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

KATEŘINA BRAUNOVÁ
(Česká filologie – Anglická filologie)

Supervisor: Mgr. Václav Jonáš Podlipský, Ph.D.
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Prohlašuji, že jsem diplomovou práci vypracovala samostatně, pouze s pomocí pramenů a literatury uvedených v bibliografii práce.

V Olomouci 14. srpna 2011 Kateřina Braunová

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Contents

1. INTRODUCTION

In my work, I am going to deal with English learners of Czech and their acquisition of Czech palatal stops /c/ and /ɟ/. 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. However in her thesis Atkey approached the question rather from the theoretical background of phonological theory, my thesis is going to be focused on more practical issues and will be based more on the research. I am going to refer to her thesis later in a section 2.6 dealing with previous research of acquisition of palatal stops.

1.1 Aim and outline of the thesis

The present study is focused on the acquisition of Czech by English native learners. Czech and English are both Indo-European languages so they are not completely different as it would be in case e.g. of English and Chinese, but they belong to different families of languages, Czech to Slavic (West Slavic branch) and English to Germanic (West Germanic branch). Czech is mainly synthetic and inflectional language and as well as other Slavic languages has rich morphology unlike English which is mainly analytic. Their inventories of vowels and consonants are in some ways different.

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 /r/, 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 just in some dialects; e.g. alveolar trill fricative /r̝/ and velar fricative /x/, or with some consonants because of their different phonetic realization.

One of the differences between Czech and English is the presence of palatal stops in the Czech phonemic inventory. They are a completely new category for English learners of Czech. In my thesis I want to study acquisition of this new phonemic category so I will first introduce some basic terminology used in second the language acquisition. Then in another section of Chapter 2, Literature review, I

will explain the differences between Czech and English stops. Chapter 2 also presents some theoretical concepts of second language acquisition 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 There are provided methods used in conducting the experiments, data analysis and discussion of results in all three chapters. Chapter 7, the final chapter of this thesis summarizes findings of my thesis and outlines questions for further research.

2 LITERATURE REVIEW

Aim of this chapter is to provide some essential insight into the second language acquisition and present the consonant systems of native and target language of English speakers.

First the basic terms used in the second language acquisition will be presented. Then in another section I will present consonant systems of Czech and English, I will mainly focus on 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 the previous research dealing with acquisition of palatal stops, theories concerned with acquisition of non-native contrasts and 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 the second language acquisition

The second language is studying “how learners learn an additional language after they have acquired their mother tongue” (Ellis 1985, 5)

acquisition is studying how learners learn another language after they have acquired their mother language. Learners when acquiring additional language have already a knowledge of their native language grammar, which is called the first language (L1) and in this case it is English. The language they are acquiring is called target language or second language (L2), in this case it is Czech.

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 identical with 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 can result in errors (see Ellis 1985, 304-305).

When acquiring a language it is important to realize and identify the differences between first and target language. Languages can differ in a various ways. If we focus just on the phonological level, they can differ in distribution of phonemes, phonotactics, phonological rules, phonetic realization of corresponding

2.2. The description of the Czech consonant system

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.

Czech has 10 vowels, which form phonemic pairs and differ by length and 27 consonants. In the phonemic inventory of Czech there is eight oral stops, three nasal stops, four affricates, eight fricatives, one alveolar trill, one fricative trill and two approximants. 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		ts dz	tʃ dʒ			
fricatives	f v	s z	ʃ ʒ		x	ɦ
trills		r̝ r				
approximants		l		j		

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

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

Czech has in its phonemic inventory 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 just briefly mention alveolar stops /t/ and /d/

because these oral stops are in inventory of both languages but they are slightly different.

2.2.1 Czech alveolar stops

The alveolars /t/ and /d/ are produced with the closure made raising the tip of the tongue 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 air flow over glottis which makes it voiced (Mluvnice Češtiny 1 1986, 43).

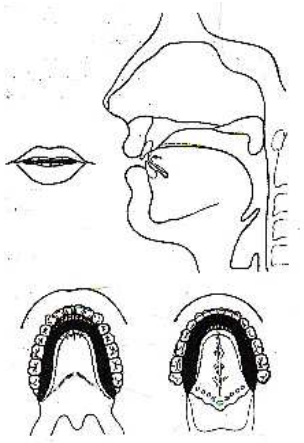


Figure 2.1 Articulation of Czech alveolar stops /t/ /d/ (adopted from Hála 1975, 182).

Now let's have a look at the Czech alveolar stops from the point of view of their acoustic properties. The acoustic spectrum of the alveolar stops has three phases. The first phase is the closing phase. The second phase is the constriction, which constitutes 80 – 90% (Mluvnice Češtiny 1 1986, 43) duration of the consonant. The constriction results in a period of silence, if the stop is not voiced and the remaining part of the acoustic spectrum is the burst.

The voiceless alveolar stop /t/ has the constriction interval about 190 ms long and the voiced /d/ slightly shorter (120 ms) The duration of the explosion is longer than by bilabials, /t/ has explosion long at most 30 ms and /d/ 10ms.

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

The explosion has the maximum of energy at 3-7kHz which is similar to /s/ because they share the place of articulation (see Mluvnice Češtiny 1 1986, 43-44).

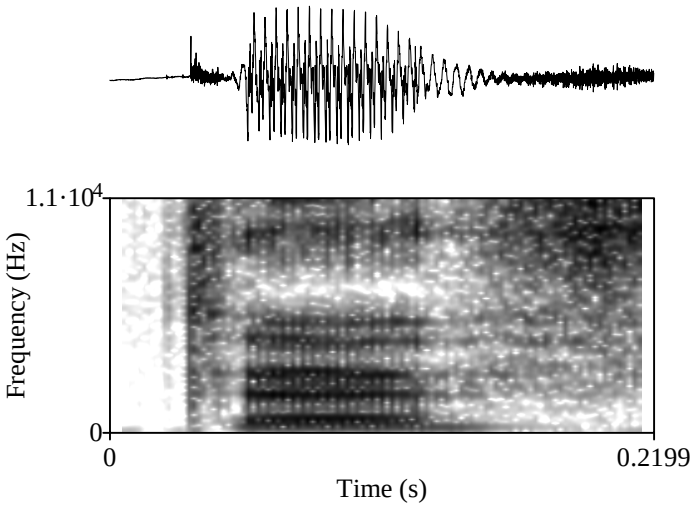


Figure 2.2 Spectrogram and waveform of Czech voiceless alveolar stop /t/ in the word "tefo" as pronounced by female speaker recorded for the FCPS task. On the horizontal line is time in s and on the vertical frequency in Hz (Praat, Boersma 2002).

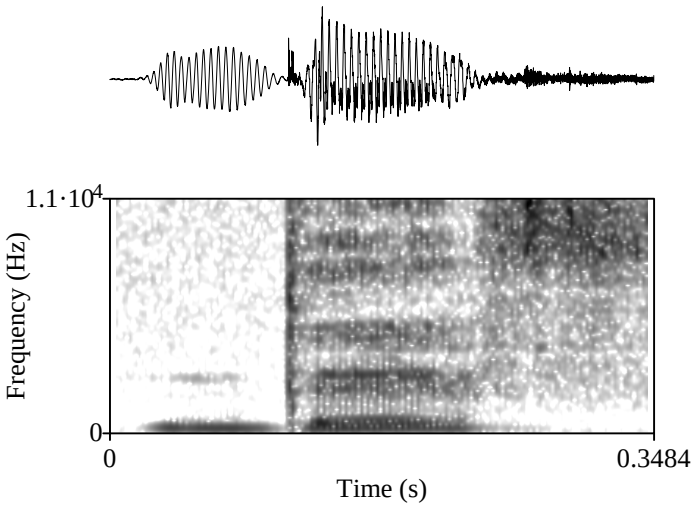


Figure 2.3 Spectrogram and waveform of Czech voiced alveolar stop /d/ in the word "defo" as pronounced by female speaker recorded for the FCPS task. On the horizontal line is time in s and on the vertical frequency in Hz (Praat, Boersma 2002).

2.2.2 Czech palatal stops

/c/ and /ɟ/ are palatal stops, which means that the closure during their production is made by tongue, which is raised towards the palate. The lips are in different shape than by production of alveolar stops, they are lengthened and the corners of lips are slightly sharpened. Moreover the tip of the tongue is leaning against the lower teeth (incisors), which enables the blade of tongue to raise 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).

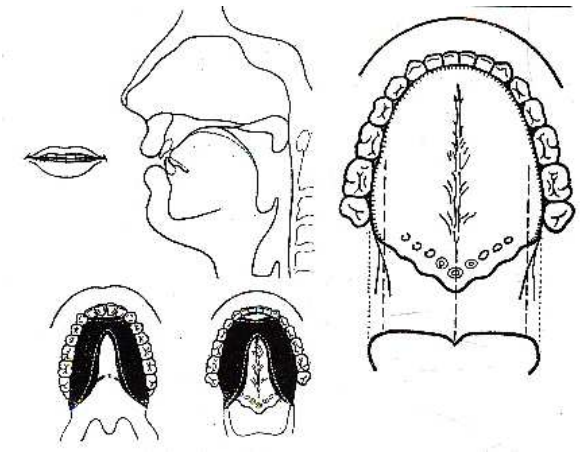


Figure 2.4 Articulation of Czech alveolar stops /c/ /ɟ/ (adapted from Hála 1975, 183).

Palatals /c/ and /ɟ/ are as well as /t/ and /d/ stops, so there is a closure, which is longer (160 ms) for /ɟ/. Duration of closure for /c/ is about 100 ms. Czech palatal stops are characterised by longest duration of burst from all consonants. The average time of burst for /ɟ/ is 40 ms and for /c/ 30 ms (see Mluvnice Češtiny 1 1986, 44).

According to Hála the burst of palatal stops is specific. It is due to slower separation of the tongue because it is squeezed into the palate and moreover the surface of the tongue is not compact but rather divided by a groove. The air pressure near the groove is reduced and because of this there is, during slower burst before the release of closure, narrow passage through which the air pressure escapes and creates friction (see Hála 1975, 186-187).

The formant transitions for palatals are except for F1 usually falling. The locus for F2 is very high around 2,5 kHz (Palková 1994, 225) and it is in the same place as F2 of vowel /ɪ/ (see Mluvnice Češtiny 1 1986, 45).

