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# VOT in Czech speakers of English and English speakers of Czech

(bakalářská práce)

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*Prohlašuji, že jsem tuto diplomovou práci vypracoval samostatně a uvedl úplný seznam citované a použité literatury.*

*V Olomouci dne 23. 6. 2016* .....

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# 1 Introduction

This thesis focuses on Voice Onset Time (VOT) phenomenon and on its influence on second language learners' perception and production. More specifically, the influence of two features - aspiration and prevoicing, which are caused by the different VOT values, will be examined.

Voice Onset Time is a significant feature when it comes to distinguishing between initial stop consonants in speech. It is defined as "the interval between the release of a closure and the start of the voicing" (Ladefoged 2014, 159). In English, VOT differs in voiced and voiceless stop consonants. When a voiceless stop occurs in a stressed syllable, it is said to be aspirated. Aspiration is the burst of air that comes out during the period of voicelessness after the release of the stop caused by longer VOT (Ladefoged 2014, 61). When a voiceless stop occurs in an unstressed syllable the VOT decreases, therefore the stop is said to be unaspirated. In voiced stop consonants, the vibration of vocal colds begins immediately after the release of the consonant. However, the voicing does not appear during the closure of the consonant. In Czech, voiceless stops are always unaspirated – the VOT is relatively short. On the other hand, in the case of voiced stops, the vocal folds start vibrating before the release of the stop consonant, thus, the VOT is negative – the stop consonant is prevoiced. Such differences are also important in speech perception. Abramson and Lisker (1972, 18) have examined these differences in English and Spanish speakers and found out that English speakers need to hear longer VOT values to perceive the initial stops as voiceless than Spanish speakers and initial stops with relatively short VOT can be still perceived as voiced.

According to the facts written above, we can suppose that the differences in VOT for voiced and voiceless stop consonants may be important for non-native perception and production of language. Czech learners of English are more likely to perceive and produce aspiration in English voiceless stops. On the other hand, since the voiced stop consonants in Czech are always prevoiced (have negative VOT), there is not a high probability that Czech learners of English will perceive relatively small amount of positive VOT in English voiced stops and they will not be likely to unlearn the prevoicing and start producing these stops with positive

VOT, either. The other reason which increases the probability that Czech learners are likely to learn to aspirate their English voiceless stops is that the absence of aspiration in English voiceless stops can influence word recognition (Utman et al 2000, 1307). Voiceless stops of Czech learners of English produced without aspiration – with short VOT – can be perceived as voiced by native English speakers (who produce their voiced stop consonants with short VOT). On the contrary, Czech speakers are not forced to start producing their voiced stop consonants without prevoicing, because stop consonants with negative VOT will still sound as voiced to English listeners, so it cannot lead to misunderstandings in meaning. Simon (2009) in her study examined Dutch learners' acquisition of English stop consonants. The study revealed that Dutch speakers were successful in acquiring English long-lag aspirated stops but they did not acquire English short-lag stops – they produced their English voiced stops with prevoicing. This was explained by the fact that aspiration is more acoustically salient than prevoicing.

For English learners of Czech it is the other way round. Their aspiration in voiceless stops cannot influence meaning in Czech so they are not forced to unlearn it – aspirated voiceless stops will be still perceived as voiceless by Czech listeners. However, the production of their voiced stops, which have positive VOT, can lead to misunderstandings, so they can be forced to learn how to prevoice their voiced stops.

The fact that the second language learners' phonetic system is influenced by different perception and production of initial stop consonants was examined by Flege, Schirru and Mackay (2001) in their study which confirmed that VOT values in the second language changes during its acquisition.

It can be hypothesized that a Czech learning English is more likely to learn to aspirate English voiceless stops, since the lack of aspiration can lead to voicing category misidentification by listeners, than to unlearn to prevoice the English voiced stops, since a prevoiced /b/ still sounds like a /b/ to an English listener. Applying the same logic, an English learner of Czech should be more likely to learn Czech prevoicing than to unlearn to aspirate. On the contrary, aspiration is more acoustically salient and conveys more perceptual cues than prevoicing. The goal of this thesis will be to test this hypothesis. In other words, this thesis finds

out if second language learners are more likely to learn subphonemic features that can differentiate meaning and carry more functional load or features which are more audible for them.

# 2 Theoretical Background

## 2.1 Stop Consonants

In the following section, I will provide basic information about stop consonants, define their characteristics, and reflect the differences between stop consonants in Czech and in English.

Stop consonants (also called stops or plosives) are such consonants which are formed by complete closure of the articulators. The closure basically blocks the airstream from the lungs and the air cannot escape through the vocal tract. Stops are divided into two categories – nasal and oral. In the case of nasal stops, the soft palate is down so the airstream can go out through the nose. In oral stops, the closure of the lips is released and followed by a burst of sound (Ladefoged and Johnson 2014, 15).

Stops are usually divided into three categories according to the place of articulation. Bilabial stops – the closure is created by a stricture of lips, alveolar stops - the closure is created by the blade or the tip of the tongue and the alveolar ridge, velar stops – the closure is created by the back of the tongue and the soft palate. The main parts of the upper and lower surface of the vocal tract are displayed in the Figure 1 and Figure 2 (taken from Ladefoged and Johnson 2014, 10 - 11).

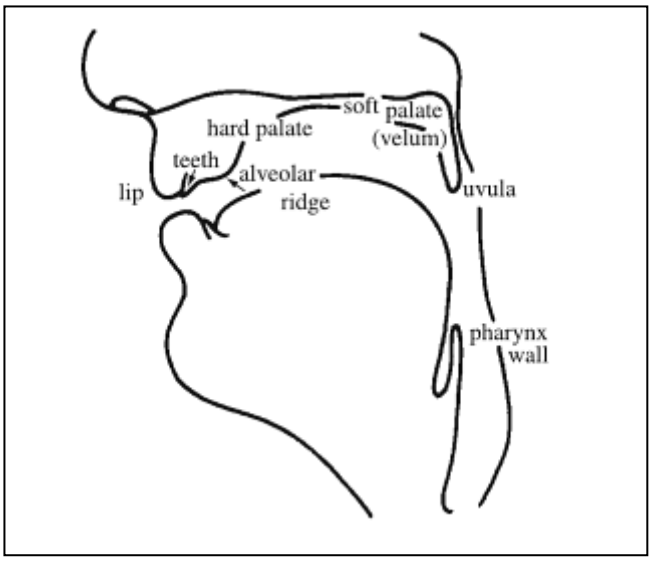


FIG. 1. The main parts of the upper surface of the vocal tract.

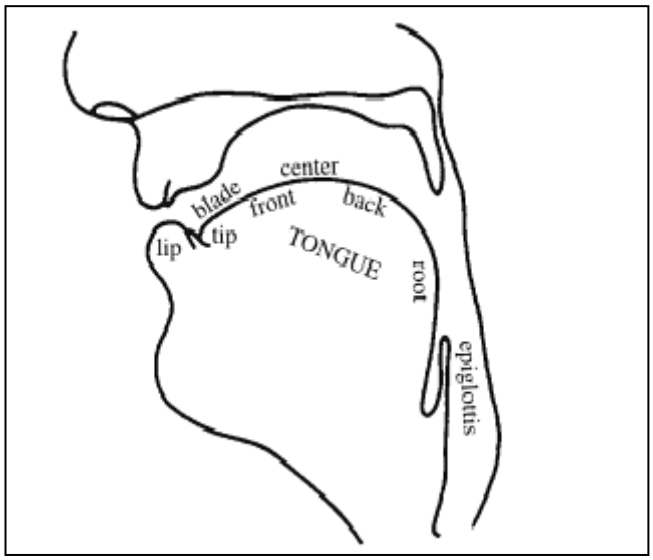

FIG. 2. The main parts of the lower surface of the vocal tract.

### *2.1.1 English Stop Consonants*

According to the place of articulation of the closure, there are three types of stops in English. Bilabial stops – the closure is created by a stricture of lips as in the words "pace, base", alveolar stops – the closure is created by the blade or the tip of the tongue and the alveolar ridge, as in the words "tie, dye" and velar stops – the closure is created by the back of the tongue and the soft palate, as in the words "cap, gap". In English, there are two categories of stop consonants – voiced and voiceless. The example of a voiced stop consonant is /b/ in the word "base", the example a voiceless stop consonant is /p/ in the word "pace". Most English speakers produce their /b/ in the initial position with no (or very little) voicing during the closure of the stop, therefore both /p/ and /b/ are basically voiceless (Ladefoged and Johnson 2014, 61). The main difference between the two categories of stop consonants is the amount of VOT. Abramson and Lisker (1964) measured the VOT values of American English speakers in their study. Most of the stops were produced with positive VOT values[1] (395), from 0 to 25 ms. Such stop consonants are called short lag stop consonants. The voiceless English stop consonants are produced with longer VOT between 60-90 ms (Simon 2010, 497) and they are called long lag stop consonants. The period of voicelessness after the stop closure and before the start of the voicing is called aspiration (Ladefoged and

[1] One of the speakers produced his stop consonants with negative VOT values, which was responsible for the average values.

Johnson 2014, 61). Thus, short and long lag stop consonants are also specified as aspirated and unaspirated. In English, voiceless stop consonants are always aspirated when they are in the initial syllable. The length of VOT is different in stops along with the place of articulation – VOT is the shortest in bilabials and the longest in velars.

#### *2.1.1.1 Fortis and Lenis*

Several studies focusing on the differences between voiced and voiceless stops that were carried in the past deal with the terms fortis and lenis - coined from Latin, meaning "strong" and "weak" (Stetson 1951, Malécot 1955, Yanagihara and Hyde 1966). These terms specify the force with which the stops are produced (Roach 1983, 31). However, Lisker (1970) argues that these studies demonstrate "neither the independence of a fortis-lenis dimension nor its priority over voicing as a distinctive feature for the English stops system" (216).

### *2.1.2 Czech Stop Consonants*

Czech stop consonants share similar characteristics with the English stops. Pálková (1994) states that the main characteristics are the creation of the closure followed by its release (explosion). There are four types of plosives in Czech – bilabial /b p/, alveolar /t d/, velar /k g/ and palatal /ď ť/ (which do not occur in English). As in English, Czech stop consonants can be voiced or voiceless. However, the difference between them is not the same as in English. Even though the acoustic properties of voiced and voiceless plosives in Czech are the same, there is a difference in voicing – the voiced stops are articulated with voicing during closure (Hála 1962, 207). This phenomenon is called prevoicing – vocal folds start vibrating before the closure so the VOT is negative.

## 2.2 Voice Onset Time

Voice onset time is one of the most crucial features of stop consonants. Ladefoged defines voice onset time as "the interval between the release of a consonant closure and the start of the voicing" (2014, 159). The "start of the voicing" stands for the moment when the vocal cords start vibrating. Voice onset time is the key factor when it comes to distinguishing between particular categories of stop consonants. First, the stop consonants are divided into a voiced

and voiceless category, depending on the amount of VOT. In English, there are very small values of VOT in voiced consonants, usually between 0-25 ms, whereas VOT in voiceless consonants is usually 60-90 ms. Such a long period of voicelessness is called aspiration.

