Autoreferát

The research project of this thesis began from my personal experience with cross-linguistic influence (hereafter CLI). As a native speaker of Czech, I started to learn French, my second language (hereafter L2), at the age of 16. After graduating from high school, I left the Czech Republic to study in France. When returning home, in the Czech Republic, after a year spent living in France, my father was surprised by my accent in Czech, i.e., my L1 (first language). During my university studies, I discovered that this phenomenon, which my father perceived in my native speech, is called phonetic CLI or, in extreme cases, L1 phonetic attrition and that it can affect late bilinguals, who, like me, started to learn an L2 after the age of six and use it in their everyday life.

An increasing number of the studies have already investigated the phonetic influence of L2 on L1 in the L1 speech of late bilinguals. The studies were based on acoustic measures (e.g., Major, 1992; Mayr, Price, & Mennen, 2012; Mennen, 2004) and/or perceptual experiments (cf., e.g., De Leeuw, 2008; Sancier & Fowler, 1997). Acoustic measurements can capture very small phonetic changes in the L1 of late bilinguals, and perceptual experiments can, through their results, help us determine which acoustic analysis to conduct (see, e.g., De Leeuw, 2008). In addition, some studies on the phonetic influence of L2 on L1 have analysed the relationship between the CLI found and factors such as bilinguals' use of L1 and L2, L2 proficiency, and length of residence in the L2 country (hereafter LOR).

Studies on the phonetic influence of L2 on L1 have mainly focused on bilinguals whose L1 or L2 was English. The case of Czech as L1 and French as L2 has not yet been studied, even though these languages show interesting phonetic differences at both segmental and suprasegmental levels. Thus, several questions arise: What is the phonetic influence of L2 on L1 when Czech is the L1 and French the L2 of bilinguals? Can this phonetic influence be perceived by monolinguals? Which segments and suprasegments of Czech speech can be phonetically influenced? How is this phonetic influence related to speakers' use of languages, proficiency in languages and other factors? This thesis examines these questions by studying the Czech speech of late Czech-French bilinguals (hereafter – CF) who are native speakers of Czech and learned French and moved to France in adolescence or adulthood; they use French (their L2) in everyday life.

In this thesis, the term phonetic CLI refers primarily to the phonetic influence of L2 on L1, including L1 phonetic attrition. When speaking about the phonetic influence of L1 on L2, I specify it. Factors such as use of languages, proficiency in languages and other similar factors are designated by the term 'extralinguistic factors' when discussing them in general, and 'predictor variables' when discussing the ones examined in this thesis. In this thesis, I base the hypotheses on models

of L2 speech perception and production, the results of studies on phonetic CLI and the differences between the Czech and French phonetic systems. We investigate the influence of French on Czech in CF's L1 speech by a perception experiment and acoustic measurements, the results of which are subsequently analysed in relation to the predictive variables.

Chapter 1: L2 speech production and perception

Chapter 1 concerns L2 speech production and perception, and more specifically how speakers learn an L2 at phonetic level. Section 1.1 presents the hypotheses of L2 speech production and perception: as mentioned in Eckman (2012), these can be divided into those that precede the formulation of the Interlanguage hypothesis (i.e. pre-1972) and those that follow it. We can classify among the former Contrastive Analysis Hypothesis (Lado, 1957) and Markedness Differential Hypothesis (Eckman, 1977). The latter begins with the Interlanguage hypothesis (Selinker, 1972), according to which, during L2 acquisition, learners create an intermediate linguistic system. Optimality Theory (Prince & Smolensky, 1993), Structural Conformity Hypothesis (Eckman, 1991) and Similarity Differential Rate Hypothesis (Major & Kim, 1996) followed the Interlanguage hypothesis.

In section 1.2, models of L2 speech production and perception are presented. These are Native Language Magnet Theory (NLM), Perceptual Assimilation Models (PAM and PAM-L2), Speech Learning Models (SLM and SLM-r), Second Language Linguistic Perception Model (L2LP) and L2 intonation learning theory (LILt). The predictions of PAM, PAM -L2 and L2LP concern the perception of contrast in L2 sounds (Best, 1994, 1995; Best & Tyler, 2007; Escudero, 2005; Escudero, Boersma, Rauber, & Bion, 2009; Van Leussen & Escudero, 2015), whereas the NLM, SLM and SLM-r concern the perception and/or production of a single L2 sound (Flege, 1988, 1995; Flege & Bohn, 2021; Kuhl, 1993). In both NLM and SLM, the production or perception of the L2 sound(s) is predicted on the basis of perceptual similarities between the L1 and L2 sounds. The SLM takes into account the similarity of the IPA symbols used for these sounds and their acoustic similarity, which is also taken into account by the L2LP. The PAM takes into account the similarity of the articulatory gestures of these sounds and the PAM-L2 takes more into account their phonetic and phonological dimensions. The SLM-r predicts that L2 acquisition depends on many phonetic and endogenous factors that vary with the individual and over the lifetime. Regarding L2 intonation, LILt proposes to compare L1 and L2 intonation in its four dimensions: systemic, realisational, semantic and frequency (Mennen, 2015). Nevertheless, the LILt assumptions are based on the SLM, which has recently been updated and given the name SLM-r. Only one LILt's assumption is compatible with SLM-r, i.e., that differences in the realisational dimension of L1 and L2 intonation can impact on the learner's ability to accurately discriminate, categorise and produce the phonological elements of L2 intonation. All the mentioned models, except for SLM and SLM-r, address CLI primarily as the influence of L1 on L2, but not necessarily as the influence of L2 on L1. According to the SLM and SLM-r, phonetic influence of L2 on L1 can occur since the phonetic categories of the L1 and L2 exist in the same phonetic space of the speaker. In contrast, L2LP views L2 learning as a development of two entirely separate perceptual grammars

which do not influence each other and, therefore, phonetic influence of L2 on L1 does not occur unless there is insufficient exposure to rich L1 input by the speaker (cf. Escudero, 2005; Yazawa, 2020).