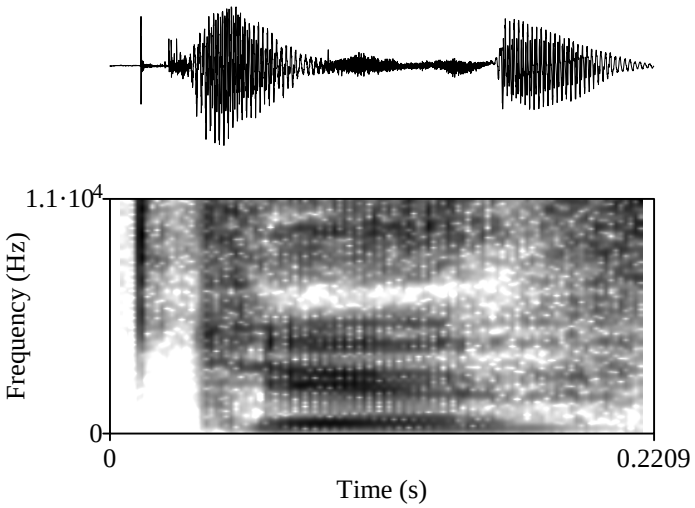


Figure 2.5 The spectrogram and waveform of Czech voiceless palatal stop /c/ in the word "těfo" as pronounced by female speaker recorded for the FCPS task. On the horizontal line is time in s and on the vertical frequency in Hz (Praat, Boersma 2002).

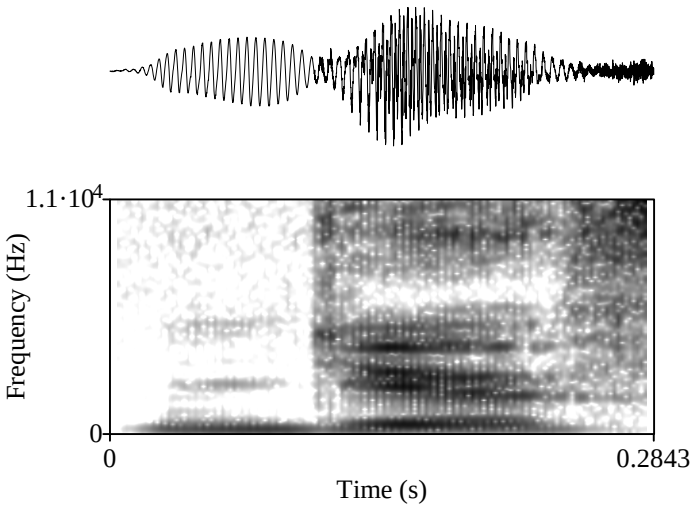


Figure 2.6 Spectrogram and waveform of Czech voiced palatal stop /ɟ/ in the word "děfo" by female speaker recorded for the FCPS task. On the horizontal line is time in s and on the vertical frequency in Hz (Praat, Boersma 2002).

2.3 The description of English consonant system

The inventory of English oral stops is a little bit poorer but there are some differences between Czech and English alveolar stops, which are worth mentioning.

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/.

2.3.1 English alveolar stops

During the production of /t/ is the air passage completely blocked by raising the soft palate and raising the tip of the tongue to touch the teeth ridge, the air is compressed by pressure from the lungs and when the tongue is removed from the teeth ridge the air suddenly escapes through the mouth, and in doing so makes an explosive sound (Jones 1993, 141).

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

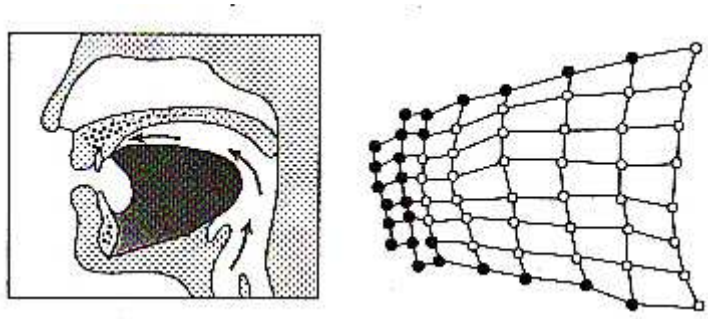


Figure 2.7 Articulation of English alveolar stops /t/ and /d/ (adapted from Gimson 2001, 163).

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 the utterance or before a voiceless sound (see Ladefoged 2001, 57).

English /t/, when it is syllable initial, stressed 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 a puff of air, which sounds as if the stop is followed by a

slight /ɦ/ (see Roach 1991, 95). Then the vocal cords come together and voicing begins.

English oral stops if they are in initial position cannot be preceded by any consonant, with the exception of voiceless oral stops /p/, /t/ and /k/ which can be preceded by /s/. In this case they are not aspirated (Ladefoged 2001, 57).

2.3.2 VOT

The gap between the consonantal release and the onset of voicing time is filled with noise (see Hayward 2000, 108) The duration of the gap is called VOT. This abbreviation means voice onset time. It refers to the point in time at which vocal cord vibration start (see Crystal 1995, 375).

It could be negative (when the voicing begins before the release or the closure of the stop), zero or positive, as it is for English voiceless aspirated stops.

In English there is rather long delay and its length depends on the amount of aspiration. Voiceless oral stops have different values of VOT. Its values vary with the place of articulation. Greatest VOT is for velar stops and smallest for labial stops, coronals are occupying an intermediate position (see Hayward 2000, 114). Different values of VOT are caused by the fact that there is different space above the glottis into which air can flow; while during production of bilabials it is largest, in velar stops there is only a small space (see Ladefoged 2001, 130).

2.4 Confrontation of English and Czech

As it is apparent from the differences between Czech and English alveolar voiceless stops, which are in phonemic inventory of both languages, they have different values of VOT. English voiceless stops have quite long VOT, if they are syllable initial and stressed and the VOT differs with the place of articulation, e.g. initial stresses /p/ have VOT about 50msec (see Ladefoged 2001, 128).

However, Czech voiceless stop are not aspirated and there is only a short time between the release of stop and start of the voicing, therefore they have zero or very

short VOT. Czech voiceless palatal stops, which are new category for native English learners of Czech have nearly zero VOT too.

It is an interesting question what VOT will new voiceles palatal stops in the speech of English speakers of Czech have.

There are several possibilities. L2cz voiceless alveolar stops may have aspiration, because English speakers have this category in their native language and they may transfer it from English to Czech. However Czech palatals are for them completely new category, so it is highly possible that this new category will have no VOT and sound more native like.

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 (positive transfer from L2)?

Q: Will L2cz speakers transfer from their L1en to L2cz ‘unaspirated after /s/’ rule?

2.5 Varieties of English

English is spoken all over the world and there are numerous standards and regional accents, which differ in some ways. I will briefly mention here two main standard accents, RP and GA.

RP, which means 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” (Gimpson 2001, 85).

RP, the British standard, is sometimes called as BBC English as “ the BBC often used to recommend this form of pronunciation for its announcers mainly because it was most widely understood and which excited at least prejudice of a regional kind” (Gimpson 2001, 79).

2.5.1 Palatal approximant in RP and GA

In English there was possible a sequence of consonants and palatal approximant, however, it changed through time and the present situation is not the same in different varieties of English. I will concentrate just on the cases when palatal approximant is following coronal stops, because I am dealing with them in my study.

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 prevails (see Wells 1982, 206).

In RP is the yod retained after /n/ as in *new* [nju:] and after coronals /t/, /d/ in strong stressed syllables as in *duke* or *tun*e [dju:k], [tju:n].

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

In both varieties of English there is a tendency towards yod coalescence (switch into fricative, either voiceless or voiced) in GA it is common in weak syllables as in *situate* [sɪtʃuɛɪt] 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/.

Cockney has tendency towards yod dropping as well as GA and yod coalescence with fricatives is common not just in Cockney but also in rapid informal speech (see Wells 1982, 331).

Czech palatal stops may English speakers resemble sequence of coronal and palatal approximant as it is in their *new, duke* etc., which may be helpful for acquisition of Czech palatals. However American English speakers which I am going to examine unlike British English speakers do not have this sequence in native language so for them the acquisition of palatal stops may be more difficult than for British English speakers.

2.6 Previous research

2.6.1 S. B. Atkey

As I already mentioned Atkey's thesis (2001) dealt with the same question as mine. However she approached the problem from more theoretical background of phonology theory. She argued that English speakers learning Czech should have prerequisites to perceive and learn Czech palatal stops.

Atkey based her thesis on generative phonology theory. It claims that there is 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]. The distinctive feature is the active articulator since we have control of it. Features are binary and unary, some features are unary, because e.g. the feature [-labial] would not tell us anything about the place of articulation.

Atkey was convinced that L1en speakers can perceive and acquire contrast between Czech alveolar and palatal stops if the feature is present in their L1. In case that the feature is not in the inventory of their native language they should not be able to perceive the difference.

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

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

Atkey's arguments based on generative phonology theory claimed 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 experimental part of her thesis she tried to support her arguments with evidence from experimental research on perception and production of Czech palatal stops by native English speakers.

2.6.2 Atkey's perception experiment

Atkey was testing 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 palatals and alveolars in a word initial, medial and final position.

Atkey tried to make the task consistent as most as possible, 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 various 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 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 *bať*.

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, one of them claims that "the recognition is solely bottom-up" and the other "that the lexical feedback does occur" (Pitt 1995, 1037).

Range of studies were trying to solve this question. Results of Ganong's (1980 presented in Pitt 1995) study supported the "top-down" flow of information. Subjects in his experiments were categorizing stimuli on word-nonword and nonword-word continua. 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.

Another studies (presented in Pitt 1995) contributed to the discussion and 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 there is supposed to be 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)

However, the question of lexical influence is still not solved, it is ambiguous, therefore it would be probably better to avoid lexical words in FCPS task.

2.6.3 Results of Atkey's perception experiment

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 really 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 experience with Czech, e.g subject three with 11 months of exposure to Czech misperceived eight palatals followed by vowel and five of them were followed by /ɪ/ and even subject five with 10 years of exposure made mistakes in perception and two out of three misperceived tokens were followed by /ɪ/.

Atkey used in her perception experiment real lexical words, the one of them which were followed by high unrounded vowel were 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 /ɪ:/; *pití* and *díra*. Out of 22 misperceptions 6 of them were in case /ɪ:/ was following. It is a question if the phonemic pair /ɪ/ /ɪ:/ differs only in length or in quality as well and if it somehow influenced perception.