### *2.2.1 Aspiration*

Aspiration is an important feature that occurs in most types of English. It is a characteristic feature of English voiceless consonants. When a stop consonant is released – the tip tongue leaves the alveolar ridge – one can feel a burst of air coming out of the mouth – this phenomenon is called aspiration (O'Connor 1973, 127). It is defined as "a period of voicelessness after the stop articulation and before the start of the voicing for the vowel (Ladefoged and Johnson 2014, 61). It is one of the features that distinguish voiced from voiceless consonants in English. Figure 3 shows the contrast between English aspirated stops /t/ and /d/ in words *tie* and *die*. After the noise burst in the word *tie*, one can see that the aspiration is not absolute voicelessness, but the vocal chords produce a friction noise before the vowel onset (Olive et al. 1993, 84). This noise is similar to the voiceless glottal fricative *h* – that is why it is indicated in a narrow transcription by a small raised *h*.

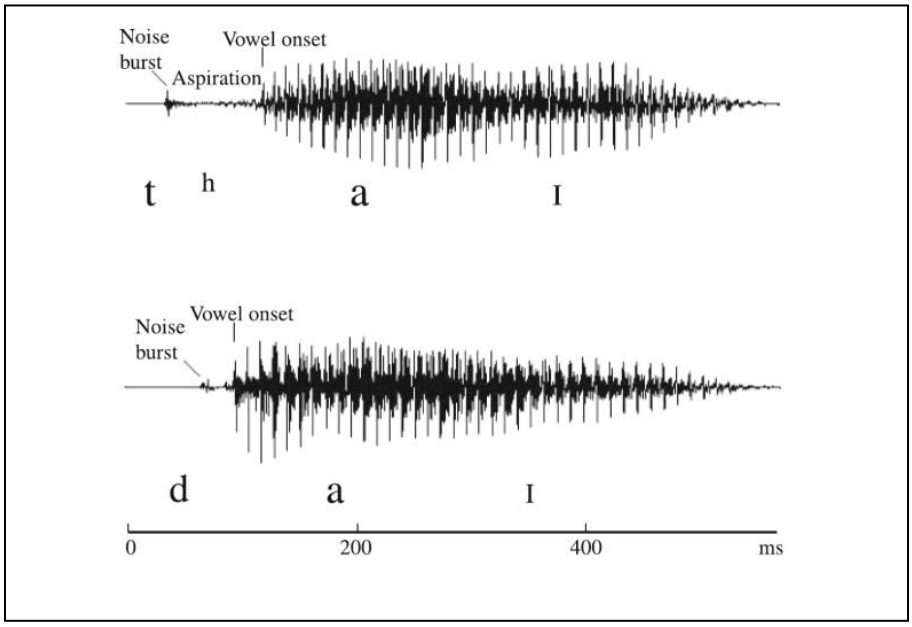


FIG. 3 The waveforms of the words *tie* and *die* (Ladefoged and Johnson 2014, 62).

### *2.2.2 Prevoicing*

In some languages, the vibrating of vocal folds takes place during the closure of the production of voiced stop consonants. This process is called prevoicing. Van Alphen and Smiths (2004) states several physiological and aerodynamic conditions under which prevoicing can occur:

> "First, the vocal folds must be adducted and tensed. Second, a sufficient transglottal pressure gradient is needed to result in enough positive airflow through the glottis to support vibration. The second condition is relatively hard to meet in the case of the closure of a plosive, since all outgoing pathways are closed. As a consequence, the air flowing through the glottis accumulates in the oral cavity, causing oral pressure to approach subglottal pressure."

## 2.3 Voicing Contrast

Discrimination between voiced and voiceless consonants with respect to differences in VOT has been the subject of many studies in the past. The studies focused on perception of the plosives as well as on their production. Abramson and Lisker carried out several studies dealing with this phenomenon. In their study from 1964, they have measured the VOT values across 11 languages and found out that voice onset time was a crucial feature for separating phonemic categories – the results showed certain boundaries in VOT values between voiced and voiceless categories in initial stops production. Later study by Abramson and Lisker (1967) concentrated on perception English, Spanish and Thai stops. The aim of the study was to match the previous production data with perception of initial stops. The results did not matched perfectly, which was probably caused by the high number of stimuli (synthetic words which varied in 10 ms steps of VOT), but they have shown that the VOT values of the three languages occupied "distinct ranges along the VOT dimension". Thus, the study confirmed that VOT is a major factor in determining category boundaries of stop consonants (15).

### *2.3.1 Acquisition of the Voicing Contrast in the L1*

In this section, I will summarize literature which focuses on the acquisition of voicing contrast in aspirating languages (English) and voicing languages (Czech) in the L1. The reason is to find out which type of the voicing contrast is easier to acquire in the L1.

### *2.3.2 Aspirating Languages*

Aspirating languages are those languages; whose voiced stops are short-lagged i.e. they have a short positive VOT values and voiceless stops are long-lagged – aspirated. An example of an aspirating language is English. One of the first studies on the acquisition of the voicing contrast in English as the L1 was carried out by Macken and Barton in 1980. The subjects of their study were four children whose parents were native speakers of American English. The children's speech was recorded every two weeks for eight-month period; the records were analyzed and VOT values were obtained. The children were the age of 1;6 when the recording sessions began. According to the analyzed data, there were three stages to the acquisition of voicing: 1) the child has no contrast; 2) the child has a contrast but one which falls within or nearly within the perceptual boundaries of one adult phoneme; 3) the child has a contrast which resembles the adult contrast (Macken and Barton 1980a, 33). More specifically, at the first stage, the children produced mostly short-lag stops, at the second stage, most stops is produced still with short-lag voicing, but they do differentiate the voiced and voiceless – VOT in voiceless stops is longer, even though it still falls to the short lag category - however, during or at the end of this stage, the first long-lag stops appear; at the beginning of the third stage, the children produced the voiceless stops with extremely long voicing and later at this stage the children shorten their voiceless stops toward the adult values (Macken and Barton 1980a, 36). To conclude, the children fully acquired the English voicing contrast at about the age of 2;4.

### *2.3.3 Voicing Languages*

The acquisition of the voicing contrast differs in voicing languages, i.e. languages that differentiate between prevoiced (negative VOT) and short-lag stops (short positive VOT). An example of a voicing language is Spanish. In Spanish,

the voiceless stops /p t k/ are produced with very low VOT values (from zero to a few milliseconds) and the voiced stops /b d g/ have negative VOT of -40 ms and less (Benkí 2005, 240). Eiler, Oller and Benito-Garcia (1984) carried a study dealing with acquisition of Spanish initial stop consonants. The aim of this study was to answer a question why the voicing contrast is acquired later in voicing languages than in the aspirating languages – this was suggested by Macken and Barton (1980b), who examined acquisition of Spanish stops by children and found out that they acquired the voicing contrast at about the age of four, which was two years later than their English peers. Results of the study by Eiler at al. suggested that both English and Spanish infants were able to acquire the voicing contrasts by the beginning of the third year life. According to Eiler at al., there were two explanations for the different results of their study and the study by Macken and Barton. First, the methodology differed – whereas Macken and Barton worked with spontaneous speech samples, the experiments by Eiler at al. were based on imitation, which could helped the children "in achieving good phonetic pronunciations since the modeled voicing contrasts were produced with hyperarticulated leads and lags by the experimenter" (Eiler, Oller and Benito-Garcia 1984, 334). However, this reason was dismissed as irrelevant after examining the records of the children's spontaneous speech. Second, each of the studies examined different dialects of Spanish, Mexican and Caribbean – this was only a speculative aspect which was not supported by data. However, another study by Allen (1985) dealing with the subject of acquiring the voicing contrast in French which also contrast between prevoiced and short-lag stop consonants supports the proposal by Macken and Barton (1980b) that the prevoiced stops are more difficult to pronounce than long-lag stops.

### *2.3.4 Acquisition of the Voicing Contrast in the L2*

Since the present study is concerned with the acquisition of the L2 laryngeal system in L2 production, I will give a summary of studies dealing with this particular issue. The early bilingual acquisition of two different voicing contrasts by a child learning English and Spanish was investigated by Deuchar and Clark (1996). The child, who was growing up in a bilingual a environment, was recorded between the ages of 1;7 and 2;3. The results showed that the child obtained the English adult-like voicing contrast by the age of 2;3 but it did not

acquired the Spanish lead vs. lag contrast. Simon (2010) examined the acquisition of L2 laryngeal system by a three-year-old native speaker of Dutch. The aim of the study was to find out if a child whose native language is Dutch is able to acquire English laryngeal system and also to examine whether the child makes a distinction between the L1 and L2 laryngeal system or uses one mixed laryngeal system. The results revealed that the child moved his Dutch laryngeal system towards the English one, i.e. he contrasted short-lag with long-lag stops in both Dutch and English (Simon 2010, 12). Simon (2009) also examined the acquisition of English laryngeal system by adult native Dutch speakers and suggested two hypotheses – Dutch learners of English will acquire English short-lag stops because they are unmarked in English and occur also in Dutch (phonetically "voiceless") or they will acquire English long-lag stops because aspiration is more acoustically salient. The first hypothesis was not confirmed – the participants of the research did not acquire English short-lag stops and produced English voiced stop with prevoicing as in Dutch, whereas the second hypothesis was confirmed – they succeeded in acquiring English long-lag stops. In comparison with the study from 2010, this study has suggested that whereas a three-year-old child influenced by L2 can "unlearn" prevoicing and fully adapt the L2 laryngeal system, adult native speakers cannot.

The level of acquiring subcategorical phonetic differences also depends on the age of exposure to the L2. This dependency was studied by Flege (1991) who examined VOT differences in Spanish-English bilinguals. The participants, native speakers of Spanish who learned English as an L2, were divided into two groups – early learners who learned English at the age of 5-6 years, and late learners who did not begin learning English until they were adults (397). The study examined the contrast which the early and late learners did in their pronunciation of Spanish and English /t/ sounds. The results showed that the early bilinguals produced English-like /t/ sounds whereas the late learners' VOT values were lower, thus they did not fully acquired English /t/ (404). Production and also perception of English stops was examined by MacKay, Flege and Piske in a more recent study from 2001. The participants were Italian speakers of English who differed in their age of arrival in Canada and the amount of L1 use. One of the questions of this study was whether the size of prevoicing in their L1 and L2 would vary with

respect to their age of arrival to Canada and/or their L1 use. According to one of the four experiments carried out in this study, the phonetic learning did take place and the participants who arrived in Canada in an early age (between 2-13 years of age) have a lower percentage of fully prevoiced stops than the participants who arrived in Canada later (between 15-26 years of age), and both of the groups prevoiced their stops less than monolingual Italian speakers (MacKay et al 2001, 521). The experiment has revealed that the amount of L1 input did not have significant influence on the L2 production. Part of the study was also an experiment dealing with perception of the stops by the same bilingual participants from the previously mentioned experiment. This experiment was based on identifying stops in non-words which occurred in no-noise and with-noise environments. The results showed that the late-bilinguals misidentified word-initial English stops more frequently than the early-bilinguals and native English speakers did which was due to the absence of prevoicing (MacKay et al 2001, 523). In the last part of the study, MacKay at al focused on Italian-English bilinguals' production of Italian /b d g/. All bilinguals prevoiced their stops less often than Italian monolinguals. The hypothesis that the early-low bilinguals would fully prevoiced their stops less often than the late-high bilinguals was confirmed.