In section 1.3 we discuss the relevance of these theoretical considerations for the experimental part of the thesis: The use of SLM to study phonetic CLI seems relevant. Indeed, according to the SLM, during L2 acquisition, either (1) a new phonetic category is not created for an L2 sound which is, therefore, classified in an L1 category or (2) a new phonetic category is created for a new L2 sound which is classified in it. In (1), L1 and L2 sounds influence each other by making their properties closer (assimilation effect), and in (2), interference between L1 and L2 sounds exists as an effort to maintain the contrast between the L1 and L2 category (dissimilation effect) (see, e.g., De Leeuw, 2019a). In addition, the SLM offers some criteria for predicting what kind of effect will occur. However, these criteria remain insufficient and only the SLM-r provides a more complete approach for predicting the type of effect to occur. Thus, according to SLM-r, the type of effect to occur depends on a large number of phonetic and endogenous factors which may vary with the speaker. Therefore, we consider that the SLM-r is probably the most suitable model to study phonetic CLI. Nevertheless, it is not possible for us to examine all these phonetic and endogenous factors determining L2 acquisition of each CF. Therefore, we decided to consider that all Czech and French phonemes that differ in at least one of the followings: IPA symbol, acoustic properties, articulatory properties, perceptual properties, phonological properties, could be affected by the phonetic CLI in L1 speech of CF. Furthermore, due to the predictions of L2LP, we consider that phonetic CLI could also occur in Czech phonemes that do not exist in French, as CF would be less frequently exposed to these phonemes.

Chapter 2: Cross-linguistic Influence and First Language Attrition

Chapter 2 concerns cross-linguistic influence and L1 attrition. In section 2.1, we provide definitions of concepts related to the notion of phonetic CLI. CLI is there defined as any kind of effect that a speaker's language may have on another of his or her languages (Pavlenko, 2000). Pavlenko (2000) lists five types of CLI, the last of which is L1 attrition. L1 attrition is them defined as the non-pathological decline of L1 skills that the speaker previously possessed, linked to less or no use of an L1 (Köpke & Schmid, 2004; Köpke, 2019). At the phonetic level, L1 attrition refers to phonetic changes in L1 speech (cf. De Leeuw, 2019b) which, given the predictions of the SLM and SLM -r, occur as an assimilation or dissimilation. In L1 speech produced by a late bilingual, the segments and/or suprasegments either approximate in their phonetic properties to those of the segments and/or suprasegments of the L2 produced by a native speaker of the L2 (i.e, assimilation) or they move away from them while also moving away from the phonetic properties of the segments and/or suprasegments of the L1 produced by a native speaker of the L1 (i.e., dissimilation) (cf. De Leeuw, 2019b).

Section 2.2 provides a quick review of studies on the phonetic influence of L1 on L2. Based on the results of the presented studies, we suggest that (1) some Czech learners of French may have difficulties in perceiving and producing correctly some

French vowels, and (2) they might speak French using Czech accentuation rules, at least at the beginning of French acquisition (Duběda, 2009).

Section 2.3 provides a review of studies of the phonetic influence of L2 on L1. We propose to summarise these studies in the following five points:

- Very few studies compared the degree of phonetic CLI produced in different speech styles (tasks). Only Major (1992) found significantly more evident phonetic CLI in informal conversation than in formal speech styles.

- Many studies investigated English as L1 or L2, used reading of word-list for the elicitation task of L1 speech and focused on VOT of stops, or/and used FAR for perceptual examination of phonetic attrition. Few studies acted differently.

- Interestingly, a shift may also occur systematically by affecting the whole vocalic system. $F1$ seems to be more prone to being affected by phonetic CLI than $F2$.

- Few studies found dissimilation effects. One study found a CLI which might be understood as borrowing. It seems that some bilinguals may undergo the assimilation effect, while other bilinguals may undergo a dissimilation effect in the same phonetic feature.

- The phonetic L2 influence on L1 suprasegmentals was rarely examined acoustically. Moreover, at segmental level, the examined acoustic features in the studies of phonetic influence of L2 on L1 seems to be limited. They are mainly VOT, $F1$, $F2$, and $F3$.

In section 2.4, extralinguistic factors are defined as factors external to the language as a system, but more related to the bilingual as a person, which may contribute to phonetic CLI. With regard to LOR, Schmid (2011) suggests that the relationship between LOR and phonetic CLI is rarely significant when a study focuses on bilinguals with LOR above ten years, which seems to be confirmed by the results of studies on phonetic CLI. The results of the studies of Bergmann, Nota, Sprenger, and Schmid (2016); Dmitrieva, Jongman, and Sereno (2010); Lang and Davidson (2019); Kupske and Alves (2016) suggest that the link would exist when late bilinguals with a short LOR are included in the study. Furthermore, Bergmann et al. (2016); De Leeuw (2008) found a significant impact of L1 use on phonetic CLI and Major (1992) found an impact of L2 profeciency. Nevertheless, studying extralinguistic factors presents certain methodological difficulties which not all authors in the field of phonetic CLI face in the same way. The questionnaire proposed by Schmid (2002) for the collection of extralinguistic data has been used by some authors (see, e.g. De Leeuw, 2008). Although it can be considered an important methodological tool, we suggest that several problems in processing the data collected by this questionnaire can lead to difficult statistical choices. We mention, for example, the conversion of ordinal variables into numerical variables and the calculation of the mean from these numerical variables which, although it allows the data to be processed, is not an ideal choice from a statistical point of view (the approach used, e.g., in De Leeuw, 2008; Sůčková, 2020).