With respect to voice 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 voice of palatal stop or by the lexical items itself.

However Atkey in her work did not solve any of these questions, and she did not say why there were so 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 - 0,45kHz) 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 for F2 is in the same place as F2 of /ɪ/, which is around 2,5 kHZ. However /a/ has falling formant transitions, so the palatal stops should be distinguished more easily (see Mluvnice Češtiny 1 1986, 31-32, 45).

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

2.6.4 Atkey's production experiment

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

Analysis revealed that any of the subjects did not produce native sounding palatal stops, which was checked by the control group of two native Czech speakers. In both parts of 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 either questioning in conversation or random samples of spontaneous speech recorded when possible (see Atkey 2001, 109).

The language material obtained in the second way was elicited by reading sentences. Subjects were asked to read 15 stimuli sentences which contained tested segments /t/, /d/, /c/ or /ɟ/. The stimuli sentences were of different length, contained real Czech standard lexical words and there were in each of them from 3 to 7 tested segments.

Atkey used in her Sentence Reading task words in which palatal stops were mostly followed by /ɪ/ and /ɛ/ and alveolar stops were followed by various vowels and therefore the Sentence Reading task seems to be unbalanced.

It was appropriate that Atkey used two different methods to elicit production. I would say that Sentence Reading task is not the best way to test production of the non-native contrasts. In some cases it could be convenient but it seems to me 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 do not pronounce sounds in a natural way but in a more controlled manner.

In the following section I will briefly present the Czech orthographic system and difficulties it can cause during Sentence Reading task.

2.6.4.1 Brief excursion into Czech orthography

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

Czech is using Latin graphic system, where particular sounds correspond to individual graphic symbols. However, in Czech phonemic inventory there are several phonemes which do not have representation in Latin (Roman) alphabet, these include velar fricative /x/, alveolar trill fricative /r̝/, postalveolar fricatives /ʃ/ and /ʒ/, palatal stops /c/ and /ɟ/ and long vowels.

They used to be represented by digraphs, which was changed by realization of the reform of orthography proposed by Jan Hus and we can still feel and see its results. For phonemes which are not present in Roman alphabet were chosen symbols used for similar sounding phonemes, e.g. for /ʃ/ *s* for /ʒ/ *z* for /c/ *t* and for /ɟ/

d and there was added special Czech diacritic called “hook” (“háček”). The results are following; e.g. *š*, *ž*, *ť* and *ď*.

However in the case of palatal stops /c/ and /ɟ/ the situation is slightly complicated. If it would be the same as for /ʃ/ and /ʒ/, which are represented just by graphemes *š* and *ž,* the sentence reading would not necessarily cause problems. Palatals are unlike postalveolars not represented only by graphemes with Czech diacritics, there are also two other ways how they are graphically represented.

In Czech there are two graphic symbols for phoneme /ɪ/. They used to represent two sounds, but nowadays they are both pronounced the same as /ɪ/, but the graphic symbols are still used to distinguish lexical and grammatical meanings. One of them (*i*) is called “soft” *i* and the second (*y*) “hard” *i* and there is a difference, if grapheme *d* is followed by *y* it represents alveolar stop /d/ and when there is *i* it represents palatal stop /ɟ/. In case of *t* and *n* the situation is the same.

Another way how to represent palatal phonemes /c/ /ɟ/ and /n/ is grapheme *ě*. If it is preceded by *t, d* or *n* it makes them sound “soft” which means that they are palatal.

To illustrate both above mentioned graphical ways I chose the word *děti*, which means “children” and is pronounced as /ɟɛcɪ/.

For foreign speakers this situation could be confusing and to make it more difficult 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 /mɲe/ as in *město* “town” pronounced as /mɲɛsto/.

Finally what I have said about *ti*, *di*, *ni* stands just for native Czech words and not for words adopted from foreign languages. Graphemes *t, d* and *n* e.g in words as *titul* “degree”, *nikotin* “nicotine” or *diplom* “diploma” are not pronounced as palatals but as alveolars /t/ or /d/ (see Mluvnice Češtiny 1 1986, 164-166, 168).

As you can see, maybe the Sentence Reading task would not be the best way how to study acquisition of Czech palatals. In Czech usually to one phoneme correspond one graphic symbol but it is not in all cases and there are several different cues how to detect palatal stops. If in the Sentence Reading task would be

used some words which subjects are unfamiliar with they would have just to rely on the written form so the results of the experiment would be according to me misleading.

Furthermore it would be a question if they produced palatal stop without the visual cue. Which means if they have it in their inventory of phonemes or they just pronounced palatal stop because they saw some of the cues.

2.6.5 Summary

To sum it up, results of Atkey's 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 not 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.

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 will try to conduct the research in a way which would be more objective.

2.7 Theories of second language acquisition

When acquiring a second language speakers have to face differences and discrepancies between their L1 and target L2. There are several theories how speakers deal with these differences and how they acquire contrasts which are not in their native language and how they map them to L1 inventory.

2.7.1 Perception Assimilation Model

One of the theories of second language acquisition is Perception Assimilation Model (PAM) by Catherine T. Best. (1993, 1994). 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 claims that humans are looking for perceptual cues when acquiring non native contrasts rather than to mental representation of sounds. And that all languages come out from the possibilities of human vocal tract. There is restricted set of possible active articulators and locations of constriction, and that if given 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 wide range of languages, some of them are identical others to some extent similar.

Best came out from this postulates and formed her Perception Assimilation Model (PAM). 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 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 second language 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).

2.7.2 Speech Learning Model

Another model which deals with differences between L1 and L2 sound systems is Fleges's Speech Learning Model (SLM) (1995), which is based on years of research and number of studies.

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 the whole life they influence our perception and identification of L1 and L2 sounds (see Flege 1995, 239).

He distinguished sounds, phonetic units, as new and similar. A new sound is according to him a phonetic unit in a second language which "differs phonetically from the closest L1 sound" (Flege 1995, 239). For this new sound the phonetic category can be established more easily because according to Flege (1995, 239) "the greater the perceived phonetic dissimilarity between an L2 sound and the closest L1 sound, the more likely is that phonetic differences between the sounds will be discerned".

However, if the sounds of the L2 are similar, they are perceived to be 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).

2.8 The relationship between speech perception and production

In this section I will present the question of the relationship between production and perception of L2 in general. It is a question if perception skills precede production skills, or vice versa or if they go hand in hand. Can L2 speakers produce sounds, which they are not able to distinguish or do they need to perceive

them well and map them somehow to L1 inventory to produce them accurately. It is a problematic question and numerous studies tried to find the solution to it.

2.8.1 Perception precedes production

According to a range of studies at second language acquisition, summary of them is in Llisterri (1995) there is a close link between perception and production.

One of the studies which supported the idea that perception precedes production 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 any group, with exception of child learners, did not 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. His 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 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 can not 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 an to contextual effects” (Llisterri 1995, 98).

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

2.9 Present thesis research questions and hypotheses

For the readers convenience are repeated and summarized research questions which have been mentioned above.

Q1: What is the relationship between production and perception of Czech palatal stops by English learners of Czech?

Do perception skills precede production skills or vice versa or do they go hand in hand?

Hypothesis: According to studies at 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 exceed production, it is highly probable, that English learners of Czech will have better perceptual abilities as well.

Hypothesis: However Sheldon & Strange (1982) found out that Japanese native speakers learning English were less accurate in perceiving /r/ - /l/ contrast than in producing it so 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 /ɪ:/ than by other vowels?

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

Q3a: 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 (positive transfer from L2)?

Hypothesis: There is an assumption that L2cz speakers will have more Czech-like VOT, because according to Flege's SLM (Speech Learning Model) palatal stops are more different 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: However it is also possible that the L2cz speakers will not form a new category and will have English-like VOT (negative transfer from L1) as they have when acquiring L2 alveolar and velar stops.

Q3b: Will L2cz speakers transfer from their L1en to L2cz ‘unaspirated after /s/’ rule?

Hypothesis: It is possible that L2cz speakers will have aspiration in the Czech voiceless stops /t/, /c/, /k/. However there should not be a negative transfer from English when they are preceded by /s/ since there is a rule: if /s/ is preceding voiceless stop, there is no aspiration. The production of /st/, /sc/ and /sk/ might be more target like and the English learners of Czech may have shorter or any VOTs.

3. GENERAL METHODS

The aim of my thesis is to study the acquisition of Czech palatal stops by English native speakers. One of my research questions was what the relationship between perception and production is. There is a close link between perception and production and it is a question whether perception skills precede production skills, or otherwise or they go hand in hand. The results of most studies reviewed in the section 2.8 support the hypothesis that perception precedes production. I was examining both perception and production of the non-native contrast between alveolar and palatal stops, which are not in the phonology inventory of L1eng speakers, to test this hypothesis.

To test L1en speakers' production of palatal stops I designed production experiment, which was based on testing production of palatal stops in four different contexts, not to rely solely on results of one type of production task.

Perception of palatal stops was tested by means of FCPS task and test examining categorization of stops according to their VOT, to see if there was some negative transfer from native language.

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

In 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 were living long term in the Czech Republic, though the length of their exposure to Czech was not 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 were staying in the Czech Republic for extended period of time and returned to the USA only for a few weeks holiday, with exception of subjects 5, 1 and 11, who reported 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 the Czech language Summer school.

All subjects were living in the Czech-speaking environment, but they used Czech in various 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, therefore they used Czech for their work and needed to speak Czech in the most native sounding way.

However there was a difference, subjects 1, 2, 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 Slovakia 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), Germany (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

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 have 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, Germany, 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 test as a control subject.

3.2 Sessions

Testing of L1eng speakers took place in the computer classroom at the department of Czech studies. There were usually individual sessions with each L1eng speaker. At 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 tests. There were breaks within and between experiments to avoid test fatigue.

Half of the L1en speakers and 10 L1cz speakers completed the first perception test before the second perception test and half of the L1en speakers and 4 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

4.1. Methods

4.1.1 Free Production task

First method to elicit data for the production experiment was the Free Production task. It is a good way to get lot of natural, authentic language material from chosen subjects. There is an advantage that the subjects are not disposed to any experimental settings so they would most probably act in a natural way and so the obtained data should not 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 on the microphone in the sound treated studio, therefore it was not natural face to conversation and 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 the similar directions and subjects were given this 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 relaxed 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 colourful pictures, they can be found in the Appendix 1.2.2, and they were asked to say what they can see on the cards.