## 2.4 Predictions for acquiring stop consonants in the L2

In this section, I will focus on probability of acquisition of the two properties of stop consonants in English and Czech discussed above – prevoicing and aspiration. When trying to make predictions for acquisition these two features of stop consonants, there are two different points of view that can be taken into account. First, we can look at these phonetic features as acoustic signals perceived without any linguistic knowledge i. e. we can consider only their acoustic characteristics. To make assumptions about the probability with which L2 learners are likely to acquire prevoicing and aspiration, we have to decide which one of these features has higher degree of noticeability. This degree of noticeability can be also called acoustic or perceptual salience.

### *2.4.1 Perceptual salience*

Perceptual salience is a term widely used in psychology and linguistics, which stands for the level of distinctiveness of one feature to other similar feature(s), in other words, how a feature stands out in comparison to its neighbors. Perceptual salience of acoustic features (also called acoustic salience or psychoacoustic salience) has been a subject of several studies, e.g., a study by Narayan (2007), dealing with the /m/-/n/ and /n/-/□/ contrasts, proved that acoustic salience has dominant influence on the perception and discrimination of phonetic contrast.

With respect to the acoustic properties, aspiration is more acoustically salient than prevoicing. Aspiration is noise at high frequencies, whereas prevoicing is tonal feature at a low frequency. Human hearing is more sensitive to high frequencies therefore it is probable that aspiration will be more salient than prevoicing. Moreover, aspiration (in English) occurs in all initial syllables that start with a voiceless consonant. Prevoicing (in Czech) is audible only when it occurs at the beginnings of sentences/utterances or a word preceding the voiced consonant ends with a voiceless consonant, it does not occur while the voiced consonant is preceded by a vowel.

The perception of two features that I focus on, aspiration and prevoicing, completely changes if we look at them as distinctive features i. e. we suppose that a listener has already acquired linguistic knowledge of his native language and these features can influence meaning. Talking about aspiration and prevoicing as distinctive features, there is a certain level of distintiveness/contrastiveness which these features have. This level of distintiveness is also called Functional Load.

### *2.4.2 Functional Load*

Wedel et. al (2013), who investigated the influence of functional load on phonological contrast loss mentions that the first idea of functional load was drawn by Gilliéro, who stated that "the probability of phoneme loss should be inversely related to the amount of "work" that the phoneme does in distinguishing words in communication" (3). Functional load was the subject of study of several linguists of Prague linguistic circle - Vilém Mathesius (1931), Roman Jakobson

(1931) and Nikolai Trubetzkoy (1939) developed the functional load hypothesis, which was later developed by Martinet (1952) and Hockett (1967). King (1967) defined functional load, based on the studies by the linguists stated above as follows:

> "The term functional load is customarily used in linguistics to describe the extent and degree of contrast between linguistic units, usually phonemes. In its simplest expression, functional load is a measure of the number of minimal pairs which can be found for a given opposition. More generally, in phonology, it is a measure of the work which two phonemes (or a distinctive feature) do in keeping utterances apart-in other words, a gauge of the frequency with which two phonemes contrast in all possible environments (831)."

Even though the acoustic difference between prevoiced voiced stops and short-lag stops is not very salient, they bear a certain level of functional load. Whereas English voiced stops are mostly short-lagged i. e. they have positive VOT, they might be perceived by native speakers of Czech as voiceless, because Czech voiceless stops are unaspirated – they have a very small amount of positive VOT and vice versa, due to the small amount of VOT, Czech voiceless stops can be perceived as voiced by native English speakers, because English voiceless stops are aspirated. This can lead to misunderstandings in meaning. For example, if a speaker of English learning Czech perceived Czech /b d g/ consonants the same way as the English ones (due to low acoustic salience of prevoicing) and produced them with positive VOT, a Czech listener could misinterpreted them as voiceless, e.g., the Czech verb "být" (to be) could be perceived as "pít" (to drink). Contrarily, if a Czech learner of English perceived English voiceless stops the same way as the Czech ones (even though the difference between them is more acoustically salient), English listeners could perceive them as voiced, e.g., the English adjective "cold" could be perceived as "gold".

### *2.4.3 Speech Learning Model*

When making predictions about the probability of acquisition of new phonetic features, we must also consider the Speech Learning Model hypothesis by Flege (1995), who investigated the influence of the L1 on the perception and production of the L2. The model is a set of hypotheses which focus on focuses on the pronunciation of the L2 by bilingual speakers, who "have spoken their L2 for many years, not beginners" (Flege 1995, 238). The first hypothesis of the model aims attention at the perception and production of positional allophones of the same phoneme in the L2, which L2 learners tend to relate to "the closest positionally defined allophone (or "sound") in the L1" (Flege 1995, 238). The second and third hypotheses deal with the phonetic similarities and differences of sounds in the L1 and the L2. Learners of an L2 are more likely to acquire a new phonetic category if they differentiate at least some of the phonetic differences between the L1 and L2 sounds, in other words, they are able to learn a sound of the L2 which is more different from the closest sound of their L1 than the sound which is more similar. Influence of the L2 learning on the L1 is also proposed by SLM. The acquisition of new phonetic categories can be affected by cross-linguistic interference. In that case, L2 learners use a single phonetic category for processing "perceptually linked L1 and L2 sounds (diaphones)" (Flege 1995, 239). Formation of a new phonetic category also depends on the age of learning (AOL), i.e. the age when an L1 speaker starts learning the L2. According to the SLM, the ability to perceive phonetic differences between L1 and L2 sounds decreases as AOL increases (Flege 1995, 239). Also, Flege states that AOL effects perception and production of both vowels and consonants. The acquisition of initial consonants, especially plosives, by L2 learners will be discussed in the next section.

According to the SML hypothesis stated above, there are some aspects which might influence the perception and production of stop consonants in second language learning. For instance, a Czech speaker learning English can relate the English aspirated [$p^h$] sound to the closest allophone in his L1, the Czech unaspirated [p], which can therefore be perceived by English native speakers as English /b/. According to the second hypothesis, it is not very probable that native speakers of a voicing language (a language that differentiates between prevoiced and short lag stops) are likely to learn aspirated stops because the phonetic

dissimilarity between aspirated and unaspirated /p/ sound is not very significant. From the opposite point of view, the probability that a speaker of aspirating language (a language that differentiates between short lag and aspirated stops) will learn to prevoice his voiced stops is even lower, because the dissimilarity between short lag voiced stops and prevoiced stops is very low.

## 2.5 Hypotheses

In this paper, I focus on the acquisition of a new voicing contrast by Czech learners of English and English learners of Czech.

In the case of Czech learners, there are two main aspects that I focus on. Firstly, it is the acquisition of English aspirated voiceless stops. As stated above, aspiration is an acoustically salient feature, therefore it can be assumed that a Czech learner of English is likely to notice the acoustic difference between Czech and English stop consonants and hence he will be likely to learn how to produce English voiceless stops. Aside from this, aspiration is also a feature that plays an important role in distinguishing the voiceless stops from the voiced stops so it can influence perception of a stop consonant and therefore influence meaning. Taking into account these two attributes – high perceptual salience of aspiration and the functional load of it - it can be hypothesized that a Czech learner of English will be likely to be successful in acquiring the English aspirated stops. The second aspect is the acquisition of English voiced stops. As well as in the case of voiceless stops, there is an acoustic difference between Czech and English voiced stops. Whereas Czech voiced stops are prevoiced – they have negative VOT – English voiced stops are often pronounced with a small positive VOT values. However, prevoicing is not a highly perceptually salient feature. Therefore, Czech speakers are not likely to perceive the absence of prevoicing in English. Moreover, the absence of prevoicing is audible in certain circumstances only – when the voiced stop is not preceded by a voiced sound (a vowel or a consonant). Furthermore, Flege (1991) states that L2 learners tend to relate positional allophones of the same phoneme to the closes to the closest allophone in the L1 so it can be assumed that Czech learners will related the English voiced stops to the Czech ones and will produce them the same way. When it comes to functional

load of prevoicing in English, its level is relatively low, because English voiced stops produced with prevoicing will be still perceived as voiced by a native speaker.

In the case of English speakers I will focus on acquisition of Czech voiceless and voiced stops. The acoustic difference between English and Czech voiceless stops is that English voiceless stops are aspirated, whereas Czech voiceless stops are not. Even though, the presence of aspiration is perceptually salient (as stated above), it cannot influence meaning. Aspirated voiceless stops will still sound as voiceless to Czech native speakers and there are no grounds for misunderstandings hence an English speaker is not likely to learn to unaspirate his voiceless stops in Czech. On the other hand, absence of prevoicing in English voiced stops can lead to misunderstandings, though it is not perceptually salient. Voiced stops with a small positive VOT value may be perceived as voiceless by a Czech native speaker. The English learner is therefore more likely to focus on the difference between the two sounds and on the right pronunciation of Czech voiced stops.

Taking into account the facts written above, two hypotheses can be proposed:

H1: Native speakers of Czech will be successful in acquiring English voiceless stops, because aspiration has a relatively high functional load in English and its absence can lead to misunderstandings by English native speakers. On the other hand, they will not be successful in acquiring English voiced stops, because prevoicing has a relatively low functional load in English and its presence cannot lead to misunderstandings by native English speakers. The hypothesis is also supported by perceptual salience of aspiration, which is higher than perceptual salience of prevoicing, therefore it will not be possible to determine which of these two properties is crucial for the acquisition of English voiceless stops.

H2: Native speakers of English will be successful in acquiring Czech voiced stops, because prevoicing has a relatively high functional load in Czech and its absence can lead to misunderstandings by Czech native speakers. On the other

hand, they will not be successful in acquiring Czech voiceless stops, because aspiration in Czech has a relatively low functional load and its presence cannot lead to misunderstandings by native Czech speakers. However, this hypothesis is weakened by the fact that prevoicing is less perceptually salient than aspiration – so it will be possible to determine which of these two properties is more crucial for the acquisition of Czech stops.

# 3 Methodology

## 3.1 Participants

6 participants took part in the experiment. Three Czechs participated – one student of grammar school, two university students, one of them was a student of the department of English and American studies at Palacký University in Olomouc. The other three participants were Americans, currently living in Olomouc, Czech Republic.

## 3.2 Stimuli

The stimuli consisted of 4 lists of words – English real words (45), English nonsense words (40), Czech real words (45), and Czech nonsense words (40). English real words consisted of 20 words beginning with stop consonants and 25 fillers beginning with other speech sounds. English nonsense words consisted of 20 made up words beginning with stop consonants and 20 made up fillers beginning with other speech sounds. Czech lists were made exactly the same way. In the all English words beginning with a voiceless stop consonant, the stops were word-initial because English stops are aspirated when they are word-initial or begin a stress syllable. Also those words beginning with voiced stops had stress on the first syllable so the participants pronounced them more properly. In each list, the words were chosen also with respect to the vowels following the initial stops. Low vowels were preferred to occur in the words more than high vowels. The reason for this was that vowels following the initial stops can influence the VOT. Stops followed by high vowels /i/ or /u/ have significantly higher VOTs than stops followed by low vowels (Morris et al 2008, 315). The influence of vowels on VOT was investigated also by other authors. Higgins et al. (1998, 721)

state that the factors which influence VOT are reduced peak air flow and increased vocal fold tension in the context of /i/ contrary to /ɑ/.

