U N I V E R Z I T A P A L A C K É H O V O L O M O U C I
F I L O Z O F I C K Á F A K U L T A

Katedra anglistiky a amerikanistiky

PERCEPTION AND PRODUCTION OF CZECH PALATAL STOPS BY ENGLISH LEARNERS OF CZECH

Percepce a produkce českých palatálních ploziv anglickými mluvčími češtiny

Master's Thesis
by

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Prohlašuji, že jsem diplomovou práci vypracovala samostatně, pouze s pomocí pramenů a literatury uvedených v bibliografii práce.

V Olomouci 2. ledna 2012 Kateřina Braunová

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1. INTRODUCTION

The present study is focused on the acquisition of Czech by native English learners. English learners of Czech can have problems with acquisition of some consonants because they are completely new for them. They do not have the alveolar trill fricative /r̝/, palatal stops /c/ and /ɟ/ and palatal nasal /ɲ/ in their phonemic inventory. They can have problems with acquisition of some consonants because they use them rarely or only in some dialects; e.g. alveolar trill /r/ and velar fricative /x/, or with some consonants because of their different phonetic realization.

One of the differences between Czech and English, which I am going to deal with in my work, is the presence of palatal stops /c/ and /ɟ/ in the Czech phonemic inventory.

My thesis has a similar aim as the study of S. B. Atkey (2001) which examined production and perception of Czech palatal stops by English speakers. I am going to refer to it later in a section 2.7 dealing with previous research in acquisition of palatal stops. However, in her thesis Atkey approached the question rather from the theoretical background of phonological theory; my thesis will be based more on the research and analysis of data.

Atkey's study is nevertheless the only study dealing with acquisition of Czech palatal stops. There was not done much research in this field therefore I am going to give a more detailed account of acquisition of Czech palatal stops by English native speakers.

1.1 Outline of the thesis

In my work I am going to deal with the acquisition of Czech palatal stops /c/ and /ɟ/ by native English learners. I want to study acquisition of this phonemic category, which is new for English learners therefore I will first introduce some basic terminology used in second language acquisition. Then in another section of Chapter 2 I will explain the differences between Czech and English stops and problems for their acquisition which can possibly arise from these differences.

Chapter 2 also presents some theoretical concepts of second language acquisition, previous research in acquisition of palatal stops and some studies dealing with the relationship of production and perception of second language. Chapter 3 presents general methods of my own research. In Chapter 4, the production experiment is presented. Chapter 5 presents the first perception experiment; the second perception experiment is presented in Chapter 6. In all these three chapters there are provided methods used in the experiments, data analysis and discussion of results. Chapter 7, the final chapter of this thesis, summarizes findings of my thesis and outlines questions for further research.

2 LITERATURE REVIEW

The aim of this chapter is to provide insight into second language acquisition, present the consonant systems of the native and target language of English speakers and acquisition of non-native contrasts.

First the basic terms used in second language acquisition will be presented. Then in another section I will present consonant systems of Czech and English, I will mainly focus on the category of palatal and alveolar stops, and problems which can arise from the differences between these languages and which can cause problems in acquisition of Czech palatal stops.

Secondly I will introduce theories concerned with acquisition of non-native contrasts, the previous research dealing with acquisition of palatal stops and I will provide outlook into the question of relationship between perception and production skills of L2 learners.

Finally I will summarize the research questions and hypotheses.

2.1 Basic terms used in second language acquisition

Second language acquisition is studying "how learners learn an additional language after they have acquired their mother tongue" (Ellis 1985, 5). Learners when acquiring additional language have already knowledge of their native language grammar, which is called the first language (L1). The language they are acquiring is called target language or second language (L2).

In my thesis I was examining English speakers acquiring Czech, therefore I will use the following abbreviations for their native language (L1en or L1en speakers) and for their second language (L2cz or L1en L2cz speakers).

English learners of Czech are approaching Czech with knowledge of their mother tongue and the process of using knowledge of L1 in L2 is called transfer. Transfer can be "positive", when an L1 pattern similar to the equivalent L2 pattern is transferred or it can be "negative", when an L1 pattern different from the closest L2 pattern is transferred. Positive transfer may be helpful and facilitate L2 acquisition initially but negative transfer result in errors (see Ellis 1985, 304-305).

2.2. The Czech consonant system

First, I will briefly describe the Czech consonantal system. Then I will focus on stops and especially on the category of palatal stops which are new for English learners of Czech.

In the phonemic inventory of Czech there are eight oral stops, three nasal stops, two affricates, eight fricatives, one alveolar trill, one fricative trill and two approximants. A complete list of Czech consonants can be seen bellow in a Table 2.1.

	labial	**Alveolar**	**postalveolar**	**palatal**	**velar**	**glottal**
stops	p b	t d		c ɟ	k g	
nasal stops	m	n		ɲ		
affricates		ʦ	ʧ			
fricatives	f v	s z	ʃ ʒ		x	ɦ
trills		r̝ r				
approximants				j		
lateral approximant		l				

Table 2.1 List of Czech consonant phonemes. If there are two consonants in a box, the left one is voiceless and the right one is voiced.

Oral stops are in the phonemic system of both languages. From the articulatory point of view they are characterised by creation of complete closure of the airflow in some place of the vocal tract and its sudden release which is followed by a burst of noise.

Czech has in its inventory of phonemes the following oral stops differing by place of articulation and voicing: labials /p b/, alveolars /t d/, palatals /c ɟ/, and velars /k g/. In the next section I will describe alveolar stops /t/ and /d/ because these oral stops are in the inventory of phonemes of both languages but they are slightly different.

2.2.1 Czech alveolar stops

The alveolars /t/ and /d/ are produced with the tongue tip raised to the upper gums. The main place of the obstruction is the alveolar ridge. The alveolar stop /d/ is produced at the same place but it differs since there is the presence of the airflow over glottis and therefore it is voiced (see Mluvnice češtiny 1 1986, 43).

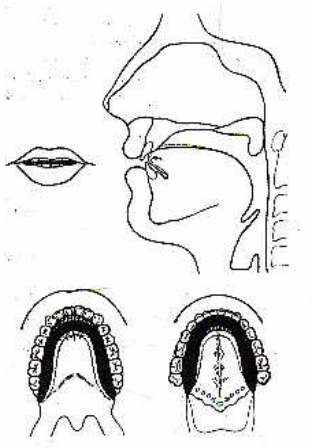


Figure 2.1 Articulation of Czech alveolar stops /t/ /d/ (adapted from Hála 1975, 182).

Now I will describe the Czech alveolar stops with regard to their acoustic properties. The alveolar stops have three phases. The first phase is the closing phase. The second phase is the constriction, which results in a period of silence, if the stop is not voiced, and the remaining part of the alveolar stop is the burst.

The duration of alveolar stops is very variable. It depends on the position and quality of surrounding vowels. The following values are average values for alveolars in intervocalic position as measured by Machač (2006). The voiceless alveolar stop /t/ has the constriction interval about 75 ms long and the voiced /d/ slightly shorter (about 47 ms). The alveolar stops have longer duration of explosion than bilabials; /t/ has explosion long at most 20 ms and /d/ 10 ms (see Machač 2006, 36).

Voiceless alveolar stop /t/ is characterised by the absence of a periodic wave, which is present at its voiced counterpart /d/ during the closure.

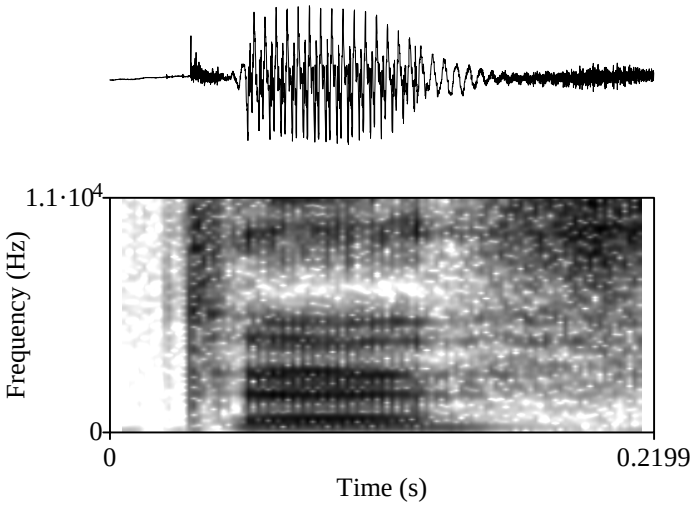


Figure 2.2 Spectrogram and waveform of Czech voiceless alveolar stop /t/ in the nonsense word "tefo", pronounced by female speaker recorded for perception experiment (Praat, Boersma and Weenink 2007).

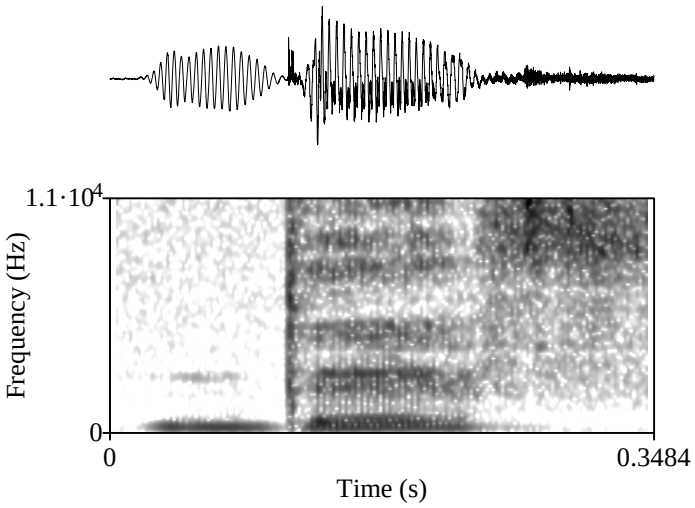


Figure 2.3 Spectrogram and waveform of Czech voiced alveolar stop /d/ in the nonsense word "defo", pronounced by female speaker recorded for perception experiment (Praat, Boersma and Weenink 2007).

2.2.2 Czech palatal stops

In Czech there are two palatal stops /c/ and /ɟ/. The closure during their production is made by the tongue blade, which is raised towards the hard palate. Moreover the tip of the tongue is leaning against the lower teeth (incisors), which

enables to raise the tongue blade toward the palate. Palatal stop /ɟ/ is produced at the same place but unlike /c/ the vocal cords are vibrating during its production (see Mluvnice češtiny 1 1986, 44).

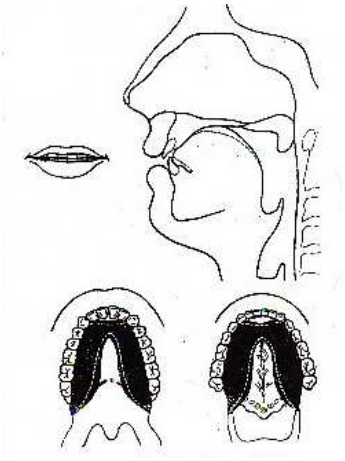


Figure 2.4 Articulation of Czech palatal stops /c/ /ɟ/ (adapted from Hála 1975, 183).

The duration of palatal stops is very variable. It depends on the position and quality of surrounding vowels. Following values are average values for palatals in intervocalic position as measured by Machač (2006). The voiceless palatal stop /c/ has the constriction interval about 65 ms long and the voiced /ɟ/ shorter (about 49 ms) (Machač 2006, 36).

Czech palatal stops are characterised by longest duration of burst from all consonants. The average time of burst for /c/ is 46 ms and for /ɟ/ 25 ms (see Machač 2006, 36).

The burst of palatal stops is specific, which is due to their production. Creating a closure of /c/ involves movement of the largest part of the tongue. The tongue blade is raised to touch the hard palate, making the contact area the most extended from all articulatory movements there are. During the release of the closure there is a long and low gap between the hard palate and the tongue through which the air escapes during the burst. The shape of the gap may cause rapid flow of air and turbulences, marked in the spectrum as higher frequency noise.

The formant transitions for palatals are except for F1 usually falling. The locus, according to Hayward “place on the frequency scale at which a transition

begins or to which it may be assumed to 'point'" (2000, 186), for F2 is very high around 2.5 kHz (Palková 1994, 225) and it is in the same place as F2 of vowel /i/ (see Mluvnice češtiny 1 1986, 45).

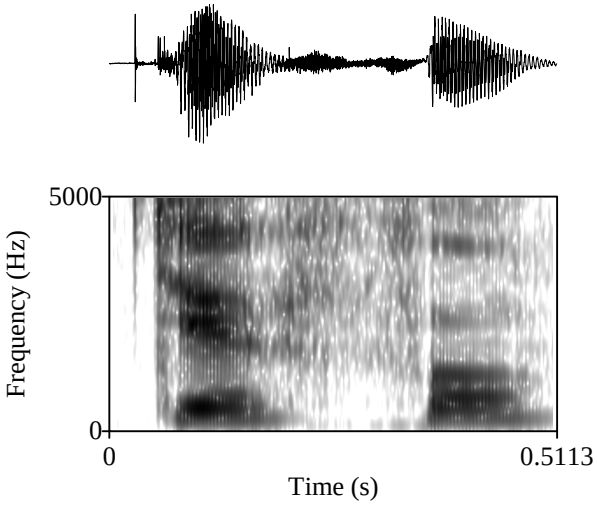


Figure 2.5 The spectrogram and waveform of Czech voiceless palatal stop /c/ in the nonsense word "těfo", pronounced by female speaker recorded for the perception experiment. (Praat, Boersma and Weenink 2007).

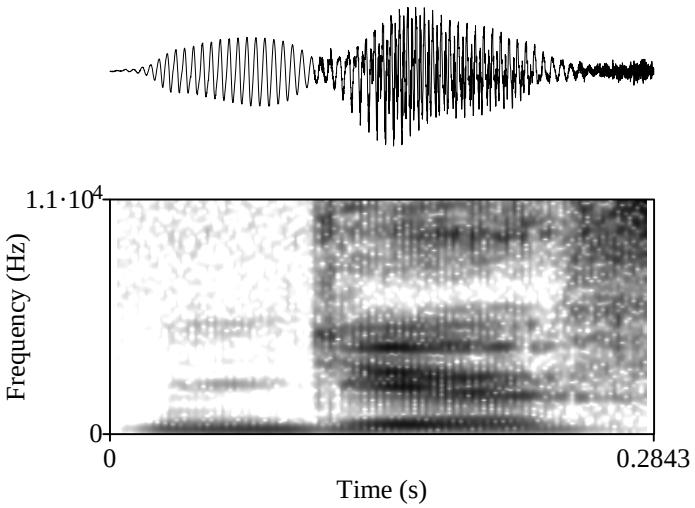


Figure 2.6 Spectrogram and waveform of Czech voiced palatal stop /ɟ/ in the nonsense word "děfo", pronounced by female speaker recorded for the perception experiment (Praat, Boersma and Weenink 2007).

2.3 The English consonant system

The inventory of English oral stops is slightly different. There are as well as in Czech pairs of oral stops which are distinguished by the presence of voicing; /p b/, /t d/ and /k g/. However, there are some differences between Czech and English alveolar stops, which are worth mentioning.

2.3.1 English alveolar stops

During the production of /t/ the air passage is completely blocked by raising the soft palate and the tongue tip to the alveolar ridge. After release of the closure the air escapes and makes and explosive sound (see Jones 1993, 141).

Alveolar stop /d/ is produced like /t/ but the force of exhalation is weaker and the vocal cords are vibrating (see Jones 1993, 144).

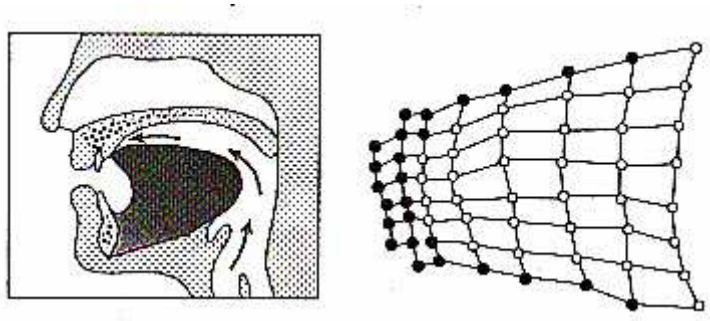


Figure 2.7 Articulation of English alveolar stops /t/ and /d/ (adapted from Gimson 2001, 163).

English voiced stop /d/ is voiceless when syllable initial, if not preceded by a voiced sound and is only partially voiced at the end of utterance or before a voiceless sound (see Ladefoged 2010, 73).

English /t/, when it is word initial, in a stressed syllable and followed by a vowel, is, unlike Czech /t/, aspirated. It means that the vowel does not begin immediately after the release of the closure, the air escapes through the vocal cords before the vowel sound begins. There is an audible plosion, which sounds as if

the stop is followed by a slight /h/ (see Roach 1991, 32). Then the vocal cords come together and voicing begins.

The duration of the gap between the consonantal release and the onset of voicing filled with noise is called VOT (see Hayward 2000, 108). This abbreviation means voice onset time.

VOT can be negative (when the voicing begins before the release of the stop) nearly zero or positive, as it is for English voiced stops.

English voiceless oral stops have a rather large positive VOT and its length varies with the place of articulation. Largest VOT is for velar stops and smallest for labial stops, coronals occupy an intermediate position (see Hayward 2000, 114).

According to Cho and Ladefoged (1999) there is number of reasons why VOT varies with the place of articulation. They presented previous principal findings in their study about VOT in various languages.

One of them is the size of cavity behind and in front of the point of constriction. For example velar stops have smaller volume of supralaryngeal cavity and larger cavity in front of the constriction than alveolar and bilabial stops. Because of the smaller size of cavity behind constriction there is a greater pressure which will take longer to fail and the greater mass of air in front of constriction causes greater obstruction to the release, therefore the pressure takes longer to fail (see Cho and Ladefoged 1999, 213).

