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Abstract

An increasing number of studies has already investigated the phonetic first language attrition and cross-linguistic influence in the L1 speech of late bilinguals. Nevertheless, none of these studies has yet to examine the phonetic first language attrition and cross-linguistic influence in the L1 speech of late Czech-French bilinguals, although Czech and French languages represent interesting phonetic differences both at segmental and suprasegmental level. This thesis aims to fill this gap. Based on the models of L2 speech production and perception, results of studies on phonetic cross-linguistic influence and phonetic differences between Czech and French language, the hypothesis of this thesis predicts that phonetic cross-linguistic influence will occur in L1 speech of late Czech-French bilinguals. This hypothesis is tested in two studies by comparing the L1 speech production in a reading aloud task and semi-spontaneous speech of late Czech-French bilinguals with that of Czech monolinguals. The first study consists of a perception experiment that investigated if the L1 speech of 14 late Czech-French bilinguals may be perceived as less typically Czech sounding compared to that of 11 Czech monolinguals by Czech monolingual listeners. The second study is composed of acoustic analyses comparing the acoustic proprieties of 17 late Czech-French bilinguals' vowels, /r/, /ɦ/, /x/ with those of 17 Czech monolinguals. The properties of non-conclusive intonation patterns and the use of final schwa is also compared. Following this, the relationship between phonetic cross-linguistic influence found in these two studies, the frequency of use of Czech by the bilinguals, their length of residence in France, proficiency in French and their preferences for either Czech or French country culture and language is analysed. The tested hypothesis was predominantly confirmed. The results of the perception experiment showed that the bilinguals' semi-spontaneous speech was perceived as significantly less typically Czech sounding compared to that of the monolinguals by the Czech monolinguals listeners. The results of the acoustic analyses suggest that phonetic cross-linguistic influence occurred in spectral characteristics of several of the bilinguals' vowels, the spectral characteristics of their /r/, /ɦ/ and /x/, the temporal characteristics of their /r/ and in their non-conclusive intonation patterns as well as in their use of final schwa. The results also showed that the phonetic cross-linguistic influence examined by the acoustic analyses, in general, occurred more in the bilinguals' semi-spontaneous speech than in their production in the reading aloud task. Further, the phonetic cross-linguistic influence found in /ɦ/ in semi-spontaneous speech and in /x/ in the reading aloud task was significantly linked to the proficiency in French of the late bilinguals. Interestingly, a certain number of our results suggests that the dissimilation and assimilation effects may coexist in the same L1 phoneme of a late bilingual, a consideration which is not included in the models of L2 speech production and perception. Therefore, this thesis presents a proposal of a three-stage development of L2 phoneme classified in the L1 category.

Résumé

Un nombre croissant d'études a déjà examiné l'attrition phonétique et l'influence translinguistique dans la parole en L1 de bilingues tardifs. Néanmoins, aucune étude ne les a encore examinées dans la parole en L1 de bilingues tardifs tchèque-français, bien que le tchèque et le français présentent des différences phonétiques intéressantes. Cette thèse vise à combler cette lacune. En s'appuyant sur les modèles de production et de perception de la parole en L2, les résultats des études sur l'influence phonétique translinguistique et les différences phonétiques entre le tchèque et le français, nous faisons l'hypothèse que l'influence phonétique translinguistique se produira dans la parole en L1 des bilingues tardifs tchèque-français. L'hypothèse est testée dans deux études en comparant la production de la parole dans une tâche de lecture à voix haute et la parole semi-spontanée en L1 de bilingues tardifs tchèque-français avec celle de monolingues tchèques. La première étude, une expérience de perception, vise à déterminer si la parole en L1 de 14 bilingues tardifs tchèque-français peut être perçue comme étant moins typiquement tchèque que celle de 11 monolingues tchèques par des auditeurs monolingues tchèques. La deuxième étude, les analyses acoustiques, compare les propriétés acoustiques des voyelles de 17 bilingues tardifs tchèque-français, de leur /r/, /ɦ/, /x/ avec les propriétés acoustiques de ces segments de 17 monolingues tchèques. Les propriétés des patrons intonatifs non-conclusifs et l'usage du schwa final sont également comparés. Les relations entre l'influence phonétique translinguistique trouvée dans ces deux études et la fréquence d'usage du tchèque par les bilingues, leur durée de résidence en France, leur compétence en français et leurs préférences pour la culture, la langue ou pays tchèque ou français sont analysées. L'hypothèse testée a été majoritairement confirmée. Les résultats de la première étude ont montré que la parole semi-spontanée des bilingues a été perçue comme étant moins typiquement tchèque que celle des monolingues par les auditeurs. Les résultats de la deuxième étude suggèrent que l'influence phonétique translinguistique s'est produite dans les caractéristiques spectrales de plusieurs voyelles des bilingues, de leur /r/, /ɦ/ et /x/, dans les caractéristiques temporelles de leur /r/ et dans leurs patrons intonatifs non-conclusifs ainsi que dans leur usage du schwa final. Les résultats ont également montré que l'influence phonétique translinguistique s'est en général produite davantage dans la parole semi-spontanée des bilingues que dans leur production dans la tâche de lecture. De plus, l'influence phonétique translinguistique trouvée dans /ɦ/ dans la parole semi-spontanée et dans /x/ dans la tâche de lecture était significativement liée à la compétence en français des bilingues. En outre, certains de nos résultats suggèrent que les effets de dissimilation et d'assimilation peuvent coexister dans le même phonème de la L1 d'un bilingue tardif, ce qui est une considération non incluse dans les modèles de production et de perception de la parole en L2. Ainsi, une proposition de développement en trois étapes du phonème de la L2 classé dans la catégorie de la L1 est présentée.

Abstrakt

Rostoucí počet studií se zabývá fonetickou atricí prvního jazyka a translingvistickým vlivem v řeči pozdně bilingvních mluvčích. Tyto studie však dosud nezkoumaly fonetickou atrici a translingvistický vliv v české řeči pozdně bilingvních česko-francouzských mluvčích, ačkoli český a francouzský jazyk představují zajímavé fonetické rozdíly, jak na segmentální, tak na suprasegmentální rovině. Tato práce si klade za cíl zaplnit tuto mezeru. Na základě modelů produkce a percepce řeči druhého jazyka, výsledků studií o fonetickém translingvistickém vlivu a fonetických rozdílech mezi českým a francouzským jazykem, je předpovídáno, že fonetický translingvistický vliv nastane v české řeči pozdně bilingvních česko-francouzských mluvčích. Tato hypotéza je testována ve dvou studiích, ve kterých porovnáme českou řeč pozdně česko-francouzských bilingvních mluvčích s řecí českých monolingvních mluvčích ve čteném projevu a jejich polospontánní řeč. První studie spočívá v percepčním experimentu, kterým jsme zkoumali, zda může být česká řeč 14 pozdně česko-francouzských bilingvních mluvčích vnímána jako méně typicky česky znějící ve srovnání s řečí 11 českých monolingvních mluvčích českými monolingvními posluchači. Druhá studie se skládá z akustických analýz, kterými srovnáváme akustické vlastnosti samohlásek, /r/, /ɦ/, /x/ v řeči 17 pozdně česko-francouzských bilingvních mluvčích s těmito segmenty v řeči 17 českých monolingvních mluvčích. Rovněž jsou porovnány vlastnosti neukončujících melodémů a užívání finálního šva. V návaznosti na to je analyzován vztah mezi fonetickým translingvistickým vlivem zjištěným v těchto dvou studiích a frekvencí užívání češtiny, délkou pobytu ve Francii, znalostí francouzštiny bilingvních mluvčích a jejich preferencí pro českou nebo francouzskou kulturu, zemi a jazyk. Testovaná hypotéza byla převážně potvrzena. Výsledky percepčního experimentu ukázaly, že polospontánní řeč bilingvních mluvčích byla vnímána jako výrazně méně typicky česky znějící ve srovnání s řečí monolingvních mluvčích českými posluchači. Výsledky akustických analýz naznačují, že k fonetickému translingvistickému vlivu došlo ve spektrálních charakteristikách několika samohlásek, /r/, /ɦ/, /x/ a temporalních charakteristikách /r/ v řeči bilingvních mluvčích. Ke translingvistickému vlivu také došlo v jejich nekončících melodémech a finálním šva. Výsledky také ukázaly, že fonetický translingvistický vliv zkoumaný akustickými analýzami se obecně vyskytoval spíše ve polospontánní řeči bilingvních mluvčích než v jejich čteném projevu. Fonetický translingvistický vliv nalezený v /ɦ/ v polospontánní řeči a v /x/ v čteném projevu byl významně ovlivněn znalostí francouzštiny bilingvních mluvčích. Je zajímavé, že určitý počet našich výsledků naznačuje, že disimilace a asimilace mohou existovat ve stejném fonému prvního jazyka pozdně bilingvního mluvčího, což není zahrnuto v modelech produkce a percepce řeči druhého jazyka. Tato práce proto představuje návrh třístupňového vývoje fonému druhého jazyka zařazeného do fonetické kategorie prvního jazyka.

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List of Acronyms

CF	Late Czech-French bilingual speakers
C	Czech monolingual speakers
L1	First language
L2	Second language
CLI	Cross-linguistic influence
LOR	Length of residence
AoA	Age of onset of acquisition of an L2
NLM	Native Language Magnet Theory
SLM	Speech Learning Model
SLM-r	Revised Speech Learning Model
PAM	Perceptual Assimilation Model
PAM-L2	Perceptual Assimilation Model-L2
L2LP	Second Language Linguistic Perception model
LILt	L2 intonation learning theory
FAR	Foreign accent rating
VOT	Voice Onset Time
$F1$	First formant
$F2$	Second formant
$F3$	Third formant
$F4$	Fourth formant
HNR	Harmonicity
COG	Center Of Gravity
$f0$	Fundamental frequency
ST	Semitone
Hz	Hertz
ms	millisecond
s	second
SD	Standard deviation

Part I

Introduction

This research project began from my personal experiences with cross-linguistic influence (hereafter CLI). My native language is Czech (hereafter L1) but at 16, I started to learn French as a second language (hereafter L2). After grammar school, I left my mother country, the Czech Republic, and my Czech family in Prague to study at a French university in Toulouse. When returning home after a year spent living in France my father was amused by the sound of my speech when I was speaking Czech, he imitated my accent. Through my university studies, I discovered that such phenomenon, which my father perceived in my Czech speech, is referred, in the academic world, as CLI or, in some extreme cases, as first language attrition. In addition, I learnt that speakers, similar to me, who began learning L2 after the age of six and use L2 in their everyday life are called late bilinguals (see chapter 2). As my father was amused by the sound of my Czech speech, we may speak about CLI occurring at phonetic level.

Studying CLI and first language attrition has social significance. The number of people living in any foreign country where their L1 is not a national language is considerable as well as the increasing number of daily users of L2 and advanced L2 learners (cf. De Leeuw, 2008; Sůčková, 2020). Even though 'CLI' and 'language attrition' may be an unknown term to the majority of people, the topic of 'losing one's mother tongue' appears in hundreds of hits, including newspaper articles, blogs, and websites online (cf. Sůčková, 2020). Besides, many people can observe CLI and first language attrition from their family members or public personalities living abroad (cf. Sůčková, 2020). From this point of view, CLI and first language attrition are no longer unknown concepts but a phenomenon that many experience or are aware of, through personal contacts or general knowledge. Furthermore, studying CLI and first language attrition may help us to better understand the strategies of L1 maintenance[1], and anxieties and worries which could arise as consequences of CLI and first language attrition (see, e.g., Serra et al., 2015).

Studying influences between the languages of a speaker also allows us to reconsider terms such as native speech, native speaker, norm, and loss. For example, in the domain of second language acquisition, Hyltenstam and Abrahamsson (2008) studied the discrepancy between the perception of native speaker status, i.e., whether the speaker is perceived as native by natives, and actual native speaker performance, i.e., the acoustic and articulatory correspondence of native speaker speech to the 'norm'. For these authors, despite the missing of a clear definition of the 'norm', it is the latter that determines whether one is really a native speaker. Taking this into consideration, we may, for instance, speak about the 'loss of native speaker status' for the 14 late bilinguals not evaluated as native-like in De Leeuw's (2008) study, accompanied or not by the 'loss of native speaker performance'. In that study,

[1] See https://theconversation.com/expats-beware-losing-confidence-in-your-mother-tongue-could-cost-you-a-job-92243, accessed 11/02/2021, published 29/03/2018.