Chapter 3: Comparison of Czech and French phonetic systems

Chapter 3 consists of a comparison of the phonetic system of Czech with that of French. In section 3.1, notions such as language variety and norm are defined. As the CF lived mainly in Toulouse or its surroundings, we present the varieties of French that are most likely to be spoken in Toulouse to determine the varieties of French to which the CF might be exposed. The CF all lived in Bohemia before coming to France. For this reason we present in this section the Standard Czech widely spoken in Bohemia. Thus, it is determined that CF could be in contact mainly with three language varieties: Standard Czech, Standard French and Toulouse French.

The phonetic systems of these three varieties are compared in sections 3.2 and 3.3. The similarities and differences between these systems can be summarised as follows:

- Standard French vocalic system is richer and more complex in the degrees of aperture and anteriority than the Standard Czech vocalic system. Toulouse French vocalic system seems simpler than the one of Standard French as the differences between /e/ and /ɛ/, /a/ and /ɑ/, /o/ and /ɔ/, and /œ/ and /ø/ may be less respected in Toulouse French.

- Vowels' length is a phonological feature in Standard Czech but not in French. Nasal vowels do not exist in Czech but they exist in Standard French. Toulouse French seems not to contain a fully nasalised vowels. Diphthongal vowels exist in Czech but not in French.

- Czech consonant system is richer than the one of Standard French and Toulouse French, which are similar. /ŋ/, /ʔ/, /χ/, /ɣ/, /ɦ/, /c/, /ɟ/, /t͡ʃ/, /d͡ʒ/, /t͡s/, /d͡z/, /r̝/ and /r̝̊/ exist in Czech but not in French. By contrast, /ʁ/, /ɥ/ and /w/ exist in French but not in Czech. Any consonant in French cannot make a nucleus of the syllable while /r/ and /l/ can do it in Czech.

- Standard French and Toulouse French are more melodic language varieties than Standard Czech which is more monotonous. The most used cadences for non-conclusive pattern seems to be the more rising in French than in Czech. Concerning pitch range, mean $f0$ was shown to be higher in Standard French than in Standard Czech particularly in female production.

- To produce the stuck schwa in French, speakers add a schwa sound to the end of the word, and thus, they create an additional syllable of the word. Stuck schwa is often produced in Toulouse French, and hence, may have an impact on the intonation patterns of Toulouse French.

- Standard French is a language with right dominance while Standard Czech is a language with left dominance. Accentual phrases are ascending or bidirectional in French, while they are descending in Standard Czech. The primary stress is on the last syllable of accentual or intonational phrase in Standard French, and it may be on penultimate syllable in Toulouse French. In Standard Czech, it seems to be the second syllable because of its higher acoustic values.

- Standard French is syllable-timed language while the nature of Standard Czech as syllable-timed language is debated. The study showed that it is more probably situated somewhere between fully stressed-timed languages and syllable-timed languages.

In section 3.4, we compare hesitation marks in Czech and French. Studies on hesitation marks in Czech are rare, whereas hesitation in French has been studied in detail by, for example, Candea (2000). In both languages, pauses are very often filled by a vowel element. In Czech, the vowel element is usually separated from words by silences, whereas in French, the vowel element is usually added at the end of the word and is of a specific duration and intensity. It can be assumed that two types of stuck schwa can be produced, especially in Toulouse French, the first being an expression of language variety, the second being an expression of speaker hesitation. Duration seems to be a potential criterion for distinguishing the two types

Chapter 4: Research questions, design and significance

Chapter 4 presents research questions, design and significance. The general hypothesis of the thesis and the research questions are given in section 4.1. The general hypothesis emerges from the theoretical considerations presented in the previous chapters. Indeed, models of L2 speech perception and production (mainly SLM and SLM-r) and the results of studies on phonetic CLI both suggest that, when the phonetic systems of L1 and L2 spoken by a late bilingual are not identical, the phonetic influence of L2 on L1 can occur. Since Czech and French differ significantly in their phonetic systems, we propose the following general hypothesis: Phonetic CLI will occur in the L1 speech of CF. Phonetic CLI means here the influence of French on Czech of CF at phonetic level. From this general hypothesis three research questions arise:

- Is CF's L1 speech perceived by Czech monolinguals as less native-like because of the presence of the phonetic CLI?

- In which phonetic features of the CF's L1 speech does CLI occur and can it be revealed by acoustic measurements?

- How are extralinguistic factors related to phonetic CLI in the CF's L1 speech?

In Section 4.2, we outline the three studies that will allow to answer the three research questions (see fig. 1). The first consists of a perceptual experiment (hereafter perceptual test). The second (chapter 6) is an acoustic study. The third (chapter 7) concerns extralinguistic factors. These three studies are linked. The results obtained in the perceptual test help to determine the segments and suprasegments and their phonetic properties to be examined in the acoustic study. The results of the perceptual test and the acoustic study are used to create the variables indicating phonetic CLI, the relationship of which with the predictor variables is examined in the third study.