Another reason of aerodynamic character is the extent of articulatory contact area. If the contact area is more extended the release is longer and there is a longer time before the transglottal pressure is made (see Cho and Ladefoged 1999, 213).

However, these reasons based on principles of aerodynamics explain better the differences between VOT of unaspirated stops rather than of aspirated" (see Cho and Ladefoged 1999, 214). The following reasons hold according to Cho and Ladefoged rather for aspirated stops.

First of them is the change of glottal opening area. "The glottal opening area after the release will decrease less rapidly for the velar than for alveolar or labial because the intraolar pressure drops more slowly for the velar" (Cho and Ladefoged 1999, 213).

The second is temporal adjustment between closure duration and VOT. The duration of vocal fold opening is fixed and there is trade-off relationship

between the duration of closure and VOT. Velar stops have shorter duration of closure than bilabials therefore the duration of VOT is longer (see Cho and Ladefoged 1999, 213).

2.4 English and Czech VOT

From what was said above it is apparent that Czech and English voiceless alveolar stops have different values of VOT. English voiceless stops, if they are word initially and in a stressed syllable, are aspirated and therefore they have rather large positive VOT.

However, Czech voiceless stops are not aspirated and there is only a short time between the release of stop and start of the voicing, therefore they have nearly zero or very short positive VOT. As it was already said above, VOT varies with the place of articulation, which is true not only for English alveolar voiceless stops but also for Czech voiceless stops; it is shorter for alveolars (about 20 ms) longer for velars (about 32 ms) while palatals have longest value of VOT (about 46 ms) which is because of their production; there is the most extended contact area, which finally results in higher frequency noise (see Machač 2006, 36).

Czech voiceless palatal stops, which are a new category for native English learners of Czech, have longer values of VOT than alveolar stops, but it is of different quality than English aspiration. However, they still have shorter positive VOT than English stops.

Some interesting questions follow the above mentioned:

Q: What VOT will the new palatal stops in the speech of the L2cz L1en speakers have?

Is it going to be English-like (negative transfer from L1) or more Czech-like?

It would be interesting to examine VOT in L2cz palatal stops. There are several possibilities, how it can result. L2cz alveolar stops may have English like VOT, because English speakers have alveolar stops in their native language and they may transfer it from English to Czech. However, Czech palatals are for them a

completely new category, so it is highly possible that this new category will have shorter VOT and sound more native like with respect to VOT.

2.5 Palatal approximant in RP and GA

English does not have palatal stops, but it has palatal approximant in its consonant system. When it is preceded by coronal stops it may remind English speakers Czech palatal stops. However, it is not the same in all varieties of English.

In English there was the diphthong of the [iu] type, which through the transfer of syllabicity from the first segment to the second developed into the rising diphthong [ju]. In certain environments the [j] disappeared, which is called yod dropping and in some environments prevails (see Wells 1982, 206).

I will describe two main standards of English, RP and GA. RP, Received Pronunciation, is representative standard of British English and GA, General American, of American English. GA "is regarded as a form of American English which does not have marked regional characteristics" (Gimson 2001, 85).

In RP the yod is retained after coronals /n/, /t/ and /d/ in strong stressed syllables as in *new* [njuː], *duke* [djuːk] or *tun*e [tjuːn].

In GA /j/ is lost after alveolars, there is preference for plain /tu du nu/ as in *tune*, *duke*, *new* [tuːn], [duːk], [nuː] (Wells 1982, 489).

In both varieties of English there is a tendency towards yod coalescence (change of palatal approximant into fricative, either voiceless or voiced) in GA it is common in weak syllables as in *situate* [sɪtʃueɪt]; in RP it used to be according to Wells taken as rather vulgar (1982, 247) but nowadays it is in unaccented position commonly changed to /tʃ dʒ/.

Czech palatal stops may British English speakers remind consonants [nj], [dj] or [tj] which are in their *new*, *duke*, *tune* etc., which may be helpful for acquisition of Czech palatals. However, American English speakers, who I am going to study, unlike British English speakers do not have this sequence in their native language,

therefore the acquisition of palatal stops may be more difficult for them than for British English speakers.

2.6 Perception and acquisition of non-native contrasts

The present study addresses the question of acquisition of Czech palatal stops by English native learners. When acquiring a second language, learners, not only those in my study, have to face differences and discrepancies between their L1 and target L2. There was a large research dealing with the perception and acquisition of non-native contrasts and there are several theories how speakers deal with these differences and how they acquire the non-native contrasts.

I will present here some theories of perception of the non-native contrasts and second language learning because they will be valuable starting points for my thesis.

2.6.1 Perceptual Assimilation Model

The first model is Perceptual Assimilation Model (PAM) by Catherine T. Best. (1993, 1994); her model concern itself with the naive non-native listeners, who are not learning actively. It is based on the ecological approach to speech perception, or in other words on Fowler's direct realism (Fowler 1986).

Fowler's direct realism rejects mental representation of sounds; listeners, when perceiving non-native contrasts, look for perceptual cues in speech signal rather than for mental representation of sounds and directly perceive gestures.

He also states that all languages build on the possibilities of human vocal tract. There is a restricted set of possible active articulators and locations of constriction, and that if particular place of constriction is not present in some language it has to be at least in its phonological space. A lot of features are common for a wide range of languages, some of them are identical, others to some extent similar.

Best based her Perceptual Assimilation Model (PAM) on these postulates. She distinguished native and non-native segments. According to her "non-native segments are those whose gestural elements or intergestural phasing do not match precisely any native constellation" (Best 1995, 193). The basic statement of her model is that non-native segments tend to be perceived according to their similarities

to and differences from the native segments which are close to them in phonological space (see Best 1995, 193).

She proposed the following "perceptual assimilation models": "assimilation to a native category", "assimilation as uncategorizable speech sound" and "no assimilation as speech sound" (see Best 1995, 194-195). The non-native speech sound (non native segment) can be perceived as a good, acceptable or deviant exemplar of the native category. If it is still perceived as a speech sound, it has some place in the native phonological space, but does not fit any of the present categories. The sound could possibly be not categorized as a speech sound "if it is not assimilated into native phonological space at all" (Best 1995, 194-195).

According to Escudero the PAM suggests that "successful L2 sound discrimination is the basis for L2 perceptual success" and that "if two foreign speech sounds are assimilated to two different native sounds, or phonemes, discrimination is predicted to be excellent, whereas if two sounds are assimilated to a single native category, discrimination will be poor" (Escudero 2007, 120).

2.6.2 Speech Learning Model

Another model dealing with differences between L1 and L2 sound systems is Flege's Speech Learning Model (SLM) (1995), which is based on years of research and number of studies. SLM unlike Best's model is concerned with active learners of non-native languages.

Flege proceeded from the postulates that "the mechanisms and processes used in learning the L1 sound system including category formation, remain intact over the life span, and can be applied to L2 learning" (Flege 1995, 239) and that categories for the native language are established in childhood and for the whole life they influence our perception and identification of L1 and L2 sounds (see Flege 1995, 239).

A new phonetic category can be according to him "established for L2 sound which differs phonetically from the closest L1 sound" (Flege 1995, 239). This category can be established more easily "the greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound" is (Flege 1995, 239). Then it is more likely that sounds will be produced adequately.

However, if the sounds of the L2 are less different, they are perceived as the same as a sound in L1. In this case the sounds according to Flege will be acquired and produced inadequately. “Category formation for an L2 sound may be blocked by the mechanism of equivalence classification. When this happens, a single phonetic category will be used to process perceptually linked L1 and L2 sounds (diaphones). Eventually the diaphones will resemble one another in production” (Flege 1995, 239).

In my paper I am studying acquisition of Czech palatal stops by English native speakers. Czech voiceless palatal stops have not such a large positive VOT as English voiceless stops. It is a question what VOT the new palatal stops in the speech of the English learners of Czech will have.

According to Flege’s SLM Czech palatal stops are more different from English voiceless stops than alveolar stops therefore English learners of Czech will more likely create a new category and adopt Czech like VOT.

2.7 Acquisition of Czech palatal stops

Following part will be concerned with acquisition of Czech palatal stops. There was not done much research in this field, only S. B. Atkey (2011) was studying acquisition of non-native contrast of Czech alveolar and palatal stops by native English speakers. In the following parts I will discuss her study, what did she base it on and I will describe its strengths and weaknesses.

2.7.1 The Acquisition of L2 Segmental Contrast: English Speakers’ Perception and Production of Czech Palatal Stops

As I already mentioned, Atkey’s thesis (2001) deals with acquisition of Czech palatal stops as my thesis do. However, she based it on more theoretical background of phonological theory. She argued that English speakers learning Czech should have preconditions to perceive and acquire Czech palatal stops.

Generative phonological theory claims that there is a set of distinctive features, which is universal and languages choose from this set of features. Phonemes of every language differ by the presence or the absence of these

distinctive features, e.g. /p/ and /m/ are distinguished by the feature [nasal] and they share the feature [labial].

Atkey was convinced that English speakers can perceive and acquire contrast between Czech alveolar and palatal stops if the feature distinguishing the contrast is present in their native language. In case that the feature is not in the inventory of their L1 they should not be able to perceive the difference.

Atkey described the segmental phonology of Czech vowels, consonants and mainly Czech alveolars and palatals. She observed that palatals and alveolars differ by the dependent feature [posterior].

Alveolar and palatal stops both share the feature [coronal] because they are both produced by the tip or the blade of the tongue and are distinguished by the feature [posterior]. The feature [posterior], which is used to distinguish palatal stops, means that the segment is articulated by the tip or blade of the tongue after the alveolar ridge.

Atkey supposed that English speakers should not have problems with the acquisition of Czech palatals /c/ and /ɟ/ because English has the feature [posterior] to distinguish fricatives /s/ and /z/ from /ʃ/ and /ʒ/.

In the experimental part of her thesis she tried to support her arguments with evidence from the experimental research on perception and production of Czech palatal stops by native English speakers.

2.7.2 Perception of Czech palatal stops (S. B. Atkey)

Atkey tested perception of the non-native contrast on a group of subjects, six adult North-American English learners of Czech, by means of Forced Choice Phoneme Selection (FCPS) task. Subjects were exposed to 100 stimuli, which contained palatal and alveolar stops in a word initial, medial and final position.

Atkey tried to make the task consistent; she used only monosyllabic and disyllabic words. There were 40 tokens of word initial consonants, 40 tokens of consonants situated word medially and 20 tokens of word final consonants. Both alveolar and palatal stops were followed by vowels /a/, /ɛ/, /ɪ/, /o/ and /u/, which were represented equally. Atkey tried to use only short vowels but in some cases it

was necessary to use long ones because there was lack of suitable words with a short vowel.

She used in her FCPS real Czech words. Some words used in her FCPS task were not very frequent words and some of them even did not seem to be Czech lexical words; e.g. *ďaha*, *hudě*, *petí*, *poťoh*, *dikal* or *baťa*.

Furthermore, it is a question, if FCPS task consisting of lexical words is testing perception of non-native contrast or rather lexical knowledge. There are two models or approaches trying to solve this question. One of them claims that "the recognition is solely bottom-up" and the other "that the lexical feedback does occur" (Pitt 1995, 1037).

The range of studies tried to solve this question. Results of Ganong (1980), presented in Pitt (1995), supported the "top-down" flow of information. Subjects in his experiments categorized stimuli on the word-nonword and nonword-word continua. The end-points of the continua were good exemplars and were perceived without problems, unlike them the stimuli in the middle of the continua were ambiguous; there was evidence of lexical identification shift (LIS) in identification of them.

Other studies (presented in Pitt 1995) claimed that there should be relationship between reaction time (RT) and LIS. There is supposed to be "shrinkage of the LIS at faster RTs" (Pitt 1995, 1038).

Furthermore it is supposed that there is the relationship between RT and ambiguity of stimuli. It is argued that if the stimuli were word congruent there should be fast response because of lexical effect and the ambiguous stimuli should have slower RT (see Pitt 1995, 1038).

The question of influence of lexical content is still not solved, it is not clear whether it has some impact on perception or not, therefore it would be probably better to avoid lexical words in FCPS task.

2.7.3 Results of perception experiment (S. B. Atkey)

Atkey's FCPS task revealed that all subjects were generally able to distinguish Czech alveolar and palatal stops, but according to Atkey they "performed significantly worse on palatal tokens with a following high front unrounded /ɪ/"

(Atkey 2001, 103). However, when palatals were followed by other vowels there were not significant problems with perception.

After having a closer look at results of Atkey's perception experiment, I found out that all six subjects of her study had problems with perception of palatal stops, if they were followed by front high unrounded vowel /ɪ/. There was no significant disparity between speakers with different length of exposure to Czech, e.g. subject three with 11 months of exposure to Czech misperceived five palatals followed by vowel /ɪ/ out of eight misperceived palatals followed by a vowel and even subject five with 10 years of exposure to Czech made mistakes in perception and two out of three misperceived tokens followed by a vowel were followed by /ɪ/.

Atkey used in her perception experiment real lexical words, those followed by /ɪ/ or /iː/ were the following: *tiše*, *tisíc*, *pití*, *peti*, *díra*, *divák*, *hodil* and *podiv*. As you can see there were just two words where palatal stop was followed by /iː/; *pití* and *díra*. Out of 22 misperceptions 6 of them were in tokens with /iː/.

With respect to voicing of palatal stops, it seemed that subjects had more problems with perception of /c/ than with /ɟ/. It is a question if it was caused by the voicing of palatal stop or by the lexical items themselves.

However Atkey in her work did not solve any of these questions, and she did not say why there were significant problems with perception of palatals followed by front high unrounded vowel /ɪ/.

Problems could have been caused by the properties of /ɪ/ and by characteristics of formant transitions. If we compare for instance /a/ which has middle values of F1 (average values are between 0.8 - 1.1 kHz) and F2 (average values are between 1.1 - 1.5 kHz) and on the other hand /ɪ/ which has low F1 (average values are between 0.3 - 0.45 kHz) and high F2 (average values are between 2.1 - 2.8 kHz) there are going to be virtually no CV formant transitions in the case of /ɪ/ because the locus of /c/ for F2 is in the same place as F2 of /ɪ/, which is around 2,5 kHz (see Mluvnice češtiny 1 1986, 31-32, 45). However, /a/ has a falling F2 formant transition, so the palatal stops should be distinguished more easily.

From what was said above about the qualities of high front unrounded vowel /ɪ/ and palatal stops the following question arises:

Q: Is the perception more difficult if the palatal stops are followed by high front vowel /ɪ/ or /iː/ than by other vowels?

2.7.4 Production of Czech palatal stops (S. B. Atkey)

In the production experiment Atkey tested random four speakers from her group. To study production of Czech palatal stops she used the material obtained by free production and by the Sentence Reading task.

Analysis revealed that none of the subjects produced native sounding palatal stops, which was checked by two native Czech speakers. In both parts of the production experiment the tested subjects substituted palatals with alveolars /t/, /d/ or sequence of alveolar stop /t/ or /d/ and palatal glide /j/; /tj/ /dj/.

According to Atkey, the samples for the Free Production task were obtained by questioning in conversation and random samples of spontaneous speech recorded when possible were used (see Atkey 2001, 109).

The language material obtained in the second way was elicited by reading sentences. Subjects were asked to read 15 sentence stimuli of different length, which contained real Czech words and in each of them there were from 3 to 7 tested segments /t/, /d/, /c/ or /ɟ/. Palatal stops were followed mostly by /ɪ/ and /ɛ/ while alveolar stops were followed by various vowels, therefore the Sentence Reading task seems to be unbalanced.

It was appropriate that Atkey used two different methods to elicit production. However, I would say that Sentence Reading task is not the best way to test production of the non-native contrasts and that it is testing rather lexical knowledge, ability to read and knowledge of orthography than production of phonemes. Moreover, when subjects are reading phrases they usually do not pronounce sounds in a natural way but in a more controlled manner.

2.7.5 Summary

To summarize Atkey, results of her experiment did not support her hypothesis in its entirety. Subjects were able to distinguish the non-native contrast but neither of them even the one with the longest exposure to Czech were able to produce native sounding palatal stops. It seems that the presence of the feature distinguishing the non-native segment's contrast in their L1 is not enough for the successful acquisition of the contrast.

Some methods Atkey used in her work to test acquisition of non-native contrast were disputable; the FCPS task was based rather on lexical knowledge and part of production data on sentence reading. In my paper I tried to conduct the research in a way which would be more objective.

2.8 The relationship between speech perception and production

The studies mentioned above were examining acquisition of non-native contrasts by testing both perception and production. It seems that there is a close link between perception and production. In Flege's SLM it was apparent that perception skills precede production skills. According to him speakers have to be at first able to perceive the contrast and categorize sounds only afterwards they can produce them adequately.

It might seem that perception skills precede production skills. However, it could be also possibly vice versa and L2 learners can be able to produce sounds, which they are not able to distinguish. In the following parts I will present the relationship between perception and production

2.8.1 Perception precedes production

There is a close link between perception and production; already in Flege's SLM it was evident that perception precedes production. The range of studies, summary of them is in Llisterri (1995) supports this assumption as well.

One of them is a study by Flege (1993). He examined perception and production of the word final English /t-d/ by four groups of subjects; Taiwanese

childhood L2 learners, experienced Taiwanese late learners, inexperienced Taiwanese later learners and inexperienced Mandarine late learners. In the production experiment none of the groups, with exception of child learners, did produce the native like duration of vowels preceding final voiced and voiceless consonants. In the perception experiment the child learners resembled native English speakers and experienced learners, who did not succeed in the production experiments, approached results of native speakers. Second and third experiment on perception supported his hypothesis because perception of vowel duration, which served as a cue, preceded its production.

