,991123	0,998781	0,986511	0,003398	0,103335	0,000706		0,162867	0,606992	0,129277	0,434940
9	en	1	1	0,207209	0,033201	0,461770	0,030208	0,701387	0,451188	0,824888	0,162867		0,050876	0,999970	0,316110
10	en	1	2	0,697164	0,176678	0,947953	0,162262	0,996264	0,943229	0,999691	0,606992	0,050876		0,019970	0,980344
11	en	2	1	0,165794	0,025817	0,386803	0,023484	0,617950	0,377192	0,751578	0,129277	0,999970	0,019970		0,139459
12	en	2	2	0,520490	0,108242	0,843431	0,098934	0,970082	0,834547	0,993391	0,434940	0,316110	0,980344	0,139459	

Boundary (syllable, word), Place (Fronter, Backer, Homorganic)

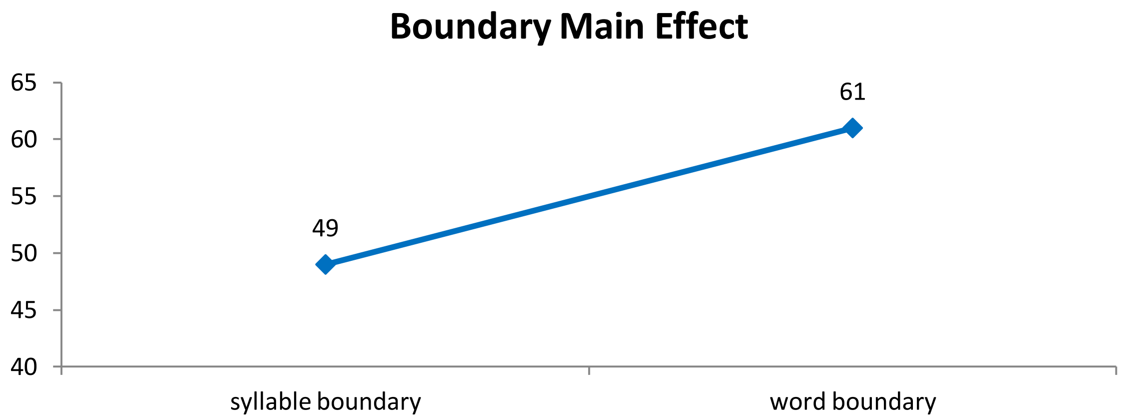
Tukey HSD test; variable DV_1 (cdur)Approximate Probabilities for Post Hoc TestsError: Between; Within; Pooled MSE =

Cell No.	folder	PLACE	{1} (,58368)	{2} (,11141)	{3} (,41643)	{4} (,77544)	{5} (,28641)	{6} (,53061)	{7} (,98571)	{8} (,70872)	{9} (,85522)
1	cz-cz	unrwhm		0,000351	0,576286	0,840491	0,358248	0,999964	0,157295	0,992105	0,612588
2	cz-cz	unrwba	0,000351		0,030847	0,000772	0,895553	0,061527	0,000210	0,007908	0,000757
3	cz-cz	unrwfr	0,576286	0,030847		0,158630	0,979593	0,990968	0,012569	0,521433	0,095092
4	cz-en	unrwhm	0,840491	0,000772	0,158630		0,000266	0,139719	0,853639	0,999912	0,999666
5	cz-en	unrwba	0,358248	0,895553	0,979593	0,000266		0,141713	0,001485	0,119735	0,012669
6	cz-en	unrwfr	0,999964	0,061527	0,990968	0,139719	0,141713		0,075173	0,935143	0,387641
7	en	unrwhm	0,157295	0,000210	0,012569	0,853639	0,001485	0,075173		0,210011	0,935708
8	en	unrwba	0,992105	0,007908	0,521433	0,999912	0,119735	0,935143	0,210011		0,884734
9	en	unrwfr	0,612588	0,000757	0,095092	0,999666	0,012669	0,387641	0,935708	0,884734	