In section 4.3, significance of the research is highlighted. Indeed, the present thesis involves the study of a set of new elements that have not been studied in the
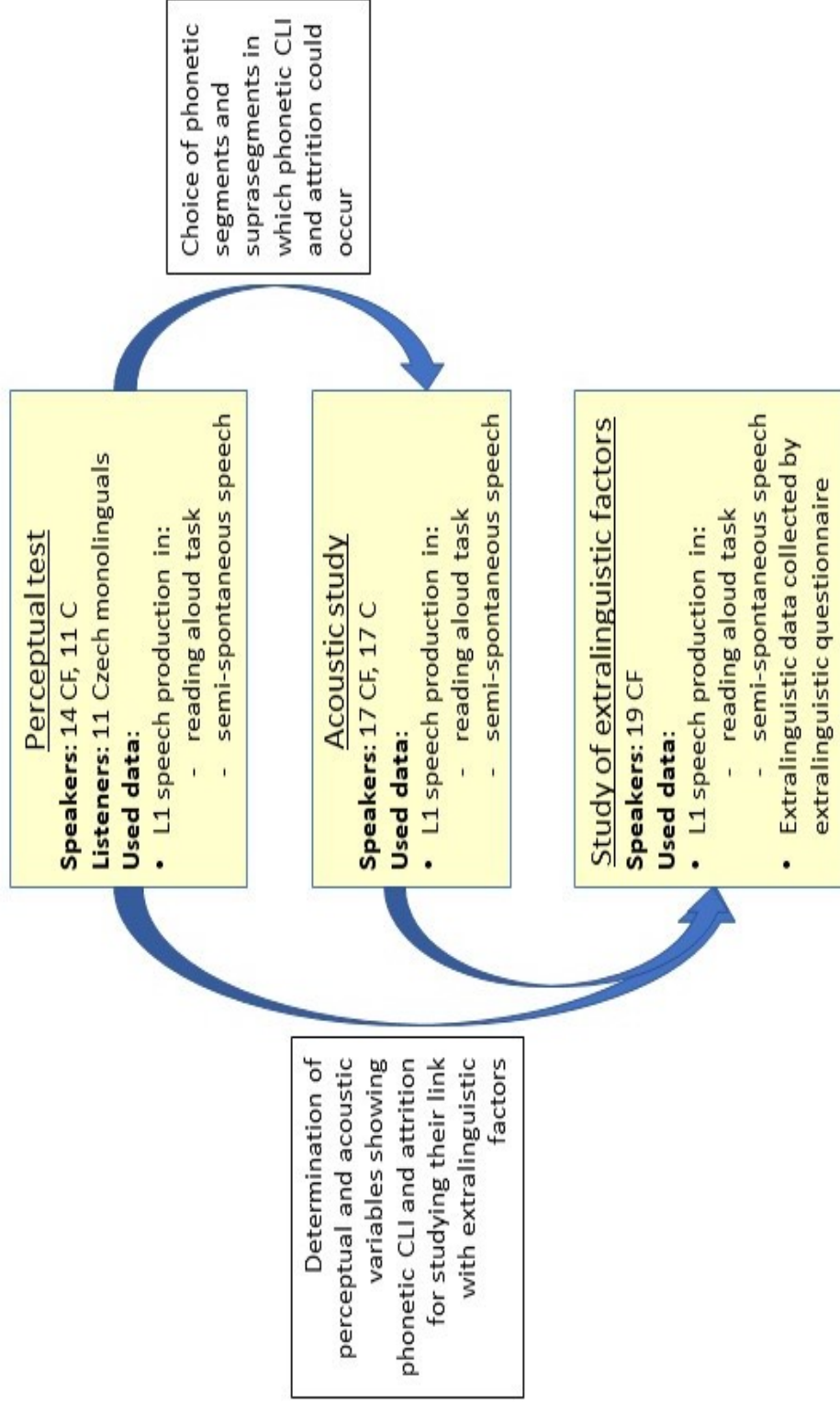
Perceptual test

Speakers: 14 CF, 11 C
Listeners: 11 Czech monolinguals
Used data:
- L1 speech production in:
  - reading aloud task
  - semi-spontaneous speech

Acoustic study

Speakers: 17 CF, 17 C
Used data:
- L1 speech production in:
  - reading aloud task
  - semi-spontaneous speech

Study of extralinguistic factors

Speakers: 19 CF
Used data:
- L1 speech production in:
  - reading aloud task
  - semi-spontaneous speech
- Extralinguistic data collected by extralinguistic questionnaire

Choice of phonetic segments and suprasegments in which phonetic CLI and attrition could occur

Determination of perceptual and acoustic variables showing phonetic CLI and attrition for studying their link with extralinguistic factors

Figure 1: Schema of research

Note: The yellow boxes indicates three studies of the thesis. The arrows and white boxes indicate links among them.

research field of phonetic CLI before. Focusing on Czech and French, an original language pair, allows studying phonetic CLI in segments and suprasegments rarely examined by authors such as /r/, fricatives and intonation, which are among the elements examined in my acoustic study. This allows to analyse the original features in comparison with those usually analysed in studies on phonetic CLI, such as HNR and spectral moments. Furthermore, in the acoustic study, we examine the stuck schwa, the typical phenomenon for Southern French, which has not yet been included in research on phonetic CLI. We also analyse phonetic CLI in two different production tasks: reading aloud and semi-spontaneous speech, which has not been done since the study of Major (1992). Finally, unlike the groups of late bilinguals frequently studied, the groups of my late bilinguals represent individuals who all live in the same geographical area without necessarily knowing each other.

Chapter 5: Perceptual test

This chapter presents the perceptual test by which we examined the perception of L1 speech of CF by Czech monolingual listeners. In Section 5.1, we propose three hypotheses for the perceptual test:

- CF's L1 speech will be perceived as less typically Czech sounding than monolingual Czechs' L1 speech by Czech monolingual listeners, due to the possible occurrence of a phonetic CLI in L1 speech of CF.

- CF's L1 production in reading aloud task will be perceived by Czech monolingual listeners as more typically Czech sounding than their L1 semi-spontaneous speech.