De Leeuw (2008) focused on L1 speech of native German speakers who moved to either Anglophone Canada or the Dutch Netherlands, in adolescence or adulthood, and stayed there from 9 to 58 years.

An increasing number of the studies have already investigated the phonetic influence of L2 on L1 in the L1 speech of late bilinguals. They were generally based on acoustic measurements (cf., e.g., Major, 1992; Mayr, Price, & Mennen, 2012; Mennen, 2004) as well as perceptual experiments (see, e.g., De Leeuw, 2008; Sancier & Fowler, 1997). A use of acoustic measurements for studying CLI is particularly interesting as it allows us to capture very slight changes in L1 of late bilinguals. Perception experiments are also important when studying phonetic influence of L2 on L1. They may be used in order to determine the design and focus of the acoustic analysis (see, e.g., De Leeuw, 2008). In addition, some of the studies of phonetic influence of L2 on L1 analysed the link between the found CLI and factors such as the bilinguals' L1 and L2 use, L2 proficiency, use of code-switching and length of residence in L2 country (hereafter LOR).

The studies of phonetic influence of L2 on L1 mainly focused on bilinguals whose L1 or L2 was English. A small number of other possible pairs of languages were examined in these studies, but the pair of Czech as L1 and French as L2 has yet to be discussed, despite these two languages presenting interesting phonetic differences both at segmental and suprasegmental level. Given this omission, several questions arise: What is the phonetic influence of L2 on L1 when the Czech is the L1 and French is the L2 of the speakers? May this phonetic influence be perceived by native Czechs living in Czech Republic as it was by my father? Which particular segments and suprasegments of Czech speech may undergo this phonetic influence? How does this phonetic influence link to the speaker's use of languages, proficiency in these languages and other factors? This thesis will assess these questions by investigating the Czech speech of late Czech-French bilinguals (hereafter – CF[2]), i.e., native Czech speakers who started to learn French (their L2) and moved to France in adolescence or adulthood, and who use French in their everyday lives in France.

I will use the term phonetic CLI primarily for designating the phonetic influence of L2 on L1, including phonetic first language attrition and phonetic drift (see chapter 2 for their definitions)[3]. When speaking about the phonetic influence of L1 on L2 (i.e., the forward phonetic CLI, see subsection 2.1.2), I will specify it. The factors such as a speaker's use of languages, proficiency in these languages and other similar factors will be designated by the term extralinguistic factors when speaking about

[2]The abbreviation 'CF' refers to the group of late Czech-French bilinguals. I will use the form 'CF's' when referring to possessions of late Czech-French bilinguals, e.g., CF's L1 speech. When speaking about one late Czech-French bilingual or more, the abbreviation will be preceded by the number or undefined article.

[3]Note that I will use the abbreviation CLI to designate the influence of L2 on L1 (singular) as well as the phonetic changes in L1 due to this influence (plural). Therefore, a form 'CLIs' will not be employed in this thesis.

them in general (see chapter 2 for their definition). I will use the term predictor variables when designating only the extralinguistic factors, which are examined in this thesis (see chapter 7).

This thesis is organised as follows:

- **Chapter 1** presents how the L2 speech segments and intonation in terms of their production and perception are acquired by L2 learners according to the models, hypotheses and theories. At the end of the chapter, I shall discuss the significance of these models, hypotheses and theories for the present thesis, and determine the model, which will be used for establishing the hypotheses.

- **Chapter 2** brings the definitions of first language attrition, CLI, bilingualism, phonetic attrition and drift. Following this, the studies of phonetic influence of L1 on L2 as well as the one of phonetic influence of L2 on L1 are presented. The term extralinguistic factors, and the studies which examine the link between them and phonetic CLI, will be discussed. Finally, the significance of these findings for the present thesis will be stated.

- **Chapter 3** commences by the determination of the language varieties of French and Czech which CF might be exposed to. Then, the phonetic systems of these language varieties are compared. Detailed acoustic differences are not the focus of the chapter as they will be presented for the selected phonetic features in chapter 6.

- In **chapter 4**, the theoretical considerations of the three previous chapters allow us to determine the main hypothesis for this research. Chapter 4 also provides three research questions, presents research design, and demonstrates the utility of the thesis.

- **Chapter 5** consists of the perception experiment in which the perception by native Czech listeners of Czech speech, produced by CF, is compared with that of native Czech monolingual speakers living in the Czech Republic (hereafter C[4]). The experiment had two goals. Firstly, I wished to examine whether the CF's L1 speech may be perceived as less typically Czech sounding compared to the one of C. Secondly, to obtain a list of phonetic features that might be affected by phonetic CLI in CF's L1 speech.

- The results of the perception experiment determined the phonetic features to be examined by acoustic measurements in **chapter 6**. In this chapter, these phonetic features are analysed in CF's L1 speech and compared with the one

[4]The abbreviation 'C' refers to the group of Czech monolinguals. I will use the form 'C's' when referring to possessions of Czech monolinguals, e.g., C's L1 speech. When speaking about one Czech monolingual or more, the abbreviation will be preceded by the number or undefined article.

in C's L1 speech. Thus, chapter 6 presents the phonetic CLI found in CF's L1 vowels, /r/, /ɦ/, /x/, intonation and a phenomenon called by as stuck schwa which refers to the schwa stuck to the end of the word (for more detail about this phenomenon, see subsection 3.3.2).

- The final experimental chapter, **chapter 7**, focuses on the relationship of the found phonetic CLI with CF's use of Czech, proficiency in French, LOR and preference for Czech or French country, language and culture.
- **Chapter 8** provides a general discussion, relating all the findings presented in the three experimental chapters. The limitations of the thesis are also considered in addition to its theoretical and methodological contributions. Chapter 8 also provides suggestions for future research arising from the thesis.

Part II

Theoretical background

Chapter 1

L2 speech production and perception

The present chapter concerns L2 speech production and perception, more precisely, how speakers learn an L2 at phonetic level. After a brief historical review of the hypotheses related to the L2 speech production and perception, the models of L2 speech production and perception are presented. The significance of all present theoretical considerations for studying phonetic CLI are concluded at the end of the chapter.

1.1 A brief historical overview of hypotheses of L2 speech production and perception

The history of research on L2 speech production and perception can broadly be divided into two periods. The period before the formulation of Interlanguage hypothesis (i.e., before 1972) and the period after 1972 (cf. Eckman, 2012). During the first period, L2 learners' errors were usually explained in terms of the difference between the L1 and the L2, with the view that the L1 influences the acquisition[1] of the L2. The researchers from this period focused, among other things, on the explanation and establishment of a hierarchy of difficulties in L2 acquisition and the prediction of learners' errors in L2. For example, Lado (1957), who formulated the basis of the Contrastive Analysis Hypothesis, claimed that the greatest challenge for the learner, at the level of pronunciation, is the ability to re-categorise two or more L1 allophones (i.e., the phonetic variants of a phoneme) into separated phonemic L2 categories. To illustrate, Lado (1957) gives an example of native Spanish learners of English. For them, sounds [d] and [ð] are allophones of the Spanish /d/, but as

[1] Note that in the present chapter, the term acquisition and learning are used as synonyms. In general, we use the term which is used by the author(s) in question. Therefore, for instance, as Mennen (2015) proposes the theory for L2 intonation 'learning', we use the term 'learning' when speaking about her model of L2 intonation, even if, we are conscious that someone may suppose that the term 'acquisition' might be more suitable when speaking about L2 intonation as the L2 intonation is more likely attained subconsciously.

they are distinct phonemes in English, the learners need to divide them into different phonemic categories in English. Lado (1957) based the Contrastive Analysis Hypothesis on structural linguistics and behavioral psychology (cf. Fouillet, 2014). Structural linguistics considers language as a set of structures while behavioural psychology views learning as conditioning (stimulation – response – reinforcement). Stockwell and Bowen (1965) adjusted the Contrastive Analysis Hypothesis, formulating eight degrees of difficulty of L2 acquisition depending on whether the L2 target sound to acquire was phonemic, allophonic, or absent in L1 language. The authors predicted that to acquire an L2 allophone absent in the L1 would be the most phonologically difficult. The difficulty of acquisition of allophones was empirically confirmed by Hammerly (1982) whose study showed that, among the six problematic areas of L2 pronunciation (namely stopping the use of a L1 allophone, acquisition an L2 phoneme that is new to the learner, stopping the use of a L1 phoneme, different distribution or function of L1 allophones in comparison to L2, different distribution or function of L1 phonemes in comparison to L2), the top three concerned allophones. However, certain studies, such as the Johannsson' s (1973) study, contested the Contrastive Analysis Hypothesis. Johannsson (1973) focused on twenty L2 learners of Swedish from eight different native-language backgrounds. The results showed that although some of the errors were predictable using the Contrastive Analysis Hypothesis, others were explainable in terms of ease of articulation meaning that phonemes acquired later in childhood by native Swedish children were also difficult to acquire for the learners.

As a consequence, Eckman (1977) revisited the Contrastive Analysis Hypothesis and proposed the Markedness Differential Hypothesis. Markedness refers to the idea that the binary opposition between certain linguistic representations (e.g., voiced-voiceless) is not the opposition of simply polar opposite elements but the opposition between one element with a more significant feature than the other. Put differently, an unmarked element is a simpler, more basic, and more natural element than the 'marked' one. The concept of markedness was introduced by Trubetzkoy (1939) who is known for a description of phenomenon called phonological deafness in L2 and foundations of phonology. According to Markedness Differential Hypothesis, more significant the opposition between an L1 and L2 element, the more difficult the acquisition of the L2 element is.

As stated above, the boundary between the two periods may be represented by the Interlanguage Hypothesis, which is often credited to Selinker (1972). The Interlanguage Hypothesis is based on the constructivist theoretical framework and consists of the idea that, during L2 acquisition, L2 learners create an intermediate language variant approaching the L2. This variant, termed 'Interlanguage', by the author, refers to the mental system developed by L2 learners that allows them to produce and understand L2 utterances. For instance, concerning the grammar (in the sens of phonological rules of a language) the interlanguage grammar is composed of phonological rules partly different from L2 grammar and partly different from L1 grammar, as the construction of interlanguage is supposed to be based on L1 transfer and L2 input. However, the studies of Eckman (1981) and Altenberg and Vago (1987) showed that some interlanguage phonological rules result from neither L1 nor L2. This result suggests that interlanguage grammar is constrained by general linguistic principles which interact with L1 phonology. These constraining principles concern distinctive features, rule types, underlying representations, derivations, the prosodic hierarchy, feature geometry, and metrical grids. Thus, interlanguage grammar is constrained by the same general principles as the L1 grammar.

Concerning the post-interlanguage hypothesis period, three main hypotheses merit mentioning. The first is linked to the connectionism Optimality Theory, introduced by Prince and Smolensky (1993), it is based on the vision of the language as a system of conflicting forces. It means that the language is represented as a system of constraints and not as a system of rules. Several universal constraints exist in each language, though the ranking of these universal constraints differs between languages. Therefore, among the stages of language acquisition, one can be considered as a modification of the ranking of these universal constraints. Thus, Optimality Theory postulates that the ranking of the universal constraints is responsible for the realisation of the variants of a language, whether phonologically or otherwise.

The final two hypotheses discussed here are the Structural Conformity Hypothesis and the Similarity Differential Rate Hypothesis. The main prediction of the former, introduced by Eckman (1991), is that the universal generalisations that hold for primary languages also hold for interlanguages. The latter was developed by Major and Kim (1996) and claims that "L2 sounds dissimilar to L1 sounds are initially difficult" to acquire but "performance on these sounds improves quickly", however, the "performance on L2 sounds similar to L1 sounds stays the same or progressively worsens" (Broselow & Kang, 2013, p. 530).

The previous paragraphs show that, for predicting an L2 sound's acquisition, the hypotheses before the Interlanguage hypothesis mainly considered the differences between L1 and L2 sounds, whereas Structural Conformity Hypothesis and Optimality Theory, i.e., two hypotheses after the Interlanguage hypothesis take into consideration the existence of universal constraints. Finally, the Similarity Differential Rate Hypothesis, is close to pre-interlanguage hypotheses but proposes new predictions mainly concerning the evolution of the performance in L2 sound pronunciation.

1.2 Models of L2 speech production and perception

With the formulation of the last post-interlanguage hypotheses, the development of several models of L2 speech segments production and perception began. In this section I describe the Native Language Magnet Theory, the Perceptual Assimilation Model, the Speech Learning Model, the Perceptual Assimilation Model-L2, the Second Language Linguistic Perception model and the Revised Speech Learning Model. We will see that these not only provide a better and more complete and complex understanding of L2 speech production and perception than the hypotheses explored above but that they also sometimes point to the limits of the hypotheses.