## 3.3 Procedure

The participants were asked to read aloud a list of words that appeared on the screen. Before reading them one at a time, they were asked to read the whole list for themselves. Each participant was supposed to read 4 lists of words – 2 lists in their L1 – the first list was real words and the second nonsense words, and 2 lists in their L2 – also real words and nonsense ones. Each list contained fillers. The words appeared on the screen automatically after a certain amount of time (real words 700 ms, nonsense words 1300 ms). If the participant made a mistake, the projection was stopped and continued from the previous word. The readings were recorded on a recorded Zoom H4n. The records were analyzed in scientific software Praat – all positive and negative VOTs were measured. After the analysis, the data were processed in STATISTICA software and submitted to a separate of analyses of variance (ANOVA).

# 4 Results and Discussion

The measured VOT values for each participant were submitted to separate analyses of variance (ANOVA) with Language (Czech, English), Stimulus Type (nonsense, real) and Voicing (voiced, voiceless) as the factors. Because the results are heterogeneous, i. e. the measured values differed for each participant, the results and discussion is stated separately for each subject in the following sections.

## 4.1 Czech learners of English

**Subject 1**

| Czech subject AP | F [1, 71] | p |
|---|---|---|
| Language | 0.3 | 0.578 |
| Stimulus Type | 0.1 | 0.706 |
| Voicing | 266.9 | 0,000* |
| Language*Stimulus Type | 1.4 | 0.245 |
| Language*Voicing | 17.7 | 0.000* |
| Stimulus Type*Voicing | 7.9 | 0.006* |
| Language*Stimulus Type*Voicing | 7.1 | 0.009* |

Table 1 – results of the ANOVA for Subject 1

As shown in Table 1, neither Language had a significant main effect on VOT, nor Stimulus Type. Unsurprisingly, the factor of Voicing had a significant effect on VOT. However, there was an interaction between the Language and Voicing – shown in the Figure 4. The measured VOT values of English voiceless stops were significantly higher (the mean VOT value = 45,9 ms) than the values of Czech voiceless stops (the mean VOT value = 29,3 ms). The subject therefore made a distinction between the voiceless stop consonants in his L1 and L2 and aspirated the English voiceless stops more. On the other hand, the subject did not reduce his prevoicing in his L2. In fact, the negative VOT values of English voiced stops were even lower (the mean negative VOT value = -47,9 ms) than the negative values in Czech (the mean negative VOT value = -26,1 ms), indicating longer prevoicing in L2 – English.

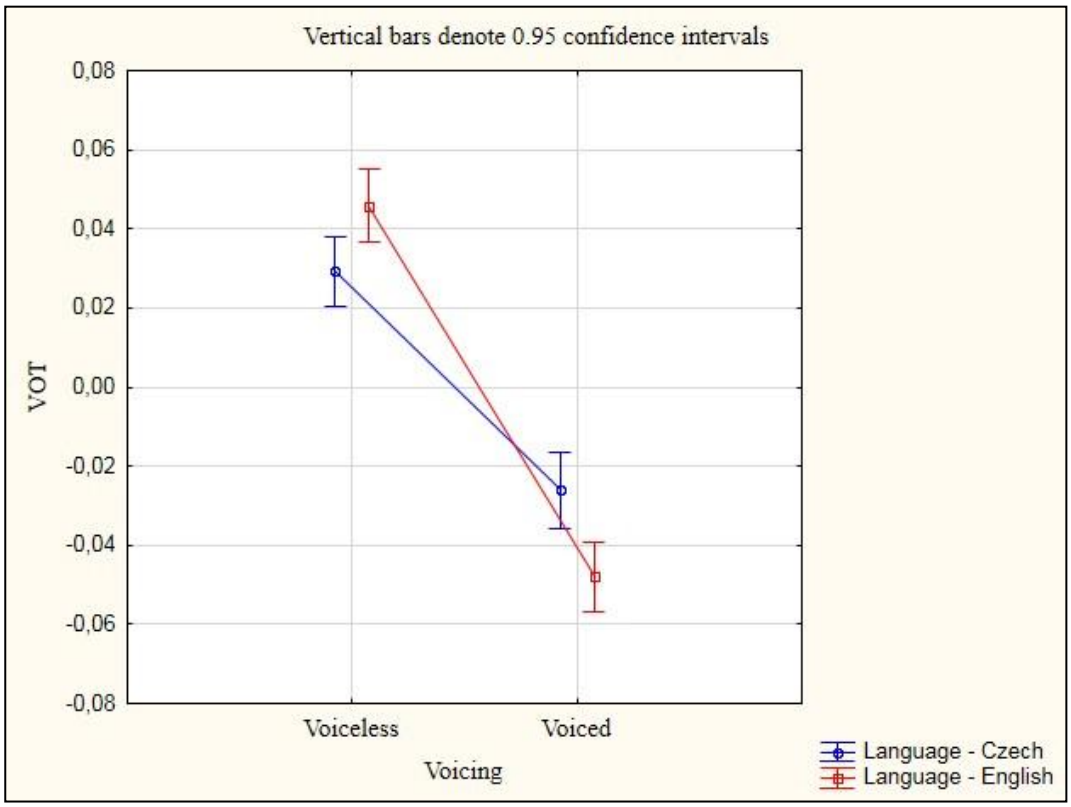


FIG. 4 ANOVA results of the interaction between Language and Voicing of the subject AP

Moreover, Subject 1's results also showed a three-way interaction between Language, Voicing and the Stimulus Type. As shown in Figure 5, the subject made a distinction between English and Czech voiceless stops only in production of real words but not in production of nonsense words.

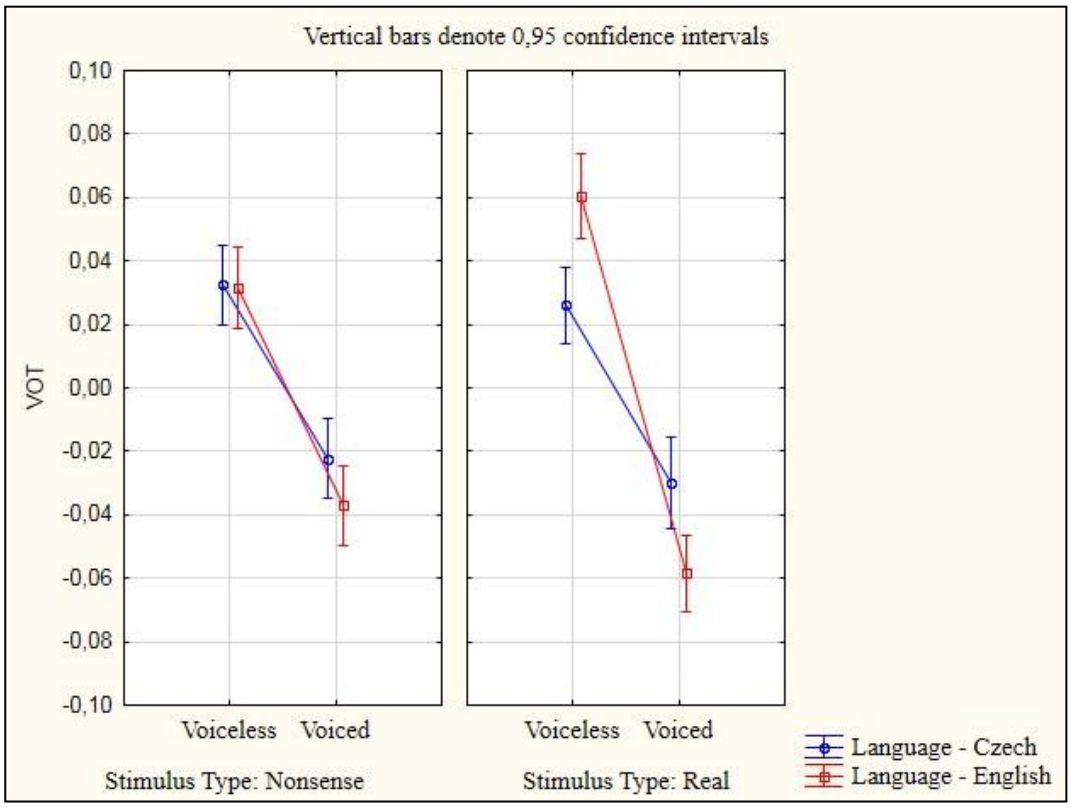


FIG. 5 The interaction between Language, Voicing and Stimulus Type

To conclude, Subject 1's results confirm H1. The subject made a distinction in pronunciation of English and Czech voiceless stops. The VOT values of English voiceless stops were close to native-like values (see Simon 2010). The VOTs of voiced stops, however, were Czech-like (Machač 2006, 144). The results do not allow us to decide between functional load and perceptual salience as the factors influencing the acquisition of English aspirated vs not prevoiced stops because, as explained above, both accounts have the same predictions: the lack of aspiration in English voiceless stops can influence meaning – unaspirated voiceless stops can be perceived by English native speakers as voiced – which might have been noticed by the subject during his L2 learning. At the same time, it is likely that the acquisition of English voiceless stops was also supported by the high level of perceptual salience of aspiration. Subject 1 might have noticed also the acoustic difference between English and Czech stops and start to produce the aspirated stops. Nevertheless, the functional load hypothesis is supported by the fact that the subject produced aspirated voiceless stops predominantly in the case of real words

and not in nonsense words, in which contrastiveness, i. e. the functional load of phonemic distinctions, does not apply.

**Subject 2**

| Czech Subject TZ | F [1. 71] | p |
|---|---|---|
| Language | 4.3 | 0.042* |
| Stimulus Type | 14.5 | 0.000* |
| Voicing | 426.2 | 0.000* |
| Language*Stimulus Type | 1.2 | 0.278 |
| Language*Voicing | 0.2 | 0.697 |
| Stimulus Type*Voicing | 5.5 | 0.022* |
| Language*Stimulus Type*Voicing | 1.5 | 0.23 |

Table 2 – results of the Subject 2

Table 2 shows that Language, Stimulus Type and Voicing had a significant effect on VOT. As shown in Figure 6, Subject 2's VOT means were higher in English than in Czech. Figure 7 shows the effect of Stimulus Type on VOT. The VOT means were lower in nonsense words than in real words. For better comprehension, there's Figure 8 that shows the data split by Language, Stimulus Type and Voicing (even though, the interaction of these 3 factors was not significant). It is evident that there was a shift between his Czech and English voiceless stops in real words, like in the case of Subject 1. The subject was therefore the most successful in acquisition of English voiceless stops – the mean VOT value was 37,9 ms. The subject did not make any distinction between English and Czech voiced stops. Although the distinction between the subject's voiceless stops in his L1 and L2 was not significant, the shift between them supports H1.