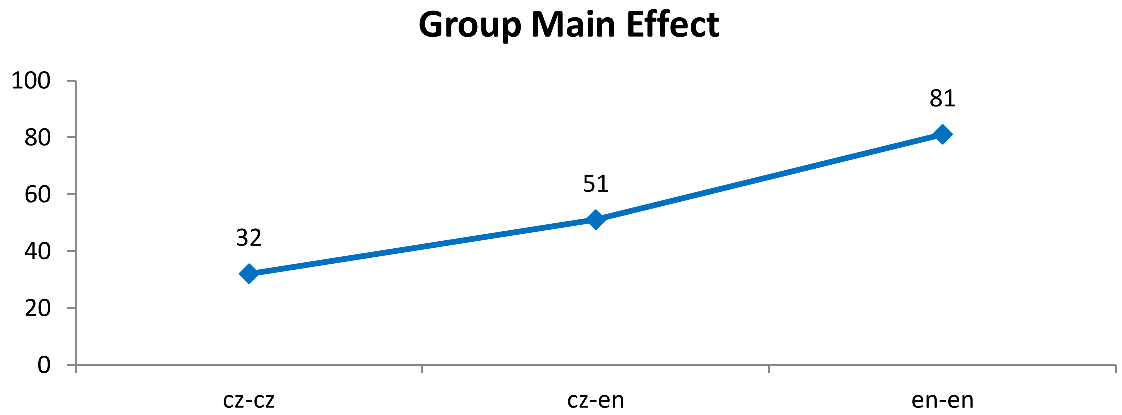
APPENDIX G

Figures of Significant Main Effects and Interactions

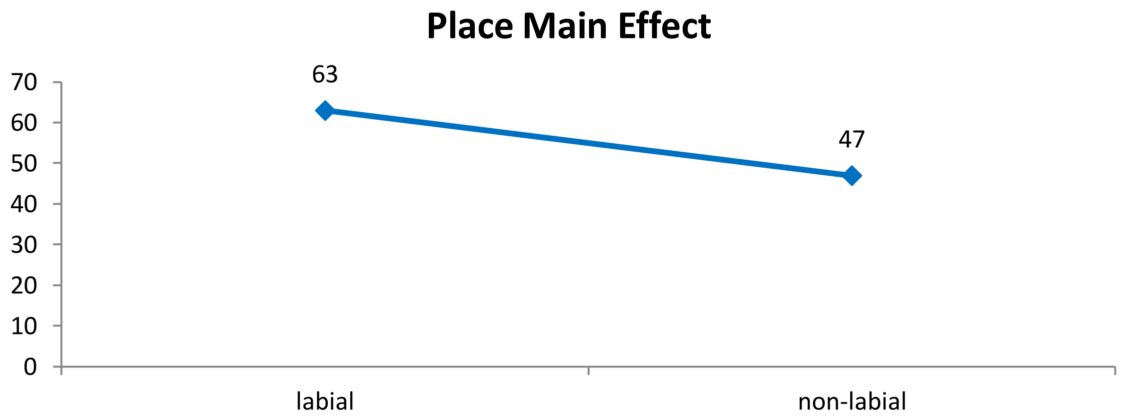
1) LABIAL – NON-LABIAL



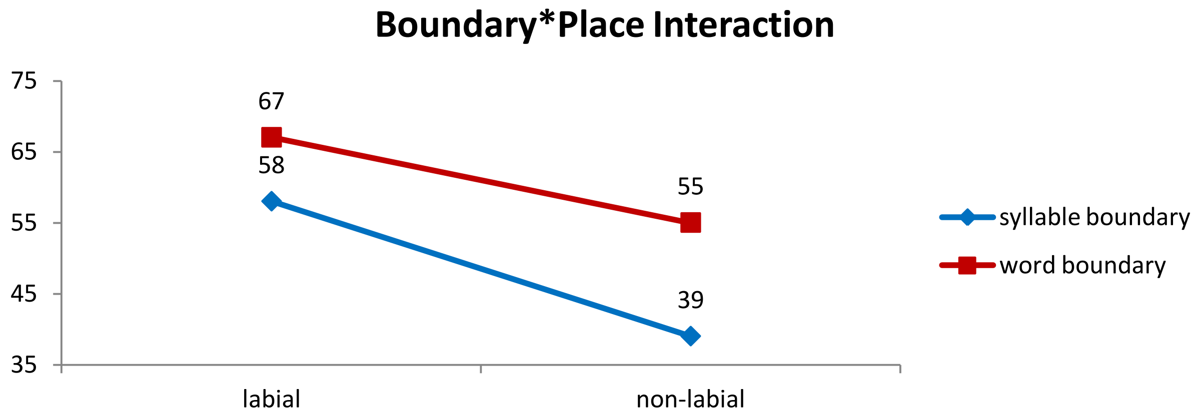
The percentage of unreleased stop-stop sequences concerning just the Boundary variable (Place: labial – non-labial).