1.2.1 Native Language Magnet Theory

Introduced by Kuhl (1991, 1992, 1994), and expanded by Kuhl et al. (2008), Native Language Magnet Theory (hereafter NLM) focuses primarily on L1 speech perception. However, it also demonstrates the difficulties in L2 perception. NLM is explained with the example of 6 month old infants, living in English speaking environment, who have heard hundreds of thousands of examples of the /ɪ/ in the words 'daddy', 'mommy' and others. The infants subconsciously create their sound map for /ɪ/ in their brain, i.e., the perfect examples of /ɪ/ with a target area around this sound. When this map for /ɪ/ is created, infants are able to pick out the /ɪ/ from the other sounds they hear (cf. Jensen, 2011). Consequently, a growing infant becomes able to recognise and categorise L1 sounds into a sound map as explained by Kuhl et al. (2008).

In theoretical terms, according to NLM, phonetic categories are organised around a prototype (the best example perceptually of /ɪ/ in the previous illustration) which has an effect of perceptual attraction on the sounds that surround it in the acoustic space. The prototype is the result of experience with the L1 and evolves progressively as the child is maturing. Therefore, changes in perception are caused by the L1 input to which the child is exposed. The prototype 'attracts' similar sounds and, by doing so, reduces the perceptual distance between itself and other sounds within this category.

NLM described three stages in the development of perception linked to the child maturation. In the first stage, infants younger than 6 months are able to differentiate all the sounds of human speech. This ability comes from their general auditory processing mechanisms (Kuhl, 1991). In the second stage (defined as infants aged between 6 months and 1 year), phonetic representations are created on the basis of the distributional properties of L1. With increasing linguistic experience, there is an increase in perceptual similarity between members of the same sounds' category, and at the same time, an increase in perceptual sensitivity on the boundaries between different sounds' categories (Kuhl, 1993). Finally, at the third stage (children older than 1 year), the 'attractor' effect of the prototype leads to the perfect perception of L1 contrasts, i.e., the listener can categorise very well an encountered sound into one of his/her L1 sound categories. At this stage, L2 sounds that are similar to L1 sounds can be perceived as typical examples of an L1 prototype of one L1 category.

Due to this, the listener's perception of contrasts between L2 sounds similar to L1 sounds is reduced. Consequently, one may suppose that the acquisition of L2 sounds similar to L1 sounds will be particularly difficult for the learner as, according to the NLM, the learner may not perceive the contrast between these sounds.

This supposition about the acquisition of L2 sounds similar to L1 sounds is contrary to the prediction of the Markedness Differential Hypothesis that the lower the markedness (i.e., greater similarity) between an L2 and L1 sound the less difficult the acquisition of the L2 sound is. However, this supposition of the NLM seems to confirm the prediction of the Contrastive Analysis Hypothesis concerning the phonological difficulty of L2 learner to divide two or more L1 allophones into different L2 categories. In addition, the NLM seems to move towards ideas from Similarity Differential Rate Hypothesis which predict stagnation or worsening of performance in pronunciation of L2 sounds which are similar to L1 sounds (see section 1.1 above).

The idea of the 'attractor' principle in the NLM is based on Dynamic Systems Theory (van Geert, 1991) and Chaos and Complexity Theory. The Dynamic Systems Theory borrows from the Chaos and Complexity Theory, utilising the 'system' which is seen as complex, dynamic and non-linear (cf. Dewaele, 2002) and claims that in the process of continual adaptation each new state depends on the previous state. In addition, this process is governed by attractor states which constitute states towards which the system irreversibly evolves if there is no disturbance (cf. De Bot, Lowie, & Verspoor, 2007). Nevertheless, there are also states in which the system cannot stabilise, not even temporarily termed repellent states. The evolution from one state to another is accompanied by a high variability which is seen as a main characteristic of development.

1.2.2 Perceptual Assimilation Model

Put forward by Best (1994, 1995), the Perceptual Assimilation Model (henceforth PAM) concerns L2 phonological perception from the beginnings of L2 acquisition. It focuses on the perception of new L2 phones by novice learners, and is based on the notion of 'phonetic contrast' between L2 phones and L1 phonemes. According to this model, the adult L2 learners perceive "information about their gestural similarities" to L1 phonemes in the new L2 phones and thus, discriminate the L2 phones in terms of these similarities (Best, 1994, p. 14). If there is not a significant difference between the articulatory gestures of L2 and L1 elements they assimilate the L2 phonological elements into L1 elements. The more dramatic the difference, the harder the assimilation will be.

PAM proposes six assimilation types, i.e., possible configurations of association between L2 phones and L1 phonemes (see Figure 1.1). At first, Best (1994) distinguished four basic assimilation types. They are:

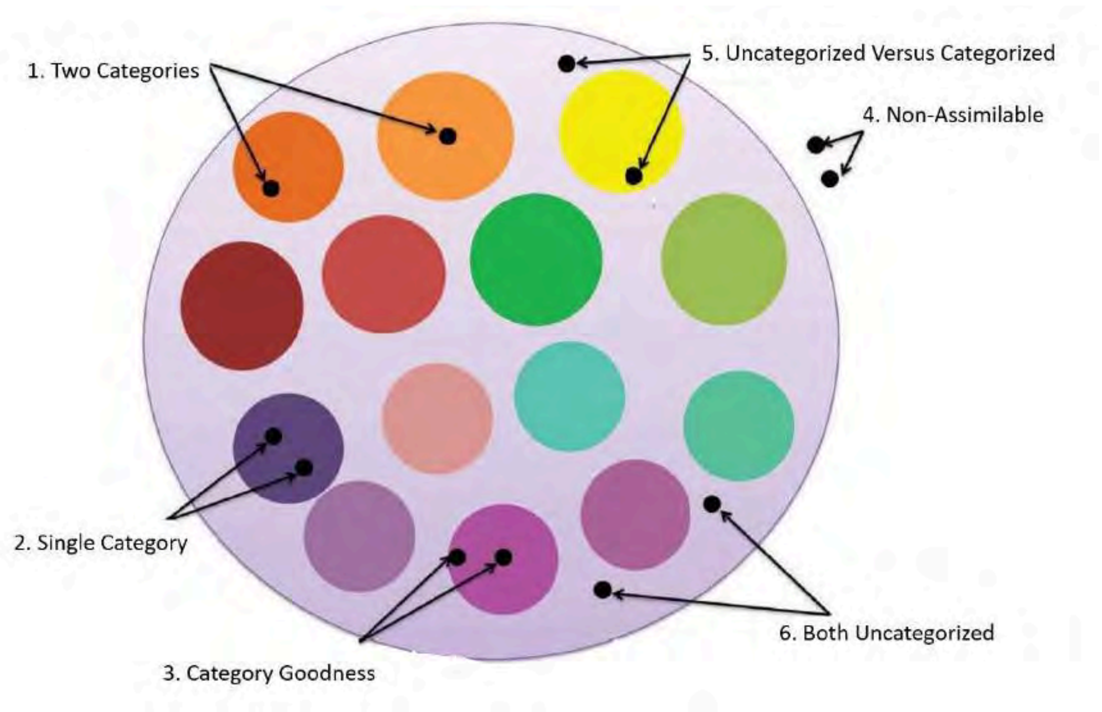


Figure 1.1: The six assimilation types proposed by PAM.

Note: Taken from Solier (2019, p. 73). The large circle indicates L1 phonological space, the small coloured circles represent the L1 phonetic categories (i.e., categories containing L1 phonemes) and the small black point are the individual L2 phones (cf. Solier, 2019).

- **Two Category type**. This refers to two L2 phones of an L2 contrast which are gesturally similar to two L1 phonemes, and therefore, are assimilated into two different L1 phonetic categories. For instance, the retroflex stop /ɖ/ and the voiced dental stop /d̪ʰ/ in Hindi represent an L2 contrast for a native English learner of Hindi. The learner will assimilate retroflex stop /ɖ/ to English [d], while /d̪ʰ/ will be assimilated to the learner's English [ð]. The discrimination of two L2 phones will be excellent and they will be perceived as good examples of L1 phonemes.

- **Single-Category type**. This occurs when two L2 phones are assimilated equally "well (or poorly)" into a single L1 phonetic category (Best, 1994, p. 14). The L2 phones can be equally discrepant or similar to an L1 phoneme. For example, in the case of an English native speaker learning Thompson Salish, both the Thompson Salish ejective velar /k'/ and uvular /q'/ will be assimilated to the English [kʰ], even if both will be perceived as strange or lacking agreement with English [kʰ] by the learner.

- **Category Goodness type**. It consists of two L2 phones assimilated into one L1 phonetic category. However, one L2 phone shares more properties with the L1 phoneme than the other. The example of an English native learner of Zulu demonstrates this. Both the Zulu voiceless aspirated velar /k/ and ejective velar /k'/ will be assimilated to the learner's English [k^h], but voiceless aspirated velar /k/ will be perceived as essentially identical to the learner's English [k^h] while ejective velar /k'/ will be perceived as quite different from it.

- **Non-Assimilable type**. It refers to two L2 phones, which cannot be assimilated into any L1 phonetic category nor to the L1 phonological space, as they are perceived as very different in their gestural properties from every L1 phoneme. Consequently, they will be perceived as nonspeech sounds. For example, Best (1994) speaks about the suction-produced click consonants of southern Bantu languages, which cannot be assimilated well to any English phonetic categories.

In 1995, Best added two others types to these:

- **Uncategorised Versus Categorised type**. It consists in the configuration of two L2 sounds where one is assimilated into one L1 phonetic category, while the other cannot be assimilated into any L1 phonetic category, even if it is situated in L1 phonological space. Discrimination is predicted to be very good.

- **Both Uncategorised type**. It refers to two L2 sounds which cannot be assimilated into any L1 phonetic category even if they both fall inside L1 phonological space. The discrimination will vary between poor and very good according to their proximity to each other and with L1 phonetic categories.

Generally speaking, we may observe that PAM brings a much more complex description of L2 sounds' perception than the hypotheses presented in section 1.1. In the light of PAM, one also may suppose that performance on L2 sounds similar to L1 sounds remains the same or progressively worsens as predicted by Broselow and Kang (2013). This is due to one of the pair of L2 sounds being classified into the L1 phoneme category even if it shares few properties with the L1 phoneme (Category Goodness type).

1.2.3 Speech Learning Model

Developed by Flege (1988); Flege and Fletcher (1992); Flege (1995), the Speech Learning Model (hereafter SLM) concerns L2 speech production. According to this model, the phonetic categories of L1 and L2 exist in a common phonetic space[2]. SLM claims that when L2 learners encounter an L2 sound, they classify it as 'identical', 'similar' or 'new' with regards to an L1 phoneme. In 1987, Flege considers that

[2]Initially, the SLM used the term 'phonological space'. However, Flege and Bohn (2021) wished to correct this term which might lead to a confusion and instead use 'phonetic space'. Due to this, I will use the term, 'phonetic space' when speaking about SLM or SLM-r.

'similar' and 'identical' L2 sounds are different from their easily identifiable counterpart in L1, but this difference is not highly significant, whereas 'new' L2 phones "have no counterpart in the L1" (Flege, 1987, p. 48). However, in 1992, Flege and Fletcher re-examined the classification of the L2 sounds as 'identical', 'similar', and 'new', and he concluded that "no principled method existed for distinguishing 'new' from 'similar' L2 sounds" (Flege & Bohn, 2021, p. 9). Therefore, the SLM from Flege (1995) does not contain classification of an L2 sound as 'new', 'similar' or 'identical'. Nevertheless, this classification of an L2 sound is used again in Flege (1997) as depending on three factors: (1) an L2 sound's transcription in International Phonetic Alphabet (IPA), (2) its acoustic proximity with an L1 phoneme, and (3) its perceptual similarity with an L1 phoneme. According to Flege (1997), L2 learners classify an L2 sound as 'identical' when it is represented by the same IPA symbol as an L1 phoneme, its acoustic properties are not significantly different from that of an L1 phoneme, and it is not perceptibly different from an L1 phoneme. L2 learners classify an L2 sound as 'similar' when it is represented by the same IPA symbol as an L1 phoneme but it differs from L1 phoneme perceptually and acoustically. Finally, the L2 sound's classification as a 'new' sound by the learner means that the L2 sound's IPA symbol is different from the L1 phoneme's IPA symbol and the L2 sound is acoustically and perceptibly different from the L1 phoneme. Interestingly, the SLM was the most frequently used model for establishing predictions about phonetic CLI in the studies over-viewed in chapter 2, (section 2.3). Even if some authors may still use the terms 'identical', 'similar', and 'new' when speaking about an L2 sound, they often did not use the rules given in Flege (1997) for their classification and for establishing the hypotheses (see, e.g., Lang & Davidson, 2019; De Leeuw, Tusha, & Schmid, 2018; Stoehr, Benders, van Hell, & Fikkert, 2017).