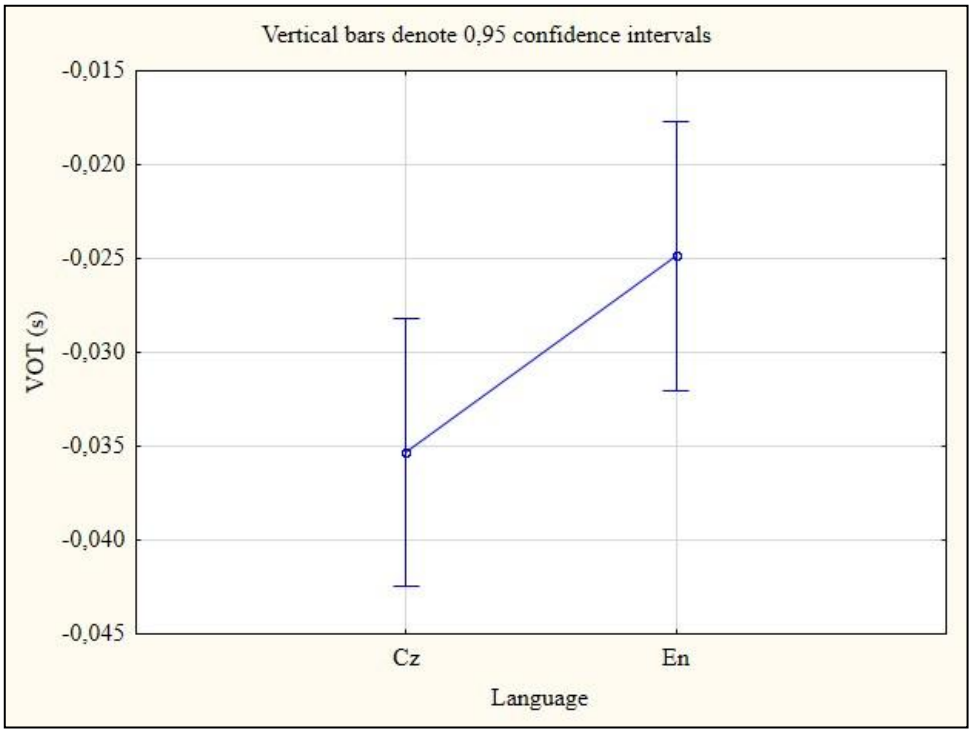


FIG. 6 Effect of Language on VOT

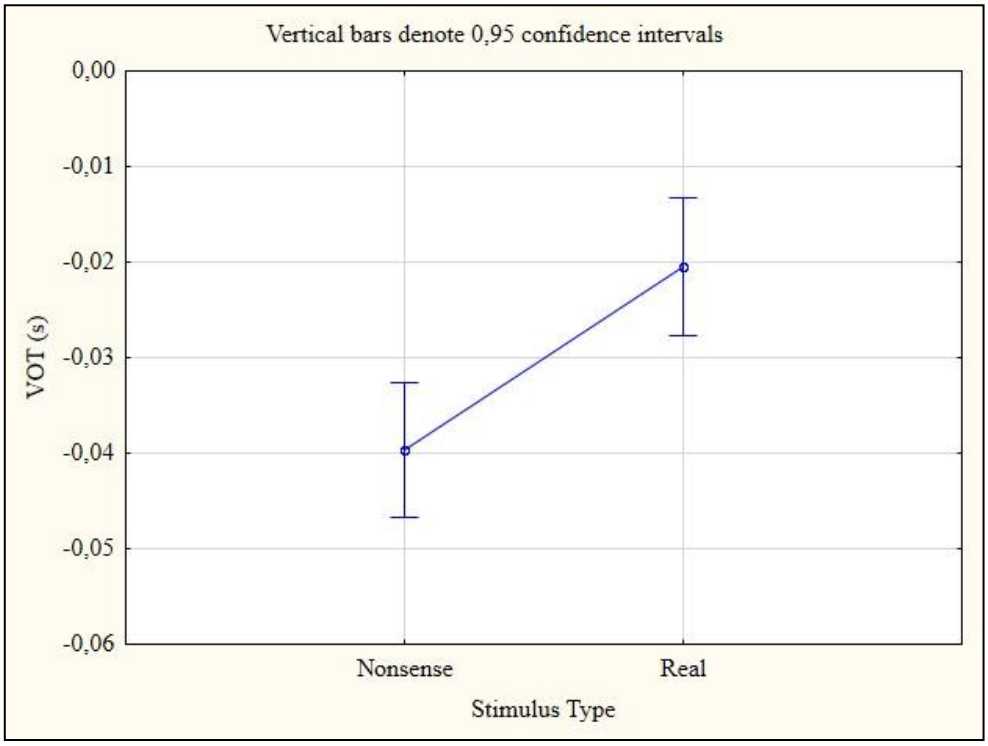


FIG. 7 Effect of Stimulus Type on VOT

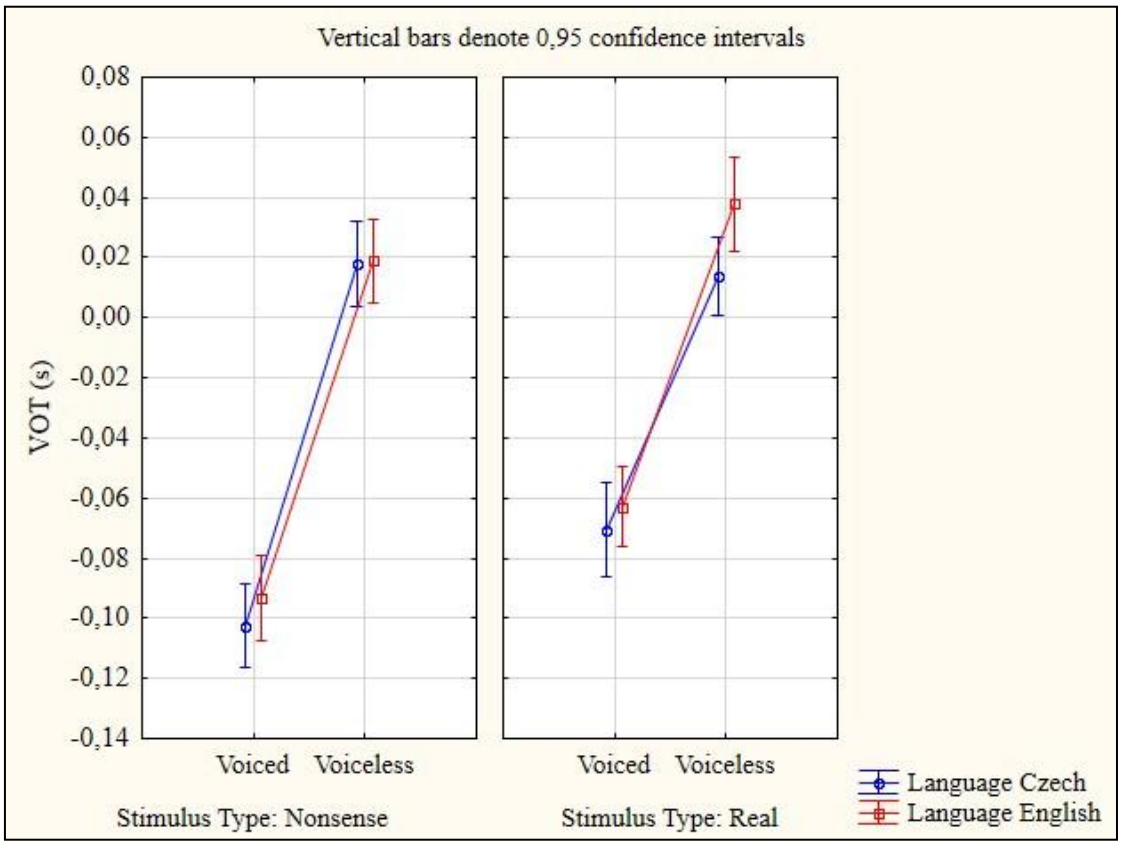


FIG. 8 Interaction of Language, Stimulus Type and Voicing

**Subject 3**

| Czech subject TR | F[1. 72] | p |
|---|---|---|
| Language | 194.0 | 0.000* |
| Stimulus Type | 0.5 | 0.499 |
| Voicing | 186.7 | 0.000* |
| Language*Stimulus Type | 1.3 | 0.249 |
| Language*Voicing | 13.9 | 0.000* |
| Stimulus Type*Voicing | 0.9 | 0.338 |
| Language*Stimulus Type*Voicing | 0.2 | 0.686 |

Table 3 – results of the Subject 3

Table 3 shows that Language has a significant main effect on VOT and again, Voicing had a significant effect on VOT, which was not surprising. The fact that Language had a significant effect on VOT means that the subject produced his voiced and voiceless stops totally differently (with absolutely different VOT values) in Czech and in English as shown in Figure 9.

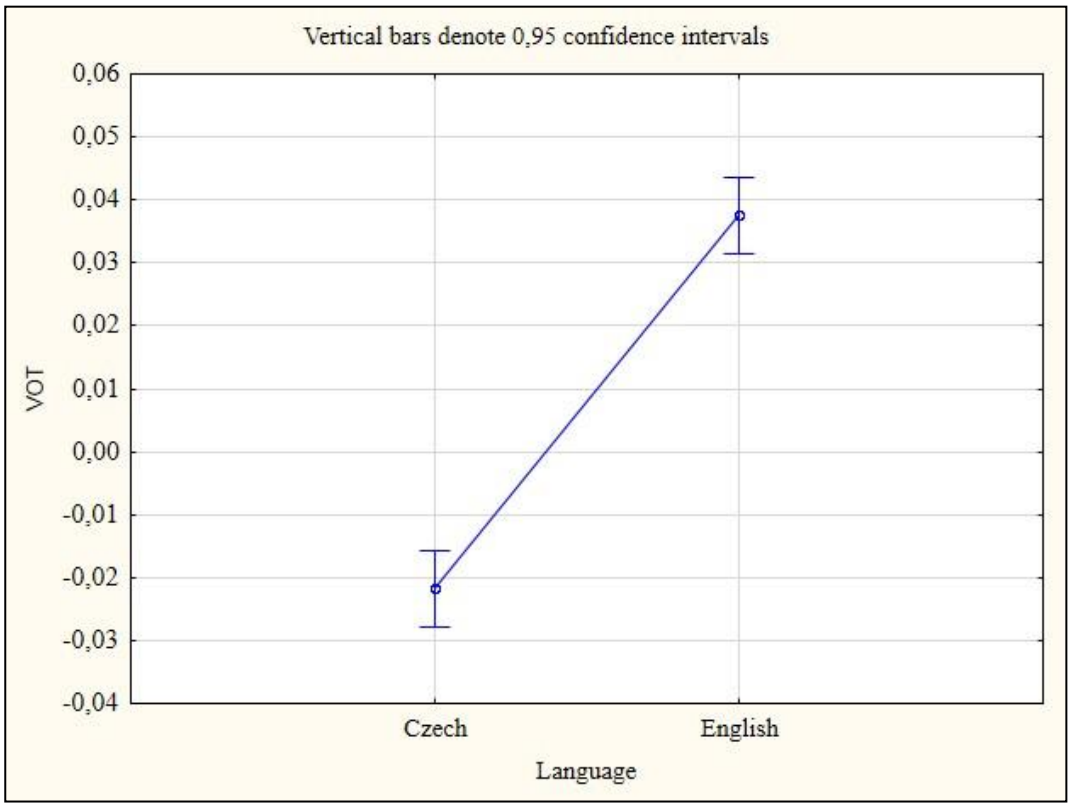


FIG. 9 Effect of Language on VOT

Language interacted with Voicing which is shown in Figure 10. The subject produced his voiced stops in Czech with negative VOT values from -68.1 ms to -0.50 ms, whereas the English voiced stops were produced with positive VOT values from 8.3 ms to 24.5 ms. The difference was significant also in production of voiceless stops – the voiceless stops in Czech were produced with VOT values from 7.2 to 23.3 ms, whereas English voiceless stops with VOT values from 50 ms to 67.4 ms.