- Some phonetic features of segments and suprasegments which are not identical in Czech and in French will be mentioned by Czech listeners as less typically Czech sounding in CF's L1 speech.

Section 5.2 consists of the methodology. To create the perceptual test, speech stimuli were selected from recordings of L1 semi-spontaneous speech and L1 reading aloud task of 11 Czech monolinguals and 14 CF. The Czech monolinguals (hereafter C) were all native speakers of standard Czech and lived in Bohemia. For recording of semi-spontaneous speech, the speakers were asked to talk about their holidays, weekends, family, profession or other similar topics. For recording of reading aloud task, speakers were asked to read a short, simple text taken from a book by a famous Czech author. For the inclusion of distractors in the perceptual test, we recorded the reading of a native French speaker and the speech synthesizer. The speech synthesis represented two French speakers' voices. Both the native speaker and the synthesizer read a text that was written in such a way that they pronounced the segments as a monolingual Czech speaker as much as possible but read it with the prosody of French. The read text was identical in content to the recorded speech of C and CF. The perceptual test consisted of 77 speech stimuli.

The perceptual test was created as a multiple-choice experiment in Praat (Boersma & Weenink, 2019) and was administered to 17 listeners who were Czech students of phonetics at the Institute of Phonetics in Prague. The listeners were asked to indicate whether the stimulus they were listening to sounded "completely Czech" or

"completely French" on a 5-point scale (answer 1= "completely Czech", answer 5= "completely French"). They could listen to each stimulus five times. The stimuli were randomised and separated by a desensitisation beep. Every twenty stimuli, listeners were asked to take a short break, during which they could listen to a short song (about 30 seconds). The perceptual test was preceded by a training session in order to verify the understanding of the instruction. If listeners noticed unusual phenomena for the Czech, they were asked to write and comment them in an Excel sheet (only for answers 2 to 4).

The results are in Section 5.3. They were obtained by computing a linear mixed model and showed that the stimuli extracted from L1 semi-spontaneous speech of CF were perceived by the listeners as significantly less typically Czech than those extracted from the semi-spontaneous speech of C. Listeners mainly commented on the quality of vowels, velar and glottal fricative, /r/ and intonation in the stimuli they rated as neither typically Czech nor typically French, but in between.

Thus, the first hypothesis was confirmed only for the semi-spontaneous speech of CF but not for the reading aloud. The second hypothesis was fully confirmed and this result is therefore in agreement with the result of Major (1992). The third hypothesis was also confirmed as the comments made by the listeners on the stimuli concerned the phonetic properties of segments and suprasegments which are not identical in Czech and French. In view of the comments made by listeners in the perceptual test, we decided to acoustically analyse the spectral characteristics of vowels, velar and glottal fricatives, and /r/, the temporal characteristics of /r/ and intonation in non-conclusive intonational patterns in the acoustic study. We also decided to examine the stuck schwa as it is a specific phonetic feature for Southern French. Since phonetic CLI can be revealed when examined acoustically even if it was not during a perceptual experiment (cf. Sůčková, 2020), we decided to examine the phonetic features of the above-mentioned segments and suprasegments in the two production tasks.

Chapter 6: Acoustic study

Chapter 6 presents the acoustic study. In section 6.1, we propose two hypotheses for this study:

- Phonetic CLI will occur in some phonetic features of CF's vowels, /r/, /ɦ/, /x/, non-conclusive intonation patterns and stuck schwa if these features are not identical in Czech and French.

- The acoustic study will reveal more phonetic CLI in the CF's L1 semi-spontaneous speech production than in their L1 production in reading aloud task

In Section 6.2, we describe the speech corpus used for the acoustic study. For the acoustic study, we use the corpus consisting of the production of 17 C and 17 CF in L1 in both tasks, i.e. reading aloud and semi-spontaneous speech. All 17 CF lived in the Toulouse area. The 17 C all lived in Bohemia. The speakers of both groups spoke Standard Czech and were of similar age. The recordings of their speech were transcribed, annotated and segmented into sentences, words and phonemes in Praat. We used all the recordings for the acoustic analyses but excluded from the analysis foreign words and unpronounced or semi-pronounced phonemes by the speaker in

Table 1: Overview of phonetic CLI in CF's L1 production in reading aloud task

speech segment(s)/ suprasegment(s)	examined value(s)	phonetic CLI	effect
a	$F1$		
	$F2$		
aː	$F1$	yes-null, Lobanov, BDM	dissimilation
	$F2$		
ɛ	$F1$		
	$F2$	yes-Lobanov	dissimilation
ɛː	$F1$	yes-Lobanov	assimilation
	$F2$		
ɪ	$F1$		
	$F2$	yes-Lobanov	dissimilation
	$F3$	yes-Lobanov	dissimilation
iː	$F1$		
	$F2$		
	$F3$	yes-null	assimilation
o	$F1$		
u	$F1$	yes-Lobanov	dissimilation
	$F2$		
uː	$F1$		
	$F2$		
r	HNR		
	normalised duration	yes	assimilation
	spectral moments	yes	assimilation
	$F1$	yes-null, Lobanov	assimilation
	$F2$	yes-Lobanov	assimilation
	$F3$	yes-Lobanov	dissimilation
x	spectral moments	yes	dissimilation or other
non-conclusive intonational patterns	ratio of very high rising		
all stuck schwa	percent schwa		
stuck schwa of support	nb of occurrences		
stuck schwa of hesitation	nb of occurrences		

Note: Gray box=no significant result, null=significant result when examined non-normalised value, Lobanov=significant result when examined normalised values by the Lobanov method, BDM=significant result when examined normalised values by the Bark Difference Metric method, nb=number.