Because of the classification of an L2 sound by an L2 learner, as explained in the previous paragraph, the L2 learners have three possibilities when they encounter an L2 sound. They either establish a new phonetic category for the new L2 sound, they modify an already existing L1 category and add the new L2 sound within, or they classify the new L2 sound in an already existing L1 category without modifying it (Flege, 1995). According to the SLM, this learning mechanism is available throughout the life of a speaker, and the L1 sounds continue to develop continually in their categories under the influence of all sounds that the speaker encounters.

In 1995, Flege formulated seven hypotheses based on the results of several studies (e.g., Flege, 1993; Flege, Munro, & MacKay, 1995; Sheldon & Strange, 1982; Takagi, 1993). According to the first hypothesis, the perceptual link between L1 and L2 sounds is "at a position-sensitive allophonic level, rather than at a more abstract phonemic level" (Flege, 1995, p. 239). Therefore, the accuracy of production of an L2 sound can vary in terms of the position of the phone in the word, its phonological context, and the speaker's familiarity with the word. The second hypothesis predicts an establishment of "a new phonetic category" for an L2 sound phonetically different from the closest L1 sound "if bilinguals discern at least some of the phonetic differences" between these two sounds (Flege, 1995, p. 239). According to the third hypothesis, the probability of the establishment of a new category increases with greater perceived phonetic difference between these two sounds. In the fourth hypothesis, it is stated that the accuracy of perceived phonetic difference between these two sounds decreases when the age of onset for L2 learning is later. The fifth hypothesis predicts that, in some cases, the establishment of a new category for new L2 sounds may be 'blocked' by the mechanism of classification. It states that when the learners meet an L2 sound, they attempt to classify it in an equivalent L1 category wherever possible. Consequently, if they classify the L2 sound as 'similar' and integrate it into their original L1 phonetic category, they will produce it as an L1 sound belonging to this category and its production will be less accurate. Nevertheless, erroneous L2 'similar' sound association to L1 category can be repaired with increasing experience in L2 and new category for this L2 sound can be established. According to the sixth hypothesis, a learners' newly established phonetic category for L2 sounds may be different from that of native speakers of L2 when (1) this learners' "category is 'deflected' away from an L1 category" with the goal "to maintain phonetic contrast" or when (2) the learners' "representation is based on different features, or feature weights" (Flege, 1995, p. 239). According to the last hypothesis, L2 sounds will finally be produced with the properties specified by the characteristics of its phonetic category meaning that if a newly established L2 category corresponds in its characteristics to that of native speakers of an L2, the learner will produce the L2 sound accurately.

As underlined for example by Elvin, Williams, and Escudero (2016), contrary to PAM (see above, subsection 1.2.2), which does not involve any explicit claim about the link between L2 speech production and perception, the SLM clearly affirms that the L2 learners' ability to produce L2 sounds accurately largely depends on how they perceive L2 sounds in relation to the L1 sounds. Similarly to PAM (namely the Category Goodness type), the SLM predicts the greatest difficulty not in the acquisition of L2 sounds that are 'different' but in the acquisition of L2 sounds that are 'similar' because of their classification in the same L1 category (cf. Elvin et al., 2016). Consequently, we may conclude that, on this point, SLM is inconsistent with Markedness Differential Hypothesis predicting easy acquisition of less marked L2 structures, i.e., more similar L2 forms to the one of L1. However, the SLM facilitates understanding of Similarity Differential Rate Hypothesis, which claims that performance on L2 sounds dissimilar to L1 sounds improve quickly while the performance on L2 sounds similar to L1 sounds remains the same or worsens. Finally, SLM supposes that L2-L1 interference exists if the L2 and L1 sounds are classified into the same category but also when a new category is established for L2 sounds because, in that situation, the L2 learner makes an effort to maintain the difference between the new L2 category and an L1 category. We may consider that in this sense, the SLM shares, at least partly, the idea of Interlanguage hypothesis, meaning the creation of an intermediate between L1 and L2 as L1 sounds influences L2 sounds and vice versa (see section 1.1 for the different hypotheses).

1.2.4 Perceptual Assimilation Model-L2

As an extension of PAM, the Perceptual Assimilation Model-L2 (PAM-L2) was developed by Best and Tyler (2007) through the merging of the findings of studies about PAM and SLM. In comparison to the SLM and PAM, the PAM-L2 provides certain new ideas and concepts, that SLM and PAM did not explore. Furthermore, the PAM-L2 considers the influence of L2 learners' knowledge level in L2 on their accuracy in perception of L2 sounds. Contrary to PAM, PAM-L2 focuses more on L2 learners than L2 beginners or L2 naive listeners.

PAM-L2 brings three main points to the SLM and PAM. The first point concerns the importance of gesture in L2 speech perception. It considers the L2 sounds to be gestural events that may be assimilated to L1 phonemes due to their gestural dimension. Thus, according to PAM-L2, the gesture dimension of L2 sounds forms the basis for judgments of its cross-linguistic similarity, and, hence, plays an essential role in L2 sounds discrimination and L2 sounds perceptual assimilation. Nevertheless, L2 sounds' acoustic properties are not essential for perceptual assimilation according to this model.

The second point concerns the attention paid to the phonological aspect of L2 and L1 sounds in perceptual assimilation. PAM-L2 claims that the contrasts between L1 and L2 phonology are essential to perceptual learning. Best and Tyler (2007) state that perceptual assimilation occurs when L2 learners identify L1 and L2 sounds as functionally equivalent and, thus, phonologically interchangeable. The authors give the French /χ/ as an example (realised as a voiceless uvular fricative), which is phonetically interchangeable and only slightly similar to the English liquid /ɾ/, "yet English L2 learners of French tend to equate the lexical-functional category /r/ across the two languages" (Best & Tyler, 2007, p. 28), because even if there are phonetic differences between these two sounds, they phonologically play the same role. The authors add that these French and English rhotics correspond graphically to the same letter, 'r', which is a fact that contributes to this assimilation. However, they also add that, L2 knowledge of learners of the L2 phonetics and phonology impact how L1 and L2 sounds are related to one another across two languages and in the phonological space of L2 learners.

The third point concerns the investigation of the combination of three L2 sounds levels: the gestural, phonetic and phonological level. PAM-L2 states that all three levels contribute to perceptual assimilation. They can interact with each other and, consequently, have a combined influence on the L2 discrimination of learners. Nevertheless, depending on the context (e.g., practice of individual sounds, acquisition of new vocabulary, learning of orthography...) or the goals of learners, they can also influence the learners' discrimination separately.

Best and Tyler (2007) provide four types of L1 and L2 sounds assimilation already described in PAM (Best, 1994, 1995), but improved in PAM-L2. These are four possible alignments of L1 and L2 sounds, i.e., four possibilities of how two L2 sounds can be assimilated into L1 phoneme(s) in terms of their similarity with L1 phoneme(s) and between each other (Table 1.1). Another two possible alignments, summarized in Table 1.2, are provided by PAM (Best, 1994, 1995), though they are not described in detail by Best and Tyler (2007).

The degree of predicted accuracy of discrimination of the contrast between the two L2 sounds for L2 adult learners varies with the type of alignment as shown in tables 1.1 and 1.2. An excellent discrimination (shown in very light grey) is predicted for the Non-Assimilable type when the two L2 sounds are integrated into two new established L2 categories or never incorporated into L2 learner's phonological space and for Two Categories type. Very good discrimination (light grey) is predicted for the Uncategorised Versus Categorised type while just good discrimination (grey colour) is predicted for the Category Goodness type, Both Uncategorised type when two L2 sounds are integrated into two new established categories, and for the Non-Assimilable type when two L2 sounds are integrated into one new established category. Discrimination is expected to be difficult in the Single Category type and Both Uncategorised type (dark grey colour) when, in the Both Uncategorised type, the two L2 sounds are integrated into the same new established L2 category (cf. Best, 1994; Strange & Shafer, 2008; Solier, 2019).

As underlined for example by Elvin et al. (2016, p. 3), contrary to PAM, which does not provide any explicit claim about the link between L2 speech production and perception, and similarly to SLM, PAM-2 assumes that, as L2 learners detect articulatory information in the perceived speech, "a common articulatory metric is shared between perception and production". The comparison of PAM-L2 with SLM allowed us to observe that PAM-L2 does not consider the acoustic properties of the sounds or its IPA symbol as decisive information according to whom the L2 learner discerns the sounds similarities. PAM-L2 is more focused on the gestural and phonological dimensions of the L2 sounds. In PAM-L2, the possibility of splitting a new L2 category into two new established L2 categories in the Both Uncategorised type and the possibility of establishment of new categories in the Single Category type with improving L2 knowledge (see Table 1.1) shares with the Interlanguage hypothesis the vision of L2 learning as an establishment of an intermediate language state evolving with improving L2 knowledge. Contrary to the hypotheses reviewed in section 1.1, focusing generally on the difficulties caused by contrasts or similarities

Table 1.1: Four types of alignment according to PAM-L2.

Type of alignment	Name in PAM	Assimilation to an L1 phoneme	Integration into an L1 category
Two L2 sounds not assimilated into the same L1 phoneme	Uncategorized Versus Categorized	One L2 sound is assimilated into one L1 phoneme at a phonetic and/ or phonological level while the other is not.	An L2 sound similar to an L1 phoneme at the phonetic level is integrated into an L1 category phonetically and phonologically. An L2 sound dissimilar from the L1 phoneme phonetically is integrated into the L1 category only phonologically.
Two L2 sounds assimilated into the same L1 phoneme with the different degree of fit	Category Goodness	Two L2 sounds are assimilated into the same L1 phoneme: One is assimilated phonologically while the other is assimilated phonetically and phonologically.	More similar L2 sound is integrated into a L1 category. Less similar L2 sound may be integrated into its category; it depends on a degree of fit.
Two L2 sounds assimilated into the same L1 phoneme with the same degree of fit	Single Category	Two L2 sounds are assimilated into the same L1 phoneme phonologically and phonetically.	Both sounds are integrated into the same L1 category, but it can change with increasing learners' L2 knowledge. The new categories can be established.
Two L2 sounds very different from the closest L1 phoneme	Both Uncategorized	Neither of both L2 sounds is perceptually assimilated into an L1 phoneme.	Two new L2 categories are established if both L2 sounds are too different from the L1 category and between themselves. Both L2 sounds are integrated into the same L2 new category if they are close to each other. With L2 learning, this category may split into two L2 categories.

Note: The colour of cells in the fourth column indicates the predicted accuracy of discrimination of contrasts between two L2 sounds. Darkest grey=the most difficult discrimination, lightest grey=excellent discrimination. To take into consideration with table 1.2. The first column indicates the type of alignment, second gives its name according to PAM, third indicates how and if the L2 sounds are assimilated to L1 phoneme(s), fourth explains how and if L2 sounds can be integrated into an L1 category/categories or into a new L2 category/categories. According to Strange and Shafer (2008).

Table 1.2: Two other types of alignment according to PAM.

<table>
<tr><th>Type of alignment</th><th>Name in PAM</th><th>Assimilation to an L1 phoneme</th><th>Integration into an L1 category</th></tr>
<tr><td>Two L2 sounds assimilated into the two L1 phonemes</td><td>Two Categories</td><td>Two L2 sounds are assimilated into two different L1 phonemes.</td><td>Two L2 sounds are integrated into two different L1 categories.</td></tr>
<tr><td rowspan="2">Two L2 sounds non-assimilable into any L1 phoneme</td><td rowspan="2">Non-Assimilable</td><td rowspan="2">Two L2 sounds are so different from any known speech sound that they are perceived as non-speech.</td><td>Two L2 sounds are integrated into one new L2 category.</td></tr>
<tr><td>Two L2 sounds are integrated into two new L2 categories or they will never be incorporated in L2 learners' phonological space.</td></tr>
</table>

Note: The colour of the cells in the fourth column indicates the predicted accuracy of discrimination of contrasts between two L2 sounds. Darkest grey=difficult discrimination, lightest grey=excellent discrimination. To take into consideration with table 1.1. The columns as in table 1.1. According to Strange and Shafer (2008).

between L2 and L1 sounds, PAM and PAM-L2 pay more attention to the difficulty in discrimination of two L2 sounds.