Bohn & Flege (1990) in their study, reported in Llisterri (1995), examined perception and production of English vowels /ɛ/ and /æ/ by two groups of German learners; inexperienced and experienced ones. Both groups of speakers were able to distinguish the contrast, but they used different cues than native speakers and only the experienced German speakers were able to produce the contrast. Results of their experiment supported the hypothesis that perception skills precede production skills.

2.8.2 Production precedes perception

The results of most studies support the hypothesis that the ability to perceive sounds precedes the ability to produce them. However Sheldon & Strange (1982) found out that Japanese speakers of English living the United States were less accurate in perception of /r-l/ contrast in natural utterances than in producing it. They were testing production, perception and self-perception of subjects as well.

They were replicating in their study the results of Goto (1971), which was unlike Sheldon & Strange experiment conducted in Japan and which had similar results.

2.8.3 Conclusions: relationship between perception and production

The results of most studies mentioned here or reviewed in Llisterri (1995) support the hypothesis that the ability to perceive sounds precedes the ability to produce them.

However, according to Llisterri it is not so straightforward to say that perception precedes production and that you can not produce sounds you do not perceive; “although it seems that perception in general might precede production, direct inferences about pronunciation accuracy cannot probably be made from perceptual abilities in a straightforward manner” (Llisterri 1995, 94).

Furthermore, there is a lot of factors which influence the relationship between perception and production, according to Llisteri these include “the age of L2 acquisition, the degree of exposure to the language, and the experience with L2” (1995, 97). It can also “differ according to the class of sounds, to the acoustic and perceptual correlates of these classes and to contextual effects” (Llisterri 1995, 98).

It would be interesting to see what it would be like in my study. From what was said above arise for my study the following questions.

Q: What would be the relationship between production and perception of Czech palatal stops by English learners of Czech?
Would perception skills precede production skills or vice versa or would they go hand in hand?

2.9 Present thesis research questions and hypotheses

For the readers’ convenience, the research questions mentioned above are repeated and summarized in this section.

Q1: What would be the relationship between production and perception of Czech palatal stops by English learners of Czech?
Would perception skills precede production skills or vice versa or would they go hand in hand?

Hypothesis A: According to studies in second language acquisition e.g. by Flege (1993) which came to conclusion that there is a close link between perception and production and that perceptual ability exceeded production, it is highly probable, that English learners of Czech could have better perceptual abilities than production abilities as well.

Hypothesis B: However, Sheldon & Strange (1982) found out that Japanese native speakers learning English were less accurate in perceiving /r-l/ contrast than in producing it therefore it possible that English learners of Czech palatal stops would be the same case.

Q2: Is the perception more difficult if the palatal stops are followed by high front vowel /ɪ/ or /iː/ than by other vowels?

Hypothesis: It can be claimed that for English learners of Czech palatal stops it will be more difficult to distinguish palatal stops if the stop is followed by high front vowel /ɪ/ or /iː/ than by other vowels because /ɪ/ has low F1 and high F2, and the locus of /c/ is in the same place as F2 of /ɪ/, therefore there are not going to be any visible CV formant transitions.

Q3: What VOT will the new palatal stops in the speech of the English learners of Czech have?
Is it going to be English-like (negative transfer from L1) or more Czech-like?

Hypothesis A: There is an assumption that L1en L2cz speakers will have more Czech-like VOT, because according to Flege's SLM (Speech Learning Model) palatal stops are more different from English alveolar stops than Czech alveolar stops and therefore learners will more probably create a new category and more easily adopt target like VOT values, there will be lower effect of L1 negative transfer.

Hypothesis B: However it is also possible that the English learners of Czech will not form a new category and will have English-like VOT (negative transfer from L1) as they may have when acquiring L2 alveolar and velar stops.

3. GENERAL METHODS

The aim of my thesis is to study the acquisition of Czech palatal stops by English native speakers. I was examining both perception and production of Czech palatal stops by English native speakers to test the hypotheses of my study.

To test L1en speakers' production of palatal stops I designed the production experiment, which tested production of palatal stops in four different contexts, not to rely solely on results of one type of production task and I measured VOT of L1en speakers' palatal and alveolar stops in selected words.

Perception of palatal stops was tested by means of a FCPS task (Forced Choice Phoneme Selection Task) and a test examining categorization of stops according to their VOT.

In Chapter 3 I will present two groups of subjects who participated in my research and explain how the testing was conducted.

In the following Chapters 4, 5 and 6 I will describe individual experiments, the methods used, analyses and discussions of results.

3.1 Subjects

3.1.1 American English speakers

The non-native experimental group consisted of twelve adult subjects, who were between 20 and 46 years of age and self-reported normal-hearing (except for the subject 6 who reported problems with one ear). All subjects had English speaking parents and were born in the USA.

American English speakers lived in the Czech Republic for extended period of time, though the length of their exposure to Czech was not the same. It ranged from one year and two months (subject 1) to twenty years (subject 11). Ages and length of the exposure to Czech are given in the table in Appendix 1.1.1.

All subjects returned to the USA only for a short holiday, with the exception of subjects 5, 1 and 11, who reported a longer interruption of their residence in the Czech Republic. Subject 1 spent two months in Slovakia, subject 5 returned to the USA for two years and subject 11 spent one year abroad.

Some subjects attended Czech language courses. Subjects 1, 2 and 3 were intensively studying Czech for two months before arrival in the Czech Republic and subjects 7 and 8 were enrolled in Czech language Summer schools.

All subjects were living in the Czech-speaking environment, but they used Czech in different situations and had different motivation to learn Czech. Subjects 1, 2, 3, 6, 7, 8 and 12 were working in the Czech Republic as missionaries; they were talking with people frequently, they used Czech for their work and therefore needed to speak Czech in the most-native sounding way.

However, there was a difference, subjects 1, 2 and 3 were staying in the Czech Republic for a shorter period of time and then they were supposed to return back to the USA and were speaking among themselves sometimes in English. Unlike them subjects 6, 7, 8 and 12 were living in the Czech Republic for a longer period of time and used Czech as much as possible in various communication situations, furthermore subject 8 reported that he had a Slovakian girlfriend and subject 7 a Czech girlfriend.

Subjects 4 and 5 reported that they used Czech minimally, only in some situations, when speaking with Czech friends and for basic public communication.

Subjects 9, 10 and 11 were living in the Czech Republic for the longest period of time (from 16 to 20 years), they were working there as university teachers, and used Czech in various situations in family and in public places.

Some of the subjects reported active knowledge of other languages; French (subjects 9 and 5), German (subjects 2, 3, 5 and 11) and Irish (subject 9).

A few of them spent longer period of time (more than one month) in other foreign countries; subject 2 in China and Guatemala, subject 5 in England, Ireland and in Germany and subject 10 in Austria. Subject 11 reported that he travelled a lot.

3.1.2 Czech speakers

Fourteen Czech native speakers were included in the perception experiments as a control group. The L1cz speakers were students at Palacký University in Olomouc, they were between 22 and 29 years of age and all self-reported normal-hearing.

All subjects in the control group were born and grew up in the Czech Republic and had Czech speaking parents. Some of them reported active knowledge of foreign languages; English, Spanish, German, French and Dutch. Some of them spent longer time abroad; (subject 2 in Spain and in Mexico, subject 6 in the USA, subject 7 in Germany, subject 8 in Ireland and in Austria, subject 11 in the UK and subject 14 in the Netherlands and Belgia).

One L1cz female speaker, age 24, also took part in three tasks of the production experiment as a control subject.

3.2 Sessions

Testing of L1en speakers took place in the computer classroom at the department of Czech studies. There were usually individual sessions with each L1en speaker. First they were tested on production and afterwards on perception to avoid subjects being affected by previous listening to tested segments.

Testing perception of control L1cz group took place during two days in the same computer classroom.

All subjects were given instructions and afterwards they proceeded to the tests. There were breaks within and between experiments to avoid test fatigue.

Half of the L1en speakers and ten L1cz speakers completed the first perception test before the second perception test and half of the L1en speakers and four L1cz speakers completed the second perception test first.

Both groups of native and non-native speakers of Czech used during the perception tests Sennheiser HD 202 headphones and production of non-native speakers and of one control native speaker was recorded in a sound treated studio.

4. PRODUCTION EXPERIMENT

In my paper I am dealing with acquisition of Czech palatal stops by English native speakers. To learn about their state of acquisition of palatal stops and to test my hypothesis, I designed four different tasks testing their production of Czech palatal stops.

The reason to design four different tasks to test production was to have production data from various contexts and not to rely solely on one type of task, which could be misleading.

By means of production experiment I intended to determine whether subjects would be able to produce palatal stops /c/ and /ɟ/, whether they would substitute them with other consonants and whether they would have some transfer from their native language. To ascertain whether they had transfer from native language I measured VOT of palatal and alveolar stops in chosen words in two different tasks.

4.1. Methods

4.1.1 Free Production task

The first method to elicit data for the production experiment was the Free Production task. It is a good way to get natural, authentic language material from chosen subjects. There is an advantage that the subjects are not exposed to any experimental settings therefore they should probably act in a natural way and the obtained data should not be overly influenced.

However, the Free Production task in my experiment was not completely free in the true sense. It was to some extent controlled. Subjects were asked to speak to the microphone in the sound treated studio; therefore it was not natural conversation. They were asked two main questions which already contained the tested segments /c/ and /ɟ/. The first of them was: Co *si myslíte o rodině?* (“What do you think about family?”) and the second was: *Na co se těšíte?* (“What are you looking forward to?”).

The dialogues were conducted in a similar manner and subjects were given these same two main questions and several sub-questions, list of them can be seen in the Appendix 1.2.1. The atmosphere during the recording was friendly and, in spite of the fact that it was under monitored condition, it resembled casual conversation. Subjects were not forced into answering questions, when it was possible they were allowed and encouraged to speak on their own in order to obtain the most natural data as possible.

4.1.2 Elicited Production task

The second method to obtain data for production experiment was Elicited Production. It is a good way to get to some extent naturally produced language material. The data for further analysis can be elicited in various ways.

The stimuli for this part of the production test were visual. Subjects were in random order presented 23 cards with pictures, which were printed in colour, they can be found in the Appendix 1.2.2, and they were asked to say what they could see on the cards.

On the cards there were represented things, people and actions; e.g. *budík* [buɟiːk] (alarm clock), *děti* [ɟɛcɪ] (“children”), *televize* [tɛlɛvɪzɛ] (“television”), *stan* [stan] (“tent”) or *stín* [sciːn] (“shadow”). The words denoting these items contained tested segments /c/, /ɟ/ and /t/ (/d/ in the initial position was by mistake missing) and also sequence /st/ and /sc/ in initial positions.

Subjects were not forced into answering, they were asked in case they did not know the right word to continue, sometimes they were given help but the related words were avoided not to make the subjects imitate.

4.1.3 Sentence Reading task

The third part of the production experiment was the Sentence Reading task. Subjects were in random order presented 39 cards with sentences and they were asked to read them.

The sentence stimuli were of various length and each of them contained a minimum of 3 up to maximum 8 (average 4) of tested segments /c/, /ɟ/ and /t/ /d/. The tested segments were in word initial, medial and final position and they were followed and preceded by various vowels, both short and long. There was also sequence /st/ and /sc/ in initial positions.

Some examples of the sentence stimuli are given under (1). List of the sentence stimuli with phonemic transcription can be found in the Appendix 1.2.3.

(1)

1. Půjdeš se mnou v pátek do divadla?	Půj**[d]**eš se mnou v pá**[t]**ek **[d]**o **[ɟ]**iva**[d]**la
2. Děti jsou základ rodiny.	**[ɟ]**ě**[c]**i jsou zákla**[t]** ro**[ɟ]**iny
3. Tomu děvčeti prosím tě netykej.	**[t]**omu **[ɟ]**ěvče**[c]**i prosím **[c]**ě ne**[t]**ykej

However, I am convinced that the Sentence Reading task is not the best way to test acquisition and production of non-native contrasts because subjects are dependent on the knowledge of orthography. In the following part I will briefly introduce Czech orthographic system and difficulties it can cause during the Sentence Reading task.

4.1.3.1 Brief excursion into Czech orthography

I will make here a little diversion and I will present the Czech orthographic system, which will illustrate my objections to the Sentence Reading task.

Czech uses Roman alphabet, in which particular graphemes correspond to individual phonemes. However, in the Czech phonemic inventory there are several phonemes which do not have representation in the Roman alphabet, these include the velar fricative /x/, the alveolar trill fricative /r̝/, postalveolar fricatives /ʃ/ and /ʒ/, palatal stops /c/ and /ɟ/ and long vowels.

Phonemes, to which no graphemes in Roman alphabet correspond, are symbolized by graphemes used for similar sounding phonemes e.g. for /ʃ/ *s* for /ʒ/ *z* for /c/ *t* and for /ɟ/ *d* with added special Czech diacritic called "hook" ("háček"); e.g. *š, ž, ť* and *ď*. However, palatal stops /c/ and /ɟ/ are, unlike postalveolar fricatives /ʃ/ and /ʒ/ which are represented only by graphemes *š* and *ž*, represented also in two other ways.

In Czech two graphemes *i* and *y* symbolize phoneme /ɪ/. If *d* is followed by *y*, it represents alveolar stop /d/ and if by *i*, it represents palatal stop /ɟ/; in case of *t* and *n* it is the same; e.g. as in word *tisíc* "thousand". However, this is valid only for Czech words and not for loanwords. Graphemes *t, d, n* which are e.g. in words as *titul* "degree", *nikotin* "nicotine" or *diplom* "diploma" are not pronounced as palatals but as alveolars /t/, /d/, /n/.

Another way how to represent palatal stops /c/, /ɟ/ and /ɲ/ is the grapheme *ě*. If *t, d* or *n* are followed by *ě* it makes them sound "soft", which means that they are palatal; e.g. as in word *tělo* "body". However, when grapheme *ě* follows *p, b* or *v* it signifies consonant clusters /jɛ/ e.g. as in word *pěna* "foam" /pjɛna/ and when it follows *m* it signifies /mɲɛ/ as in *město* "town" /mɲɛsto/

For non-native speakers it can be difficult to distinguish palatal stops and, as it is evident from the above mentioned, the Sentence Reading may not be the best way to examine acquisition of Czech palatal stops because there are several ways how to detect palatal stops, which could be misleading. Furthermore, it would be a question if subjects produced palatal stops because they had them in their inventory of phonemes or because of the diacritics.

4.1.4 Word List Reading task

The last part of the production experiment was the Word List Reading task. Subjects were in random order presented the cards with words and they were asked to read them.

The tested segments were in the word initial, medial and final position and they were followed and preceded by various vowels, both short and long and there were also sequence /st/ and /sc/ in initial positions.

Some examples of word stimuli are given under (2). List of the word stimuli with transcription can be seen in the Appendix 1.2.4.

(2)

1. **d**ívka	[**ɟ**iːfka]	4. s**t**ěna	[s**c**ɛna]
2. la**t**ě	[la**c**ɛ]	5. s**t**yl	[s**t**ɪl]
3. **t**a**d**y	[ta**d**ɪ]	6. a**t'**	[a**c**]

4.2 Results

4.2.1 Data analysis

The tokens with intended palatal stops /c/ and /ɟ/ from four different parts of production experiment were transcribed by me and the quality assessment was based only on perceptual impression.

The intended palatal stops were classified into three categories; as palatals, which sounded native-like or nearly native-like, as alveolars or as "in between". Under this category there were pooled tokens which could have been categorized neither as native sounding palatals nor as alveolars and tokens which were mispronounced. There was not included a category "other substitutions" because no subject substituted palatal stops with something like [dj] or [tj].

The tested segments were rated as corresponding intended palatals regardless of their voice, since some subjects did not devoice word final stops in some production tasks or produced word initial stops which were not fully voiced.

In the production tasks the production of alveolar stops was not analyzed, it was supposed that subjects should be able to produce them because this category is present in subjects' L1.

Data for the first production task were selected from words in which palatal stops should have been realized, which were uttered by L1en speakers during

the Free Production task and also from words which were spontaneously produced during other production tasks.

The percentage of different realizations of intended palatals for individual subjects was counted from the tokens in which palatal stops should have been realized. There were a different number of tokens for individual L1en speakers. While some subjects produced about five or six different words with intended palatal stops, others produced only a few of them or repeated some words. Therefore results for individual subjects are not based on approximately the same number of tokens.

The percentage of different realizations of intended palatals for individual subjects in the Elicited Production task was counted from tokens which were in the words containing tested segments /c/ and /ɟ/ subjects uttered when describing presented pictures. The tested segments which were in the words subjects did not recognize or used a word without palatal stop to describe the pictures, were not included.

The percentage of different realizations of intended palatals for individual speakers in the Sentence and Word List Reading task were counted from the number of tested segments /c/ and /ɟ/, which were in the sentence and word stimuli; there were 49 tokens of /c/ and 31 of /ɟ/ in the sentence stimuli and 36 tokens of /c/ and 26 of /ɟ/ in the word stimuli. In the Word List Reading task were data from 11 subjects, data from subject 4 were not available because of time constraints.

To test my hypothesis about possible negative transfer I measured VOT in palatal and alveolar stops in words from Sentence and Word List Reading tasks. However, I did not measure VOT for all palatal and alveolar stops in these tasks. In both tasks I selected four words; I choose words in which most of the subjects realized palatal stop, although not all of them. As I already said, there were no data for subject 4 in the Word List Reading task.

4.2.2 Results of Production experiment

All subjects produced in all four production tasks some tokens correctly with palatal stops [c], [ɟ], some with alveolar stops [t], [d], and some with something “in

between" which was difficult to categorize. L1en speakers substituted Czech palatal stops only by alveolar stops and not by any other consonants or consonant clusters.

There were both inter-speaker and intra-speaker variations in production of palatal stops [c] and [ɟ], some speakers were not consistent; not only between different words but also within the same word in the Free Production task.