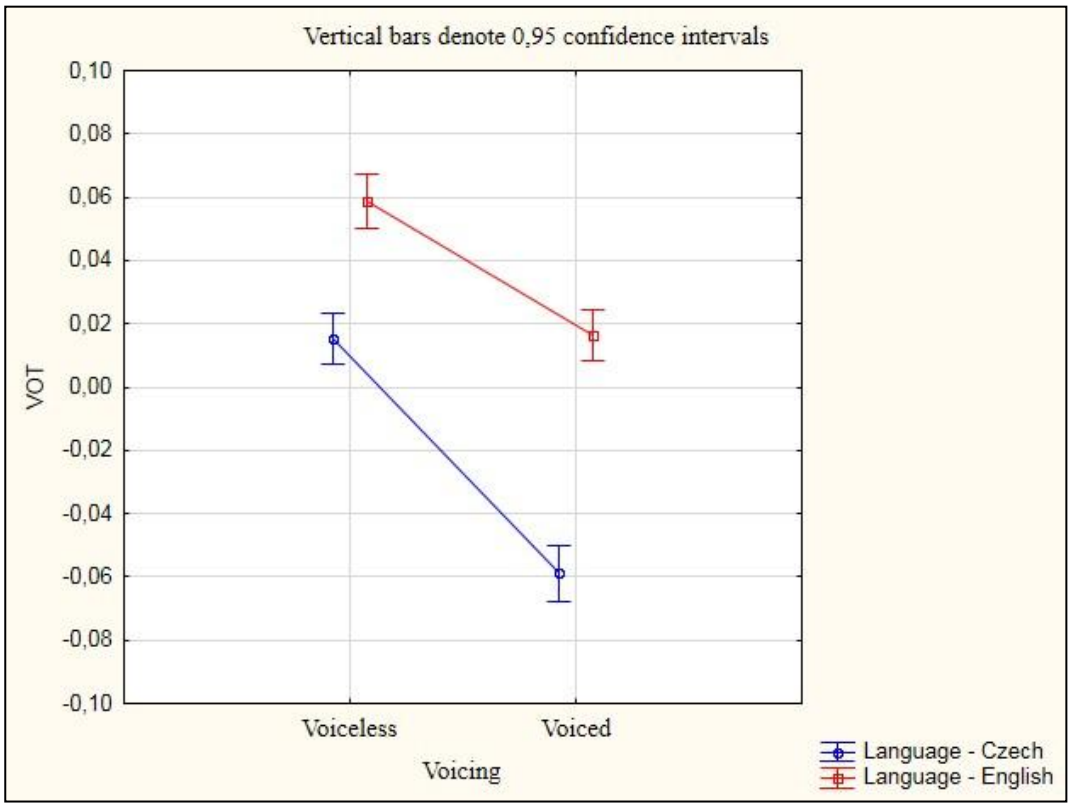


FIG. 10 Interaction between Language and Voicing of the Subject 3.

It is evident that Subject 3 made distinction in pronunciation of both voiced and voiceless stops in his L1 and L2. He learned to aspirate his English voiceless stops but the most interesting thing is that he learned to unprevoice his English voiced stops (all English voiced stops had positive VOT values), whereas all his Czech voiced stops remained prevoiced. This subject therefore succeeded in acquiring both English voiced and voiceless stops. This is an interesting result – the absence of prevoicing in English has a relatively low level of perceptual salience. Prevoiced and unprevoiced voiced stops neither make a difference with respect to meaning – they have a low level of functional load. This is, however, true from the English native speaker's point of view only – English native speaker perceives prevoiced and unprevoiced voiced stop as the same. On the other hand, a Czech native speaker is likely to misunderstand English voiced stop and perceive them as voiceless. It is possible that these misunderstandings led to Subject 3's realization of the difference between Czech and English voiced stops and consequential acquisition of the L2 voiced stops.

Since the subject fully acquired both voiced and voiceless English stops, the results neither confirm H1 nor reject it – the subject might have passed a stage where there was a difference in the degree of acquisition between his English voiced and voiceless stops, which is undeterminable.

## 4.2 English learners of Czech

### Subject 4

| English Subject ZP | F [1. 71] | p |
|---|---|---|
| Language | 7,2 | 0.009* |
| Stimulus Type | 0 | 0.859 |
| Voicing | 122,7 | 0.000* |
| Language*Stimulus Type | 0 | 0.860 |
| Language*Voicing | 4,2 | 0.044* |
| Stimulus Type*Voicing | 0.2 | 0.681 |
| Language*StimType*Voicing | 0.6 | 0.433 |

Table 4 – results of Subject 4

Table 4 shows that Language and Voicing had a significant main effect on the L1-English Subject 4's L2-Czech VOT. The effect of Language is shown in Figure 11. The figure shows that there was a significant distinction between Czech and English VOT values.

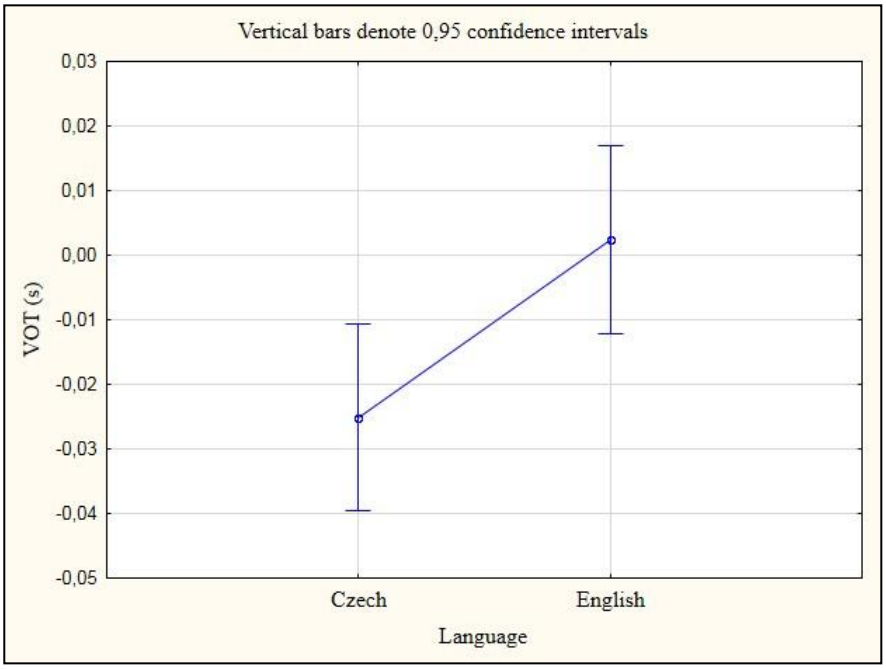


FIG. 11 – Effect of Language on VOT

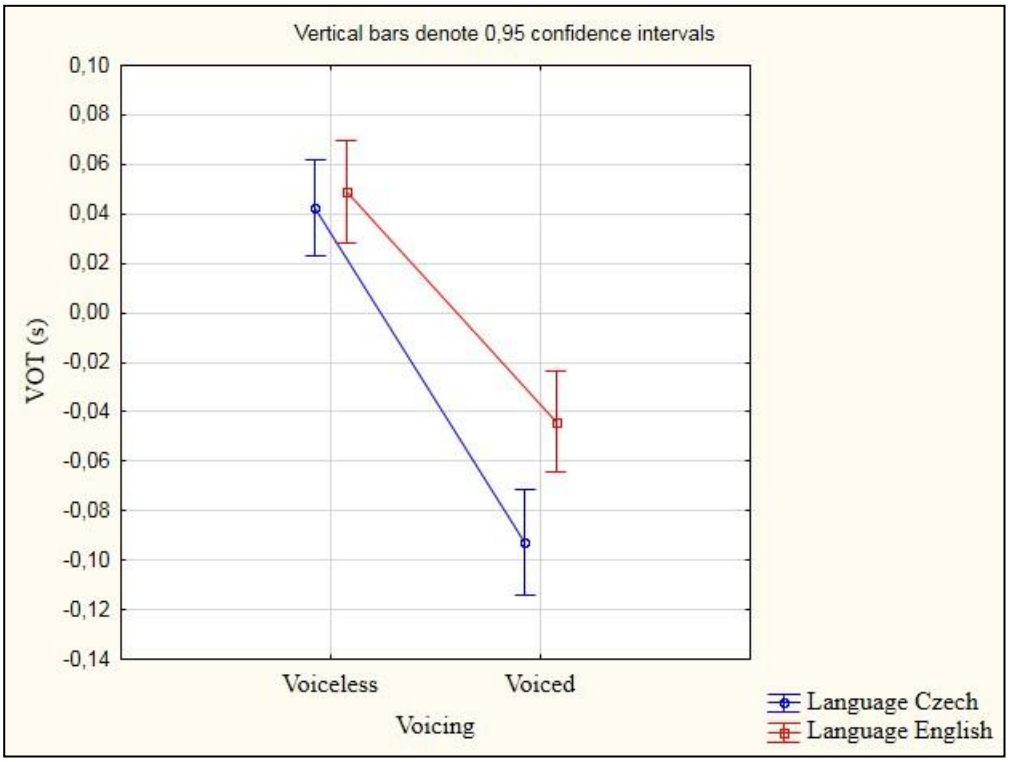


FIG. 12 – Interaction between Language and Voicing

Even though the subject made some distinction between Czech and English, Figure 12 shows that there was only a subtle difference in pronunciation of English and Czech voiceless stops and the subject aspirated his voiceless stops in Czech. The difference of voiced stops was more significant. The figure shows he prevoiced Czech voiced stops somewhat more than the English ones. Moreover, the negative means for his English is caused by occasional occurrence of prevoicing. This result supports H2.

**Subject 5**

| English Subject CF | F [1.71] | p |
|---|---|---|
| Language | 2.52 | 0.117 |
| Stimulus Type | 6.81 | 0.011* |
| Voicing | 76.63 | 0.000* |
| Language*Stimulus Type | 8.04 | 0.006* |
| Language*Voicing | 0.27 | 0.605 |
| Stimulus Type*Voicing | 6.5 | 0.013* |
| Language*Stimulus Type*Voicing | 7.68 | 0.007* |

Table 5 – results of Subject 5

Table 5 presents the ANOVA results for Subject 5. It shows that apart from the expected main effect of Voicing, only Stimulus Type had a significant main effect on VOT, but not Language. The effect of Stimulus Type is displayed in Figure 13.