1.2.5 Second Language Linguistic Perception model

Second Language Linguistic Perception model (hereafter L2LP) was introduced by Escudero (2005), developed and revised by Escudero (2009); Van Leussen and Escudero (2015). It is inspired by Stochastic Optimality Theory (Boersma, 1998), and Optimality theory (Prince & Smolensky, 1993), and is the most recent model of L2 speech perception. L2LP explains L2 perception and lexicalisation, i.e., how a word is integrated into the L2 learner's mental lexicon.

As explained by Escudero (2005, p. 4), L2LP consists of "five theoretical ingredients" explicitly predicting, linguistically explaining, and phonetically or phonologically describing the perception of an L2 sound. L2LP consider three states of the acquisition process in L2 sound perception, i.e., initial, developmental, and end, to which correspond ingredients 2, 3, and 5. Thus, L2LP model concerns the L1 speakers when they started to learn an L2, and the way in L2 learning they made for achieving a final stage of L2 learning.

Figure 1.2 shows the five ingredients of L2LP model as in Escudero (2005). Ingredient 1 is related to *Optimal perception hypothesis*, according to which, the L1 speakers have a perception grammar formed by the acoustic properties of their

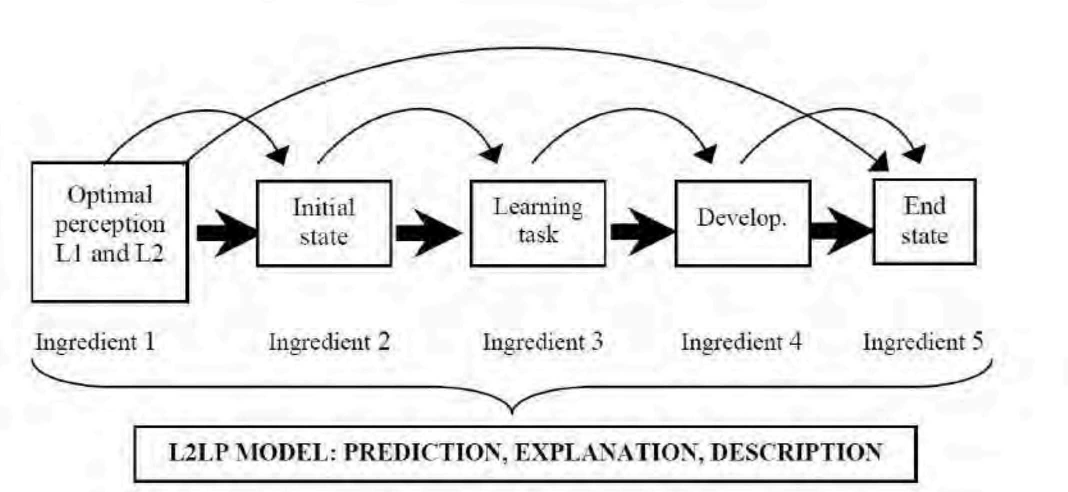


Figure 1.2: L2LP theoretical ingredients.

Note: Develop.=Development. Taken from Escudero (2005, p. 95)

production of L1 sounds categories (Escudero, 2009). Consequently, L1 speakers who just started learning an L2 will initially perceive all L2 sounds in a manner similar to the production of these same sounds in their L1 environment (Escudero, 2005, 2009; Van Leussen & Escudero, 2015). This is why L2LP claims that acoustic differences and similarities between L1 and L2 phonemes determine the L2 learning development and thus, the acoustic properties of the L1 and L2 must be described. Therefore, the ingredient 1, i.e., optimal perception of L1 and L2, consists in a comparison of acoustic properties of L1 and L2 sounds allowing to predict and establish the initial state of L2 learning, i.e., ingredient 2 (Elvin & Escudero, 2019).

In the initial state (ingredient 2), which is considered as an onset of L2 learning, L2 beginners have no knowledge at all in L2, and use their L1 system for the perception of L2 sounds. Following the *Full Copying hypothesis* (Escudero, 2005), as the L2 sounds are perceived as equivalent to L1 sounds by the L2 beginners, L2 beginners will create a duplicate of their L1 perception grammar and assign that to their L2 grammar (Van Leussen & Escudero, 2015). Consequently, L2 beginners' "perception and production of the L2 sounds will look exactly the same as their perception and production of their L1 sounds" (Elvin & Escudero, 2019, p. 6). This L2 perception grammar made by duplication will be progressively modified as it receives perceptual input of L2 sounds (Elvin & Escudero, 2019). However, L1 perceptual grammar will remain "intact" (Yazawa, Whang, Kondo, & Escudero, 2019, p. 567).

Ingredient 3 consists of the learning task, meaning that L2 learners must modify their L2 perception in the initial state so that it tends towards optimal L2 perception. Therefore, the learning task relates to how much the L2 perception grammar, created as a duplicate copy of L1 in the initial state, needs to develop or modify in order to match the L2 perception and production. L2LP specifies three possible 'learning scenarios' that may occur (see Table 1.3 for their summary). The scenario are:

1. **NEW scenario** equivalent to the Single Category type in PAM. In this scenario, most productions of a contrast between two L2 sounds "are acoustically closest to typical or average productions of a single L1 sound" (Van Leussen & Escudero, 2015, p. 2) meaning that two L2 sounds are equivalent of one L1 sound. For example, both the southern British English /i/ and /ɪ/ are equivalent of the Spanish /i/ for native Spanish speaker learning English (Escudero, 2005) as illustrated in Figure 2.2. As fewer categories exist in L1 than in L2, L2 learners must either establish a new L2 category or split the already existing single L1 category into two. According to L2LP, PAM and PAM-L2, this scenario is the most difficult for L2 learners (Van Leussen & Escudero, 2015).

2. **SIMILAR scenario** equivalent to the Two Categories type in PAM. In this scenario, most productions of a contrast between two L2 sounds "are acoustically closest to the typical productions of two separate L1 sounds" (Van Leussen & Escudero, 2015, p. 2), i.e., two L2 sounds are equivalent to two separate L1 sounds. For instance, Canadian English and Canadian French contain both /ɛ/ and /æ/. However, as Figure 1.4 illustrates, native Canadian English speakers learning Canadian French perceive the Canadian French /æ/ as [æ] or as [ɛ] (Escudero, 2005). In this scenario, the number of L1 and L2 categories is the same, but these categories cover different phoneme spaces, because the existing L1 categories are duplicated and then modified in the way that their boundaries correspond to the boundaries between the two L2 sounds. According to PAM, PAM-L2 and L2LP, the acquisition of the contrast between the two L2 sounds in this scenario is less difficult compared to that in the other two scenarios. (see also Escudero, Sisinni, & Grimaldi, 2014).

3. **SUBSET scenario** resembles Both Uncategorised or Uncategorised Versus Categorised type in PAM according to how each of the two L2 sounds is integrated into L1 categories (Best, 1994). In this scenario, the two L2 sounds are perceived as two different L1 sounds belongings to two different L1 categories. Thus, for an L2 sound, L2 learners perceive more L2 categories than actually exist because there are fewer categories in L2 than in L1. For instance, native Dutch speakers learning Spanish will perceive the Spanish /i/ as an equivalent of the Dutch /i/ or /ɪ/ (see Figure 1.3 for illustration). Both the PAM and L2LP models predict that in this scenario, L2 sound perception is less difficult than in the NEW scenario but more difficult than in SIMILAR scenario. Furthermore, if the L2 sounds remain later to be perceived as belonging to more than one L1 category, the attainment of a fully native-like L2 pronunciation may be complicated (see Van Leussen & Escudero, 2015).

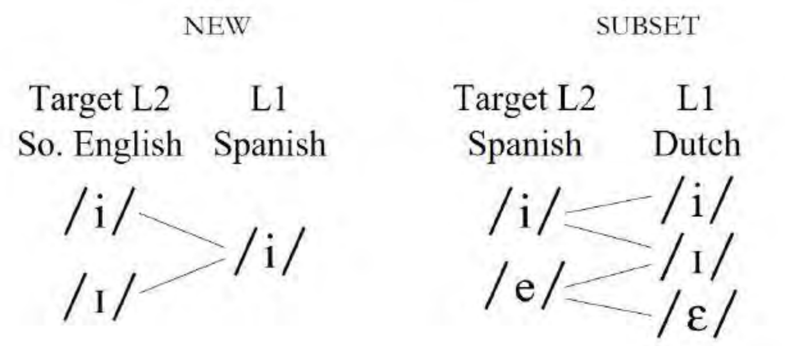


Figure 1.3: L1 and L2 phoneme categories in the NEW versus the SUBSET L2 scenario.

Note: So.=southern British. Taken from Escudero (2005, p. 203).

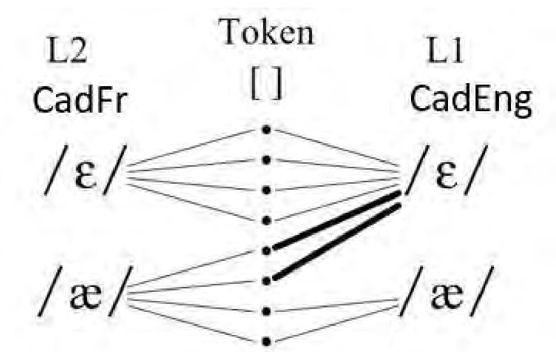


Figure 1.4: Perceptual mapping in the SIMILAR scenario

Note: CadEng = Canadian English, and CadFr = Canadian French. Taken from Escudero (2005, p. 255).

Table 1.3: Initial states and difficulty in three L2LP scenarios.

	scenario		
	NEW	SUBSET	SIMILAR
Initial state	Too few L1 categories	Too many L1 categories	Non-optimal mappings
Relative difficulty	Most difficult	Medium difficulty	Less difficult

Note: Taken from Escudero (2005, p. 314). Second, third and fourth columns represent the three scenarios. The initial state, i.e., the number of L1 phoneme categories compared to L2 phoneme categories before perception of contrast between L2 sounds, is indicated in the third row. The last row indicates relative difficulty, i.e., how difficult it is for the speaker to perceive the contrast between the two L2 sounds.

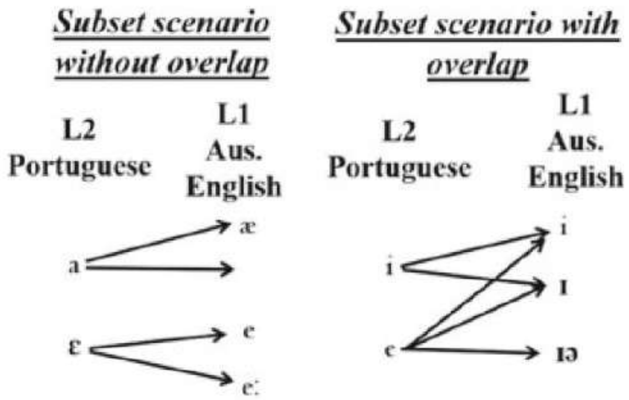


Figure 1.5: L2LP learning SUBSET scenarios with and without overlap.

Note: Aus.=Australian. Taken from Elvin and Escudero (2019).

The third scenario, i.e., the SUBSET scenario, may be divided into two situations as illustrated more recently in Elvin and Escudero (2019). In the first situation, the SUBSET scenario happens without overlap, i.e., each of the L2 sounds are perceived as an equivalent of different L1 categories. In the second situation, the SUBSET scenario happens with overlap. In this situation, one of the two L2 sounds is perceived as an equivalent of more than one L1 category from which at least one is the L1 category equivalent to the other L2 sound (see Figure 1.5 for the illustration). In the first case, the discrimination between the two L2 sounds is predicted to be good while in the second situation, it is predicted to be poor. In order to achieve an optimal perception of these L2 sounds in both situations, the L2 learner must stop perceiving differences in an L2 sound that exists in L1 as these differences have no signification in L2. That may be especially difficult in the case of the SUBSET scenario with overlap (Elvin & Escudero, 2019).

Ingredient 4, i.e., L2 development, is composed of two stages, (1) perceptual learning using the Gradual Learning Algorithm and (2) recognition learning. In the first stage, changes in L2 perceptual grammar of learners are made thanks to the Gradual Learning Algorithm (Boersma, Escudero, Hayes, et al., 2003), in order to closely resemble that of native speakers of the L2 (Elvin & Escudero, 2019). The Gradual Learning Algorithm learns to classify speech sounds via a human learning mechanism called distributional learning (Escudero, 2009) whereby "perception is affected by the phonetic distribution of speech sounds along an acoustic continuum that encompass the two sound categories" (Elvin & Escudero, 2019, p. 10). In the L2LP, distributional learning is responsible for the creation of new sound categories in the L2 (Elvin & Escudero, 2019). It has direct and long term effects in L2 perception (see D. Williams & Escudero, 2014). In perceptual learning, using the Gradual Learning Algorithm, L2 learners also "improve their perception or adjust their use of auditory cues by updating their perception grammar when they mishear a sound" (Elvin & Escudero, 2019, p. 10).