On the cards there were represented things, people and actions; e.g. *budík* [buɟɪːk] (alarm clock), *děti* [ɟɛcɪ] (“children”), *televize* [tɛlɛvɪzɛ] (“television”), *stan* [stan] (“tent”) or *stín* [scɪːn] (“shadow”). The words denoting these facts 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 no to make the subjects imitate.

4.1.3 Sentence Reading task

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

The stimuli sentences 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.

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

4.1.4 Word List Reading task

The last part of the production experiment was Word List Reading task. Subjects were in random order presented 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.

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**ɪ:fka]	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 myself and the quality assessment was based only on perceptual impression.

The intended palatal stops were classified according to their quality into three categories; as palatals, which were sounding native like or nearly native like, as alveolars or as "in between". Under this category were pooled tokens which could not be categorized neither as native sounding palatals nor as alveolars and tokens which were mispronounced. There was not included a category "substitutions" because any subject did not substitute 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 final stops in some production tasks or produced initial stops which were not fully voiced; this problem was not part of my research and it could be a question for further studies.

In the production tasks the production of alveolar stops were not analyzed, it was supposed that there should not be problems with their production because this category is present in subjects' L1.

4.2.2 Results of the Free Production task

The tokens with intended palatal stops /c/, /ɟ/ for the free production data were selected from words in which should have been realized palatal stops, which were uttered by L1eng speakers during the Free Production task and also from words which were spontaneously produced during other production tasks.

The percentage of intended palatals realized as palatals, alveolars or "in between" for individual subjects were counted from the tokens in which should have been realized palatal stops. There was a different number of tokens for individual L1eng speakers. While some subjects produced about five or six different words with intended palatal stops others produced only a few of them or have repeated some words. Therefore results in percents for individual subjects are not based on approximately the same number of tokens.

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

subj.	[**c**]	[**t**]	"**in between**"
1	pros**t**ě [pros**c**ɛ]	**-**	dě**t**i [ɟɛ**t**ɪ]
7	tatínka [ta**c**ɪ:nka]	**-**	**-**
11	děti [ɟɛ**c**ɪ]	těžko [tɛʃko]	městě [mɲɛs**t**ɛ]

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

subj.	[ɟ]	[d]	"in between"
2	ro**d**ina [roɟɪna]	-	ro**d**ině [rodɪɲɛ]
3	kamará**d**i [kamara:ɟɪ]	ro**d**iny [rodɪnɪ]	**d**ěti [dɛtɪ]
8	**d**ětí [ɟɛtɪ:]	-	-

Table 4.2 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 [d]. First there is listed orthographic form of the word which is followed by the phonetic form.

4.2.3 Results of the Elicited Production task

The percentage of intended palatals realized as palatals, alveolars or "in between" for individual subjects were counted only from tokens elicited in this task; from tokens, which were in the words, subjects used to denote and describe presented pictures and which contained tested segments /c/ and /ɟ/.

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 counted.

All subjects produced, when asked to say, what is on the picture, some words with palatal stops /c/ /ɟ/, some with alveolar stops /t/ /d/. and some with something "in between.

picture / subj.	**d**ěti	bu**d**ík	**t**isíc	**t**ělo
CZ	[ɟɛcɪ]	[buɟɪ:k]	[cɪsɪ:ts]	-
1	[ɟɛcɪ]	[buɟɪk]	[cɪsɪ:ts]	[cɛlo] **?**
4	[ɟɛtɪ] **?**	[hoɟɪnkɪ]	[cɪsɪ:ts]	[cɛlo]
8	[ɟɛcɪ]	[buɟɪ:k]	[cɪsɪ:ts]	[cɛlo]

Table 4.3 Examples of L1eng speakers description of some pictures. In the top part of the table are some of the words presented by pictures and its Czech orthographic form. In the first line there are responses of control L1cz subject and their phonetic form. In the next lines there are responses of some L1eng subjects. The question mark represents something "in between".

4.2.4 Results the of Sentence Reading task

The percentage of intended palatals realized as palatals, alveolars or "in between" for individual speakers were counted from the number of tested segments /c/ and /ɟ/, which were in the sentences; there were 49 tokens of /c/ and 31 of /ɟ/.

All subjects produced while reading sentences palatal stops, some pronounced palatal stops as alveolars and some as something "in between".

	Dě**t**i jsou zákla**d** ro**d**iny.
CZ	[ɟ] [**c**] [**t**] [ɟ]
1	[ɟ] [**c**] [**d**] [ɟ]
2	[ɟ] [**?**] [**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 4.4 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 L1eng subjects. Individual responses to the stimuli are in the phonetic brackets, the question mark represents something in "between".

4.2.5 Results of the Word List Reading task

The percentage of intended palatals realized as palatals, alveolars or "in between" for individual speakers were counted from the number of tested segments /c/ and /ɟ/, which were in words presented subjects on cards, there was 36 tokens of /c/ and 26 of /ɟ/.

In this part of production experiment were data from 11 subjects, data from subject 4 were not available.

All subjects produced in presented words some palatal stops, some alveolar stops and some "in between" stops.

	těsto	nákla**ď**ák	**d**ivoch
CZ	[**c**ɛsto]	[na:kla**ɟ**a:k]	[**ɟ**ɪvox]
2	[**c**ɛsto]	[nakla**ɟ**a:k]	[**d**ɪvox]
10	[**c**ɛsto]	[nakla**ɟ**a:k]	[**d**ɪvox]
12	[**c**ɛsto]	[nakla**ɟ**ak]	[**ɟ**ɪvox]

Table 4.5 Examples of some responses to the word stimuli. In the top of table there are orthographic forms of words, in the "first" line there are responses of control L1cz subject and then responses of three chosen L1eng subjects.

4.2.6 Summary

In all parts of the production experiment subjects produced palatal stops /c/ /ɟ/ in all word positions, word initially, medially and finally and when followed or preceded by various vowels both short and long.

The mean percentage of realization of intended palatals in all tested contexts was according to repeated measures of analysis of variance (henceforward ANOVA) [F(2, 20)=41.111, p=.00000] following; on the whole L1eng 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 contexts can be seen on 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)].

The realization of intended palatals as palatals was around 80% in the following three contexts - picture, word list and sentence, if the context changed to the context of free production the realization of intended palatals as palatals decreased to 60,12%. The realization of intended palatals as alveolars was in the three contexts around 10%, in the free production context was the realization of intended palatals as alveolars 11,06%. However, the realization of intended palatals as "something between" increased in the free production context, it was 28,17% in other three contexts it was around 10%.

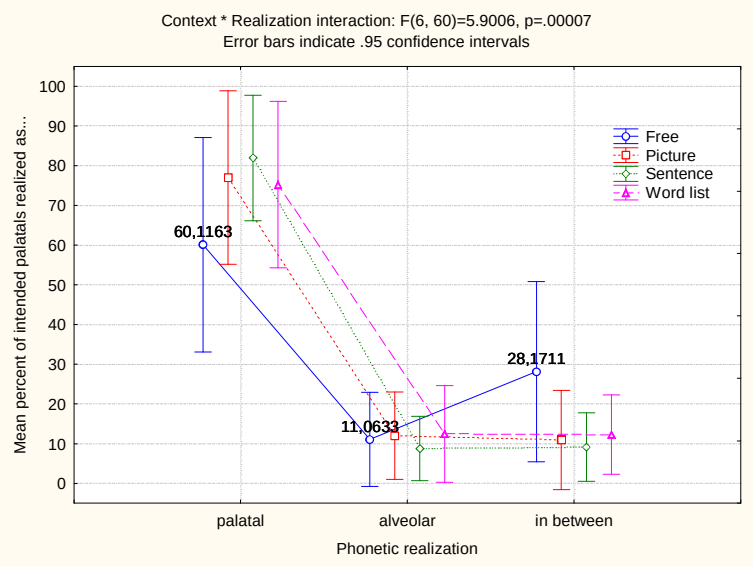


Figure 4.1 Mean percentage of intended palatals realized as palatal stops [c] [ɟ], as alveolar stops [t] [d] or as something "in between" in four tested contexts; in free production context, in picture context, in sentence context and word list context.

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%.

4.3 Discussion

L1en speakers produced palatal stops in all tested contexts, though in free production they produced significantly less palatal stops (about 60%) and more palatal stops which could not be categorized as palatal stops (about 28%)

The last category also might indicate that they acquired the category of palatal stops because they were trying to contrast the alveolars and palatals but may have some problems with articulation of native sounding palatals.

Lower occurrence of palatal stops in the Free Production task could be due to the fact that palatal stops were in natural, fluent speech, which is more complex and tested segments were influenced by surrounding sounds. Palatal stops uttered in the picture context were produced as well as in Free Production task without graphical help, but words were usually uttered on their own without context.

It could be also due to fact that the speech material in the free production part was not well balanced, while some subjects produced many tokens, some produced only a few.

L1en speakers produced more palatal stops in the Sentence and Word List Reading task, it could be due to the fact that there was visual help. The palatal stops where signalized by graphic symbols and even the subjects who did not produce native sounding palatals in the Free Production task may uttered palatal stops because of the visual cue and furthermore the subjects were reading the sentences carefully and slowly.

5. PERCEPTION EXPERIMENT 1

5.1. Methods

5.1.1 Stimuli

The stimuli for the Forced Choice Phoneme Selection (thereafter FCPS) task were in my perception experiment nonsense words, which resembled real Czech words as least as possible. I decided to use nonsense words to avoid influence by lexical content.

The FCPS task consisted of 250 disyllabic stimuli. Each of them contained one of the tested segments /t/ /d/, /c/ /ɟ/, /k/ /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. The exceptions were /d/, /ɟ/ and /g/, they did not occur word finally because in Czech they are subjects of final devoicing.