In the following Tables 4.1 and 4.2 you can see examples of the different realizations of intended palatal stops in the Free Production task and Sentence Reading task.

subj.	[ɟ]	[**d**]	"**in between**"
2	ro**d**ina [roɟɪna]	-	ro**d**ině [ro**ʔ**ɪɲɛ]
3	kamará**d**i [kamaraːɟɪ]	ro**d**iny [ro**d**ɪnɪ]	**d**ěti [**ʔ**ɛtɪ]
8	**d**ětí [ɟɛtiː]	**-**	-

Table 4.1 Examples of tokens with different realization of palatal stop /ɟ/ produced by different subjects. In the first column there are words with realized palatal stop [ɟ], in the second with alveolar stop [d] and in the third with something "in between", which is marked by "?". First there is listed orthographic form of the word which is followed by the phonetic form.

	Dě**t**i jsou zákla**d** ro**d**iny.
CZ	[ɟ] [**c**] [**t**] [ɟ]
1	[ɟ] [**c**] [**d**] [ɟ]
2	[ɟ] [**ʔ**] [**d**] [**d**]
8	[ɟ] [**c**] [**d**] [ɟ]
	Tomu **d**ěvče**t**i prosím **t**ě ne**t**ykej.
CZ	[**t**] [ɟ] [**c**] [**c**] [**t**]
4	[**t**] [**d**] [**c**] [**c**] [**t**]
10	[**t**] [**d**] [**t**] [**c**] [**t**]
12	[**t**] [ɟ] [**t**] [**c**] [**c**]

Table 4.2 Examples of some responses to the sentence stimuli. There are orthographic forms of sentences, in the "first" lines, under them there are responses of control L1cz subject and responses of three chosen L1en subjects. Individual responses to the stimuli are in the phonetic brackets, the question mark represents something in "between".

The data obtained by four production tasks were analyzed by the repeated measures of analysis of variance (henceforward ANOVA); the main effect of realization of intended palatal stops was [$F(2, 20) = 41.111$, $p = .00000$]. The mean

percentage of realization of intended palatals in all tested tasks was according to ANOVA following; on the whole L1en speakers realized 73.6% of intended palatals as palatals [c] [ɟ], 11.1% as alveolar stops [t] [d] and 15.14% as something between alveolars and palatals.

The mean percentage of realization of intended palatals in individual tasks can be seen in a Figure 4.1. The graph was produced by repeated measures ANOVA with the following within speaker factors (context and realization). The interaction of context and realization was significant [F(6, 60) = 5.9006, p = .00007)].

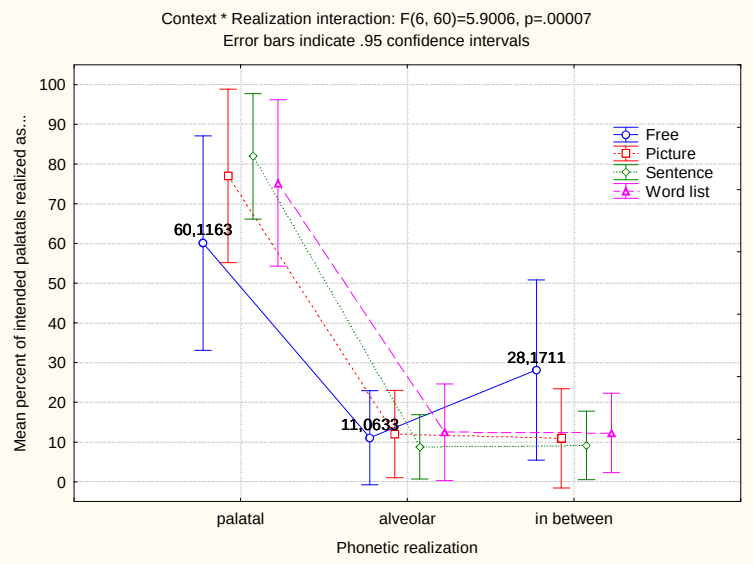


Figure 4.1 Mean percentage of intended palatals realized as palatal stops [c] [ɟ], as alveolar stops [t] [d] or as something "in between" in four tested tasks; in the Free Production task, in Elicited Production task, in the Sentence Reading task and in the Word List Reading task.
* By "context" is meant "task" and by "picture" is meant "Elicited Production task".

The realization of intended palatals as palatals was around 80% in the following three tasks – Elicited Production, Word List and Sentence, if the task changed into Free Production the realization of intended palatals as palatals decreased to 60.12%. The realization of intended palatals as alveolars was in the three tasks around 10%, in the Free Production task was the realization of intended palatals as alveolars 11.06%. However, the realization of intended palatals as "something between" increased in the Free Production task, it was 28.17% in other three tasks it was around 10%.

These findings applied to both voiced and voiceless palatals. According to repeated measures ANOVA with two within speaker factors (context and voice) there was not any significant difference [F(2, 20) = .07295, p = .92989] between the production of voiced and voiceless palatals [c] [ɟ].

One control Czech subject scored in the three parts of production experiment 100%.

The measured VOT data for palatal and alveolar stops in selected words from the Sentence and Word List Reading task were analyzed by repeated measures ANOVA. Repeated measures ANOVA with one within-speaker factor (voice) revealed that the main effect of voice was significant [F(1, 7) = 34.173, p = .00063]. L1en speakers realized intended palatal voiceless stops with VOT about 0.047 s and intended voiced stops with VOT about -0.054 s.

The main effect of place in the repeated measures ANOVA with one within-speaker factor (place) did not reach significance. The main effect of context was not significant as well.

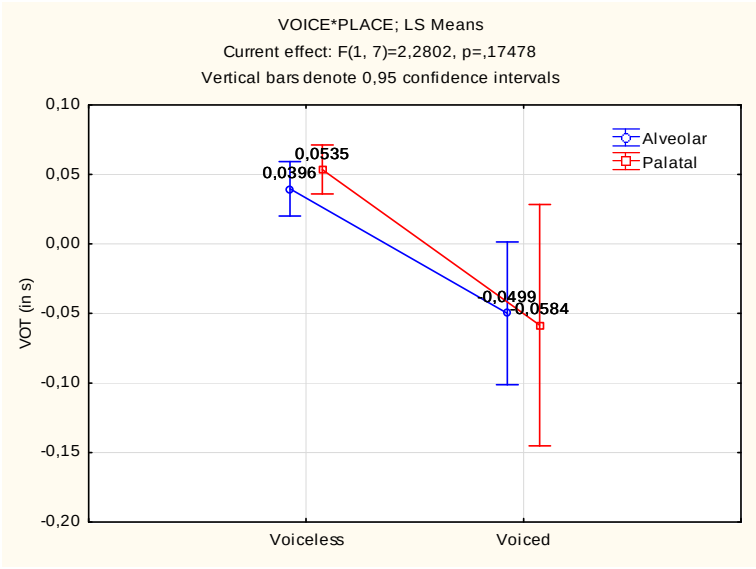


Figure 4.2 Mean values of VOT in intended voiceless and voiced palatal and alveolar stops in chosen words from Sentence and Wordlist Reading task.

The graph in the Figure 4.2 shows ANOVA with the following within-speaker factors (voice and place). The interaction of voice and place was not significant [F(1, 7) = 2.2802, p = .17478]. L1en speakers produced intended voiceless alveolar stops with VOT about 0.04 s, intended voiced alveolar stops with VOT about

-0.05 s, intended voiceless palatal stops with VOT about 0.054 s and intended voiced palatal stops with VOT about -0.058 s.

Post hoc Fisher's LSD test revealed that there was not any significant difference between VOT in intended voiceless alveolar and palatal stops and between VOT in intended voiced alveolar and palatal stops at α=0.05. However, as you can see in the graph in the Figure 4.2 both alveolar and palatal voiced stops had different variation of VOT; the standard deviation for intended /d/ was 0.051 s and for intended /ɟ/ was 0.073 s.

One control L1cz speaker produced voiceless alveolar stops with VOT about 0.018 s, voiced alveolar stops with VOT about -0.076 s, voiceless palatals stop with VOT about 0.039 s and voiced palatal stops with VOT about -0.104 s.

4.3 Discussion

L1en speakers produced palatal stops in all tasks, though in the Free Production they produced significantly fewer palatal stops (about 60%) and more stops which could not be categorized as native sounding palatal stops (about 28%). The last category might indicate that they acquired the category of palatal stops because they were trying to contrast the alveolars and palatals but might have had some problems with articulation of native sounding palatals. The production experiment also revealed that L1en speakers substituted palatal stops only with alveolar stops /t/ and /d/ and not with other consonants or consonant clusters.

Lower occurrence of palatal stops in the Free Production task could result from the fact that palatal stops were in fluent speech, which is more complex and the tested segments could be influenced by surrounding sounds. However, palatal stops in the Elicited Production task were produced as well as in the Free Production task without orthographical help, but words were usually produced individually, not in the sentence.

Lower occurrence of palatal stops in the Free Production task could be also due to fact that the speech material in the Free Production task was not well balanced while some subjects produced many tokens with palatal stops, some produced only a few.

L1en speakers produced more palatal stops in the Sentence and Word List Reading task. Palatal stops were signalized by diacritics and therefore even subjects who did not produce native sounding palatals in the Free Production task may have produced palatal stops. Furthermore, subjects were reading the sentence stimuli slowly and carefully.

Analysis of VOT in palatal and alveolar stops in selected words revealed that L1en speakers produced voiceless palatal stops with VOT longer (about 0.054 s) than one control L1cz subject (about 0.039 s) and they also differ from the data suggested by Machač (2006); his palatal stops have VOT about 0.046 s (however, he unlike me measured stops in intervocalic position).

When we compare production of Czech alveolar stops, we will see larger difference, while L1en speakers produced voiceless alveolar stops with VOT about 0.04 s; L1cz speaker produced them with VOT only about 0.018 s.

In case of voiceless alveolar stops L1en speakers had probably transfer from their native language but in case of voiceless palatal stops there was not a big difference from L1cz palatals. However, it was probably because of the fact that Czech voiceless palatals have from all stops longest VOT.

L1en speakers production of both voiced stops showed influence of their L1, even though on average they produced voiced stops with negative VOT (alveolar stops had VOT about -0.05 s and palatal stops about -0.058 s) the VOT was still not so large as in voiced stops produced by L1cz speaker (alveolar stops had VOT about -0.076 s and palatal stops about -0.104 s) and there were different variations of VOT. It ranged from positive to negative VOT and in case of intended palatal stops the variation was even bigger (0.073 s) than by alveolar stops (0.051 s).

The assumption based on Flege's SLM was not confirmed. On the whole there was evident influence of negative transfer in case of both palatal and alveolar stops without much difference.

However what was said above cannot be taken generally, because every subject was presented only by two tokens from for each stop and furthermore the words which were in the Sentence Reading task were in different position in the sentence stimuli, therefore they were under different stress.

5. PERCEPTION EXPERIMENT 1

To test perception of palatal stops I designed two experiments; the first of them was based on identification of alveolar, palatal and velar stops in different word positions and preceded and followed by different vowels.

5.1. Methods

5.1.1 Stimuli

The Forced Choice Phoneme Selection (thereafter FCPS) task consisted of 250 disyllabic nonsense words stimuli, which resembled real Czech words the least. I decided to use nonsense words to avoid influence by lexical content. Each of the stimuli contained one of the tested segments /t/, /d/, /c/, /ɟ/, /k/ or /g/. (Velar stops were included in the perception experiment because it was supposed that L1en speakers could perceive a new category of palatal stops possibly as either alveolar stops or velar stops, because both categories are next to the palatal stops.) The tested segments occurred word initially, medially and finally; voiced stops /d/, /ɟ/ and /g/ were not in the word final position because in Czech they are subjects to final devoicing.

One of my research questions was whether perception is more difficult if the palatal stops are followed by the high front vowels /ɪ/ /iː/ than by other vowels. To test my hypothesis each of the tested segments in word initial and medial position was followed, in case of word final stops preceded, by each vowel /a/, /ɛ/, /ɪ/, /o/, /u/; by both short and long vowel.

Summary of the nonsense stimuli according to position of tested segments as well as vowel quality is given under (1). Examples of some stimuli in FCPS task can be seen below in Table 5.1, list of all stimuli in the FCPS task can be found in the Appendix 1.3.1.

(1)

(a) 100 tokens with a word initial stop: 20 tokens of each /t/, /c/, /d/, /ɟ/; 10 tokens of each /k/, /g/

- 2 nonsense words with /t/, /c/, /d/, /ɟ/; 1 nonsense word with /k/, /g/
- each /t/, /c/, /d/, /ɟ/, /k/, /g/ was followed by /a/, /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, /o/, /oː/, /u/, /uː/

(b) 100 tokens with a word medial stop: 20 tokens of each /t/, /c/, /d/, /ɟ/; 10 tokens of each /k/, /g/

- 2 nonsense words with /t/, /c/, /d/, /ɟ/; 1 nonsense word with /k/, /g/
- each /t/, /c/, /d/, /ɟ/, /k/, /g/ was followed by /a/, /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, /o/, /oː/, /u/, /uː/

(c) 50 tokens with a word final stop: 20 tokens of each /t/, /c/; 10 tokens of each /k/

- 2 nonsense words with /t/, /c/; 1 nonsense word with /k/
- each /t/, /c/, /k/ was preceded by /a/, /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, /o/, /oː/, /u/, /uː/

word initial stop	**t**ěfo [**c**ɛfo] **t'**éfo [**c**ɛːfo]	**t**ifo [**c**ɪfo] **t**ífo [**c**iːfo]	**t'**afo [**c**afo] **t'**áfo [**c**aːfo]	**t'**ofo [**c**ofo] **t'**ófo [**c**oːfo]	**t'**ufo [**c**ufo] **t'**úfo [**c**uːfo]
word medial stop	mu**d**es [mu**d**ɛs] mu**d**és [mu**d**ɛːs]	mu**d**ys [mu**d**ɪs] mu**d**ýs [mu**d**iːs]	mu**d**as [mu**d**as] mu**d**ás [mu**d**aːs]	mu**d**os [mu**d**os] mu**d**ós [mu**d**oːs]	mu**d**us [mu**d**us] mu**d**ús [mu**d**uːs]
word final stop	sule**k** [sulɛ**k**] sulé**k** [sulɛː**k**]	suli**k** [sulɪ**k**] sulí**k** [suliː**k**]	sula**k** [sula**k**] sulá**k** [sulaː**k**]	sulo**k** [sulo**k**] suló**k** [suloː**k**]	sulu**k** [sulu**k**] sulú**k** [suluː**k**]

Table 5.1 Examples of nonsense stimuli in the FCPS task; orthographic form is followed by phonetic form.

The nonsense word stimuli were produced by two female native Czech speakers, students at Palacký University, age 22 and 26. Both were speakers of Bohemian variety of Czech; one of the standard varieties of Czech. The stimuli were recorded in a sound treated studio. There were together 500 stimuli from both speakers. They were edited in the program Praat (Boersma and Weenink 2007). Finally in the FCPS task there were 250 stimuli. Approximately half of the stimuli were by one speaker and half by the other and both speakers were represented almost equally, with respect to tested segments and quality of vowels.

The FCPS task was made and ran in the program Praat (Boersma and Weenink 2007). The stimuli in the FCPS task were presented in a random order and each of

them was repeated only once. However, subjects could hear the stimulus twice because in the FCPS task there was a replay button. On one hand the subjects could hear the stimulus again if they had misheard it but on the other hand it could influence the results because subjects could listen to the stimulus intentionally twice to click on the right response button.

5.1.2 Procedure

The FCPS task was presented on computers. The test was run in Praat (Boersma and Weenink 2007). Subjects heard the stimuli over Sennheiser HD 202 headphones and on the computer screen they saw six response buttons, with labels *t*, *d*, *ť*, *ď*, *k* and *g* and were asked to click on the button according to which tested segment they heard in the stimuli.

Before the proper test began subjects were given instructions in Czech and there was a trial test to make subjects familiar with the procedure. There were six response buttons and a replay button in the trial test and the tested segments were in word initial, medial and final position as in the FCPS task. Unlike in the proper test there were only 18 stimuli with tested segments and the stimuli were real Czech words; e.g. *ticho* [cɪxo] (“silence”), *lékař* [lɛːkaɽ] (“doctor”) or *mladý* [mladiː] (“young”). By accident there occurred two errors; there were two tested segments in two stimuli and subjects were informed about it and asked to click on one of the corresponding buttons.

Subjects were also told that the sound they heard in e.g. [pocɛʃiː] is represented by the button with the label *ť* not to confuse the sound with its orthographical representation. The orthographic form of [pocɛʃiː]] is *potěší* so they might have clicked on the button with label *t*.

After the trial test subjects proceeded to the experiment. Between both tests and within the FCPS task there were breaks to avoid test fatigue.

5.2 Results

Repeated measures ANOVA with one within-speaker factor (location) examining the FCPS task revealed that the main effect of the location was significant [F(2, 22) = 9.7295, p = .000094]. L1en speakers perceived incorrectly most segments, which were in the word final position (about 25% of incorrectly perceived). They had fewest problems with perception of segments, which were word medial (about 10%); the word initial segments were misperceived in about 15%. The graphical representation of this difference can be seen in a Figure 5.1.