Table 2: Overview of phonetic CLI in CF's L1 semi-spontaneous speech

speech segment(s)/ suprasegment(s)	examined value(s)	phonetic CLI	effect
a	$F1$		
	$F2$		
aː	$F1$	yes-null	dissimilation
	$F2$		
ɛ	$F1$	yes-Lobanov	assimilation
	$F2$		
ɛː	$F1$	yes-Lobanov	assimilation
	$F2$	yes-BDM	assimilation
ɪ	$F1$		
	$F2$	yes-null, BDM	assimilation
	$F3$	yes-BDM	dissimilation
iː	$F1$		
	$F2$	yes-null	assimilation
	$F3$	yes-null, Lobanov	assimilation
o	$F1$		
u	$F1$		
	$F2$		
uː	$F1$		
	$F2$		
r	HNR		
	normalised duration	yes	dissimilation
	spectral moments	yes	assimilation
	$F1$		
	$F2$		
	$F3$		
x	spectral moments	yes	dissimilation or other
ɦ	spectral moments	yes	dissimilation or other
ɦ–x	distance in spectral moments	yes	dissimilation or other
non-conclusive intonation patterns	ratio of very high rising	yes	assimilation
all stuck schwa	percent schwa	yes	other
stuck schwa of support	nb of occurrences	yes	other
stuck schwa of hesitation	nb of occurrences	yes	other

Note: Gray box=no significant result, null=significant result when examined non-normalised value, Lobanov=significant result when examined normalised values by the Lobanov method, BDM=significant result when examined normalised values by the Bark Difference Metric method, nb=number.

the recordings (as it may be the case of the vowel /o/ in the word "protože" in Czech).

Sections 6.3 to 6.7 present the acoustic analyses of the different segments and suprasegments. The phonetic CLI is examined by comparing the spectral characteristics of vowels, rhotics, and velar and glottal fricative in CF's speech with those in C's speech. We also compare the temporal characteristics of rhotics, the $f0$ in non-conclusive intonational patterns and the occurrence of stuck schwas in CF's speech with those in C's speech. Several acoustic properties were studied: the first three formants, spectral moments, duration, HNR and $f0$ contours. Each section begins in general with a comparison of the acoustic properties of the studied segment or suprasegment in Czech and French, followed by predictions and methodology. For statistical analyses, linear mixed models were often used. Note that for the analysis of vowel formants, we have chosen to do three types of analysis: an analysis of the values of the non-normalised formants, an analysis of the formants normalised by Lobanov method and an analysis of the formants normalised by Bark Difference Metric method. For the study of the formants of /r/, only the non-normalized values and the values normalized by the Lobanov method were analysed. Significant results for each acoustic property studied were interpreted as either the effect of assimilation or dissimilation. The tables 1 and 2 gives the results.

In Section 6.8, we discuss the results of our acoustic study. CLI occurred in CF's speech in some acoustic properties that are not identical in French and Czech. Thus, the first hypothesis was confirmed. Concerning the second hypothesis, it was confirmed if we take all our results into account and do not look at them separately. We also demonstrated, by examining the results in the light of the phonetic differences between Czech and French, that all found phonetic CLI in the L1 speech of CF are interpretable as the influence of French on Czech, with the exception of our result concerning /ɦ/ and /x/. The acoustic properties of /ɦ/ and /x/ were significantly different in the production of C and CF, but it is less certain that this is due to the influence of French on Czech /ɦ/ and /x/. CLI has generally occurred as an assimilation or dissimilation effect. The result concerning the stuck schwa can be considered as a borrowing of a feature from the L2 incorporated into the L1 of CF. Interestingly, our results showed that assimilation and dissimilation effects can coexist in the phoneme. This finding was at odds with what SLM, PAM and SLM-r can predict, and so we proposed a slight modification in the conception of the effect of assimilation and dissimilation and their link to phonetic categories in a speaker's phonetic space.

Chapter 7: Extralinguistic factors

Chapter 7 focuses mainly on the relationship between the phonetic CLI found in CF's speech and four predictor variables, i.e., *LOR*, *Proficiency in French*, *Use of Czech*, and *Preferred identity* of the speaker namely his/her preference for the Czech or French culture, country and language. CLI is described by the "acoustic indicator variables" which are obtained from the results of our acoustic study and by the "perceptual indicator variable" which is obtained from the results of our perceptual test. In section 7.1, we make the following four hypotheses:

- As the CF cover a large LOR range (from 0,17 to 28,25 years) and the low LOR

values are included, the higher CF's *LOR* will be related to more phonetic CLI in the indicator variables.

- Lower amount of *Use of Czech* of CF will not be related to more phonetic CLI in the acoustic indicator variables. Contrarily, a lower amount of *Use of Czech* of CF will be related to more phonetic CLI in the perceptual indicator variable.

- Higher *Proficiency in French* will be related to more phonetic CLI in indicator variables.

- Higher value in *Preferred identity*, meaning more preference for French culture, language and country will be related to more phonetic CLI in indicator variables.

Section 7.2 presents the methodology. The extralinguistic data was collected from the 19 CF after the recording of their speech by the extralinguistic questionnaire containing 41 questions and a language self-evaluation. Predictive variables were created from the collected data. The variable *Use of Czech* was created by 7 questions asking how often CF use Czech with partners, children, other family members, friends, at work, during studies, in church, clubs or other organisations (possible answers: 'always', 'often', 'sometimes', 'rarely' and 'never'). The variable *Preferred identity* was created by three questions in which CF indicated their preference for Czech or French culture, language and country. The variable *Proficiency in French* was created by the language self-evaluation in which CF indicated whether they can do the given skill in understanding or speaking French with no difficulty or not at all. Since the data collected to constitute these three predictor variables were ordinal unlike LOR, a numerical variable, we decided to divide the CF into subgroups using k-means in R to avoid the statistical methodological error mentioned above and observable, for example, in the studies of De Leeuw (2008); ? (?). We also established a general portrait of CF from the observation of extralinguistic data and also examined correlations between indicator variables.