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

Summary of 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/, /a:/, /ɛ/, /ɛ:/, /ɪ/, /ɪ:/, /o/, /o:/, /u/, /u:/

(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/, /a:/, /ɛ/, /ɛ:/, /ɪ/, /ɪ:/, /o/, /o:/, /u/, /u:/

(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/, /a:/, /ɛ/, /ɛ:/, /ɪ/, /ɪ:/, /o/, /o:/, /u/, /u:/

word initial stop	**t**ěfo [**c**ɛfo] **t'**éfo [**c**ɛ:fo]	**t**ifo [**c**ɪfo] **t**ífo [**c**ɪ:fo]	**t'**afo [**c**afo] **t'**áfo [**c**a:fo]	**t'**ofo [**c**ofo] **t'**ófo [**c**o:fo]	**t'**ufo [**c**ufo] **t'**úfo [**c**u:fo]
word medial stop	mu**d**es [mu**d**ɛs] mu**d**és [mu**d**ɛ:s]	mu**d**ys [mu**d**ɪs] mu**d**ýs [mu**d**ɪ:s]	mu**d**as [mu**d**as] mu**d**ás [mu**d**a:s]	mu**d**os [mu**d**os] mu**d**ós [mu**d**o:s]	mu**d**us [mu**d**us] mu**d**ús [mu**d**u:s]
word final stop	sule**k** [sulɛ**k**] sulé**k** [sulɛ:**k**]	suli**k** [sulɪ**k**] sulí**k** [sulɪ:**k**]	sula**k** [sula**k**] sulá**k** [sula:**k**]	sulo**k** [sulo:**k**] sulók [sulo:**k**]	sulu**k** [sulu**k**] sulú**k** [sulu:**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 colloquial Czech; one of the standard varieties 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, 2002). Finally in the FCPS task there was 250 stimuli. Approximately half of the stimuli was 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 in the program Praat (Boersma, 2002). The stimuli in the FCPS task were presented in a random order and each of them was repeated only once.

In the FCPS task there was a replay button and subjects could hear the stimulus twice. 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 and aimed 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 2002). Subjects heard the stimuli over Sennheiser HD 202 headphones, on the monitor 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 FCP 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* [lɛ:kaŗ] (“doctor”) or *mladý* [mladɪ:] (“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. [poceʃɪ:] is represented by the button with the label *ť* not to confuse it with orthography. The orthographic form of [poceʃɪ:]] is *potěší* so they might click 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(1, 11)=26.323, p=.00033]. 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 medially (about 10%); the word initial segments were misperceived in about 15%. The graphical representation of this difference can be seen on Figure 5.1.

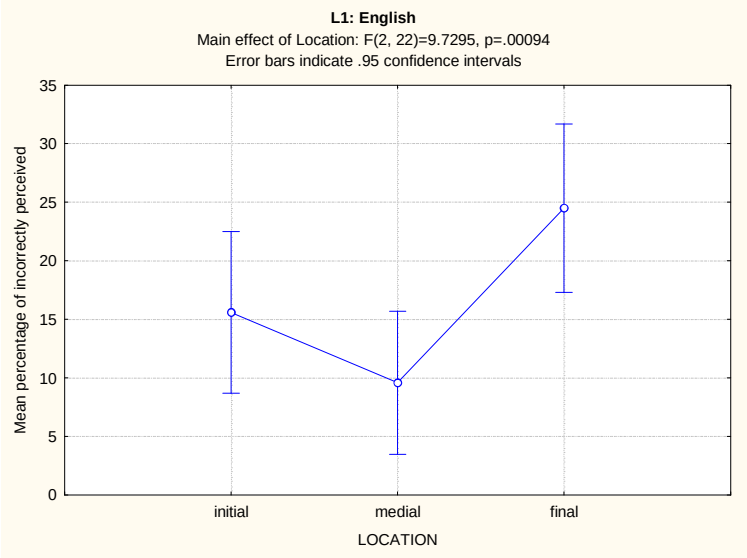


Figure 5.1 The mean percentage of incorrectly perceived oral stops with respect to the location of the tested segments by L1en speakers.

L1cz speakers have according to repeated measures ANOVA with one within speaker factor (location) significantly (p=.00837) most problems with perception of tested segments, which were located word initially. The graph made by ANOVA can be seen on Figure 5.2.

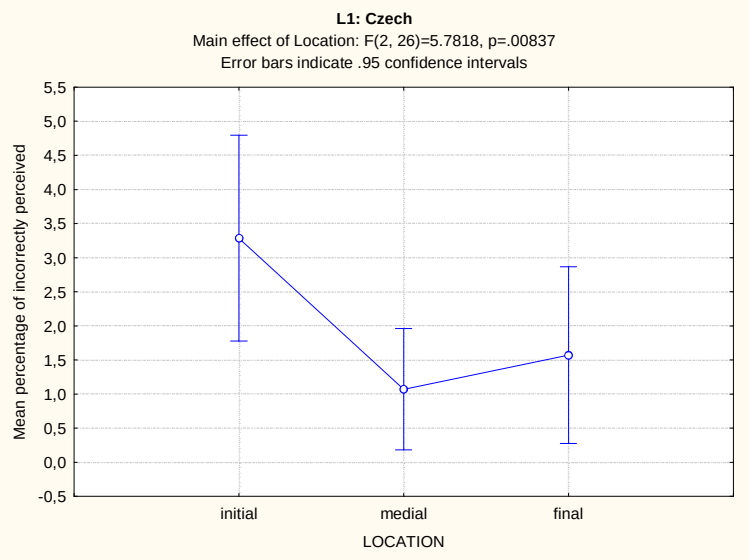


Figure 5.2 The mean percentage of incorrectly perceived stops with respect to the location of the tested segments by L1cz speakers.

Native speakers perceived incorrectly about 3,4% of word initial stops. They had fewest problems with perception of word medial stops (about 1% of incorrectly perceived stimuli), while incorrectly perceived word final stops were in the middle (about 1,5% of incorrectly perceived stimuli).

The main effect of place of articulation in the repeated measures ANOVA with following within speakers 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/.

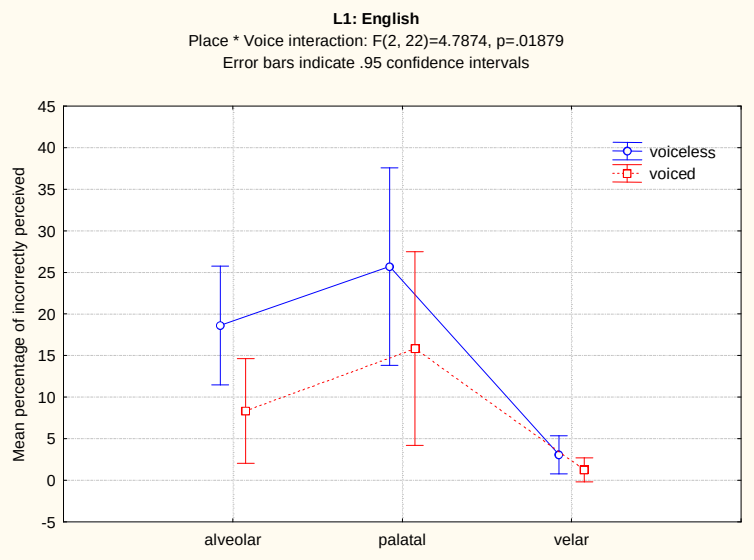


Figure 5.3 The mean percentage of incorrectly perceived tested segments /t/, /d/, /c/, /ɟ/, /k/ and /g/ with respect to their voice and place of articulation by L1en speakers.

The interaction of place of articulation and voice can be seen on Figure 5.3 which was made by repeated measures ANOVA. The interaction of this 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.

Post hoc Fisher's LSD test revealed that there was a significant difference between L1en speakers responses to voiced alveolar stop /d/ and palatal 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% incorrectly perceived) than voiced palatal stops (about 15% incorrectly perceived).

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 L1 en 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 /ɪː/ or by other vowels.

Repeated measures ANOVA with one within speaker factor (the following vowel), indicated that there was a significant (p=.00243) difference of 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/ /ɪː/ and 21,01% of palatals followed by other vowels.

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

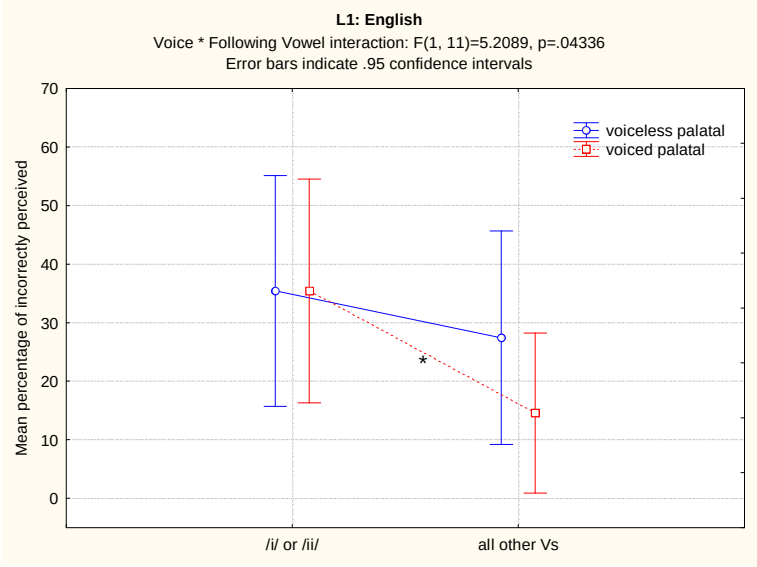


Figure 5.4 The mean percentage of incorrectly perceived voiced palatal /ɟ/ and voiceless palatal /c/ followed by either /ɪ/ or /ɪː/ or other vowels by L1en speakers.
* Significant difference revealed by *post hoc* Tukey's test at α =0.01.
/ii/ Stands for high unrounded vowel /ɪː/.

L1en speakers perceived incorrectly 35,42% of palatals followed by front high unrounded vowels /ɪ/ /ɪ:/ (it applied to both voiced and voiceless palatals). *Post hoc* Tukey's test revealed that there was a significant difference between L1en speaker's responses to the voiced palatal followed by front high unrounded vowels /ɪ/ /ɪ:/ 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/ /ɪ:/ 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 /ɪ:/. They perceived incorrectly 11,16% of palatal stops followed by high front unrounded vowel /ɪ/ or /ɪ:/ 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 weaker burst and unlike word initial consonants are not stressed (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 consult more acoustic cues such as voicing, VOT, burst, formant transitions or onset frequency.

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

It seems that both 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 and according to ANOVA they had more problems with identification of voiceless palatal stops.