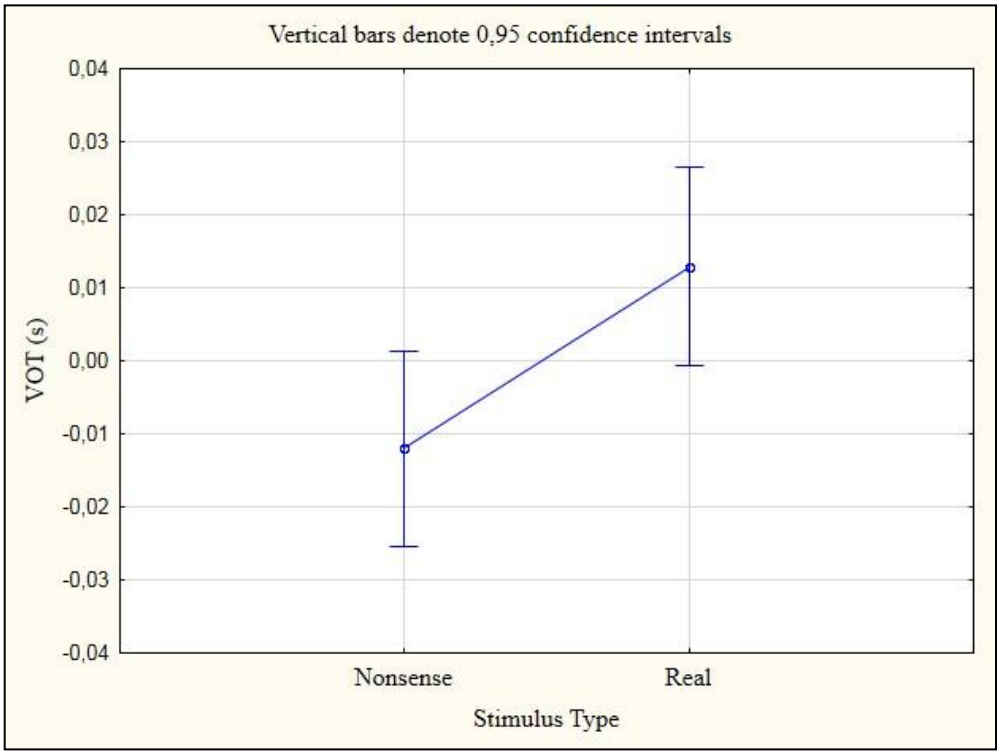


FIG. 13 – Effect of Stimulus Type on VOT

The figure shows that the VOT values were significantly higher in real words than in nonsense words, which could be attributed to the fact that there's a very low level of functional load (or contrastiveness) in nonsense words than in the real ones. However, the lower VOT in nonsense words was due to more negative VOT in Czech words (as can be seen in Figure 14), which might be also caused by the tempo – the subject produced prevoicing more often in slower speech (nonsense words) than in faster speech (real words).

The interaction between Language, Stimulus Type and Voicing (Figure 14) shows that the subject prevoiced Czech non-sense words but did not prevoice Czech real words. A possible explanation for this could be that the subject has realized the difference between Czech and English voiced stops, but was able to produce only when focusing on the pronunciation – the intervals of screening of nonsense words were longer than of real words and the participants had more time to focus

on the pronunciation. Moreover, the subject prevoiced also his English voiced stops in real words so the results cannot be taken as a strong support of H2.

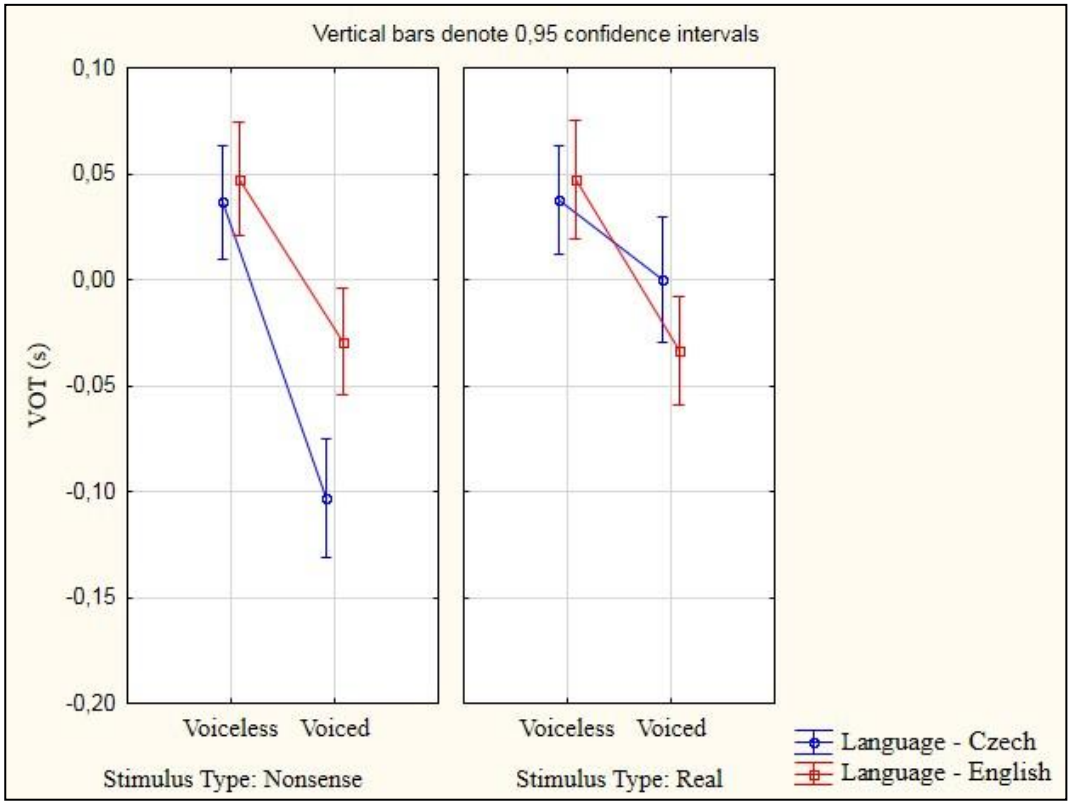


FIG. 14 - Interaction between Language, Stimulus Type and Voicing

**Subject 6**

| English Subject DB | F [1.72] | p |
|---|---|---|
| Language | 5,3 | 0.025* |
| Stimulus Type | 0.0 | 0.865 |
| Voicing | 175.3 | 0.000* |
| Language*Stimulus Type | 0.0 | 0.932 |
| Language*Voicing | 0.7 | 0.418 |
| Stimulus Type*Voicing | 1.1 | 0.303 |
| Language*Stimulus Type*Voicing | 0.6 | 0.460 |

Table 6 – results of Subject 6

Table 6 shows that Language and Voicing had a significant effect on VOT. Effect of Language on VOT is shown in Figure 15. It is evident that VOT values were significantly higher in English stops than in Czech.

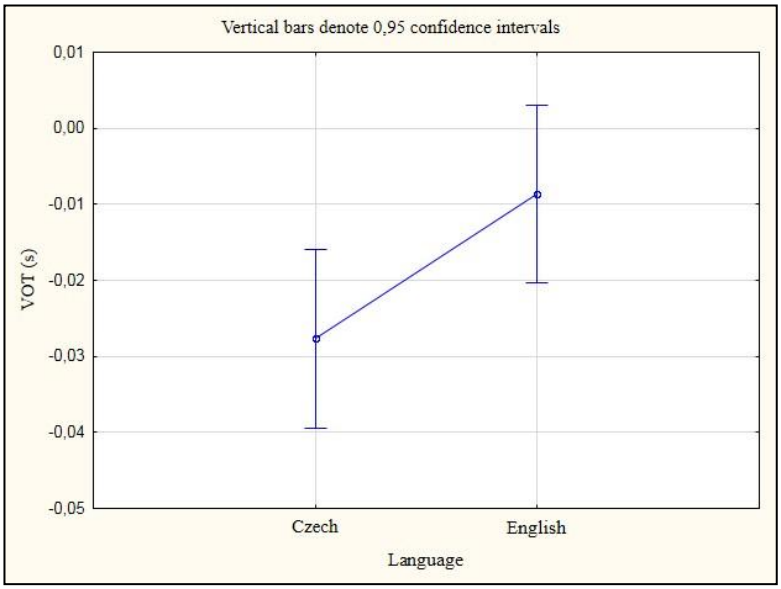


FIG. 15 Effect of Language on VOT

Even though there was not a significant interaction between Language and Voicing (p = 0.419), Figure 16 shows that Subject 6 produced his Czech voiceless stops with lower (i. e. more Czech-like) VOT values – from 8,5 ms to 39,1 ms, than his English voiceless stops – from 32.7 ms to 66, 4 ms, which indicates a certain shift the speaker's L2 away from his L1 values. This shift indicates that the subject has noticed the acoustic differences between English and Czech voiceless stops, which have a high level of perceptual salience. There was almost no difference in his English and Czech voiced stops – the subject prevoiced his voiced stops in both the L1 and the L2 the same, with highly negative VOT values.

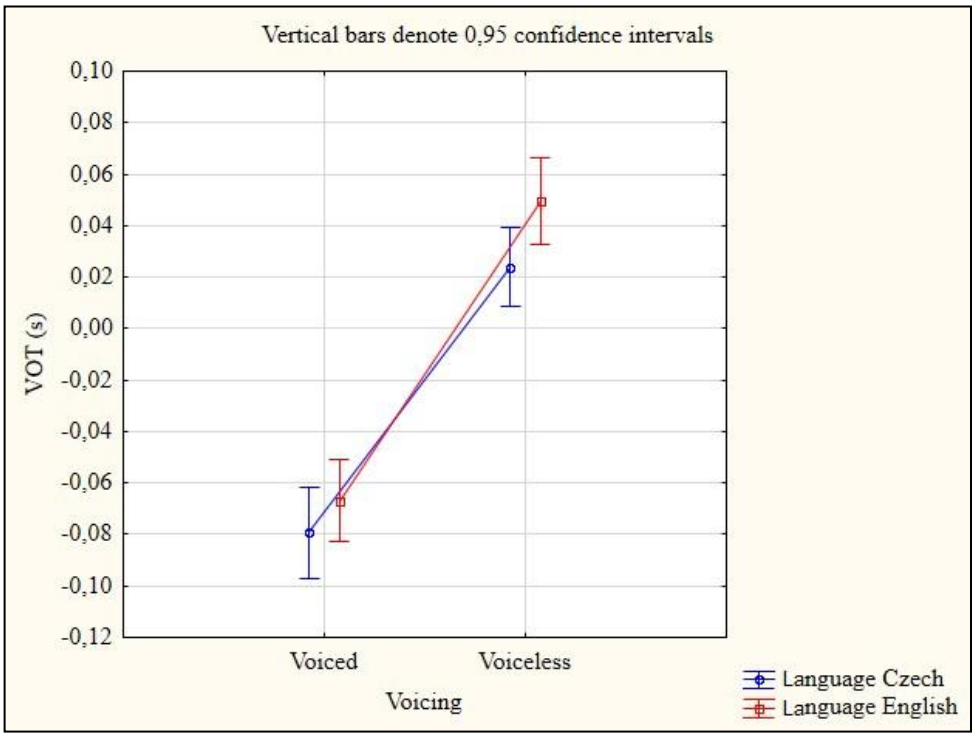


FIG. 16 – Interaction between Language and Voicing

## 4.3 Final Discussion

In this section, I would like to summarize and discuss the results of the two groups of speakers who took part in the experiment.

In the case of Czech speakers, all of the data of the three participants support the H1. Subjects 1 and 2 were more successful in acquiring English voiceless than in acquiring English voiced stops, which they failed to acquire – they produced them with prevoicing, as in their L1. Subject 3 was successful in acquisition of both English voiced and voiceless stops which contradicts one of the Simon's (2009) conclusions and that is that an adult whose native language is a voicing language cannot "unlearn" prevoicing. The fact that the Czech learners were more successful in acquiring English voiceless stops was, however, expected. Aspiration carries more functional load than prevoicing and is more perceptually salient. The ANOVA analyses of subjects 1 and 2, though, showed that the subjects made a distinction in real words whereas in nonsense words did not –

they made the distinction in the case where the presence of aspiration was more important to carry meaning.