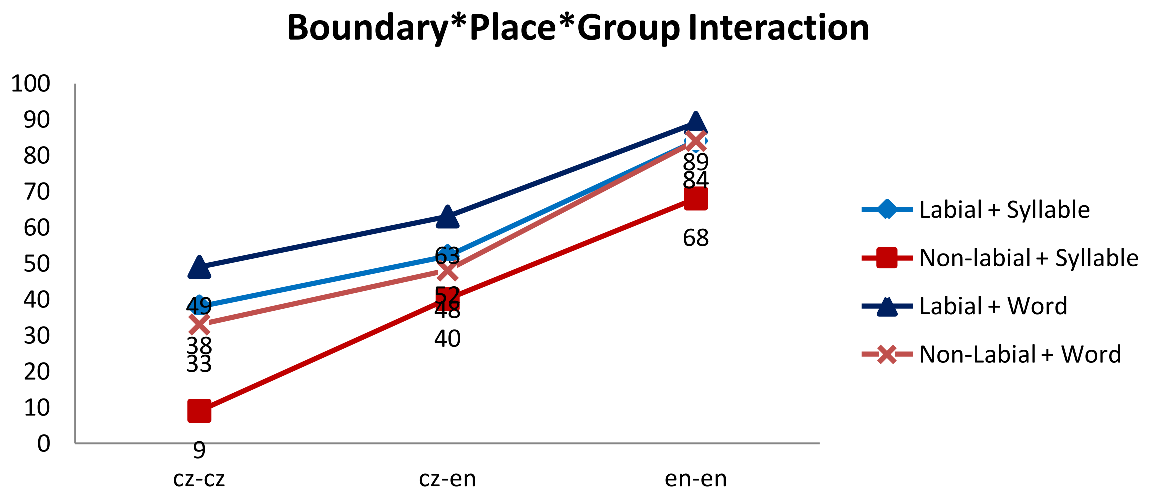
The percentage of unreleased stop-stop sequences concerning just the Group variable (Place: labial – non-labial).



The percentage of unreleased stop-stop sequences concerning just the Place variable (Place: labial – non-labial).

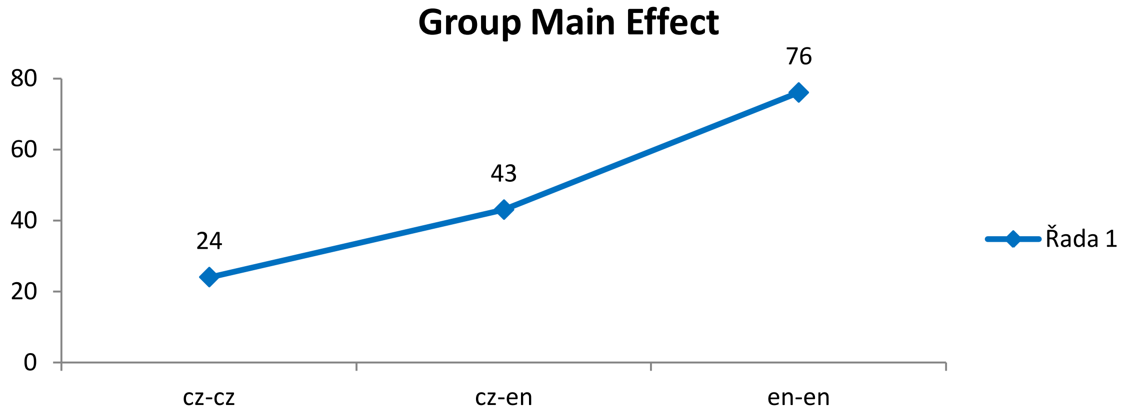


The percentage of unreleased stop-stop sequences considering the Boundary and the Place variable (Place: labial – non-labial).