The alveolar stops are part of the non-native contrast of alveolar and palatal stops, therefore they might not be distinguished from palatal stops. Unlike the alveolar stops, the velar stops are an old category for L1en learners of Czech and they did not have problems with perception of this category.

The palatal stops /c/ and /ɟ/ which were perceived incorrectly by L1en speakers could be perceived either as the alveolar stops /t/, /d/ or as the velar stops /k/ /g/. Nevertheless, it is not possible to say, whether one of these possibilities prevailed or they were balanced, it would need further analysis of misperceived palatal stimuli.

However, it was not entirely necessary to analyze it, because L1en speakers perceived correctly about 80% of palatal stops /c/, /ɟ/; at greater than chance level, which means that they have most probably acquired category of palatal stops and are able to distinguish them from the alveolar stops in the non-native contrast of alveolar and palatal stops.

Furthermore the results of production experiment did not indicate that L1en learners of Czech would substitute Czech palatal stops with velar 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 any 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 have 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 any significant differences in perception of voiceless palatal stop /c/ when it was followed by either /ɪ/ or /ɪ/ or by other vowels. There was only significant difference between perception of voiced palatal stop /ɟ/ when followed by /ɪ/ or /ɪ/ and when followed 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 subjects probably preferred as a cue rather burst than formant transitions, unlike the voiceless the voiced palatals have weaker burst, so subjects had to use as a cue formant transitions.

6. PERCEPTION EXPERIMENT 2

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 -75ms to 75ms (0 was not included). The steps were not raising arithmetically but logarithmically; steps along the continuum can be seen in the Table 6.1.

	VOT values/ms									
/t-d/ continuum	-75	-38	-19	-10	-5	5	10	19	38	75

Table 6.1 Example of /t-d/ continua.

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 token of human speech recorded token of [tɛfo]. The vowel [ɛ] in the stimuli was used from one token of [dɛfo] and was manipulated in Praat (Boersma 2002) 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 was taken from the token of [dɛfo].

To make the /t-d/ stimuli with longer values of positive VOT the noise was truncated in 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 2002). Tokens of [ɟɛfo] and [cɛfo] had different intensity of burst. The burst noise was used from natural token of [cɛfo] and the lower part of burst was filtered; from 500-22050 and smoothed 100.

The vowel of the 38 /c-ɟ/ stimulus was shortened. The stimulus with the VOT 75ms 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 stimulus with VOT 19, 10 and 5ms were made from the preceding stimuli, which were shortened; eg. the stimulus /c-ɟ/ 19ms was made from the stimulus /c-ɟ/ 38ms which was shortened to 19ms.

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 0ms to 5ms, 10ms, 19ms and 38ms.

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 burst was reduced and the cycle before beginning of voice was used from natural token of [gɛfo].

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

The aspiration noise in the /k-g/ stimulus with VOT 75ms 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/ 5ms and there was added corresponding voicing.

Each stimulus was repeated five times and they were presented in a random order, but there did not occur any doublets, 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 2002). Subjects heard the stimuli in Sennheiser HD 202 headphones, on the monitor 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 75ms and -75ms.

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 it with orthography. The orthographical form of [cɛfo] is *tělo* so the subjects might click 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 were significant differences in incorrectly perceived stimuli. The main

effect of L1 was [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 [(F2, 22)]=11,206, p=.00044]. L1en speakers identified incorrectly most stimuli with palatals stops (13,5% of incorrectly perceived), than stimuli with alveolar stops (7%) and the fewest problems with perception of place of articulation they had at stimuli with velar stops (0,33%).

The main effect of place reached significance [F(2, 26)=3.9774, p=.03111] also by L1cz speakers. They according to repeated measures ANOVA with one within speaker factor (place) made most errors in identification of place of articulation at stimuli with alveolar stops (6,43%), than in stimuli with palatal stops (3%) and at least in stimuli with velar stops (0,07%).

On Figure 6.1 you can see the significant [F2(2, 48)=5.4009, p=.00766] interaction of L1 and place. The graph was produced by repeated measures ANOVA with the following between speaker factor (L1) and within speaker factor (place).

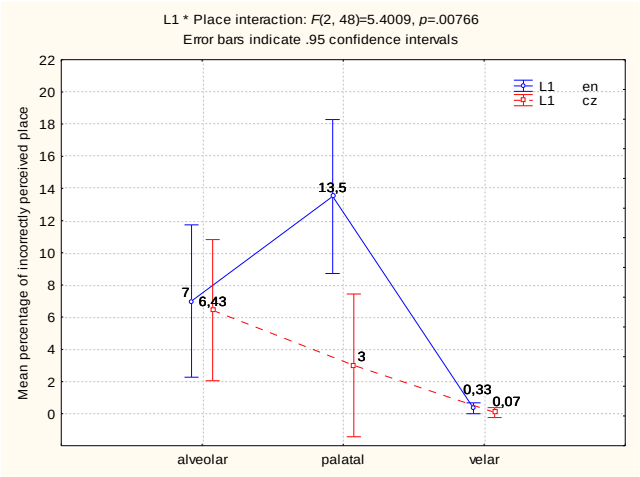


Figure 6.1 Mean percentage of incorrectly perceived place of articulation for L1cz and L1 eng speakers in responses to the stimuli along alveolar, palatal and velar continuum with varying VOT.

The mean percentage of responses to stimuli along the VOT /t-d/ continuum ranging from stimuli with values of VOT from -75ms to +75ms perceived as voiced is shown in Figure 6.2. There are two lines, one represents the responses to stimuli

by L1en speakers and the second of L1cz speakers. It was produced by repeated measures ANOVA with following between speakers factor (L1) and within speaker factor (VOT). The interaction of L1 and VOT was [F(9, 216)=8.0098, p=.00000].

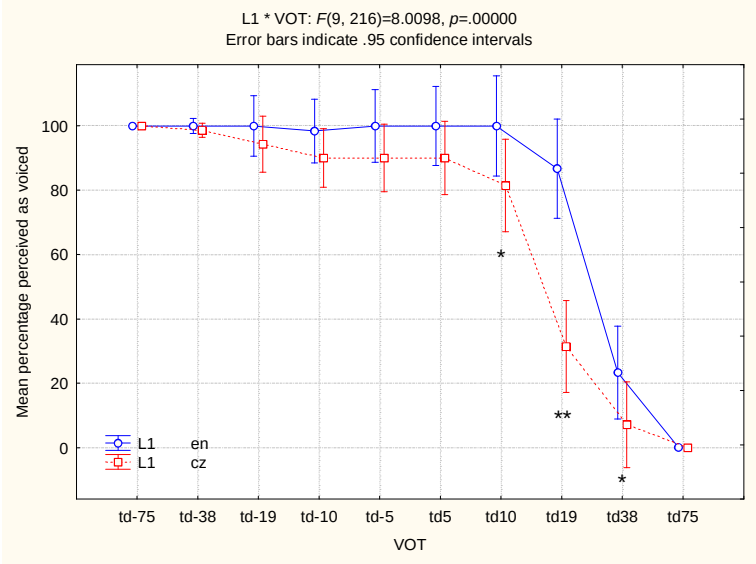


Figure 6.2 The mean percentage of responses on the /t-d/ continuum perceived as voiced by L1en and by L1cz speakers. The horizontal axes represents the VOT continuum ranging from -75ms on the left to +75ms on the right.
** Significant difference revealed by *post hoc* Tukey's test at α =0.001.
* Significant difference revealed by *post hoc* Fisher's LSD test at α =0.5.

Stimuli with large VOT were identified as voiced by both L1en and L1cz speakers. Fisher's LSD *post hoc* was used and it revealed that there was a significant difference between L1en speaker's and L1cz speaker's responses to the stimulus "td10" at α=0.5; both groups of L1 speakers perceived it still as voiced.

Post hoc Tukey's test was used and it revealed that there was a significant difference between L1en speaker's and L1cz speaker's responses to the stimulus "td19" at α=0.001. 100% of stimuli with VOT 19ms was perceived as voiced by L1en speakers, the L1cz speakers perceived as voiced about 80% of this stimuli.

The *post hoc* Fisher's LSD test revealed that there was a significant difference between L1en speaker's and L1cz speaker's responses to the stimulus "td38" at α=0.5. About 20% of tokens of the stimuli "td38" was perceived as voiced by L1en speakers. However L1cz speakers perceived as voiced only 10% tokens of this stimuli.

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

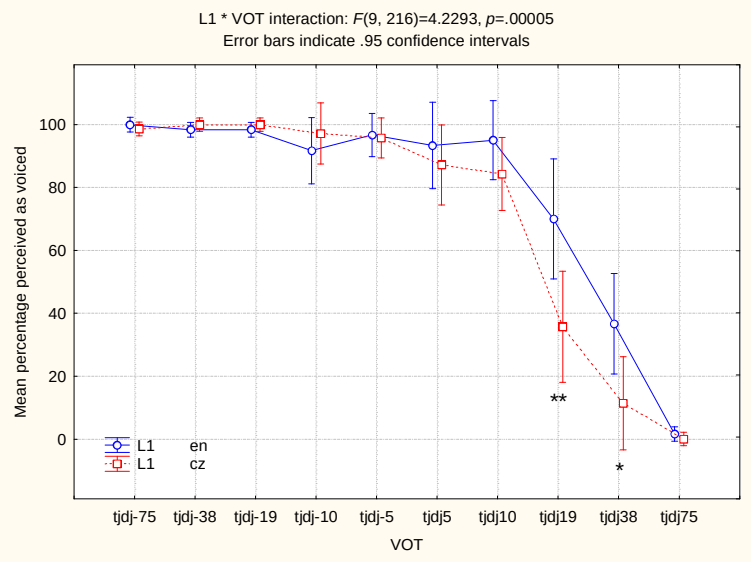


Figure 6.3 The mean percentage of responses on the /c-ɟ/ continuum perceived as voiced by L1en and by L1cz speakers. The horizontal axes represents the VOT continuum ranging from -75ms on the left to +75ms on the right.
tjdj Stands for palatal stops /c/ and /ɟ/.
** Significant difference revealed by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

On Figure 6.3 is represented classification of stimuli with varying VOT along /c-ɟ/ continuum by L1en and L1cz speakers. It was produced by repeated measures ANOVA with following between speakers factor (L1) and within speaker factor (VOT). The interaction of L1 and VOT was [F(9, 216)=4.2293, p=.00005].