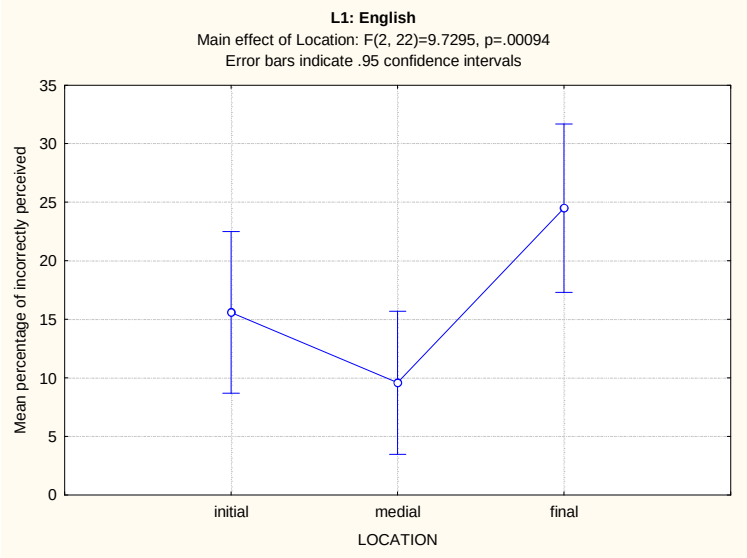


Figure 5.1 The mean percentage of incorrectly perceived oral stops with respect to the location of the tested segments by L1en speakers.

Repeated measures ANOVA with one within-speaker factor (location) examining perception of L1cz speakers yielded that the main effect of location was significant [F(2, 26) = 5.7818, p = .00837] also by L1cz speakers; it can be seen in a Figure 5.2. Native speakers had most problems with perception of word initial segments (about 3.25% of incorrectly perceived. They had fewest problems with perception of word medial stops (about 1% of incorrectly perceived stimuli) and word final stops caused less problems with perception than word medial stops (about 1.5% of incorrectly perceived stimuli).

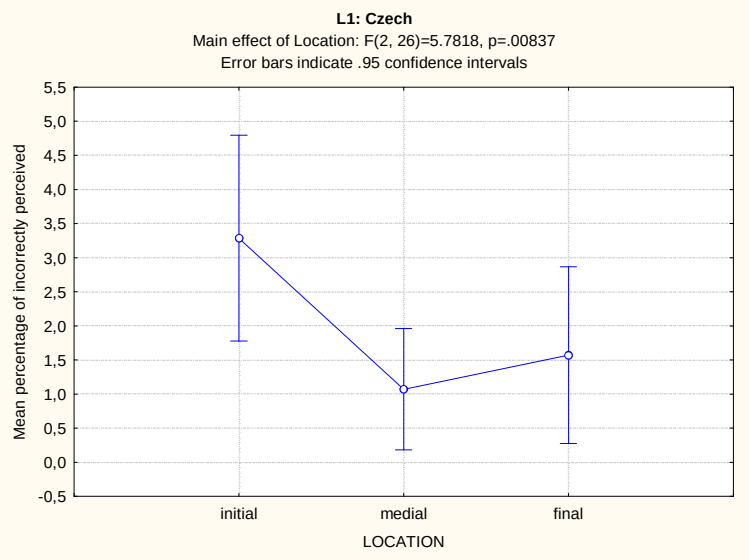


Figure 5.2 The mean percentage of incorrectly perceived stops with respect to the location of the tested segments by L1cz speakers.

The main effect of place of articulation in the repeated measures ANOVA with the following within-speaker factors (place of articulation and voicing) reached significance [F(2, 22) = 7.9293, p = .00255]. L1en speakers perceived incorrectly 20.76% of stimuli with palatal stops, 13.47% of stimuli with alveolar stops and 2.5% of stimuli with velar stops.

Repeated measures ANOVA with one within-speaker factor (voice) revealed that L1en speakers had significantly [F(1, 11) = 26.323, (p = .00033)] more problems with perception of voiceless palatal stops. They perceived incorrectly 15.79% of voiceless palatal stops /c/ and 8.47% of voiced palatal stops /ɟ/.

The interaction of place of articulation and voice can be seen in a Figure 5.3 which was produced by repeated measures ANOVA. The interaction of these two within-speaker factors was significant [F(2, 22) = 4,7874, p = .01879].

Post hoc Fisher's LSD test revealed that there was a significant difference between L1en speakers' responses to voiceless alveolar stop /t/ and palatal voiceless stop /c/ at α=0.01, they perceived incorrectly about 25% of voiceless palatal stops.

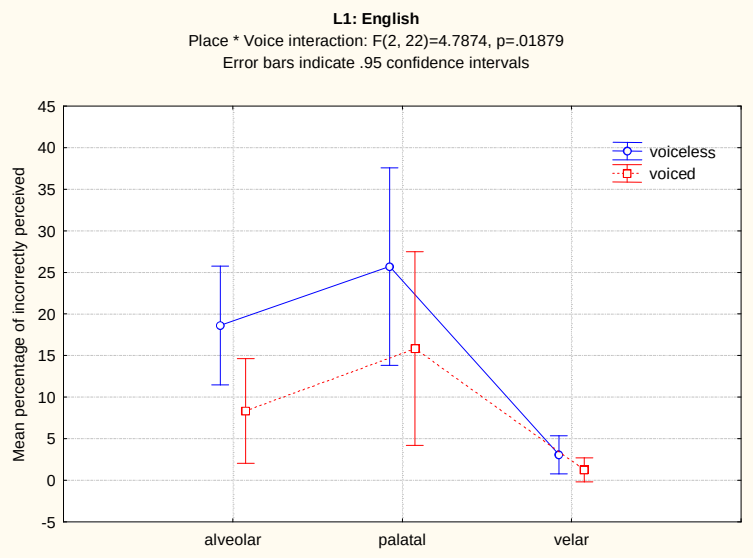


Figure 5.3 The mean percentage of incorrectly perceived tested segments /t/, /d/, /c/, /ɟ/, /k/ and /g/ with respect to their voice and place of articulation by L1en speakers.

Post hoc Fisher's LSD test revealed that there was a significant difference between L1en speakers' responses to voiced alveolar stop /d/ and voiced palatal stop /ɟ/ at α=0.01; they perceived incorrectly about 15% of voiced palatal stops.

Post hoc Fisher's LSD test revealed that there was a significant difference between L1en speakers' responses to voiceless palatal stop /c/ and palatal voiced stop /ɟ/ at α=0.05. It was more difficult for them to perceive voiceless palatal stops (about 25% of incorrectly perceived) than voiced palatal stops (about of 15% incorrectly perceived).

Further analysis of misperceived palatal stops revealed that L1en speakers mistook palatal stops mostly for alveolar stops (about 62%) and only rarely for velar stops (about 7%).

Misperceived voiceless palatal stops were perceived as alveolar stops (about 39% of misperceived voiceless palatals) and less as velar stops (about 2%). Misperceived voiced palatal stops were perceived as alveolar stops (about 85%) and as velar stops (about 12%).

L1cz speakers did not have any significant (p = .24704) problems with the perception of stops with respect to the place of articulation.

Repeated measures ANOVA with one within-speaker factor (preceding vowel) revealed that there was not any significant (p = .57172) difference in perception of

L1en speakers with respect to preceding vowel in case of word final stops (word medial stops were not included, because there was not equal representation of vowels, only high front rounded vowel /u/ was preceding word medial stops).

L1cz speakers also did not have any significant (p = .36363) problems with perception of palatal stops if they were preceded either by high front unrounded vowels /ɪ/ or /iː/ or by other vowels.

Repeated measures ANOVA with one within-speaker factor (the following vowel) indicated that there was a significant (p = .00243) difference in L1en speakers' perception of palatal stops, if they were followed by different vowels. L1en speakers perceived incorrectly 35.42% of palatals followed by high front unrounded vowels /ɪ/ /iː/ and 21.01% of palatals followed by other vowels.

The interaction of voice and following vowel was significant [F(1, 11) = 5.2089, p = .04336]; it can be seen in a Figure 5.4 produced by repeated measures ANOVA with the following within-speaker factors (voice and following vowel).

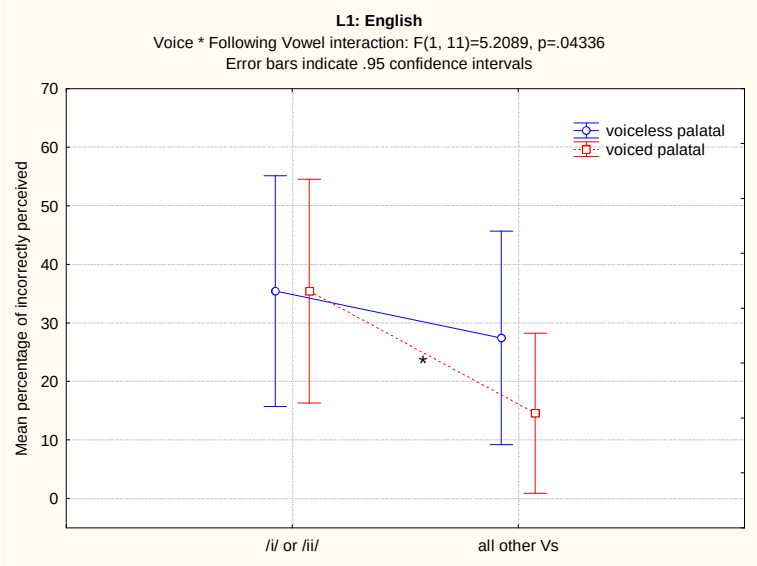


Figure 5.4 The mean percentage of incorrectly perceived voiced palatal /ɟ/ and voiceless palatal /c/ followed by either /ɪ/ or /iː/ or other vowels by L1en speakers.
* Significant difference revealed by *post hoc* Tukey's test at α =0.01.
/ii/ high unrounded vowel /iː/

L1en speakers perceived incorrectly 35.42% of palatals followed by front high unrounded vowels /ɪ/ /iː/ (it applied to both voiced and voiceless palatals). *Post hoc*

Tukey's test revealed that there was a significant difference between L1en speakers' responses to the voiced palatals followed by front high unrounded vowels /ɪ/ /iː/ and voiced palatal stimuli followed by other vowels at α=0.01. They perceived incorrectly 35.42% of voiced palatals followed by front high unrounded vowels /ɪ/ /iː/ and 14.58% of voiced palatals followed by other vowels.

Repeated measures ANOVA with one within-speaker factor (following vowel) examining perception of L1cz speakers revealed that they had marginally significant (p = .06154) problems with perception of palatal stops followed by high front unrounded vowel /ɪ/ or /iː/. They perceived incorrectly 11.16% of palatal stops followed by high front unrounded vowel /ɪ/ or /iː/ and 1.4% of palatal stops followed by other vowels.

The interaction of voice and following vowel was not significant [F(1, 13) = 1.5970, p = .22853].

5.3 Discussion

L1en speakers had most problems with identification of word final consonants; this result is in accordance with findings of M. A. Redford and R. L Diehl (1999). Results of their experiments strongly supported their prediction that syllable-initial consonants are identified more accurately than syllable final consonants. As they were testing the CVC syllable, their results might be applied rather to word initial than to syllable initial consonants.

The word final consonants have a weaker burst and because they are not in a stressed syllable like word initial consonants (in Czech there is usually the main stress on the first syllable) they are not so prominent and therefore they are not so easily identifiable.

Word initial consonants were more easily identifiable by L1en speakers than final consonants, probably because they could tune in more acoustic cues such as VOT, burst or formant transitions.

L1cz speakers had different pattern of misperceived oral stops with respect to position of target segments. They identified more accurately word final than word

initial consonants. It seems that the two groups of subjects needed different cues to identify consonants.

The word medial stops caused least problems with identification for both groups of L1 speakers. It might be due to the fact that besides other acoustic cues there are vowel formant transitions, which provide information about place of articulation, from both sides, into and out of the consonant.

The results of the FCSP task also revealed that L1en speakers had most problems with identification of palatal stops. This finding is in accordance with the fact that they are not in the phonemic inventory of their L1 and they are a new category for L1en learners of Czech. According to ANOVA they had more problems with identification of voiceless palatal stops.

Further analysis of misperceived palatal stops revealed that L1en speakers identified about 60% of misperceived voiceless palatal stops as voiced palatal stops. This fact indicates that it was probably because of negative transfer from their L1; English word initial voiceless stops are aspirated and voiced alveolar stops are partially voiced only at the end of utterance or before a voiceless sound.

The palatal stops which were perceived incorrectly by L1en speakers could be perceived either as the alveolar stops or as the velar stops. Analysis revealed that the incorrectly perceived palatal stops were identified mainly as alveolar stops. L1en speakers identified about 39% of misperceived voiceless palatal stops as alveolar stops and about 85% of misperceived voiced palatal stops as alveolar stops, which are part of non-native contrast of palatal and alveolar stops.

L1cz speakers, as native speakers did not have any significant problems with perception of stops when considering place of articulation.

Both L1en and L1cz speakers did not have significant problems with perception of palatals when they were preceded by different vowels. They were probably identified by different acoustic cues than by transitions into a consonant.

Repeated measures ANOVA revealed that both groups had problems with perception of palatals in context of different following vowels, when we consider category of palatals as a whole.

However Tukey's *post hoc* test revealed that L1en speakers did not have any significant differences in perception of voiceless palatal stop /c/ when it was followed by either /ɪ/ or /iː/ or by other vowels. There was only significant difference

between perception of voiced palatal stop /ɟ/ followed by /ɪ/ or /iː/ or by other vowels. L1cz speakers did not have any significant interaction of voice and following vowel.

In spite of the fact that locus for F2 is very high and it is in the same place as F2 of vowel /ɪ/ (see Mluvnice češtiny 1 1986, 45) it did not cause L1en speakers problems with perception of voiceless palatal stops.

The voiceless palatal stops have stronger burst than the voiced one, therefore the L1en speakers probably preferred as a cue rather burst than formant transitions. The voiced palatals have unlike the voiceless weaker burst, so subjects had to use as a cue probably rather formant transitions.

6. PERCEPTION EXPERIMENT 2

The second experiment to test perception of palatal stops was based on identification of alveolar, palatal and velar stops, which were in word initial position, with varying values of VOT.

6.1 Methods

6.1.1 Stimuli

The stimuli for the second perception experiment were nonsense words, which could be possibly well formed Czech words; *těfo* /cɛfo/, *děfo* /ɟɛfo/, *tefo* /tɛfo/, *defo* /dɛfo/, *kefo* /kɛfo/ and *gefo* /gɛfo/. The stimuli had different values of VOT and were placed on the three continua; /t-d/, /c-ɟ/, and /k-g/. Each continuum had 10 steps, the range of values was from -75 ms to 75 ms (0 was not included). The steps were not rising arithmetically but logarithmically. The intermediate VOT values were interpolated between the natural logarithm of the minimal value (5 ms) and the natural logarithm of the maximal value (75 ms) and then they were converted back to absolute values. The steps along the continua were following -75, -38, -19, -10, -5, 5, 10, 19, 38 and 75 ms.

Individual steps along continua were made from human speech tokens of /cɛfo/, /ɟɛfo/, /tɛfo/, /dɛfo/, /kɛfo/ and /gɛfo/ produced by an adult male speaker, which were edited to make each steps in the continua, while still resembling human speech as much as possible.

Stimuli on the /t-d/ continuum were edited from human speech recorded tokens of [tɛfo] and [dɛfo]. There was a burst noise from one natural token of [tɛfo]. The vowel [ɛ] in the stimuli was used from one token of [dɛfo] and was manipulated in Praat (Boersma and Weenink 2007) by the method PSOLA. The vowel length was reduced to 80% of its original length, to make it sound natural in all tokens

along the /t-d/ continuum. Formant transitions for the base stimulus were taken from the token of [dɛfo].

To make the /t-d/ stimuli with longer values of positive VOT the noise was inserted into the central portion of the noise. The noise was taken randomly from different tokens of [tɛfo] by the same speaker and inserted randomly into the central part of the aspiration noise. The voicing for the stimuli with negative values of VOT was taken from one natural token of [dɛfo] and was elongated or truncated as needed.

To make the base stimulus for /c-ɟ/ continuum, the vowel was used from one natural token of [ɟɛfo] and it was manipulated in Praat (Boersma and Weenink 2007). Tokens of [ɟɛfo] and [cɛfo] had different intensity of burst. The burst noise was used from natural token of [ɟɛfo]; the lower part of intensity of burst was filtered out, the interval between 500-22050 Hz was kept and smoothed 100 Hz.

The vowel in the /c-ɟ/ 38 ms stimulus was shortened. The stimulus with the VOT 75 ms was made from the natural token of [cɛfo], the vowel was shortened and the aspiration noise was taken from another natural token of [cɛfo] and was inserted nearly into the same place.

The stimuli with VOT 19, 10 and 5 ms were made from the preceding stimuli, in which the aspiration noise was shortened; e.g. the stimulus /c-ɟ/ 19 ms was made from the stimulus /c-ɟ/ 38 ms in which the aspiration noise was shortened to 19 ms.

The stimuli with negative values of VOT were made from the base stimulus and there was added prevoicing from natural token of [ɟɛfo]. The cursor was moved to zero and the prevocing was selected from 0 ms to 5 ms, 10 ms, 19 ms and 38 ms.

The sound [ɛfo] in the base stimulus on the /k-g/ continuum was used from one natural token of [kɛfo]. The glottal pulse was used from one natural token of [gɛfo]. The intensity of burst was reduced and the first cycle before beginning of voice was used from natural token of [gɛfo].

The stimulus with VOT 19 ms was made from the natural token of [kɛfo], the burst was reduced and the intensity was lowered. The stimulus with VOT 10 ms and 5 ms were shortened from the stimulus with VOT 19 ms.

The aspiration noise in the /k-g/ stimulus with VOT 75 ms was taken from another natural token of [kɛfo] and was randomly inserted nearly in the same place.

The stimuli with negative values of VOT were made from the stimulus /k-g/ 5 ms and there was added corresponding voicing.

Each stimulus was repeated five times and they were presented in a random order, but no doublets occurred there, which means that the same stimuli were not after each other. In the identification task there was a replay button and the stimuli could be played again.