The second stage of ingredient 4, i.e., recognition learning, concerns recognition of words spoken in L2. According to L2LP, phonetic contrasts confused in speech perception are also often confused in L2 spoken word recognition. During L2 speech perception, the word recognition by L2 learners depends on how well they understand the message of an L2 speaker. Thus, L2 speech recognition is developed through message perception because the message triggers learning if there is an error or misunderstanding in the interpretation (Elvin & Escudero, 2019).

Ingredient 5, i.e., end state, is the ultimate L2 attainment. Various L2 proficiency levels that L2 learners reach perfectly match or not the L2 (cf. Escudero, 2005). Both the speed of attainment of this end state and the developmental path vary across L2 learners according to the learning task scenarios that an L2 learner has to undertake (NEW, SIMILAR and SUBSET). End state also depends on amount and richness of received L2 input during L2 development (Ingredient 4) by the speaker (Elvin & Escudero, 2019). L2LP claims that the more L2 input L2 learners receive during L2 development, the more likely they are to achieve optimal perception and production in the L2. Moreover, in the end state, L2 learners have separate grammars and language activation modes that allow them to attain optimal perception of L2 and preserve the one of L1 (Escudero, 2005). The L1 is only affected by the L2 if L2 learners are not sufficiently exposed to L1 input. To maintain optimal L1 and L2 perception and production, the learner must be exposed to rich L1 and L2 input (Elvin & Escudero, 2019). Though of great relevance to this thesis, unfortunately, (Elvin & Escudero, 2019) do not develop this aspect in any more detail.

From the previous paragraphs, we may observe that, similarly to SLM, L2LP pays attention to acoustic differences between L1 and L2 sounds. Nevertheless, L2LP does not base its predictions on the acoustic comparison of one L1 and one L2 sound as SLM does. More like PAM and PAM-L2, its predictions are related to the contrast between two L2 sounds. We also saw that L2LP shares several predictions of discrimination of two L2 sounds with PAM. Contrary to the other models and hypotheses presented in section 1.1, L2LP describes in detail all steps of L2 acquisition and attainment. According to both L2LP and the Interlanguage Hypothesis a new object (in the sense of intermediate language) is created when learning an L2. According to L2LP, it is a copy of L1 perception grammar (ingredient 2), while according to the Interlanguage Hypothesis, it is interlanguage. However, the L2LP supposes that a copy of L1 perception changes progressively, while the Interlanguage Hypothesis considers interlanguage as something intermediate between L1 and L2. Similarly to PAM and the Contrastive Analysis Hypothesis and contrary to the Markedness Differential Hypothesis, L2LP considers the most difficult discrimination to occur in NEW scenario, i.e., when two L2 sounds are perceived as an equivalent of one and same L1 category. Contrary to Similarity Differential Rate Hypothesis claiming that performance on L2 sounds similar to L1 sounds remains the same or progressively worsens, the L2LP claims that L2 learners may achieve an optimal L2 perception and production even in L2 sounds similar to the one of L1.

1.2.6 Revised Speech Learning Model

The Speech Learning Model was very recently revised by Flege and Bohn (2021). The authors present the core tenets of SLM-r concerning eleven aspects. These are L2 experience, production and perception, L2 category formation, the full access hypothesis, cue weighting, phonetic factors, endogenous factors, intersubject variability, L1 category precision, L1 phonetic category differences, and continuous learning.

Concerning the first aspect, i.e., L2 experience, the SLM-r does not focus on very experienced L2 learners nor their possibility to "master" L2 sounds as SLM did (Flege & Bohn, 2021, p. 64). According to Flege and Bohn (2021), L2 learners' L2 speech production and perception will never perfectly correspond to that of monolingual L2 speakers because the phonetic elements constituting the bilingual's L1 and L2 phonetic subsystems necessarily interact with one another. Moreover, L2 learners are rarely exposed to the same phonetic L2 input that some monolingual L2 speakers received when in childhood. L2 learners, even if living in L2 country, may be exposed to L2 spoken by its nonnative speakers, i.e., various immigrants. Thus, new L2 phonetic categories of the L2 learners may be different from those of native L2 speakers as they are based upon dissimilar L2 input (Flege & Bohn, 2021).

For the second aspect, i.e., the relationship between production and perception, the SLM hypothesised that the accuracy of L2 sounds perception is necessary for the accuracy of the L2 sounds production. In contrast, the SLM-r claims that the production and perception of L2 sounds "co-evolve without precedence" (Flege & Bohn, 2021, p. 29). Flege and Bohn (2021) propose this adjustment of SLM as some studies demonstrated that L2 learners may produce contrasts in L2 sounds that they cannot readily perceive. Even if other studies found a correlation between accuracy of L2 sound perception and production, Flege and Bohn (2021) recall that correlations do not allow any conclusions about causality.

The third aspect, i.e., L2 category formation, in SLM-r is possible regardless of the age of first exposure of the learner to an L2. Flege and Bohn (2021) add that the formation of a new phonetic category is essential for organising and reorganising the phonetic space of the learner during the life-span. The formation of a new phonetic category for an L2 sound transforms the learner's phonetic performance as this L2 sound may be produced more accurately. In contrast, when an L2 sound is classified as equivalent of an L1 sound into an L1 category, this category will become "a composite L1–L2 phonetic category", and will develop with phonetic input of L1 as well as of L2 (Flege & Bohn, 2021, p. 65).

SLM provided a 'feature' hypothesis according to which L2 learners cannot access features or perceptual cues, which specifies L2 categories but are not used in the L1 meaning that, if an L2 sound is determined, at least partly, by features not used in the learner's L1, a new phonetic category, which was formed for L2 sound by the learner, may differ from the phonetic category, which a native L2 speaker would form for the same sound (Flege & Bohn, 2021). In opposition to this hypothesis, SLM-r provides a 'full access' hypothesis claiming that L2 learners can have access to features of L2 sounds which are not used in the L1, because all processes and mechanisms involved in the development of L1 phonetic categories remain intact and accessible for L2 learning across the life-span (Flege & Bohn, 2021).

Concerning cue weighting, i.e., weighting of perceptual cues that define phonetic categories, SLM-r claims that the shape of new L2 categories as well as composite L1–L2 categories changes progressively with input distributions. These changes in the shape of phonetic categories are motivated by the necessity to rapidly and accurately classify phonetic segments (Flege & Bohn, 2021).

The next aspect, phonetic factors, concerns the conditions on which the formation or nonformation of a new phonetic category for an L2 sound depends. SLM-r predicts that the formation or nonformation of a new phonetic category depends on (1) the degree of perceived phonetic dissimilarity of L2 sound from the closest L1 sound, (2) "the quantity and quality of L2 input" the learner obtained for the given L2 "sound in meaningful conversations", and (3) the precision of the closest L1 category at the moment of onset of L2 learning (Flege & Bohn, 2021, p. 65).

The formation of a new phonetic category for an L2 sound is also determined by endogenous factors. According to SLM-r, phonetic category formation for an L2 sound depends on:

> *"the discernment of cross-language phonetic differences, the creation of stable perceptual links between L1 and L2 sounds, the aggregation of 'equivalence classes' of L2 sounds that are perceived to be distinct from*

> *the realisations of any L1 phonetic category and, finally, the sundering of previously establish L1–L2 perceptual links"* (Flege & Bohn, 2021, p. 66)

Flege and Bohn (2021) explain that these phonetic processes may be modulated by differences among learners in their "auditory acuity, early-stage (precategorical) auditory processing, and working auditory memory" which affect the quantity of L2 input that the learners need for improving their L2 (Flege & Bohn, 2021, p. 66).

To sum up the phonetic and endogenous factors, we may see that contrary to SLM which is focused on the differences between groups of speakers (e.g., child *versus* adult learners, experienced *versus* inexperienced L2 learners), SLM-r considers the differences between individual speakers. Thus, SLM-r claims that individual learners differ in (1) their specification of L1 categories (in terms of cue weighting and level of precision of categories) during the onset of L2 learning, (2) their mapping of L2 sounds onto L1 categories, (3) the amount of dissimilarity they perceive between L2 sounds and the closest L1 sound in their individual phonetic system, (4) the amount and kind of L2 input they receive, and (5) their auditory acuity and auditory working memory (cf. Bohn, 2021). Consequently, the intersubject phonetic variability, the next aspect, may be explained, at least partly, by the named elements, i.e., (1) to (5) (Flege & Bohn, 2021).

SLM-r differs from the SLM 'age' hypothesis. Concerning L1 category precision, SLM-r claims that speakers "with relatively precise L1 phonetic categories" will better discern phonetic differences between an L2 sound and its closest L1 equivalent than speakers "with relatively imprecise L1 categories" (Flege & Bohn, 2021, p. 65). Hence, there is a higher probability of the formation of new phonetic categories for L2 sounds for the first group of speakers than for the second group of speakers. Flege and Bohn (2021) add that even if L1 category precision generally increases from childhood to early adolescence, significant differences exist for speakers of all ages. Thus, it is useless to associate the differences in precision of an L1 category among speakers to the age of the learners at the moment of onset of L2 learning (Flege & Bohn, 2021).

For the aspect L1 phonetic category differences, Flege and Bohn (2021) claim that the L1 categories of beginning L2 learners are far from identical, and differ in terms of cue weighting. This is because the cue weighting depends on the input that the speakers received during L1 speech development in which the speakers may vary, and for the level of precision with which the L1 categories are defined (Flege & Bohn, 2021).

For the last aspect, i.e., continuous learning, Flege and Bohn (2021, p. 66) state that phonetic categories of the learner are "malleable across the life-span", and change with the phonetic L1 and L2 input that they receive. Due to the changes of phonetic categories with reception of phonetic L2 input, Flege and Bohn (2021) consider, in L2 learning, the "end state" may occur only when learners are "no longer exposed to phonetic input" different from that which they were exposed to earlier in life (Flege & Bohn, 2021, p. 66).

In the previous paragraphs, I highlighted several differences and similarities between SLM and SLM-r. Moreover, SLM-r seems to contrast with NLM, as SLM-r claims that a new phonetic category may be created regardless of the age of L2 learner's first exposure to L2 while NLM predicts limited perception of L2 sounds during the third stage in development of perception linked to the child maturation. SLM-r does not contest the age effect of L2 learning but provides a more complex vision of L2 learning which also depends on factors other than age, which vary between individual speakers (Flege & Bohn, 2021). We may also highlight the differences in conception of the 'end state' of L2 acquisition by SLM-r and L2LP. For Flege and Bohn (2021), L2 speech production and perception of learners will never perfectly correspond to that of native speakers of L2, as the phonetic elements constituting the bilingual's L1 and L2 phonetic subsystems interact with one another, and the bilingual receives different L2 input from one that which native speakers of L2 received when they were children. By contrast, L2LP considers that thanks to the separate grammars of L1 and L2 and language activation modes, the speakers may attain optimal speech production and perception of L2 and preserve one of L1. In addition, according to L2LP, for maintenance of optimal L1 and L2 perception and production, the learner must be exposed to rich L1 and L2 input, i.e., living in a bilingual environment (Elvin & Escudero, 2019), while SLM-r supposes that if the speaker is exposed to L1 and L2, the phonetic categories of both will still interact, thereby, not allowing the speaker to achieve optimal L1 and L2 perception and production. Finally, taking into account individual differences, SLM-r seems to give a more complex conception of L2 acquisition than the other models and hypotheses (see section 1.1 for the hypotheses).

1.2.7 L2 intonation learning theory and Developmental L2 Intonation hypothesis

Put forward by Mennen (2015), L2 intonation learning theory (LILt) is inspired by Ladd (2008) dimensions of cross-language variation. It is most likely one of the most recent models of L2 intonation learning. LILt distinguishes four dimensions according to which the similarities and differences between the intonation of L1 and L2 can be specified (Mennen, 2015). These dimensions may also be used for describing the differences and similarities in intonation of two language varieties. The dimensions are:

1. **Systemic dimension**, referring to "the inventory and distribution" of phonological elements (Mennen, 2015, p. 8). By phonological elements, the author means pitch accents, accentual phrases, prosodic words and boundary phe-

nomena.