Section 7.3 reports the results. The general portrait of CF was drawn by dividing them into two categories according to the reason of their stay in France, job, partner's L1, number of children and degree of education. The first category was mainly composed of university students who were without a French partner and without children, while CF in the second category were mainly living with a French partner, had children and a profession. The analysis of the correlations between the indicator variables showed that few of them are strongly correlated. Finally, analysis of the relationships between the indicator and predictor variables yielded only two significant results: CF with higher *Proficiency in French* showed less phonetic CLI in *kurtosis* of /ɦ/ in semi-spontaneous speech and in *COG* of /x/ in reading aloud than CF with lower *Proficiency in French*.

In section 7.4 we discuss the results. The first hypothesis was not confirmed as well as the fourth one since no significant relationship between LOR and phonetic CLI and no relationship between LOR and *Preferred Identity* was found. The second hypothesis was confirmed only in the sense that we did not find a significant link between the acoustic variables and *Use of Czech* and the third hypothesis was confirmed by our results concerning *kurtosis* of /ɦ/ in semi-spontaneous speech and in *COG* of /x/ in reading aloud task. However, we stress that, although the results

of significant and non-significant relationships between predictor and indicator variables may be interesting, they should not be generalized due to the methodological problems of extralinguistic data analysis. Furthermore, our results could be due to the choice of analysing the relationships using multiple linear regression models with all four predictor variables in the models, which is not statistically ideal given the number of our CF.

Chapter 8: General discussion

Chapter 8 consists of the general discussion of our results. In section 8.1, a brief summary of all our results is given followed by a discussion of them. We first ask whether the explanations of the results of the phonetic CLI studies proposed by the authors might not provide other possible explanations of our results. Indeed, besides the possible explanation of our results concerning the perceptual test by the claim of SLM, PAM-L2 and SLM-r that L1 and L2 sounds interact in a common phonetic space, following Sancier and Fowler (1997), we can propose a less common explanation, i.e., speakers are willing to imitate the sound of the surrounding language. This might also explain why we found significant CLI in the semi-spontaneous speech of CF in the perceptual test but not in their reading aloud task. Indeed, the CF would have involuntarily imitated the French language to which they were exposed much more in spontaneous speech than in read speech. Another interesting consideration is that of dissimilation, which has been little found in studies of phonetic CLI but was found in our thesis. Linking the considerations of Chang (2010) about the effect of dissimilation with our results from the analysis of extralinguistic factors, we could suggest that CF with a lower *Proficiency in French* perceive the Czech /ɦ/ and /x/ and French rhotic as not being very different sounds because a large dissimilation occurs between these sounds in their phonetic space, whereas CF with higher *Profecincy in French* perceive Czech /ɦ/ and /x/ and French rhotic as very dissimilar because little or no dissimilation is likely to occur between these sounds in their phonetic space. Moreover, the acoustic study confirmed for some phonetic features the perception that listeners had in the perceptual test and that they communicated in their comments. This seems to be particularly the case for the stuck schwa and the non-conclusive intonational patterns. On the other hand, at the segmental level, listeners' comments on some phonetic features of the segments were in agreement with the results of their acoustic analysis, while others were not. We also discuss whether it is possible to argue that phonetic CLI occurs more in informal speech styles than in formal speech styles generally. Our perceptual test results suggest this. Our results from the acoustic study also suggest this, with the exception of $F1$ of /r/, where a greater phonetic CLI was found in the CF's reading aloud task than in their semi-spontaneous speech. Thus, we suggest that phonetic CLI occurs more in informal speech styles than in formal speech styles when speech is examined as a whole and not just in a small number of its segments.