6.1.2 Procedure

The "VOT identification test" was presented on computers. The test was run in Praat (Boersma and Weenink 2007). Subjects heard the stimuli in Sennheiser HD 202 headphones, on the computer screen they saw six response buttons, with labels *t*, *d*, *ť*, *ď*, *k* and *g* and were asked to click on the button according to which tested segment they heard in the stimuli.

Before the proper test began subjects were given instructions in Czech and there was a trial test to make subjects familiar with the procedure. There were six response buttons and a replay button in the trial test as in the "VOT identification" test. Unlike in the proper test there were only 6 stimuli, the end points of the three continua; it means the stimuli with VOT 75 ms and -75 ms.

Subjects were also told that the sound they heard in e.g. [cɛfo] is represented by the button with the label *ť* not to confuse the sound with its orthographical representation. The orthographical form of [cɛfo] is *těfo* so the subjects might have clicked on the button with label *t*.

After the trial test subjects proceeded to the experiment. Between both tests and within the test there were breaks to avoid test fatigue.

6.2 Results

Repeated measures ANOVA with one between-speaker factor (L1) indicated that there was a significant difference in incorrectly perceived stimuli. The main effect of L1 was significant [F(1, 24) = 5.8841, p = .02316]. L1en speakers perceived incorrectly place of articulation in 6.94% of all stimuli while L1cz speakers perceived incorrectly place of articulation in 3.17% of all stimuli.

Repeated measures ANOVA with one within-speaker factor (place) examining perception of L1en speakers revealed that the main effect of place was significant [F(2, 22)] = 11.206, p = .00044]. L1en speakers had the most problems with identification of stimuli with palatals stops (13.5% of incorrectly perceived), then with stimuli with alveolar stops (7%) and they had fewest problems with perception of stimuli with velar stops (0.33%).

The main effect of place reached significance [F(2, 26) = 3.9774, p = .03111] also at L1cz speakers. They had most problems with identification of stimuli with alveolar stops (6.43%), then with stimuli with palatal stops (3%) and least with stimuli with velar stops (0.07%).

In a Figure 6.1 you can see ANOVA with the following between-speaker factor (L1) and within-speaker factor (place). The interaction of L1 and place was significant [F2(2, 48) = 5.4009, p = .00766].

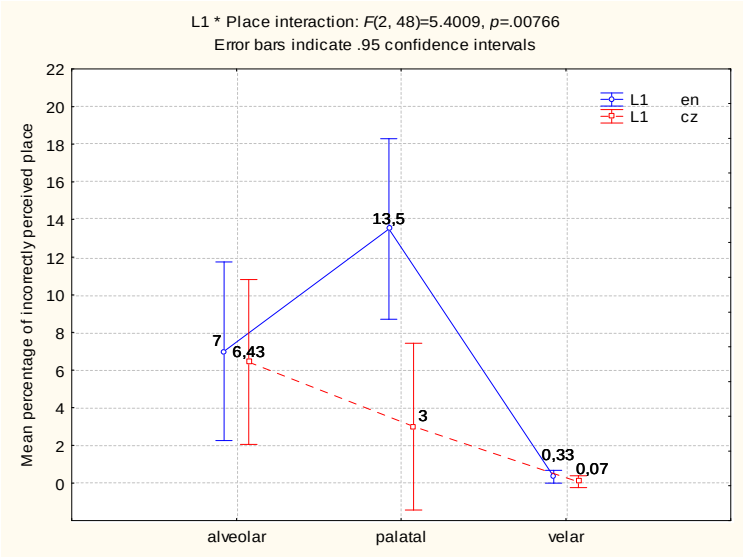


Figure 6.1 Mean percentage of incorrectly perceived place of articulation for L1cz and L1 eng speakers in responses to the stimuli along alveolar, palatal and velar continuum with varying VOT.

The mean percentage of responses to stimuli along the VOT /t-d/ continuum ranging from stimuli with values of VOT from -75 ms to +75 ms perceived as voiced is shown in a Figure 6.2. There are two lines; one represents the responses to stimuli by L1en speakers and the second by L1cz speakers. It was produced by repeated measures ANOVA with the following between-speakers factor (L1) and within-speaker factor (VOT). The interaction of L1 and VOT was significant [F(9, 216) = 8.0098, p = .00000].

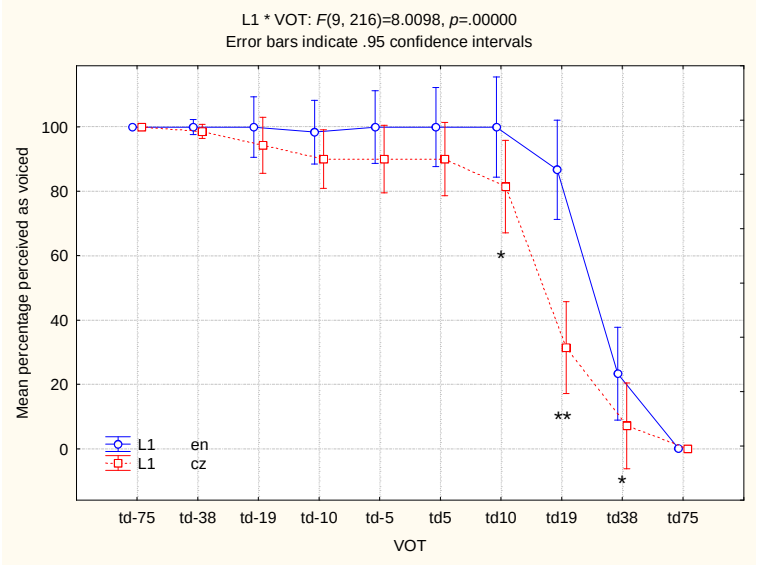


Figure 6.2 The mean percentage of responses on the /t-d/ continuum perceived as voiced by L1en and by L1cz speakers. The horizontal axis represents the VOT continuum ranging from -75 ms on the left to +75 ms on the right.
* Significant difference revealed by *post hoc* Fisher's LSD test at α =0.05.
** Significant difference revealed by *post hoc* Tukey's test at α =0.001.

Post hoc Tukey's test was used and it revealed that there was a significant difference between L1en speakers' and L1cz speakers' responses to the stimulus "td19" at α=0.001. L1en speakers perceived about 90% of stimuli with VOT 19 ms as voiced, while the L1cz speakers perceived as voiced about 30% of these stimuli.

The *post hoc* Fisher's LSD test revealed that there was a significant difference between L1en speakers' and L1cz speakers' responses to the stimulus "td38" at α=0.05. L1en speakers perceived about 20% of tokens of the stimuli "td38" as voiced by L1en speakers, while L1cz speakers perceived as voiced only 10% tokens of these stimuli.

The "td75" stimuli were perceived as voiceless by both groups of speakers.

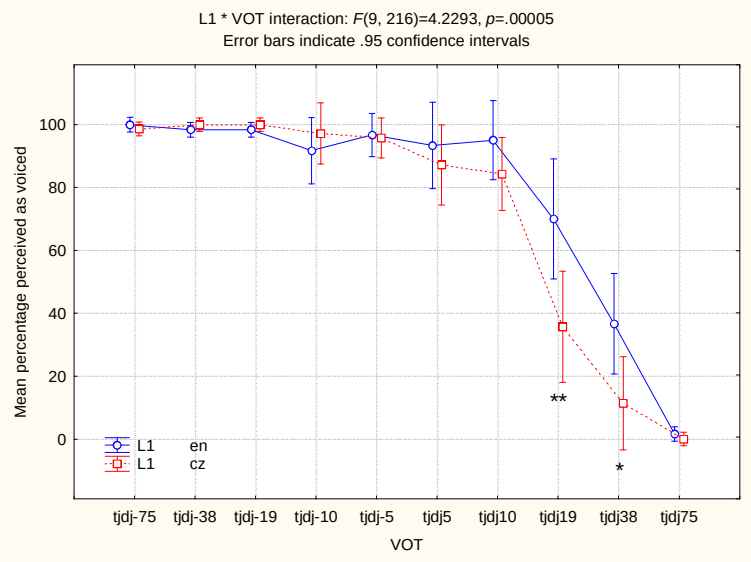


Figure 6.3 The mean percentage of responses on the /c-ɟ/ continuum perceived as voiced by L1en and by L1cz speakers. The horizontal axis represents the VOT continuum ranging from -75 ms on the left to +75 ms on the right.
tjdj - palatal stops /c/ and /ɟ/
** Significant difference revealed by *post hoc* Tukey's test at α =0.001.
* Significant difference revealed by *post hoc* Tukey's test at α =0.05.

In a Figure 6.3 you can see categorization of stimuli with varying VOT along /c-ɟ/ continuum by L1en and L1cz speakers. In the graph there is ANOVA with the following between-speaker factor (L1) and within-speaker factor (VOT); the interaction of L1 and VOT was significant [F(9, 216) = 4.2293, p = .00005].

The stimuli with negative VOT were by both L1en and L1cz speakers identified mostly as voiced. *Post hoc* Tukey's test revealed that there was a significant difference between L1en speakers' and L1cz speakers' responses to the stimulus "tjdj19" at α=0.001; while the L1en speakers identified as voiced about 70% of the "tjdj19" stimuli, the L1cz speakers identified as voiced only 40% of them.

Post hoc Tukey's test also revealed that there was a significant difference between L1en speakers' and L1cz speakers' responses to the stimulus "tjdj38" at α=0.05; nearly 40% of tokens of this stimulus was perceived as voiced by L1 en speakers, while only about 15% of these stimuli was perceived as voiced by L1cz speakers.

The "tjdj75" stimuli were perceived as voiceless by both groups of speakers.

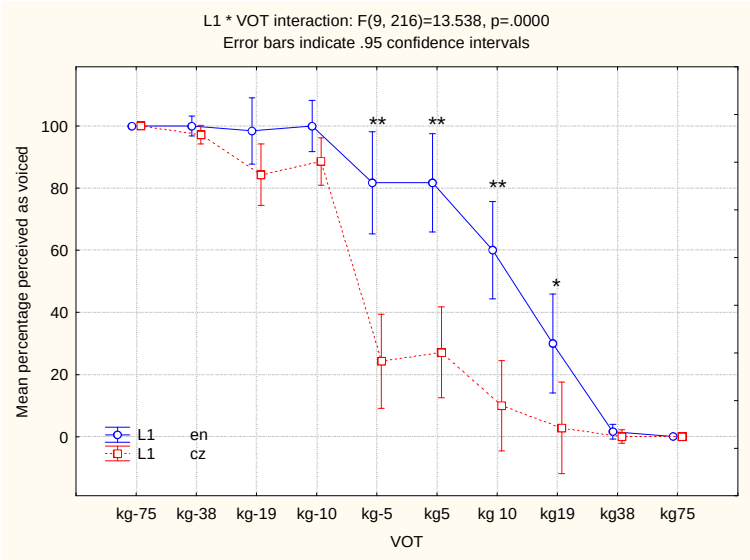


Figure 6.4 The mean percentage of responses on the /k-g/ continuum perceived as voiced by L1en and by L1cz speakers. The horizontal axis represents the VOT continuum ranging from -75 ms on the left to +75 ms on the right.
** Significant difference revealed by *post hoc* Tukey's test at α =0.001.
* Significant difference revealed by *post hoc* Tukey's test at α =0.05.

In a Figure 6.4 you can see the mean percentage of classification of individual steps along the /k-g/ continuum, which were perceived as voiced. In the graph there is ANOVA with the following between-speakers factor (L1) and within-speaker factor (VOT); the interaction of L1 and VOT was significant [F(9. 216) = 13.538, p=.0000].

The stimuli with negative VOT were identified mainly as voiced by both L1en and L1cz speakers. *Post hoc* Tukey's test revealed that there was a significant difference between L1en speakers' and L1cz speakers' responses to the stimuli "kg-5", "kg5" and "kg10" at α=0.001. Nearly 80% of "kg-5" and "kg5" stimuli were perceived as voiced by L1en speakers, while L1cz speakers perceived as voiced only about 25% of them. Nearly about 60% of the "kg10" stimuli were perceived as voiced by L1en speakers, while L1cz speakers perceived only about 10% of these stimuli as voiced.

Post hoc Tukey's test also revealed that there was a significant difference between L1en speakers' and L1cz speakers' responses to the stimulus "kg19" at α=0.05. While L1en speakers perceived about 30% of the stimuli still as voiced, L1cz speakers perceived them mostly as voiceless.

The “kg38” and “kg75” stimuli were perceived as voiceless by nearly all speakers.

In a Figure 6.5 you can see the mean percentage of alveolar, palatal and velar stimuli perceived as voiced by L1en speakers. In the graph there is ANOVA with the following within-speaker factors (place and VOT). The interaction of place and VOT was significant [F(18, 198) = 7.1760, p = .0000].

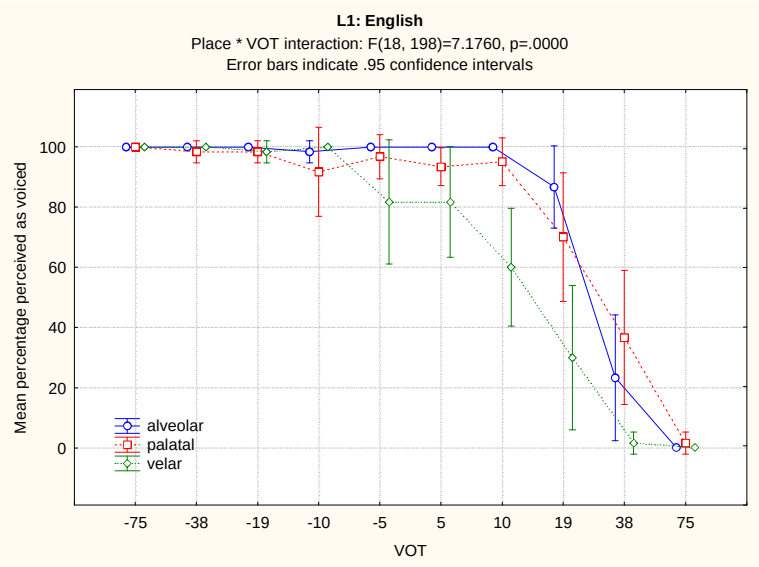


Figure 6.5 The mean percentage of responses along the three continua perceived as voiced by L1en speakers. The horizontal axis represents the VOT continuum, from -75 ms on the left to +75 ms on the right.

Post hoc Fisher’s LSD test revealed that there was a significant difference between L1en speakers’ responses to the alveolar and palatal stimuli with VOT 19 ms at α=0.01 and VOT 38 ms at α=0.05.

Post hoc Fisher’s LSD test revealed that there was a significant difference between L1en speakers’ responses to the palatal and velar stimuli with VOT -5 ms at α=0.05 and between the responses to the alveolar and velar stimuli with the same VOT at α=0.01. The alveolar and palatal stimuli were identified mainly as voiced but the velar stimuli were already considered as voiceless; about 20% perceived as voiceless.

Post hoc Fisher’s LSD test revealed that there was a significant difference between L1en speakers’ responses to the alveolar and velar stimuli with VOT 5 ms at α=0.01.

Tukey's *post hoc* test revealed that there was a significant difference between L1en speakers' responses to the palatal and velar stimuli with VOT 10 ms, 19 ms and 38 ms at α=0.001. *Post hoc* Tukey's test also revealed that there was a significant difference between L1en speakers' responses to the alveolar and velar stimuli with VOT 10 ms and 19 ms at α=0.001.

Post hoc Tukey's LSD test revealed that there was a significant difference between L1en speakers' responses to the alveolar and velar stimuli with VOT 38 ms at α=0.001.

Whereas the alveolar and palatal stimuli with VOT 10ms were perceived as voiced, about 40% of velar stimuli with VOT 10 ms were considered as voiceless. The alveolar and palatal stimuli with VOT 19 ms were still considered as voiced but about 20% of the velar stimuli with this value of VOT were perceived as voiceless.

In the following graph in a Figure 6.6 you can see the mean percentage of responses along the three continua perceived as voiced by L1cz speakers. In the graph there is ANOVA with the following within-speaker factors (place and VOT). The interaction of place and VOT was significant [F(18, 234) = 19.960, p = .0000].

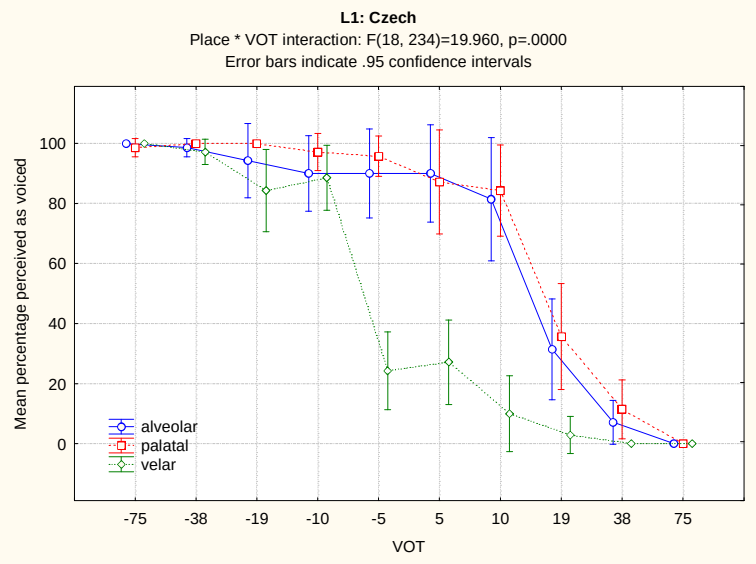


Figure 6.6 The mean percentage of tokens on the three continua perceived as voiced by L1cz speakers. The horizontal axis represents the VOT continuum ranging from -75 ms on the left to +75 ms on the right.

Post hoc Tukey's and Fisher's tests revealed that there were not any significant differences between L1cz speakers' responses to the alveolar and palatal stimuli. The pattern of identification was nearly the same.