2. **Realisational dimension**, referring to the manner by which "the phonological elements are phonetically implemented or realised", for instance, a manner of lining up pitch accents with the segments of utterances (i.e., tonal alignment). It may also refer to the relative height of pitch accents, or to their shape or slope (Mennen, 2015, p. 8).

3. **Semantic dimension**, referring to "the functionality" of the phonological elements or tunes (Mennen, 2015, p. 8). This dimension concerns the use of the elements or tunes for indicating the meaning, for instance, the focus or interrogativity.

4. **Frequency dimension**, referring to "the frequency of use" of the phonological elements (Mennen, 2015, p. 8). For example, two language varieties may have the same inventory and distribution of rises, however, they are more frequent in one language variety than in another.

Discussing the possibility to extent the considerations of SLM and PAM-L2 about L2 speech segments on L2 intonation learning, Mennen (2015) proposes the following four hypotheses concerning L2 intonation learning:

1. As with SLM and PAM-L2, LILt predicts that many difficulties in acquisition of L2 intonation may be linked to the learner's difficulties to perceive accurately the L2 intonation. Similarly, as with SLM and PAM-L2, LILt does not exclude other possible explanations of difficulties in the attainment of native-like L2 intonation in production, such as the explanation by learner's powerlessness in the articulation of certain differences between L1 and L2 intonation or in saving these differences into acoustic memory.

2. SLM and PAM-L2 claim that L1 influence on L2 is not only phonological, but also phonetic and perceptual, LILt posits that L1 and L2 intonation may differ in more dimensions than in just the systemic dimension. Primarily, the differences in the realisational dimension of L1 and L2 intonation may impact how much the learner is able to accurately "discriminate, categorise and produce a L2 phonological element" (Mennen, 2015, p. 19).

3. SLM and PAM-L2 consider the onset age of L2 learning as an important predictor of native-like L2 attainment, LILt assumes that the age of onset of L2 learning or of arrival in L2 country is relevant for predicting overall native-like L2 intonation attainment. LILt hypotheses greater success in native-like L2 intonation attainment when learning begins at a younger age, however, it does not predict that the influence of age is necessarily the same for all four intonation dimensions.

4. SLM and PAM-L2 suppose that with increasing L2 learning and experience, L2 learners could perform better in perception of L2 specific phonetic properties, and approach or reach native-like L2 production (see, also Flege, 2011). LILt also predicts that with growing experience in L2, a learner's production of L2 intonation will become more native-like. Nevertheless, according to LILt, that not all dimensions of intonation represent the same degree of difficulty during L2 learning, suggesting that it is possible to produce at least some dimensions of L2 intonation accurately, but it remains unknown if an achievement of native-like production is possible in all intonation dimensions.

As these four hypotheses are based on SLM, which was very recently revised, I propose to relate them to SLM-r and discuss possible limitations in light of the revision of SLM. Concerning the first LILt's hypothesis, SLM-r brought the conception of co-evolving of perception and production and highlighted that even if an L2 sound is not accurately perceived, in some cases, it may nevertheless be accurately produced. Hence, the first hypothesis of a direct link between difficulties in perception and production of L2 intonation has been questioned with the publication of SLM-r in 2021. As considered in the second LILt hypothesis, SLM-r also claims that the phonetic differences between L1 and L2 are crucial for predicting L2 learning. Hence, with respect to SLM-r, the second hypothesis of LILt remains valid. Next, concerning the onset of L2 learning, as SLM-r does not adopt the point of view that learning from a younger age is more beneficial, the third hypothesis of LILt is debatable. Finally, partly in opposition with the fourth hypothesis of LILt, SLM-r claims that L2 may never be perfectly attained because of unceasing interactions of a bilingual's L1 and L2 phonetic subsystems.

Concerning acquisition of L2 intonation, Pešková (2020) most recently put forward a nine-point Developmental L2 Intonation hypothesis. However, a detailed presentation of this hypothesis has not been published yet. I would like to highlight two new interesting predictions stated in the abstract of (Pešková, 2020) which provides preliminary information about this hypothesis. According to the first prediction, phonological elements with a heavy semantic weight in a clause are acquired earlier than elements where there are no changes to the meaning of the clause. For example, Pešková (2020) uses the finding by Jorge (2018) that some L1 English learners of Spanish stopped using uptalk in statements after a certain time of L2 learning because uptalk might lead to wrong interpretation of Spanish statements. According to the second prediction, L2 phonological elements, which are new for the learner but frequent in L2 and perceptually prominent, tend to be overgeneralized by the learner. For instance, in Pešková (2020), learners of Italian overgeneralised the (L+)H*+L element, specific for emphasis and focus in Italian and did not exist in the L1 of learners.

1.3 Summary and significance of the chapter for our research

Table 1.4 summarises the main information provided above regarding the models and hypotheses of L2 speech segments production and perception. We may observe that the three hypotheses in the third row of the table do not consider the same aspects to be the most difficult in L2 speech segments acquisition. The three hypotheses in the fourth row of the table share the same conception of interlanguage. Concerning the models, we may see that, the PAM, PAM-2 and L2LP predictions focus on L2 sounds' contrast perception while the NLM, SLM and SLM-r focus on perception and/or production of a single L2 sound. The L2 sound(s) production or perception is predicted on the basis of perceptual similarities between L1 and L2 sound in the NLM and SLM. SLM also takes into consideration L1 and L2 sound similarities in the IPA symbol they represent and in their acoustic properties, which is an important component for the L2LP. PAM takes into consideration the similarity in articulatory gestures between L1 and L2 sounds for its predictions. Similarly, the PAM-L2 concerns the gestural dimension of the sounds, but also their phonetic and phonological dimensions. Finally, the SLM-r takes into consideration numerous phonetic and endogenous factors which may vary considerably across individuals during L2 learning. We may conclude that none of these models base their predictions on exactly the same sound dimensions.

Similarly, none of the models predict the same situation(s) of L2 sound(s) perception or acquisition except for the PAM and its extension, the PAM-L2. Even if the SLM and L2LP predict the same number of situations, i.e., three, their situations are not equivalent because L2LP is focusing on the acquisition of L2 contrasts while SLM is focusing on the acquisition of an individual L2 sound. Moreover, the L2LP contains the SUBSET scenario which is missing in the SLM. As underlined by Elvin et al. (2016), the SLM, PAM, PAM-L2, L2LP, and SLM-r all share the common assumption that listeners filter and categorise the sounds of the L2 according to existing categories in their own L1. Finally, for L2 sound(s) similar to the L1 sound(s), but not entirely the same as the ones of L1, all models claim that they will be the most difficult to acquire and to discriminate in L2 while the acquisition and discrimination is seemingly easy if the L2 sound(s) are identical to the L1 sound(s) (cf. PAM, PAM-L2, L2LP, SLM, SLM-r). The situation of acquisition and discrimination of (very) different L2 sound(s) from L1 sound(s) is considered in the SLM, SLM-r, PAM and PAM-L2, but is completely missing in the L2LP.

Concerning L2 intonation, the LILt proposes to compare the L1 and L2 intonation in its four dimensions: systemic, realisational, semantic, and frequency. However, as we saw, LILt hypotheses are based on SLM predictions, many of which were changed with SLM-r. The only compatible LILt's hypothesis with the SLM-r is that

Table 1.4: Summary of hypotheses and models of L2 speech segments production and perception

	Hypotheses					
	Contrastive Analysis H.	**Markedness Differential H.**	**Interlanguage H.**	**Optimality Theory**	**Structural Conformity H.**	**Similarity Differential Rate H.**
The biggest difficulty in L2 acquisition	Re-categorization of two or more L1 allophones into separated L2 categories	Acquisition of L1 and L2 sounds with big markedness				Initial acquisition of L2 sounds dissimilar to L1 sounds and improvement of performance on L2 sounds similar to L1 sounds
Conception of L2 acquisition			Interlanguage= intermediate language variant approaching the L2	language=system of conflicting constraints, L2 acquisition=modification of ranking of universal constraints	universal generalizations that hold for primary languages hold also for interlanguage	
	Models					
	NLM	**PAM**	**SLM**	**PAM-L2**	**L2LP**	**SLM-r**
Sound dimension(s)	perceptual	articulatory	IPA symbol, acoustic, perceptual	gestural, phonetic, phonological	acoustic	defined by phonetic and endogenous factors
L2 sound(s) acquisition	L1 prototype 'attracting' an L2 sound similar to it	six assimilation types of L2 sounds contrast perception	similar, new, identical L2 sound acquisition	six assimilation types of L2 sounds contrast perception	NEW, SIMILAR, SUBSET scenario for L2 sounds contrast perception	varying with individual speaker

Note: The third row indicates the aspect considered to be the most difficult to acquire in L2 by the given hypothesis, the fourth row shows the conception of L2 speech acquisition by the given hypothesis. The penultimate row indicates on which dimension(s) of L1 and L2 sound(s), the model bases its prediction about L2 sound(s) acquisition (with the meaning of production or/and perception). The final row demonstrates the different situation(s) of L2 sound(s) acquisition that, according to the model, may occur. H.=hypothesis differences in realisational dimension of L1 and L2 intonation (i.e., how the phonological elements are phonetically implemented or realised in L1 and L2) may have an impact on the ability of the learner to accurately discriminate, categorise and produce L2 phonological elements. We mentioned Pešková's (2020) Developmental L2 Intonation hypothesis as another possibility for prediction of L2 intonation acquisition, and underlined that a detailed publication about this hypothesis is not yet available.

In order to underline the significance of the present chapter for our experimental investigations, in the following paragraphs, I will discuss the relevance of the models presented above for studying phonetic CLI.

As underlined by Chang (2019b), all discussed models address CLI mainly as the influence of L1 on L2, but not necessarily as the influence of L2 on L1, except for the SLM and SLM-r. SLM and SLM-r consider the influence of L2 on L1 due to their claim that L1 and L2 phonetic categories exist in a common phonetic space of the speaker. NLM, PAM and PAM-L2 generally agree with the existence of L1-L2 common space claimed by the SLM and SLM-r (Bergmann, Nota, Sprenger, & Schmid, 2016), but do not consider the influence of L2 on L1. Due to this, and because of their main focus on L2 perception and not on L2 production, the NLM, PAM and PAM-L2, do not seem to be the best models for use in the study of phonetic CLI.

Concerning the L2LP, it does not share the conception of L1-L2 common space with the other models; instead it considers L2 learning as a development of two entirely separate perception grammars. Moreover, the L2LP supposes that L1 and L2 perception grammars do not directly influence each other, and therefore is not expected to be attested in general phonetic L2 influence on L1, apart from if there is insufficient exposure to a rich L1 input (cf. Escudero, 2005; Yazawa, 2020). Due to that, we may consider that L2LP poses several problems for use when studying phonetic CLI, as some studies show the existence of phonetic L2 influence on L1 in the case of L2 learning when living in an L1 environment (Herd, Walden, Knight, & Alexander, 2015), and others show the phonetic influence of L2 on L1 in the case of speakers who used L2 in their everyday lives even if they were not completely without exposure to L1 (e.g., De Leeuw, 2008; Mayr, Sánchez, & Mennen, 2020). Though, in these studies, the exact L1 input is not measured, one may suppose that it is richer than in L2 learners who are completely dis-exposed to and dis-using their L1. Due to this, the L2LP is insufficiently relevant for the study of phonetic CLI. (For more details about the studies of phonetic CLI, see, section 2.3.)