In Section 8.2, we discuss the contributions of the present thesis. We suggest that its major theoretical contribution is the proposal of the evolution of the L2 phoneme categorised as L1 in the following three stages:
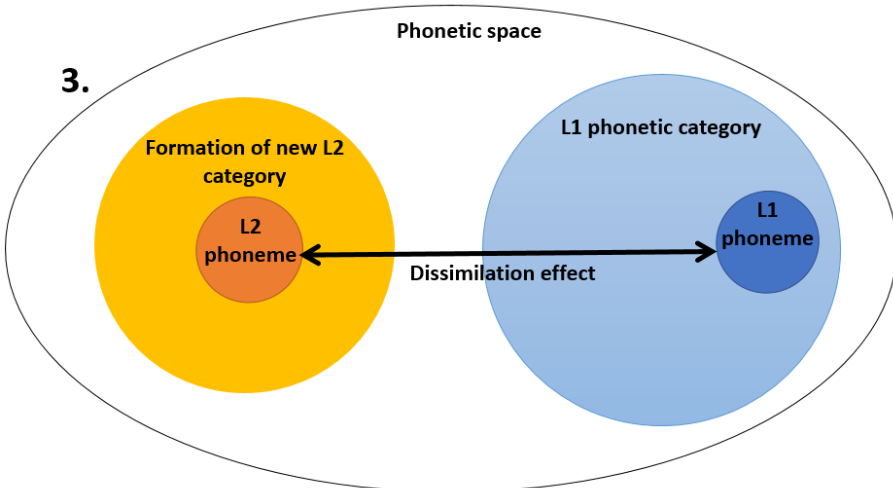
1. An L2 phoneme is classified into L1 phonetic category because a new L2 category was not established. The only effect which may occur is the assimilation
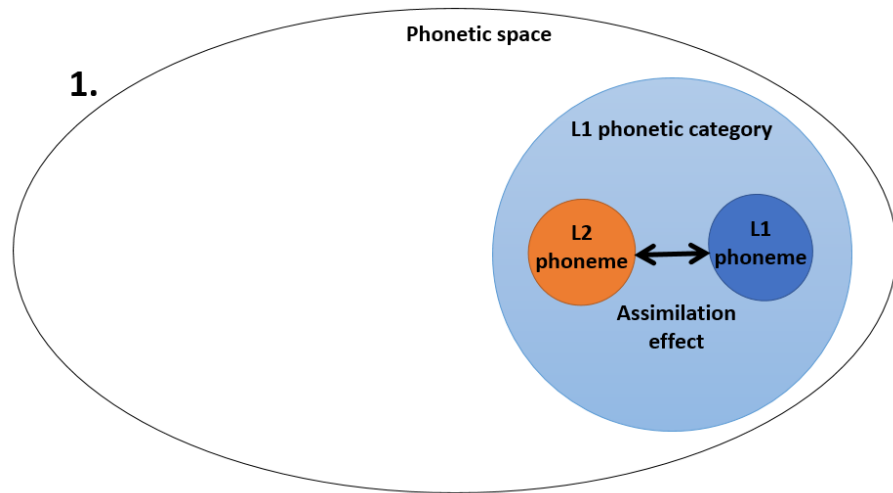
(a) Stage 1.
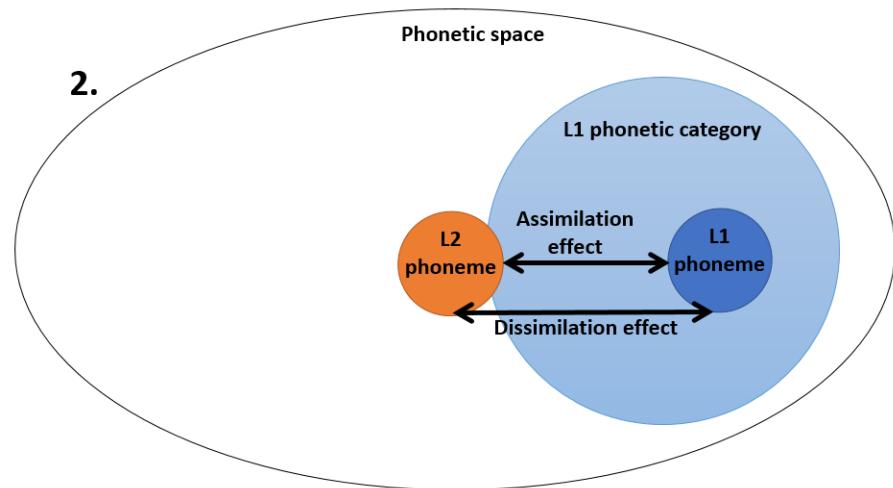
(b) Stage 2.

(c) Stage 3.

Figure 2: Envisaged 3-stages development of L2 sound classified into L1 category in the beginning of L2 learning.

Note: Proposed with respect to our results. L1 phoneme in dark blue, L1 category in light blue. L2 phoneme in dark orange, L2 category which is established in light orange. Phonetic space is a big white ellipse.

effect (see fig. 2a).

2. With growing L2 input, L2 experience and dependently on other factors mentioned by SLM-r, the L2 phoneme starts to be perceived as sufficiently different for being classified in a separated phonetic category. The L2 phoneme starts to move away from the L1 phoneme, thus removed from the L1 phonetic category. Before the L2 phoneme has completely moved away, there is a period when a part of of the L2 phoneme is still inside the L1 phonetic category, though another part is already outside the category. The two parts of the phoneme represent its different phonetic features. In the part inside the L1 phonetic category, there will occur the assimilation effect. In the part outside the L1 phonetic category, there will occur the dissimilation effect. The consideration of the dissimilation effect's occurrence suppose that the dissimilation effect may also occur between a part of L2 phoneme outside the L1 category (i.e., in a phonetic space without being in the category) and the L1 phoneme in that category, and not only between separated L1 and L2 categories (fig. 2b).

3. With growing L2 input, L2 experience and depending on other factors mentioned by SLM-r, the L2 phoneme will completely leave the L1 category and will become the beginning of the new L2 category. Only the dissimilation effect between the L2 phoneme and L1 phoneme which is in the L1 category may occur in this stage (fig. 2c).

As a methodological contribution of the thesis, we mention that it has shown that the analysis of HNR and spectral moments can be relevant for studying phonetic CLI as well as the analysis of intonation using k-means which can also be used to deal with the ordinal variables obtained from data collection with the extralinguistic questionnaire.

In section 8.3, we highlight the limitations of this thesis and future directions. The first limitation consists in interpretation of our results of the acoustic study as dissimilation or assimilation without having examined the L2 phonemes of the CF acoustically. Therefore, a future direction that emerges from this thesis is to acoustically examine the L2 of CF. Secondly, we mention that due to the number of statistical models used for the vowel analysis and the analysis of extralinguistic factors, a first order error could occur. Our results should therefore not be taken as absolute. We also mention that the recordings for a longitudinal study on phonetic CLI in L1 speech of CF were collected, and we point out that this study as well as any longitudinal study on phonetic CLI could verify the accuracy of the envisaged 3-stages development of an L2 phoneme classified into L1 category by us.

In conclusion, this thesis demonstrates that phonetic CLI occurs in L1 speech of CF and provides a proposal of 3-stages development of an L2 phoneme classified into L1 category made by us to models of L2 speech production and perception.