The stimuli with large VOT were perceived as voiced. The stimuli with VOT 19 ms were perceived as voiceless. About 60% tokens of these stimuli were perceived as voiceless. The stimuli with VOT 38 ms were perceived mainly as voiceless.

Post hoc Fisher's test revealed that there was a significant difference between L1cz speakers' responses to the palatal and velar stimuli with VOT -19 ms at α=0.01.

Post hoc Tukey's test revealed that there was a significant difference between L1cz speakers' responses to the palatal and velar stop stimuli with VOT -5 ms, 5 ms, 10 ms, 19 ms at α=0.001.

There was also according to *post hoc* Tukey's test a significant difference between L1cz speakers' responses to the alveolar and velar stimuli with VOT -5 ms, 5 ms, 10 ms and 19 ms at α=0.001 While the velar stimuli with VOT -5 ms were perceived as voiceless, the palatal and alveolar stimuli were identified mostly as voiced. Palatal and alveolar stimuli with VOT 19 ms were perceived as voiceless.

Post hoc Fisher's test revealed that there was a significant difference between L1cz speakers' responses to the palatal and velar stimuli with VOT 38 ms at α=0.05. While the velar stimuli were considered as voiceless, still about 20% of responses to the palatal stimuli were identified as voiced.

6.3 Discussion

Results of the second perception experiment revealed that L1en speakers had the same pattern of incorrectly perceived place of articulation as in the first experiment. It was for them most difficult to identify correctly palatal stops, probably because they were a new category for them. For L1cz speakers, as they are native speakers, it was not so difficult to perceive correctly palatal stops.

Alveolar and velar stops were difficult for both groups approximately at the same rate, and the velar stops were most easily identified by both groups of speakers.

L1cz speakers had most problems with identification of alveolar stops (about 6% of incorrectly perceived) it could be due to the fact that L1cz speakers are not used to oral stops with longer values of VOT.

L1en speakers resembled native Czech speakers in perception of “td” stimuli with negative VOT, however there was different cross over point for both group of speakers. L1en speakers needed larger positive VOT to classify the alveolar stop as voiceless. There was a difference between perception of stimuli with VOT 19 ms; while L1en speakers perceived them still as voiced, L1cz speakers perceived them already mainly as voiceless. The L1en speakers still did not perceive the stimuli with VOT 38 ms as perfect voiceless alveolar stop.

L1en speakers had negative transfer from L1. English voiceless alveolar stops, which, if they are in a stressed syllable and syllable initial, have longer values of VOT, therefore L1en speakers need longer values of VOT to perceive alveolar stops as voiceless. Furthermore, the voiced alveolar stops, which are in English syllable initial, are not fully voiced so L1en learners of Czech perceived alveolar stimuli with positive values of VOT still as voiced.

Perception of palatal stops resembled perception of alveolar stops. L1en speakers needed longer values of VOT to perceive palatal stop as voiceless. L1cz speakers perceived already the stimuli with VOT 19 ms as voiceless palatal stops, L1en speakers perceived them still as voiced.

According to ANOVA and *post hoc* tests there was a difference between L1en speakers’ perception of alveolar and palatal stimuli with VOT 19 ms and 38 ms. While they perceived the “td19” stimuli more as voiced in case of alveolar stops; in case of the “tjdj38” stimuli the perception was reversed, about 35% of “tjdj38” stimuli was perceived as voiced and only about 20% of “td38” stimuli was perceived as voiced.

In case of alveolar stops was the perception of L1en speakers’ more categorical than in case of alveolar stops, where was more continuous. Alveolar stops are unlike palatal stops an old and well established category in their native language therefore their perception was more categorical.

My research question was what VOT will the new palatal stops in the speech of the English learners of Czech have. If it is going to be English-like (negative transfer from L1) or more Czech like.

Results of the second experiment suggest that L1en speakers needed larger values of VOT to categorize palatal stops as voiceless than alveolar stops. It seems that in spite of the fact that L1en speakers were able to perceive palatal stops they needed large values of VOT to perceive them as voiceless.

When considering velar stops there was different pattern of perception than by alveolar and palatal stops. Both groups of L1 speakers identified already the stimuli with VOT -5 ms and 5 ms as voiceless, though the L1en speakers only about 20% of them, the L1cz perceived them mainly as voiceless. It is possible that it was caused by the "kg-5" and "kg5" stimuli themselves because the stimuli with VOT -5 ms was made from the stimuli "kg5" and there was added voicing.

The percentage of stimuli perceived as voiced was nearly linearly declining for L1en speakers and unlike the alveolar and palatal stops they perceived as voiceless already the stimuli with VOT 19 ms and the stimuli with VOT 38 ms was perceived mainly as voiceless.

Both groups of subjects needed shorter values of VOT to categorize velar stops as voiceless than to categorize alveolar stops. This finding is in disagreement with the fact that the velar stops have larger values of VOT in both languages. However, L1en speakers had still negative transfer and demanded larger values of VOT to classify velar stops as voiceless than L1cz speakers.

It would be better, if the range of the continua was larger, therefore both groups of subjects would probably categorize mainly as voiceless larger number of stimuli. However, it was technically difficult to made naturally sounding stimuli with large positive VOT.

7 CONCLUSION

7.1 Findings of the thesis

The aim of this paper was to study the acquisition of Czech palatal stops by English native speakers. I was testing both perception and production of palatal stops.

Results of my four production tasks revealed that L1en speakers were able to produce palatal stops in four different tested contexts not only in Sentence and Word List Reading task, which could be because of orthography, but also in free speech and in Elicited Production task. On the whole they produced 73.6% of palatal stops, which were intended as palatal stops and 15.4% of stops which were categorized as something between palatal stops and alveolar stops, but it could indicate that they acquired the category of palatal stops. Although these stops did not sound native like, which could have been because of problems with articulation or because of negative transfer from native language, there was probably intention to distinguish palatal and alveolar stops.

Some of the intended palatal stops (11.1%) were substituted with alveolar stops. Palatal stops are a new category for L1en speakers and it could suggest that the subjects still did not form this category well. There could be various explanations of this. There could be influence of native language, and one of the reasons was probably the fact that the group of tested subjects was not homogenous.

There were subjects with different length of exposure to Czech, it ranged from 1 year 2 months to 20 years and subjects had different motivations to use Czech, therefore some of them were speaking nearly native like, in spite of the fact that they did not stay here long and others even after longer exposure to Czech did not produce native sounding palatal stops in the same extent.

Analysis of selected words in the Sentence Reading and Word List Reading task revealed that L1en speakers had larger VOT than one control L1cz speaker and also larger than stops measured by Machač (2006) in case of both alveolar and palatal stops and that both voiced palatal and alveolar stops had different variation.

Both perception tests proved that English learners of Czech were able to identify palatal stops and distinguish them from alveolar and velar stops. They

identified correctly about 80% of palatal stops in the first perception experiment and about 87% in the second perception experiment.

L1en speakers substituted misperceived palatal stops in the first perception experiment mostly with alveolar stops (about 39% of misperceived voiceless palatals and about 85% of misperceived voiced palatals) and only rarely with velar stops (about 2% of misperceived voiceless palatals and about 12% of misperceived voiced palatals).

The FCPS task also revealed that they had significant problems with perception of voiceless palatals. This was probably because of the negative transfer from their native language, analysis of misperceived palatal stops revealed that L1speakers identified 60% of misperceived palatal stops as voiced palatal stops. English voiceless stops are unlike Czech aspirated, in word initial position, and voiced stops are partially voiced only at the end of utterance or before a voiceless sound, therefore they identified Czech voiceless stops as voiced.

The second research question whether the perception of palatal stops is more difficult when palatal stops are followed by the high front vowels /ɪ/ or /iː/ than by other vowels was not confirmed in all its entirety.

Results of the FCPS task proved that L1en speakers had more problems with identification of palatal stops followed by high front vowels /ɪ/ and /iː/ and the controlled Czech group had marginally significant problems with perception of these palatal stops.

However further analysis and *post hoc* tests revealed that there were only significant problems with perception of voiced palatal stops followed by high front vowels /ɪ/ and /iː/ and in case of voiceless palatal stops there were not any significant differences between perception of palatal stops followed by high front vowels /ɪ/ and /iː/ or by other vowels.

It is probable that L1en subjects used when identifying the voiceless palatal stops as a cue rather burst than formant transitions because voiceless palatal stops are characterised by more intense burst than voiced palatals.

Voiced palatal stops have weaker burst so subjects had to use as a cue rather formant transitions, but /ɪ/ has low F1 and high F2, and the locus of /ɟ/ is in the same place as F2 of /ɪ/, therefore there are not any CV formant transitions.

One of my research questions was what VOT will the new palatal stops in the speech of the English learners of Czech have. If it is going to be English-like (negative transfer from L1) or more Czech like.

Results of the second perception experiment revealed that that L1en speakers demanded longer values of VOT to classify all stops, not only alveolars and velars, but also palatals as voiceless.

Analysis of measured VOT data revealed that L1en speakers produced voiceless palatal stops with larger VOT than L1cz speaker and that they produced voiced palatal stops with negative VOT, however it was not very large and there was different variation. On the whole there was evident negative transfer from their L1 as it was in case of alveolar stops.

These findings were not completely in correspondence with Flege's SLM which predicted that palatal stops are more different than Czech alveolar stops therefore learners will create a new category and more easily adopt target like VOT values and there will be lower effect of L1 negative transfer.

In spite of the fact that perception and production tests revealed that L1en speakers probably formed a new category of palatal stops and were able to distinguish them both in perception and in production, they needed longer values of VOT than L1cz speakers to identify not only the alveolar stops, which are in the inventory of their L1, but also to identify palatal stops which were a new category for them.

Another question of the presented study was to examine the relationship between perception and production skills of English learners of Czech.

There are three possibilities; perception skills can precede production, or otherwise, or they can go hand in hand. According to studies in second language acquisition the perception skills of second language learners should precede production skills. It is supposed that L2 learners are not able to produce non-native contrasts, if they are not able to perceive them. However, Sheldon & Strange (1982) found out that Japanese native speakers learning English were less accurate in perceiving /r-l/ contrast than in producing it.

In case of my tested subjects, when we take them as a whole group, neither skill preceded; they went hand in hand. One of the possible explanations is the fact, that there were subjects with different length of exposure and motivation to learn Czech.

Results of my thesis were not completely in correspondence with results of Atkey (2000). She proposed that L1en speakers should be able to acquire the category of palatal stops because they have the feature [posterior] distinguishing palatal and alveolar stops to distinguish alveolar and postalveolar fricatives in their native language, but results of her experiments did not support her hypothesis wholly.

However, it is a question, if subjects in her experiment were really able to distinguish the palatal and alveolar stops perceptually or they were influenced by lexical content of the stimuli. To test perception I used unlike her in my FCPS task nonsense stimuli, therefore the possible influence of lexical content was diminished. Also the speech data for the production experiment were from different tasks; therefore they should have better predictive value about acquisition of palatal stops.

It is possible to say that my tested subjects, unlike Atkey's, were able to both perceive and produce palatal stops and distinguish them from alveolar and velar stops, although there was evident negative transfer from English.

The language acquisition is a very complex field and it seems that just the presence of the features distinguishing parts of non-native contrasts in native language is not sufficient for acquisition of the non-native contrasts; there is a lot other factors which can influence successful language acquisition such as length of exposure to L2 or motivation to use L2.

Among further findings of the research was that L1en speakers did not have any significant problems with perception of final palatal stops which were preceded either by high front vowels /ɪ/ and /iː/ or by other vowels. It seems that when distinguishing final palatal stops L1en speakers used different cues than when distinguishing initial and medial stops and that maybe the formant transitions into a consonant do not have very significant role as do transitions out of the consonant.

In the FCPS task it was also found out that L1en speakers had, unlike L1cz speakers, problems with perception of word final stops. L1cz speakers perceived

most incorrectly word initial stops. It seems that both groups of speaker preferred different cues when identifying Czech stops.

7.2 Questions for further research

The present thesis has some imperfections which is the author aware of. For further studies it would be convenient to analyse the production data more objectively. It would be better not to base the assessment of quality only on perception impression of the author but also on analysis of spectra and spectrograms and possibly have some native speakers to evaluate the production of L1en speakers and rate the production for the degree of foreign accent.

It would be also interesting to have a closer look at the production data whether the production of palatal stops is more difficult if they are followed by high front vowels /ɪ/ and /iː/ than by other vowels as it was partly in perception.

When it comes to the question of VOT, in English there is a rule that voiceless stops preceded by /s/ are not aspirated. It would be interesting to see if it would be the same in case of Czech palatal stops acquired by L1en speakers.

The perception experiment revealed that L1en speakers had most problems with identification of word final stops and it is a question if it would be the same in production of word final palatal stops.

The group of subjects in the presented study was not homogenous; in further research it would be better to have at least two groups of subjects; with short length of exposure and with longer exposure to Czech and possibly include child learners of Czech. Groups could be also differentiated according to proficiency of subjects in L2.

In further study there could be also included British English speakers to see if there would be some differences in acquisition of palatal stops as suggested in the section 2.5.1, since British English has the sequence of coronal stop and palatal approximant, as in *dew* [djuː] and American English does not, as in [duː].

APPENDIX 1.1.1

L1 English subjects

Subj.	Gender	Age	Length of exposure to Czech (interuption)
1	M	22	1 year 4months (2months Slovakia)
2	M	24	1 year 2months
3	M	20	1 year 2months
4	F	30	4 years 5months
5	M	28	7 years (2 years)
6	F	31	4 years 6 months
7	M	31	4 years 6 months
8	M	31	5 years
9	M	46	16 years
10	M	41	18 years
11	M	45	20 years
12	M	32	4 years 6 months

APPENDIX 1.1.2

Questionnaire – L1 English speakers

Subjekt:	
Jméno a příjmení:	
Pohlaví:	
Věk:	
Problémy se sluchem:	ANO / NE
Místo původu:	
Jazykové pozadí (rodiče):	
Délka pobytu v ČR:	
Přerušení pobytu v ČR:	
Délka studia ČJ:	
Studium ČJ před pobytem v ČR: **Jak dlouho:**	ANO / NE
Kde používám/mluvím ČJ:	
Znalost cizích jazyků:	
Pobyt v cizině (déle než měsíc):	

APPENDIX 1.1.3

Questionnaire – L1 Czech speakers

Subjekt:	
Jméno a příjmení:	
Pohlaví:	
Věk:	
Problémy se sluchem:	ANO / NE
Místo původu:	
Jazykové pozadí (rodiče):	
Znalost cizích jazyků:	
Pobyt v cizině (déle než měsíc):	

APPENDIX 1.2.1

Free Production task - questions

1) Co si myslíte o rodině?

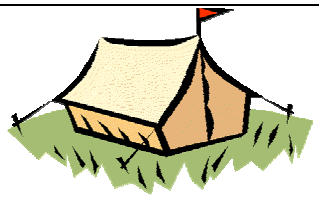
- Kolik by měla mít rodina dětí?
  - Jsou nějaké rozdíly mezi rodinami v Čechách a v Americe?
  - Slyšela jsem, že v Americe je v rodině více dětí, je to pravda?

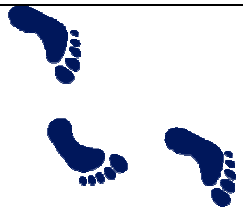
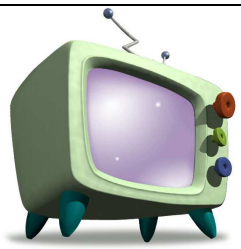
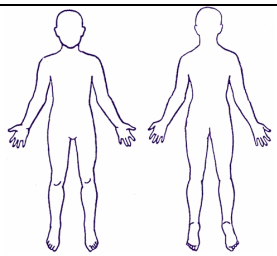
2) Na co se těšíte?

- Co budete dělat o prázdninách?
- Jak dlouho budete v Čechách?/Kdy se vrátíte do Ameriky?
- Líbí se Vám v Čechách?/Co se vám/ti tady líbí?

APPENDIX 1.2.2

Elicited Production task– visual stimuli

		
baťoh [ba**c**ox]	budík [bu**ɟ**i:k]	dělo [**ɟ**ɛlo]
		
děti [**ɟ**ɛ**c**ɪ]	divadlo [**ɟ**ɪva**d**lo]	kladivo [kla**d**ɪvo]
		
loď/lodě [lo**c**]/[lo**ɟ**ɛ]	rodina [ro**ɟ**ɪna]	řidička/řidič [r̰ɪ**ɟ**ɪtʃka]/ [r̰ɪ**ɟ**ɪtʃ]
		
schodiště/schody [sxo**ɟ**ɪʃcɛ]/[sxo**d**ɪ]	stan [s**t**an]	stín [s**c**i:n]

100		
sto [**s**to]	stopy [**s**topɪ]	stůl [**s**tu:l]
		
talíř [**t**ali:r]	tanec [**t**anɛts]	televize [**t**ɛlɛvɪzɛ]
		1000
tělo/těla [**c**ɛlo]/[**c**ɛla]	tílko [**c**i:lko	tisíc [**c**ɪsi:ts]
		
tiskárna [**c**ɪska:rna]	ťukat [**c**ukat]	

APPENDIX 1.2.3

Sentence Reading task – sentence stimuli[1]

1.	Pojedu s tebou stanovat.
	Poje**[d]**u s **[t]**ebou s**[t]**anova**[t]**
2.	Nemá teď chuť debatovat, stydí se.
	Nemá **[t]**e**[c]** chu**[c] [d]**eba**[t]**ova**[t]** s**[t]**y**[ɟ]**í se
3.	Poschoďový autobus je plný, je tu moc lidí.
	Poscho**[ɟ]**ový au**[t]**obus je plný, je **[t]**u moc li**[ɟ]**í
4.	Vrať se pro ten tisk později, jsi v pořadí.
	Vra**[c]** se pro ten **[c]**isk poz**[ɟ]**ěji, jsi v poře**[ɟ]**í
5.	Podej tatínkovi tu tyč.
	Po**[d]**ej **[t]**a**[c]**ínkovi **[t]**u **[t]**yč
6.	Dešťová voda není k pití.
	[d]eš**[c]**ová vo**[d]**a není k pi**[c]**í
7.	Divím se, že chceš jet do divočiny.
	[ɟ]ivím se, že chceš je**[t] [d]**o **[ɟ]**ivočiny
8.	Musíš tiše ťapkat a zaťukat.
	Musíš **[c]**iše **[c]**apka**[t]** a za**[c]**uka**[t]**
9.	Tebe jsem dlouho neviděl.
	[t]ebe jsem **[d]**louho nevi**[ɟ]**ěl
10.	Půjdeš se mnou v pátek do divadla?
	Půj**[d]**eš se mnou v pá**[t]**ek **[d]**o **[ɟ]**iva**[d]**la
11.	Dávej pozor, je tam díra.
	[d]ávej pozor, je **[t]**am **[ɟ]**íra

[1] In the list there are presented sentence stimuli in their orthographic form and only the tested segments are marked in the bold in their phonetic form.