The results of the English native speakers were more relevant for this study, because in their case it was determinable if the acquisition of Czech stop consonants relied more on the functional load or the perceptual salience. However, the results were not unequivocal. Only the first subject's VOT values in voiced stops supported H2. The subject prevoiced his Czech voiced stops more than his English voiced stops - the difference between his voiced stops in his L1 and L2 was significant so it can be stated that the subject acquired Czech voiced stops. The second English speaker also made a distinction in English and Czech voiced stops, however, it occurred in nonsense words only. The reason for that could be that the subject was focusing more on the right pronunciation of words in the case of nonsense words when he had more time to say one word than in the case of real words. Still, this finding does not enable to take the results of Subject 2 as a confirmation of H2. The last participant's results did not confirm H2 either. Even thought, the VOT values were lower in Czech than in English, the ANOVA showed that there was only a slight difference between his Czech and English voiced stops, which were both strongly prevoiced, and also between voiceless stops – the aspiration was slightly reduced in subject's Czech voiceless stops.

# 5 Apendix

## 5.1 Part 1

Part 1 includes 4 wordlists (Czech and English real and nonsense words) used in the experiment.

**English Wordlists:**

| **English Real Words** | |
|---|---|
| Words beginning with a stop | Fillers |
| barber | always |
| bark | animal |
| bored | aspect |
| dartboard | chicken |
| duchess | center |
| duck | cinema |
| dude | circle |
| dumping | envelope |
| garden | expensive |
| garlic | flower |
| golf | formal |
| partly | freedom |
| pass | homework |
| power | horrible |
| task | honesty |
| town | income |
| carpet | informal |
| color | intended |
| custom | introduction |
| cool | justice |
| | uncovered |

| | |
|---|---|
| | violence |
| | winning |
| | yellow |
| | zombie |

| **English Non-sense Words** | |
|---|---|
| Words beginning with a stop | Fillers |
| dorfidge | miscoon |
| dorbidge | oskwidge |
| daskwick | lanwick |
| gongridge | onwidge |
| gandroop | fillscoot |
| bantwick | rabidge |
| baswick | fludge |
| bokridge | fedge |
| bostooke | samidge |
| borwick | falidge |
| torfidge | niscoon |
| torbidge | uskwidge |
| taskwick | ranwick |
| congridge | unwidge |
| candroop | villscoot |
| pantwick | labidge |
| paswick | ludge |
| pokridge | vedge |
| postooke | hamidge |
| porwick | validge |

**Czech Wordlists:**

| Czech real words (p, t, k, b, d, g) | |
|---|---|
| Words beginning with a stop | Fillers |

| | |
|---|---|
| balík | anděl |
| boháč | anketa |
| boule | armáda |
| dálka | čekání |
| dárce | hadice |
| dobrák | hadr |
| galeje | hájek |
| gáza | hlad |
| padák | hrábě |
| pádlo | labuť |
| počátek | ladění |
| počítač | láhev |
| tabák | líčení |
| tábor | lilek |
| táhlo | lůžko |
| topůrko | lupič |
| kabát | macecha |
| kačer | mávnutí |
| kočka | meč |
| koláč | medvěd |
| | míček |
| | záměna |
| | žebřík |
| | zedník |
| | ženich |

| **Czech Nonsense Words** | |
|---|---|
| Words beginning with a stop | Fillers |
| bášek | solín |
| dokůl | hlámek |
| boliša | holák |
| došina | repál |

| | |
|---|---|
| dožina | lentoš |
| gábola | fornál |
| bontář | valnáž |
| damíř | zolnáž |
| gornál | strapál |
| baltán | hažán |
| pášek | zolín |
| tokůl | lámek |
| poliša | cholák |
| tošina | lepál |
| tožina | lemtoš |
| kábola | vornál |
| pontář | falnáž |
| tamíř | solnáž |
| kornál | ztrápal |
| paltán | lažán |

## 5.2 Part 2 – DVD

The DVD contains the recordings which were used for the experiment, their Praat scripts and statistics made in STATISTICA software.

Abramson, Arthur S., and Leigh Lisker. 1964. "A cross-language study of voicing in initial stops: Acoustical measurements." 384-422.

Abramson, Arthur S., and Leigh Lisker. 1972. "Voice-timing perception in Spanish word-initial stops." *Haskins Laboratories Status Report on Speech Research* 29 (30): 15-25.

Allen, George D. 1985. "How the young French child avoids the pre-voicing problem for word-initial voiced stops." *Journal of Child Language* 12 (1): 37-46.

Benkí, José. 2005. "Perception of VOT and first formant onset by Spanish and English speakers." *Proceedings of the Fourth International Symposium on Bilingualism*.

Deuchar, Margaret, and Angeles Clark. 1996. "Early bilingual acquisition of the voicing contrast in English and Spanish." *Journal of Phonetics* 24 (3): 351-365.

Eilers, Rebecca E., D. Kimbrough Oller, and Carmen R. Benito-Garcia. 1984. "The acquisition of voicing contrasts in Spanish and English learning infants and children: A longitudinal study." *Journal of Child Language* 11 (2): 313-336.

Flege, James Emil. 1991. "Age of learning affects the authenticity of voice-onset time (VOT) in stop consonants produced in a second language." *The Journal of the Acoustical Society of America* 89(1): 395-411.

Flege, James E., Carlo Schirru, and Ian RA MacKay. 2003. "Interaction between the native and second language phonetic subsystems." *Speech communication* 40 (4): 467-491.

Hála, Bohuslav. 1962. *Uvedení do fonetiky češtiny na obecně fonetickém základě*. Nakl. ČSAV.

Ladefoged, Peter, and Keith Johnson. 2014. *A Course in Phonetics*. Cengage Learning.

Lisker, Leigh. "Supraglottal air pressure in the production of English stops."*Language and Speech* 13.4 (1970): 215-230.

Lisker, Leigh, and Arthur S. Abramson. 1967. "Some effects of context on voice onset time in English stops." *Language and speech* 10 (1): 1-28.

Machač, Pavel. 2006. "Temporální a spektrální struktura českých explozív." *Disertační práce, Univerzita Karlova v Praze*.

MacKay, Ian RA, et al. 2001. "Category restructuring during second-language speech acquisition." *The Journal of the Acoustical Society of America* 110 (1): 516-528.

Macken, Marlys A., and David Barton. 1980(a). "The acquisition of the voicing contrast in English: A study of voice onset time in word-initial stop consonants." *Journal of Child Language* 7 (1): 41-74.

Macken, Marlys A., and David Barton. 1980(b). "The acquisition of the voicing contrast in Spanish: A phonetic and phonological study of word-initial stop consonants."*Journal of Child Language* 7 (3): 433-458.

Malécot, André. 1955. "An experimental study of force of articulation." *Studia Linguistica* 9 (1-2): 35-44.

Morris, Richard J., Christopher R. McCrea, and Kaileen D. Herring. 2008. "Voice onset time differences between adult males and females: Isolated syllables." *Journal of Phonetics* 36 (2): 308-317.

O'Connor, Joseph Desmond. 1973. *Phonetics*. Penguin Books.

Palková, Zdena. 1994. *Fonetika a fonologie češtiny: s obecným úvodem do problematiky oboru*. Karolinum.

Roach, Peter. 1983. *English phonetics and phonology*.

Simon, Ellen. 2009. "Acquiring a new second language contrast: an analysis of the English laryngeal system of native speakers of Dutch." *Second Language Research* 25 (3): 377-408.

Simon, Ellen. 2010. "Child L2 development: A longitudinal case study on Voice Onset Times in word-initial stops." *Journal of child language* 37 (1): 159-173.

Stetson, Raymond Herbert. "Motor phonetics; a study of speech movements in action.." (1951).

Utman, J. A., Blumstein, S. E., & Burton, M. W. 2000. "Effects of subphonetic and syllable structure variation on word recognition. " *Perception & Psychophysics* 62 (2): 1297–1311.

Van Alphen, Petra M., and Roel Smits. 2004. "Acoustical and perceptual analysis of the voicing distinction in Dutch initial plosives: The role of prevoicing." *Journal of phonetics* 32 (4): 455-491.

Wedel, Andrew, Abby Kaplan, and Scott Jackson. 2013. "High functional load inhibits phonological contrast loss: A corpus study." *Cognition* 128 (2): 179-186.

Yanagihara, Naoaki, and Charlene Hyde. 1966. "An aerodynamic study of the articulatory mechanism in the production of bilabial stop consonants."

# 6 Anotace

**Autor:** Jakub Grepl

**Katedra:** Katedra anglistiky a amerikanistiky FF UPOL

**Studijní obor:** Anglická filologie

**Název česky:** VOT u českých mluvčích angličtiny a anglických mluvčích češtiny

**Název anglicky:** VOT in Czech speakers of English and English speakers of Czech

**Vedoucí práce:** Mgr. Václav Jonáš Podlipský, Ph. D.

**Počet stran:** 47

**Počet příloh:** 1 + DVD

**Klíčová slova v ČJ:** doba nástupu hlasivkového tónu, plozivy, aspirace, znělost během závěru, percepční význačnost, funkční zatíženost

**Klíčová slova v AJ:** Voice Onset Time, Stop Consonants, Aspiration, Prevoicing, Perceptual Salience, Functional Load

**Anotace v ČJ:** Tato práce se zabývá osvojováním ploziv v druhém jazyce anglickými rodilými mluvčími, kteří se učí česky a čekými rodilými mluvčími, kteří se učí anglicky. Práce si klade otázku, zda jsou čeští rodilý mluvčí schopni si plně osvojit anglické plozivy a angličtí rodilý mluvčí schopni si plně osvojit české plozivy. Práce se zaměřuje na dva fonetické jevy - aspiraci a znělost během závěru ploziv. Studie zkoumá, zda jsou čeští rodilý mluvčí schopni osvojit si aspiraci u anglických neznělých ploziv a zbavit se znělosti během závěru u anglických znělých ploziv a zda jsou angličtí rodilý mluvčí schopni si osvojit znělost během závěru u českých znělých ploziv a zbavit se aspirace u českých neznělých ploziv. Hlavním cílem bylo rozhodnout, zda jsou mluvčí úspěšnější při osvojování jevů, které jsou více percepčně význačné nebo jevů, které mají větší funkční zatížení. Práce je rozdělená na dvě části, první část shrnuje teoretické

poznatky a literaturu o daném tématu a druhá část popisuje experiment, zabývající se osvojováním ploziv v druhém jazyce českými a anglickými mluvčími.

**Anotace v AJ:** This thesis deals with the acquisition of L2 stop consonants by English speakers learning Czech and Czech speakers learning English. The study finds out if Czech native speakers are able to fully acquire English stop consonants and if English native speakers are able to fully acquire Czech stop consonants. The focus was put on two phonetic features - aspiration and prevoicing. The study finds out if Czech speakers can acquire aspiration in English voiceless stops and get rid of prevoicing in their English voiced stops and if English speakers can acquire prevoicing in their Czech voiced stops and gert rid of aspiration in their Czech voiceless stops. The main goal of the study was to decide whether the speakers are more successful in acquisition of the features which are more perceptual salient or the features which carry more functional load. The thesis consists of two main parts, the first part summarizes the theoretical background and literature dealing with the topic, the second part describes the experiment which investigates the acquisition of L2 stop consonants by English speakers learning Czech and Czech speakers learning English.