The stimuli with large 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 speaker's and L1cz speaker's 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 nearly 40% of them.

Post hoc Tukey's test also revealed that there was a significant difference between L1en speaker's and L1cz speaker's 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 was perceived as voiceless by both groups of speakers.

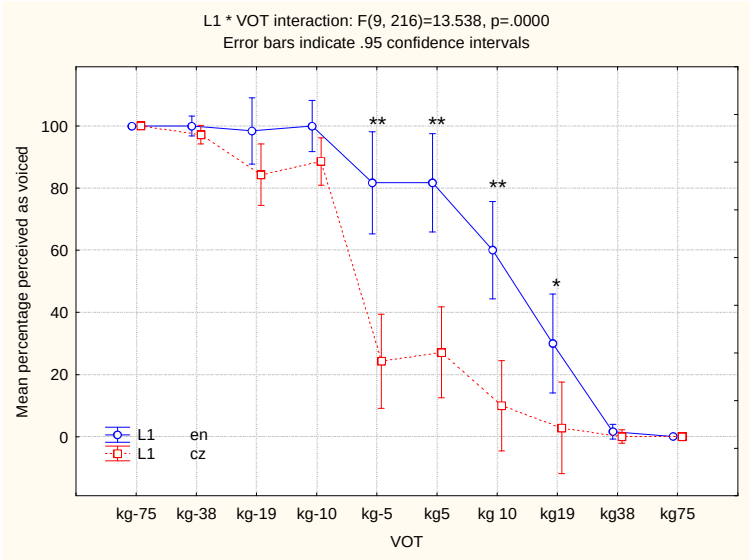


Figure 6.4 The mean percentage of responses on the /k-g/ continuum perceived as voiced by L1en and by L1cz speakers. The horizontal axes represents the VOT continuum ranging from -75ms on the left to +75ms on the right.
** Significant difference revealed by *post hoc* Tukey's test at α =0.001.
* Significant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

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

The stimuli with large 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 speaker's and L1cz speaker's 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 just about 10% of this stimuli as voiced.

Post hoc Tukey's test also revealed that there was a significant difference between L1en speaker's and L1cz speaker's 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.

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

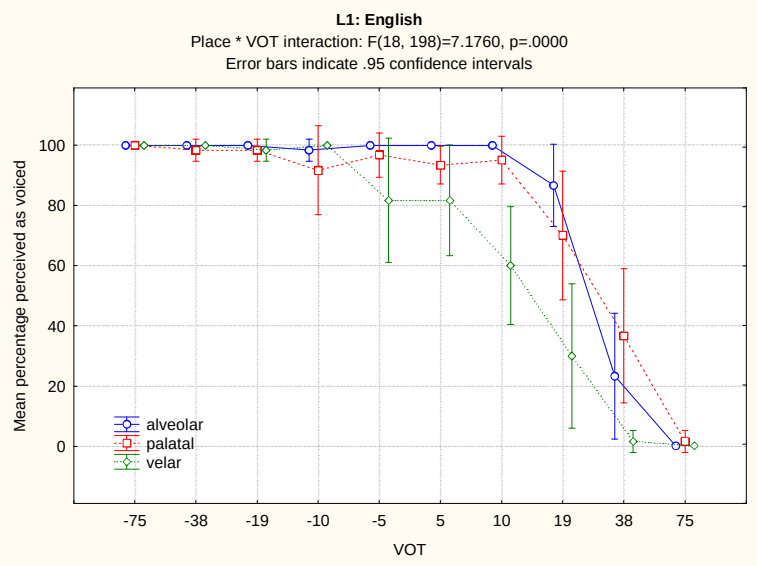


Figure 6.5 The mean percentage of responses along the three continua perceived as voiced by L1en speakers. The horizontal axes represents the VOT continuum, from -75ms on the left to +75ms on the right.

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 19ms at α=0.01 and VOT 38ms 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 -5ms 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 5ms 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 10ms, 19ms and 38ms 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 and 19 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 38ms at α=0.001.

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

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

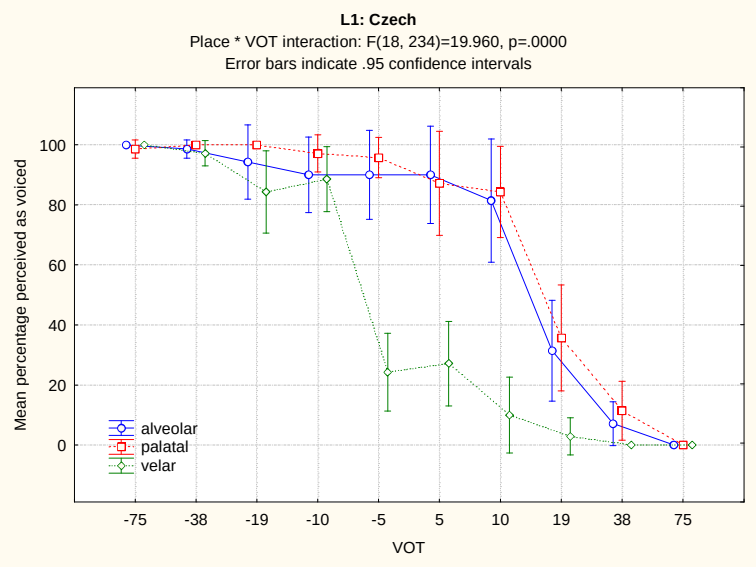


Figure 6.6 The mean percentage of tokens on the three continua perceived as voiced by L1cz speakers. The horizontal axes represents the VOT continuum ranging from -75ms on the left to +75ms on the right.

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 19ms were perceived as voiceless. About 60% tokens of this stimuli was perceived as voiceless. The stimuli with VOT 38ms 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 -19ms 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 -5ms, 5ms, 10ms, 19ms 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- 5ms, 5ms, 10ms and 19ms at α=0.001 While the velar stimuli with VOT -5ms were perceived as voiceless, the palatal and alveolar stimuli were indentified mostly as voiced. As voiceless were perceived the palatal and alveolar stimuli with VOT 19ms.

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

6.3 Discussion

Results of the second perception experiment revealed that L1en speakers have 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. It could be due to the fact that they are not pairs of the contrast palatal and alveolar stops.

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 and unlike the velar stops they were in contrast with palatal stops.

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. It seems that L1en speakers needed larger positive VOT to classify the alveolar stop as voiceless. There was a difference in perception of stimuli with VOT 19ms, 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 38ms as perfect voiceless alveolar stop.

L1en speakers had probably negative transfer from L1. English voiceless alveolar stops, which are stressed 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 demanded longer values of VOT to perceive palatal stop as voiceless. For L1cz speakers were already the stimuli with VOT 19ms examples of voiceless palatal stops, L1en speakers perceived them still as voiced.

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

There was as in case of alveolar stops negative transfer from native language, English. It seems that in spite of the fact that L1en speakers were able to perceive and produce native sounding 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 -5ms and 5ms 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 itself, because the stimuli with VOT -5ms 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 19ms and the stimuli with VOT 38ms was perceived mainly as voiceless.

This finding is in accordance with the fact that the velar stops have shorter values of VOT because of the different size of cavity above glottis therefore both groups of speakers needed shorter values of VOT to identify velar stops as voiceless. Though there was still negative transfer and L1en speakers demanded larger values of VOT to classify velar stops as voiceless than L1cz speakers.

It would be better, if the range of continua was larger, therefore both groups of subjects would probably categorize mainly as voiceless more stimuli. On the graphs there was long “line” of stimuli perceived as voiced, then “boundary region” and only short “line” of stimuli perceived as voiceless.

However it, was technically difficult to made natural sounding stimuli with large positive VOT.

7 CONCLUSION

7.1 Findings of the thesis

Aim of this paper was to study the acquisition of Czech palatal stops by English native speakers. One of the questions of presented study was to examine the relationship between perception and production skills of English learners of Czech.

There were three possibilities; perception skills could precede production, or otherwise, or they could go hand in hand. According to studies at second language acquisition the perception skills of second language learners should precede production skills.

However Sheldon & Strange (1982) found out that Japanese native speakers learning English were less accurate in perceiving /r/ - /l/ contrast than in producing it.

Results of my production tests 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 helped with the visual cues of orthography but also in free speech and in elicited production. 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 this stops did not sound native like, it could have been because of problems with articulation or because of negative transfer from native language, there was clearly 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.

It was also revealed in the production experiment that L1en speakers did not have any significant differences in production of palatal stops with respect to voice of palatal stops.

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. However, it is not possible to say if L1en speakers substitute the misperceived palatal stops with alveolar stops or velar stops. On the other hand, results of production experiment did not indicate any inclination of L1en speakers to substitute Czech palatal stops /c ɟ/ with velar stops /k g/.

Unlike in the production experiment where L1en speakers did not have any significant problems with production of voiceless or voiced palatal stops, the FCPS task revealed that they had significant problems with perception of voiceless palatals.

It is possible to say that my tested subjects were able to both perceive and produce palatal stops and distinguish them from alveolar stops which are in contrast with them and they as the whole they acquired category of palatal stops.

It seems that there is a relationship between perception and production and that L1 en speakers probably would not be able to produce palatal stops, if they were not able to perceive them. However, in case of my tested group neither skill prevailed; 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 and maybe if the group was divided into less experienced and experienced learners the perception skill in the less experienced group would prevail.

The second research question whether the perception of palatal stops is more difficult if palatal stops are followed by the high front vowels /ɪ/ or /ɪː/ than by other vowels has not been confirmed it 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 /ɪː/ 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 /ɪ:/ and in case of voiceless palatal stops there were not any significant differences in perception of palatal stops followed by high front vowels /ɪ/ and /ɪ:/ by L1en speakers.

It is probable that L1en subjects used when identifying the voiceless palatal stops as cue rather burst than formant transitions and the burst of voiceless palatal stops are stronger than burst of voiced palatal stops. Furthermore palatal stops are characterized by intense burst which could help as an acoustic cue in perception.

Unlike the voiceless palatals the voiced one have weaker burst so subjects had to use as a cue rather formant transitions, but the palatal constriction looks similar, therefore there were not any visible CV formant transitions.

The third research question was not addressed wholly. The second perception test revealed that L1en speakers demanded longer values of VOT to classify stops as voiceless. These findings were not 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 proved that L1en speakers 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 then L1cz speakers to identify not only the voiceless alveolar and velar stimuli, which are in inventory of their L1, but also to identify the voiceless palatal stops which were a new category for them.