12.	Ďábel je pokušitel křesťanů.
	[ɟ]ábel je pokuši**[t]**el křes**[c]**anů
13.	Méďa rád tancuje v týmu.
	Mé**[ɟ]**a rá**[t] [t]**ancuje v **[t]**ýmu.
14.	Těším se, že dostanu starou dýku.
	[c]ěším se, že **[d]**ostanu s**[t]**arou **[d]**ýku
15.	Stěží stojí, ťápnul vedle.
	S**[c]**ěží s**[t]**ojí, **[c]**ápnul ve**[d]**le
16.	Děti jsou základ rodiny.
	[ɟ]ě**[c]**i jsou zákla**[t]** ro**[ɟ]**iny
17.	Tomu děvčeti prosím tě netykej.
	[t]omu **[ɟ]**ěvče**[c]**i prosím **[c]**ě ne**[t]**ykej
18.	Mladý Vláďa je hrdina celé děděiny.
	Mla**[d]**ý Vlá**[ɟ]**a je hr**[ɟ]**ina celé **[ɟ]**ě**[ɟ]**iny
19.	Let byl divný, pořád se něco dělo.
	Le**[t]** byl **[ɟ]**ivný, poř**á[t]** se něco **[ɟ]**ělo
20.	On ti taky tyká?
	On **[c]**i **[t]**aky **[t]**yká
21.	Téměř denně si stěžuje na dýmku.
	[t]éměř **[d]**enně si s**[c]**ěžuje na **[d]**ýmku
22.	Musí mu vrátit noty.
	Musí mu vrá**[c]**i**[t]** no**[t]**y
23.	Z té dílny stoupá dým.
	Z **[t]**é **[ɟ]**ílny s**[t]**oupá **[d]**ým
24.	Sotva stihne stěhování, ale ještě má naději.
	So**[t]**va s**[c]**ihne s**[c]**ěhování, ale ješ**[c]**ě má na**[ɟ]**ěji
25.	To je tíha, loď je moc těžká.
	[t]o je **[c]**íha, lo**[c]** je moc **[c]**ěžká

26.	Mláďátko tě vždy potěší.
	Mlá**[ɟ]**á**[t]**ko **[c]**ě vž**[d]**y po**[c]**ěší
27.	Ty hodiny tikají potichu.
	[t]y ho**[ɟ]**iny **[c]**ikají po**[c]**ichu
28.	Musí sedět, je rudý a má rychlý tep.
	Musí se**[ɟ]**ě**[t]**, je ru**[d]**ý a má rychlý **[t]**ep
29.	Sedí ve městě na teplé dece.
	Se**[ɟ]**í ve měs**[c]**ě na **[t]**eplé **[d]**ece
30.	Vláda se shromažďuje každý týden.
	Vlá**[d]**a se shromaž**[ɟ]**uje kaž**[d]**ý **[t]**ý**[d]**en
31.	Od těhotné se díku nikdy nedočkáš.
	O**[t]** **[c]**ěho**[t]**né se **[ɟ]**íku nik**[d]**y ne**[d]**očkáš
32.	Jeď pryč, nemá žádné city.
	Je**[c]** pryč, nemá žá**[d]**né ci**[t]**y
33.	Zeptej se těla, co cítí.
	Zep**[t]**ej se **[c]**ěla, co cí**[c]**í
34.	Slaď pro jistotu to tílko a dýni.
	Sla**[c]** pro jis**[t]**o**[t]**u **[t]**o **[c]**ílko a **[d]**ýni
35.	Posviť mi, ať najdu foťák.
	Posvi**[c]** mi, a**[c]** naj**[d]**u fo**[c]**ák
36.	Na stěně je tisíc ťuhýků a tykadlo.
	Na s**[c]**ěně je **[c]**isíc **[c]**uhýků a **[t]**yka**[d]**lo
37.	Dej Láďovi zatím baťoh.
	[d]ej Lá**[ɟ]**ovi za**[c]**ím ba**[c]**oh
38.	Přispěj na dítě v tísni.
	Přispěj na **[ɟ]**í**[c]**ě v **[c]**ísni
39.	Mladá hospodyně se tísní daleko ve stínu.
	Mla**[d]**á hospo**[d]**yně se **[c]**ísní **[d]**aleko ve s**[c]**ínu

APPENDIX 1.2.4

Word List Reading task – word stimuli[2]

[c]	[ɟ]
út**ě**k	**d**ívka
š**ť**áva	ři**d**ič
tíseň	po**d**íl
la**t**ě	pr**ď**ola
dycht**i**vý	**ď**ubky
ťukal	nákla**ď**ák
ťapa	hýž**ď**ový
umíst**i**lo	**d**ivoch
těsný	blon**ď**ák
čás**t**i	**d**ivák
za**ť**ukal	lá**ď**u
pla**t**í	**ď**as
tiskárna	**d**ílo
tím	**ď**ůlek
po**t**íže	**ď**olíček
ple**ť**ový	kana**ď**an
fo**ť**ák	**d**ěda
poci**ť**uje	**d**ějiny
ba**ť**a	**ď**obat
ticho	vo**d**í
těsto	an**d**ěl
ba**ť**oh	opož**ď**uje
s**t**íhal	ma**ď**ar

[2] In the list there are only word stimuli with tested segments /c/ and /ɟ/. The words in the list are in their orthographic form and the tested segment are marked in the bold. In the Word List Reading task there were also included words with alveolar stops /t/ and /ɗ/, but there was different amount of them. Word with final /ɟ/ are listed under [ɟ] because they are subjects of final devoicing in Czech.

s**t**ín	u**d**ělal
s**ť**atý	**ď**ubám
s**t**ěna	ú**d**iv
a**ť**	
cho**ť**	
ra**ď**	
svi**ť**	
bu**ď**	
te**ď**	
ple**ť**	
chu**ť**	
poj**ď**	
vi**ď**	

APPENDIX 1.3.1

FCPS task - list of stimuli

WORD INITIALLY				
/**tɛ**/	/**tɪ**/	/**ta**/	/**tu**/	/**to**/
tefo	tyfo	tafo	tufo	tofo
temuf	tymuf	tamuf	tumuf	tomuf
/**tɛː**/	/**tiː**/	/**taː**/	/**tuː**/	/**toː**/
téfo	týfo	táfo	túfo	tófo
témuf	týmuf	támuf	túmuf	tómuf
/**dɛ**/	/**dɪ**/	/**da**/	/**du**/	/**do**/
defo	dyfo	dafo	dufo	dofo
demuf	dymuf	damuf	dumuf	domuf
/**dɛː**/	/**diː**/	/**daː**/	/**duː**/	/**doː**/
defo	dýfo	dáfo	dúfo	dófo
démuf	dýmuf	dámuf	dúmuf	dómuf
/**cɛ**/	/**cɪ**/	/**ca**/	/**cu**/	/**co**/
těfo	tifo	ťafo	ťufo	ťofo
těmuf	timuf	ťamuf	ťumuf	ťomuf
/**cɛː**/	/**ciː**/	/**caː**/	/**cuː**/	/**coː**/
ťéfo	tífo	ťáfo	ťúfo	ťófo
ťémuf	tímuf	ťámuf	ťúmuf	ťómuf
/**ɟɛ**/	/**ɟɪ**/	/**ɟa**/	/**ɟu**/	/**ɟo**/
děfo	difo	ďafo	ďufo	ďofo
děmuf	dimuf	ďamuf	ďumuf	ďomuf
/**ɟɛː**/	/**ɟiː**/	/**ɟaː**/	/**ɟuː**/	/**ɟoː**/
ďéfo	dífo	ďáfo	ďúfo	ďófo
ďémuf	dímuf	ďámuf	ďúmuf	ďómuf

/**kɛ**/	/**kɪ**/	/**ka**/	/**ku**/	/**ko**/
kefo	kyfo	kafo	kufo	kofo
/**kɛː**/	/**kiː**/	/**kaː**/	/**kuː**/	/**koː**/
kéfo	kýfo	káfo	kúfo	kófo
/**gɛ**/	/**gɪ**/	/**ga**/	/**gu**/	/**go**/
gefo	gyfo	gafo	gufo	gofo
/**gɛː**/	/**giː**/	/**gaː**/	/**guː**/	/**goː**/
géfo	gýfo	gáfo	gúfo	gófo
WORD MEDIALLY				
/**tɛ**/	/**tɪ**/	/**ta**/	/**tu**/	/**to**/
mutes	mutys	mutas	mutus	mutos
huten	hutyn	hutan	hutun	huton
/**tɛː/**	/**tiː**/	/**taː**/	/**tuː**/	/**toː**/
mutes	mutýs	mutás	mutús	mutós
hutén	hutýn	hután	hutún	hutón
/**dɛ**/	/**dɪ**/	/**da**/	/**du**/	/**do**/
mudes	mudys	mudas	mudus	mudos
huden	hudyn	hudan	hudun	hudon
/**dɛː**/	/**diː**/	/**daː**/	/**duː**/	/**doː**/
mudés	mudýs	mudás	mudús	mudós
hudén	hudýn	hudán	hudún	hudón
/**cɛ**/	/**cɪ**/	/**ca**/	/**cu**/	/**co**/
mutěs	mutis	muťas	muťus	muťos
hutěn	hutin	huťan	huťun	huťon
/**cɛː**/	/**ciː**/	/**caː**/	/**cuː**/	/**coː**/
muťés	mutís	muťás	muťús	muťós
huťén	hutín	huťán	huťún	huťón
/**ɟɛ**/	/**ɟɪ**/	/**ɟa**/	/**ɟu**/	/**ɟo**/
muděs	mudis	muďas	muďus	muďos

huděn	hudin	huďan	huďun	huďon
/ɟɛː/	/ɟiː/	/ɟaː/	/ɟuː/	/ɟoː/
muďés	muďís	muďás	muďús	muďós
huďén	huďín	huďán	huďún	huďón
/kɛ/	/kɪ/	/ka/	/ku/	/ko/
huken	hukyn	hukan	hukun	hukon
/kɛː/	/kiː/	/kaː/	/kuː/	/koː/
hukén	hukýn	hukán	hukún	hukón
/gɛ/	/gɪ/	/ga/	/gu/	/go/
hugen	hugyn	hugan	hugun	hugon
/gɛː/	/giː/	/gaː/	/guː/	/goː/
hugén	hugýn	hugán	hugún	hugón
WORD FINALLY				
/ɛt/	/ɪt/	/at/	/ut/	/ot/
lofet	lofit	lofat	lofut	lofot
sulet	sulit	sulat	sulut	sulot
/ɛːt/	/iːt/	/aːt/	/uːt/	/oːt/
lofét	lofít	lofát	lofút	lofót
sulét	sulít	sulát	sulút	sulót
/ɛc/	/ɪc/	/ac/	/uc/	/oc/
lofeť	lofiť	lofať	lofuť	lofoť
suleť	suliť	sulať	suluť	suloť
/ɛːc/	/iːc/	/aːc/	/uːc/	/oːc/
loféť	lofíť	lofáť	lofúť	lofóť
suléť	sulíť	suláť	sulúť	sulóť
/ɛk/	/ɪk/	/ak/	/uk/	/ok/
lofek	lofik	lofak	lofuk	lofok
/ɛːk/	/iːk/	/aːk/	/uːk/	/oːk/
lofék	lofík	lofák	lofúk	lofók

SHRNUTÍ

Tato diplomová práce se zabývá osvojováním českých palatálních ploziv anglickými mluvčími americké angličtiny. Reaguje na práci S. B. Atkey, která se zabývá podobným tématem, přistupuje však k problematice z pohledu teorie generativní fonologie.

V teoretické části práce jsou popsány české a anglické plozivy, které mají odlišné vlastnosti. Tyto odlišnosti mohou způsobit problémy při osvojování českých palatálních ploziv. Anglické plozivy mají na rozdíl od českých delší hodnoty VOT a je otázka, zda angličtí mluvčí budou mít při osvojení českých palatálních ploziv hodnoty VOT jako u svého mateřského jazyka nebo se přizpůsobí cílovému jazyku, češtině.

Z uvedených vlastností českých palatálních ploziv vyplývá, že mohou být problémy při percepci palatálních ploziv, které následují samohlásky /ɪ/ a /iː/, protože tranzienty formantů jsou ve stejné poloze jako exploze palatálních ploziv, což může způsobit problémy při percepci.

Dále je otázka zda existuje nějaký vztah mezi percepcí a produkcí palatálních ploziv, zda některá ze schopností předchází nebo se rozvíjejí souměrně. V teoretické části práce jsou shrnuty některé ze studií, které zabývaly tímto tématem a převážně došly k závěru, že percepční schopnosti předchází produkci, a mluvčí nejsou schopni produkovat kontrast, který nejsou schopní percepčně rozlišit.

Hypotézy této diplomové práce byly ověřeny pomocí percepčních a produkčních testů. Byla testována skupina amerických mluvčích žijících v České Republice, kteří se učí česky. Tito mluvčí byli podrobeni identifikačnímu testu, při kterém rozlišovali prezentované stimuly do následujících kategorií /t/, /d/ /c/, /ɟ/ a /k/, /g/. Ve druhém percepční testu identifikovali stimuly s odlišnými hodnotami VOT jako /t/, /d/ /c/, /ɟ/ a /k/, /g/. Tyto percepční testy absolvovala též kontrolní skupina českých mluvčí.

Výsledky percepčních testů byly statisticky zpracované pomocí analýzy rozptylu (ANOVY).

Produkce palatálních ploziv byla testována ve čtyřech různých úkolech, v přirozené řeči, v reakcích na vizuální stimuly, čtení vět a slov, která obsahovala

testované segmenty. U vybraných slov ve dvou úkolech bylo měřeno VOT. Angličtí mluvčí měli delší VOT než kontrolní mluvčí a to jak u alveolárních tak i u palatálních okluziv a jejich /d/ a /ɟ/ měli sice negativní VOT, ale nebylo tak velké jak u českého mluvčí a u naměřených dat byl větší rozptyl.

Analýza výsledků prvního percepčního testu ukázala, že problémy při percepci jsou pouze v případě znělých ploziv, které následují /ɪ/ a /iː/. Může to být způsobené tím, že znělé plozivy mají slabší explozy než neznělé plozivy a posluchači tudíž musí použít při identifikaci jiné akustické signály, např. tranzienty formantů. Ty jsou však v případě /ɪ/ a /iː/ málo zřetelné, protože vycházejí ze stejného místa jako exploze ploziv.

Výsledky druhého percepčního testu ukázaly, že angličtí mluvčí při identifikaci neznělých ploziv potřebovali delší hodnoty VOT než rodilý mluvčí, což naznačuje negativní transfer z mateřského jazyka.

Výsledky percepčních a produkčních testů prokázaly, že angličtí mluvčí češtiny si osvojily kontrast, který se nenachází v jejich mateřském jazyku a byly schopni percepčně rozlišit a produkovat palatální plozivy, které zněly přirozeně česky.

Tato diplomová práce přispěla k výzkumu problematiky osvojování cizích kontrastů a naznačila otázky pro případný další výzkum v oblasti palatálních ploziv.

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ANOTTATION

The present study deals with the acquisition of Czech palatal stops by English native speakers. This study is a reaction to the thesis of S. B. Atkey dealing with this topic as well. In study there are presented information about phonemes of native and non native language of English speakers of Czech and problems these differences can cause in second language acquisition, there is given insight into the question of acquisition of non native contrasts and essential background of the relationship between perception and production skills of L2 learners. To test the hypotheses of this study the experiments examining the perception and production of the non native contrast were conducted. Results were analysed and discussed.

Key words: second language acquisition, positive transfer, negative transfer, perception, production, non native contrast, alveolar and palatal stops, VOT

ANOTACE

Diplomová práce se zabývá osvojováním českých palatálních ploziv anglickými mluvčími. Je reakcí na práci S. B. Atkey, která se zabývá podobným tématem, ale spíše z pohledu fonologie. V diplomové práci jsou představeny fonémy mateřského a cílového jazyka anglických mluvčí a problémy, které z těchto rozdílů mohou vyplývat při osvojování cizího jazyka. Jsou zde představeny některé z teorií zabývající se osvojováním cizího kontrastu a vhled do problematiky percepce a produkce studentů cizího jazyka. Hypotézy diplomové práce byly testovány pomocí percepčních a produkčních experimentů. Výsledky experimentů byly analyzovány a projednány.

Klíčová slova: osvojování cizího jazyka, pozitivní transfer, negativní transfer, percepce, produkce, cizí kontrast, alveolární a palatální okluzivy, VOT