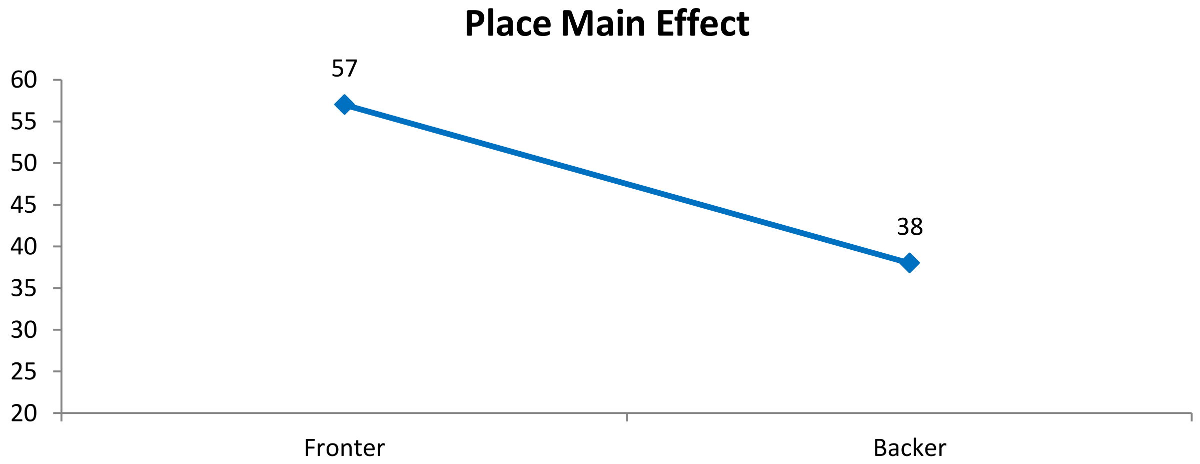


The percentage of unreleased stop-stop sequences considering the Boundary, the Group and the Place (Place: labial – non-labial).

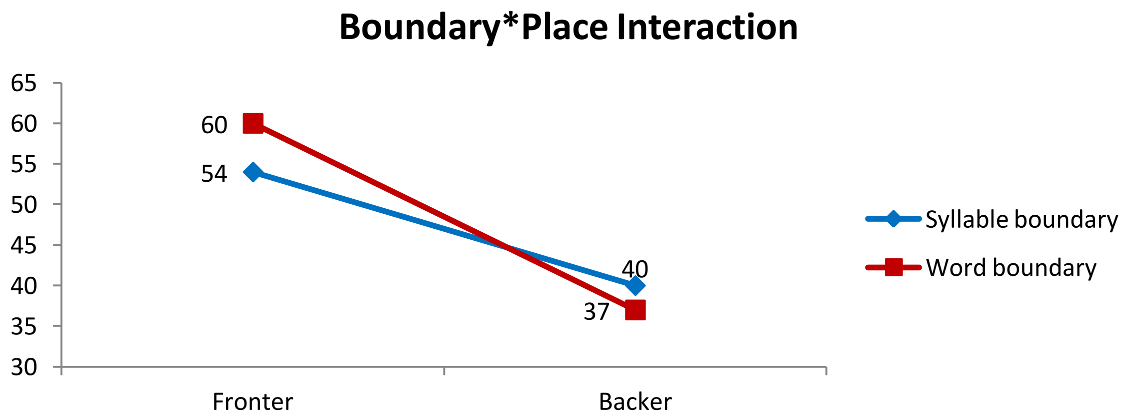
2) FRONTER - BACKER



The percentage of unreleased stop consonant sequences concerning the Group variable (Place: fronter – backer)..

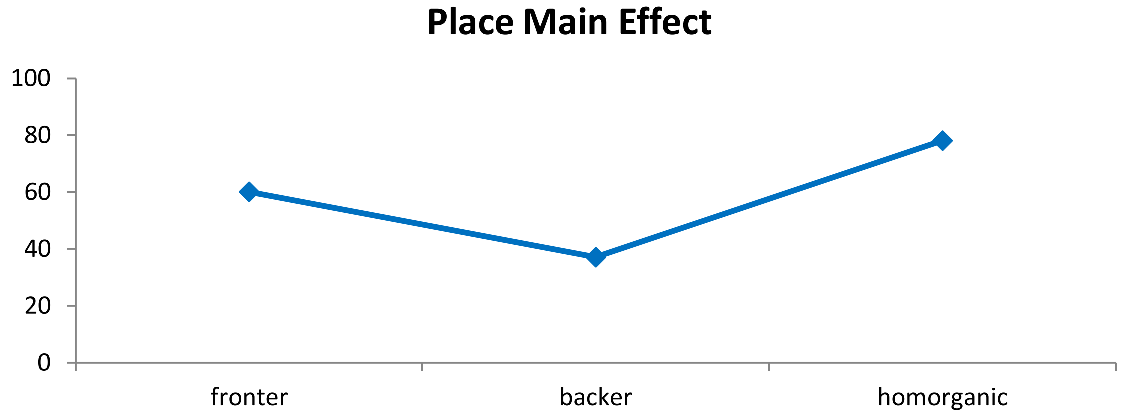


The percentage of unreleased stop consonant sequences concerning the Place variable (Place: fronter – backer).