Results of my thesis were not completely in correspondence with results of Atkey. She proposed that L1en speakers should be able to acquire the category of palatal stops because they use the feature distinguishing palatal and alveolar stops to distinguish alveolar and postalveolar fricatives, but results of her experiments did not supported 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 nonsense stimuli, therefore the possible influence of lexical content was diminished. Also the speech

data for production experiment were from different contexts, therefore they should have better predictive value about acquisition of palatal stops.

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 the fact 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 /ɪː/ or by other vowels. It seems that when distinguishing final palatal stops used L1en speakers 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 are preferring different cues when identifying Czech stops.

7.2 Questions for further research

The present thesis have 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 do be also interesting to have a closer look at the production data whether there is some connection between perception and production and whether the production of palatal stops is more difficult if they are followed by high front vowels /ɪ/ and /ɪː/ than by other vowels as it was partly in perception. And whether there is a negative transfer as it was in perception with respect of VOT and voicing.

English unlike Czech does not completely devoice word final stops and word initial stops are not fully voiced.

Furthermore, 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 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 be differentiate 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* [dju:] and American English does not, as in [du:].

In presented study was dealt with palatal stops /c/ and /ɟ/, however in Czech there is also nasal palatal stop /ɲ/, it would be interesting to examine acquisition of this palatal stop in further study as well.

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?

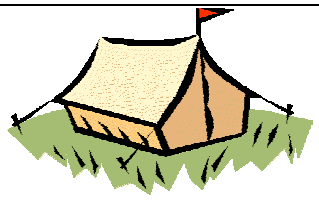
- Kolik by měla mít rodina dětí?
  - Jsou nějaké rozdíly mezi rodinami v Čechách a v Americe?
  - Slyšela jsem, že v Americe je v rodině více dětí, je to pravda?

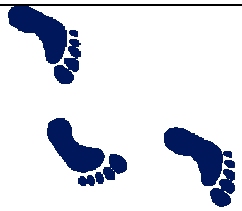
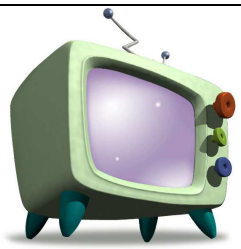
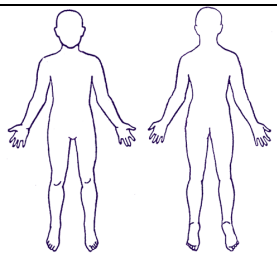
2) Na co se těšíte?

- 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**ɪ: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 [rɪ**ɟ**ɪtʃka]/ [rɪ**ɟ**ɪtʃ]
		
schodiště/schody [sxo**ɟ**ɪʃcɛ]/[sxo**d**ɪ]	stan [s**t**an]	stín [s**c**ɪ:n]

100		
sto [**s**to]	stopy [**s**topɪ]	stůl [**s**tu:l]
		
talíř [**t**alɪ:r]	tanec [**t**anɛts]	televize [**t**ɛlɛvɪzɛ]
		1000
tělo/těla [**c**ɛlo]/[**c**ɛla]	tílko [**c**ɪ:lko	tisíc [**c**ɪsɪ: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
/**tɛ:**/	/**tɪ:**/	/**ta:**/	/**tu:**/	/**to:**/
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
/**dɛ:**/	/**dɪ:**/	/**da:**/	/**du:**/	/**do:**/
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
/**cɛ:**/	/**cɪ:**/	/**ca:**/	/**cu:**/	/**co:**/
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
/**ɟɛ**/	/**ɟɪ**/	/**ɟa**/	/**ɟu**/	/**ɟo**/
ďéfo	dífo	ďáfo	ďúfo	ďófo
ďémuf	dímuf	ďámuf	ďúmuf	ďómuf

/**kɛ**/	/**kɪ**/	/**ka**/	/**ku**/	/**ko**/
kefo	kyfo	kafo	kufo	kofo
/**kɛ**:/	/**kɪ**:/	/**ka**:/	/**ku**:/	/**ko**:/
kéfo	kýfo	káfo	kúfo	kófo
/**gɛ**/	/**gɪ**/	/**ga**/	/**gu**/	/**go**/
gefo	gyfo	gafo	gufo	gofo
/**gɛ**:/	/**gɪ**:/	/**ga**:/	/**gu**:/	/**go**:/
géfo	gýfo	gáfo	gúfo	gófo
WORD MEDIALLY				
/**tɛ**/	/**tɪ**/	/**ta**/	/**tu**/	/**to**/
mutes	mutys	mutas	mutus	mutos
huten	hutyn	hutan	hutun	huton
/**tɛ**:/	/**tɪ**:/	/**ta**:/	/**tu**:/	/**to**:/
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
/**dɛ**:/	/**dɪ**:/	/**da**:/	/**du**:/	/**do**:/
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
/**cɛ**:/	/**cɪ**:/	/**ca**:/	/**cu**:/	/**co**:/
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
/ɟɛ/	/ɟɪ/	/ɟa/	/ɟu/	/ɟo/
muďés	muďís	muďás	muďús	muďós
huďén	huďín	huďán	huďún	huďón
/kɛ/	/kɪ/	/ka/	/ku/	/ko/
huken	hukyn	hukan	hukun	hukon
/kɛː/	/kɪː/	/kaː/	/kuː/	/koː/
hukén	hukýn	hukán	hukún	hukón
/gɛ/	/gɪ/	/ga/	/gu/	/go/
hugen	hugyn	hugan	hugun	hugon
/gɛː/	/gɪː/	/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/	/ɪːt/	/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/	/ɪːc/	/aːc/	/uːc/	/oːc/
loféť	lofíť	lofáť	lofúť	lofóť
suléť	sulíť	suláť	sulúť	sulóť
/ɛk/	/ɪk/	/ak/	/uk/	/ok/
lofek	lofik	lofak	lofuk	lofok
/ɛːk/	/ɪːk/	/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 /ɪ/, 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 kontextech, v přirozené řeči, v reakcích na vizuální stimuly, čtení vět a slov, která obsahovala testované segmenty.

Analýza výsledků prvního percepčního testu ukázala, že problémy při percepci jsou pouze v případě znělých ploziv, které následují /ɪ/ a /ɪ:/. 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 /ɪ:/ 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.

REFERENCES

Atkey, Susan Barbara. *The Acquisition of L2 Segmental Contrasts: English Speakers' Perception and Production of Czech Palatal Stops*. MA thesis. University of Calgary, Calgary, 2001.

Best, Catherine T. "A Direct Realist View of Cross-Language Speech Perception." *Speech perception and linguistic experience: Issues in Cross Language Research*. Ed. W. Strange. Baltimore: York Press, 1995. 171-206.

Crystal, David. *A Dictionary of Linguistic and Phonetics*. Oxford: Blackwell, 1995.

Ellis, Rod. *Understanding Second Language Acquisition*. Oxford: Oxford University Press, 1985.

Escudero, Paola. "Second-language phonology: the role of perception." *Phonology in Context*. Ed. Martha C. Pennington. New York: Palgrave Macmillan, 2007. 109-134.

Flege, James Emil. "Production and perception of a novel, second-language phonetic contrast." *Journal of the Acoustic Society of America* 93 (3) (1993): 1589-1608.

Flege, James Emil. "Second Language Speech Learning: Theory, Findings and Problems." *Speech Perception and Linguistic Experience: Issues in Cross-language research*. Ed. W. Strange. Baltimore: York Press, 1995. 229-273.

Hála, Bohuslav. *Fonetika v teorii a v praxi*. Praha: Státní pedagogické nakladatelství, 1975.

Hayward, Catherine. *Experimental Phonetics*. London: Longman, 2000.

Højen, Anders Damgren. *Second-language speech perception and production in adult learners before and after short term immersion*. Ph.D. thesis. University of Aarhus, Aarhus, 2003.

Gimson, Alfred Charles. Gimson's Pronunciation of English. 6th ed. London: Edward Arnold, 2001.

Jones, Daniel. *An Outline of English Phonetics*. Cambridge: Cambridge University Press, 1993.

Ladefoged, Peter. *A course in Phonetics*. 4th ed. Hardcourt College Publishers, 2001.

Llisterri, Joaquim. "Relationship between speech production and speech perception in a second language." *ICPhS 1995, Proceedings of the 13th International Congress of Phonetic Sciences Vol 4*. Stockholm, 1995. 92-99.

Lust, Barbara. *Child language: Acquisition and Growth*. Cambridge: Cambridge University Press, 2006.

Mluvnice češtiny 1. Praha: Academia, 1986.

Machač, Pavel, Skarnitzl, Radek. *Fonetická segmentace hlásek*. Praha: Epocha, 2009.

Massaro, Dominic W. and Oden, Gregg C. "Independence of Lexical Context and Phonological Information in Speech Perception." *Journal of Experimental Psychology: Learning, Memory and Cognition*. 21 (4) (1995): 1053-1064.

Palková, Zdena. *Fonetika a fonologie češtiny*. Praha: Karolinum, 1994.

Pitt, Mark A. "The Locus of Lexical Shift in Phoneme Identification." *Journal of Experimental Psychology: Learning, Memory and Cognition*. 21 (3) (1995): 1037-1052.

Redford, Melissa A. and Diehl, Randy L. "The relative perceptual distinctiveness of initial and final consonants in CVC syllables." *Journal of the Acoustic Society of America* 106 (3) (1999): 1555-1565.

Roach, Peter. *English Phonetics and Phonology: A Practical Course*. Cambridge: Cambridge University Press, 1991.

Sheldon, Amy; Strange, Winifred. "The Acquisition of /r/ and /l/ by Japanese Learners of English - Evidence that Speech Production Can Precede Perception". *Applied Psycholinguistics* 3 (1982): 243-261.

Volín, Jan. *Statistické metody ve fonetickém výzkumu.* Praha: Epocha, 2007

Wells, John Christopher. *Accents of English. I, An introduction.* Cambridge: Cambridge University Press, 1982.

Wells, John Christopher. *Accents of English. II, The British Isles.* Cambridge: Cambridge University Press, 1982.

Wells, John Christopher. *Accents of English. III, Beyond the British Isles*. Cambridge: Cambridge University Press, 1982.

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