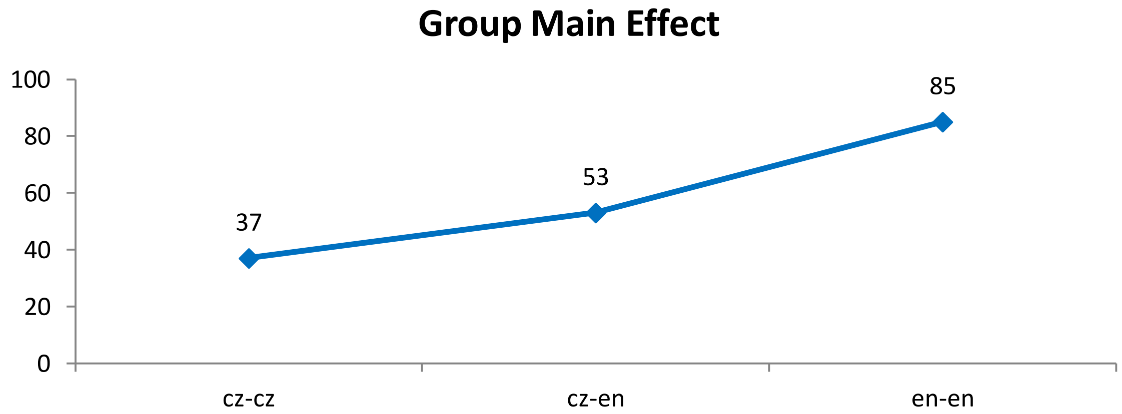


The percentage of unreleased stop consonant sequences concerning the Place and the Boundary (Place: fronter – backer).

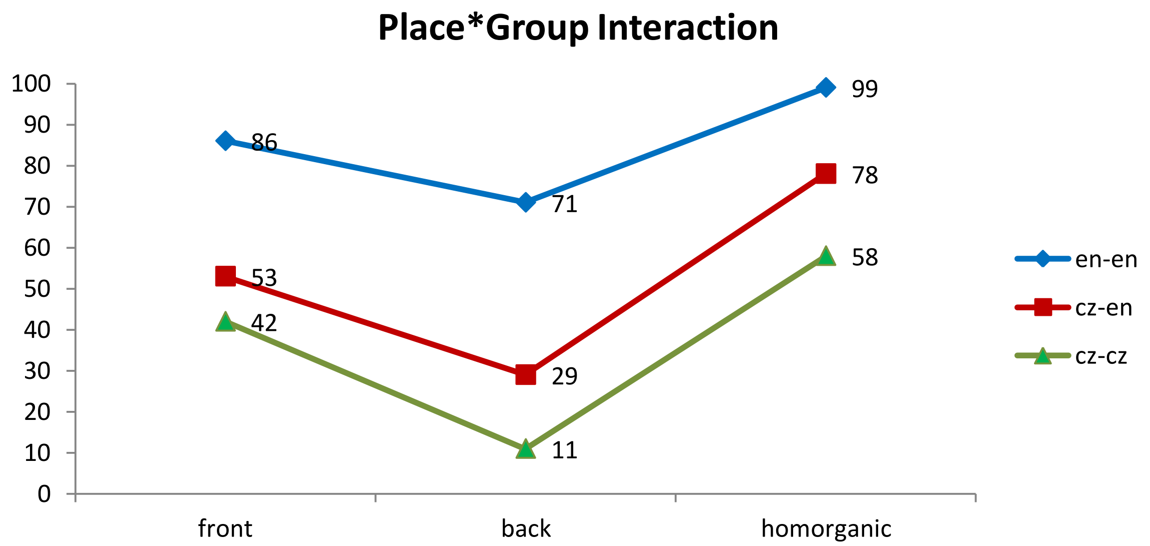
3) FRONTER – BACKER HOMORGANIC



The percentage of unreleased stop consonant sequences concerning the Place variable (Place: fronter – backer – homorganic).



The percentage of unreleased stop consonant sequences concerning the Group variable (Place: fronter – backer – homorganic).



The percentage of unreleased stop consonant sequences concerning the Place and the Group.