However, the considerations of L2LP concerning the speed of attainment of the 'end state' in L2 acquisition, which vary with L2 learning scenarios (NEW, SIMILAR or SUBSET scenario), are of relevance when studying phonetic CLI. This consideration should mean that L2 contrast of SIMILAR scenarios will be acquired

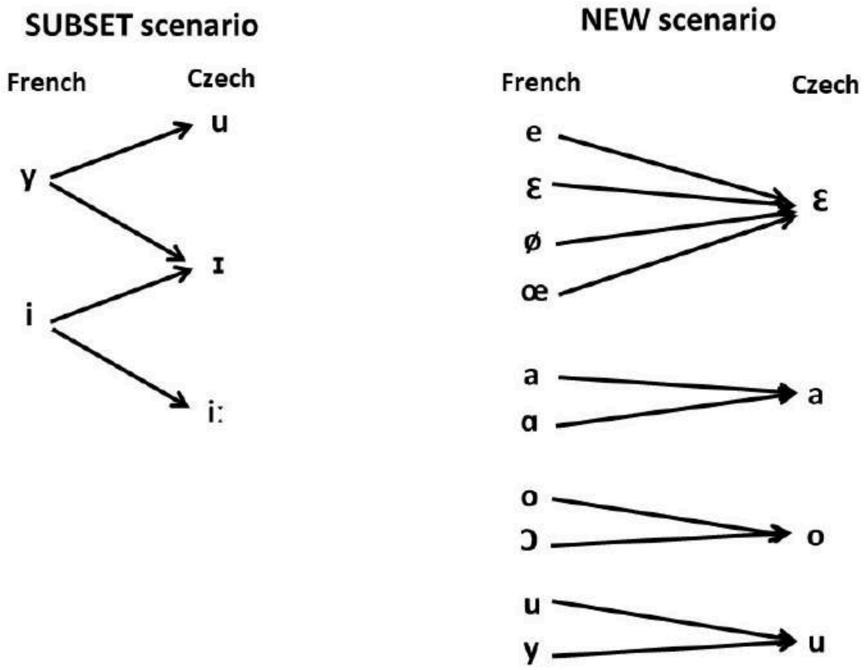


Figure 1.6: Predicted SUBSET and NEW scenario for French (L2) and Czech (L1) sounds according to L2LP.

first, followed by a SUBSET scenario, and then a NEW scenario (cf. the paragraphs above and Escudero, 2005; Elvin & Escudero, 2019). Consequently, one may suppose that by reversing this hypothesis, (1) the L2 sounds of NEW scenarios will be the last to be affected by phonetic CLI as they are acquired last, and (2) the L2 sounds of SUBSET scenario will be affected by phonetic CLI before the L2 sounds of NEW scenarios as they were acquired first. The phonetic CLI in L2 sounds of SIMILAR scenarios is uncertain as these sounds are practically the same as those of L1. We may suppose that no phonetic CLI will occur in these sounds. Figure 1.6 shows the SUBSET and NEW scenario, which I would argue, may occur when Czech speakers are acquiring French in their vowels. One may suppose that phonetic CLI will occur in Czech sounds in SUBSET scenarios on the figure in Czech speech of all CF while it will occur in Czech sounds in NEW scenarios on the figure in Czech speech of CF with advanced learning level in French. Note that more NEW scenarios are predicted than SUBSET scenarios as, in general, the French vocalic system is richer than the one of Czech (see subsection 3.2.1).

As noted above, the SLM was largely used in studies of phonetic CLI for making predictions even if the authors seem to be conscious about the lack of exact rules for the classification of L2 sounds as ‘new’, ‘identical’ or ‘similar’. Indeed, the use of SLM for studying phonetic CLI may seem to be very relevant. Recall that in SLM, either (1) the new category is not established for an L2 sound and it is classified into an L1 category or (2) the new category is established for a new L2 sounds. Due to this, in (1), L1 sounds interact with L2 sounds in the same category and influence each other, and in (2), L2-L1 interferences exist in the sense of the effort to maintain the contrast between the two different categories. The result of (1) is assimilation effect, and the result of (2) is dissimilation effect (see, also De Leeuw, 2019a). (See subsection 2.1.4 for more detail about these two effects.)

From these considerations, one may be tempted to predict whether the phonetic influence between given L2 and L1 sounds in a particular study will occur as assimilation or dissimilation effect. Indeed, according to SLM, only an L2 sound classified as 'similar' is integrated into L1 category and hence, it must undergo an assimilation effect. By contrast, a new L2 category should be established only for an L2 sound classified as 'new' and hence, this new L2 sound must undergo a disssimilation effect. However, as discussed, universal rules of classification of an L2 sound as 'identical', 'similar' or 'new' do not exist. Moreover, with SLM-r, it seems evident that the classification of an L2 sound may vary between individual speakers. Therefore, SLM-r seems to suggest that even if one L2 sound may be perceived, for example, as 'similar' by an L1 speaker, it might be perceived as 'new' by another speaker of the same L1. On account of that, SLM-r also suggests that the speakers might vary in the effect their L1 phoneme undergoes because of phonetic CLI. Thus, SLM-r affirms that phonetic differences between an L1 and L2 sounds are far from sufficient for predicting whether an assimilation or a dissimilation effect will occur as phonetic CLI.

Taking all this into consideration, SLM-r is the most complete model for studying phonetic CLI. Nevertheless, to predict phonetic CLI for an individual speaker by this model may be a complex task due to the necessity of taking into consideration many factors, phonetic and endogenous. Therefore, due to that and given our limited knowledge of all these factors defining CF, I have decided to consider that all Czech and French sounds which differ in at least one of these following elements: IPA symbol, acoustic properties, articulatory properties, perceptual properties, phonological properties, might be affected by phonetic CLI in CF's L1 speech. Additionally, I include the phonetic CLI that might also occur in Czech phonemes which do not exist in French as CF would likely use them less often and be less often exposed to them (this assumption is similar to the one made in L2LP). It is important to note that I will not predict whether phonetic CLI will occur as assimilation or dissimilation effect as we saw that this seems to be impossible when not having an access to all endogenous factors related to the individual speaker mentioned by SLM-r.

Predicting L2 intonation acquisition and phonetic CLI in L1 intonation is complex as LILt was based on SLM and PAM-L2 hypothesis which are probably no longer the most pertinent due to the recent revision of SLM in SLM-r. Therefore, I propose to also use SLM-r for predictions of phonetic CLI in L1 intonation of CF and consider that possible assimilation or dissimilation effects between the L1 and L2 intonation properties may vary with individuals. As for phonetic CLI in L1 speech segments of CF, we suppose that phonetic CLI in L1 intonation of CF might occur in intonation properties which are not identical in Czech and French, and they might occur in each of four intonation dimensions (for the dimensions, see Mennen, 2015, and above). In addition, with regard to Pešková's (2020) Developmental L2 Intonation hypothesis, we may suppose that frequent and perceptually prominent phonological elements in French might be overgeneralized by CF and, thus, easily acquired.

Chapter 2

Cross-linguistic Influence and First Language Attrition

Chapter 1 presented the hypotheses and models of L2 speech production and perception. These models were widely used for making predictions about phonetic CLI. The present chapter aims to explain what CLI is and defines related concepts such as bilingualism, first language attrition, phonetic L1 attrition and phonetic drift. This chapter presents experimental studies of phonetic L1 influence on L2 and of phonetic L2 on L1. The extralinguistic factors are also presented. I discuss the methods used for their examination in studies of phonetic CLI as well as the findings of these studies.

2.1 Definitions related to CLI

This section provides definitions of bilingualism, CLI, first language attrition, phonetic first language attrition, and phonetic drift.

2.1.1 Bilingualism

In the most recent definitions of bilingualism, bilingualism relates to the use or need of multiple languages by a speaker. For example, according to Grosjean (2010, 2013), bilingualism refers to “the knowledge and use of two or more languages” (Grosjean, 2013, p. 5) and their necessity of use by a speaker, meaning that bilinguals are speakers who use two or more languages or dialects in their everyday life. Similarly, for Kohnert (2020), bilinguals are speakers who need at least two of their languages in their environment.

As explained by Grosjean (2013), bilinguals may not have equal fluency in their languages, and may speak with a foreign accent in one of their languages. Speakers who acquired an L2 when they were adolescents or adults may also be considered as bilinguals. Bilinguals usually acquire and use their languages for different purposes and in different domains of their life (Grosjean, 2013).

Code-switching and borrowing may also be characteristic for bilingualism. The former consists in the 'alternate use' of L1 and L2, i.e., shifting from one language to another language by the speaker (Grosjean, 2013). In the latter, the speakers borrow an L2 word, create its L1 form and integrate it into L1 sentence (see Grosjean, 2013).

As put forward by Köpke (2013), many bilingualisms exist. Hence, depending on the age of beginning of L2 learning, the following types of bilingualism may be distinguished (Köpke, 2018):

- Simultaneous early bilingualism referring to speakers who learned both languages from birth at the same time.
- Successive early bilingualism referring to speakers who started to learn an L2 early in childhood, between 2 and 6 years old.
- Late bilingualism referring to speakers who started to learn an L2 after the age of 6 or 7, for example, in adolescence or adulthood. This is also a consecutive bilingualism as this bilingualism occurs after the acquisition of the L1.[1].

We may see that the distinction between early and late bilingualism is linked to the age of onset of L2 learning. In the past, it was considered that this age may refer to a so-called critical period hypothesis (Lenneberg, 1967), claiming that language develops easily during the first few years of life, but after these years, language acquisition is more difficult and it is harder to achieve native-like L2 proficiency (cf. Siegler, 2006). Concerning the critical period hypothesis, there were principally three different conceptions of it proposed by the authors. Firstly, critical period was considered as a age which defines a sudden decline in ability of learning of an L2 (Lenneberg, 1967; Ventureyra, Pallier, & Yoo, 2004). Secondly, critical period was considered more as a process of gradual decline ending at the age of 11, and it is then assumed that the age effect is not apparent in older learners by Johnson and Newport (1989). Thirdly, critical period was considered as a gradual decline associated with age throughout the whole of a learner's life (Flege, Munro, & MacKay, 1995; Hakuta, Bialystok, & Wiley, 2003).

However, as underlined by Birdsong (2013, 2018), in particular, the link between age of onset of L2 learning and the ability to attain a native-like L2 proficiency is complex and the concept of any critical period hypothesis is problematic. Even if the degree attained by the speakers in L2 acquisition is "conditioned by age" of onset of learning, "which itself conditions [the brain] plasticity", age also impacts other factors such as experience in the L2 and language dominance which can be used

[1]See also: *Bilingualism - Types of Bilingualism*, http://developpement-langagier.fpfcb.bc.ca/en/bilingualism-types-bilingualism, accessed: 19/04/2021.

as predictors for the variability in L2 attainment among speakers (Birdsong, 2018, p. 13-14). Therefore, the age may not be the only factor explaining the variability in L2 attainment, i.e., L2 native-likeness among speakers.

If we consider that an early bilingual might achieve L2 native-likeness while a late bilingual cannot, as it was advanced by the critical period hypothesis, the issue of evaluating this L2 native-likeness emerges. For the most precise evaluation of native-likeness of an L2 speaker all linguistic aspects of the speaker's L2 should be measured and carefully analysed in detail. Consequently, the critical period hypothesis and the effect of age of onset of learning on the L2 native-likeness might be contested only if at least one late bilingual who was identical to a monolingual native speaker in every imaginable measure and knowledge of L2 was identified (Birdsong, 2013, 2018).

Nevertheless, the attainment of native-like L2 at phonetic level seems to be impossible for all users of more than one language, because as claimed by SLM-r (see subsection 1.2.6), L1 and L2 exist in a common phonetic space where their sounds incessantly interact with each other. Similarly, it was found that the deviation from monolingual L2 norm may exist in L2 of late bilinguals as well as in L2 of simultaneous early bilinguals (Birdsong, 2018). Hence, to distinguish the early and late bilingualism just because the age of onset of learning was supposed to determine the possibility of attainment of native-like L2 proficiency seems to be absurd. Despite of that, might the distinction between early and late bilingualism remind to be pertinent?

Distinction between early and late bilingual not only enables us to separate the bilinguals into two groups according to their age of onset of learning of an L2 but also to consider other difference between them. We may list, for example, the possible differences in motivation (e.g., learning of L2 for speaking with one of two parents *versus* learning for using L2 in a professional life), and the difference in the type of memory which is used during the L2 learning. For instance while procedural memory is the basis of language acquisition in early bilingualism, declarative memory is relied on more in late bilingualism (Köpke, 2018). For the acquisition of L2 at phonetic level, the L2 input seems to us the most crucial factor for underlying the relevance of distinction between early and late bilingualism. As seen in subsection 1.2.6, according to SLM-r, phonetic categories are determined by the language input they receive. L2 input received by early bilinguals may differ from that received by monolinguals (contact with an L2 at home, in maternity school *versus* contact with an L2 at work, in society, with friends, partner), which, in the light of SLM-r, allows us to suggest that the phonetic categories of L2 formed by early and late bilinguals are far from identical, and moreover, those of late bilinguals will rarely become the same as the one of early bilinguals (see subsection 1.2.6).

Table 2.1: Classification of crosslinguistic influence.

Dimension	Type
Area of language knowledge/use	phonological, orthographic, morphological, lexical, semantic, syntactic, discoursive, sociolinguistic, pragmatic
Directionality	forward, reverse, lateral, bi- or multi-directional
Cognitive level	linguistic, conceptual
Type of knowledge	implicit, explicit
Intentionality	intentional, unintentional
Mode	productive, receptive
Channel	aural, visual
Form	verbal, nonverbal
Manifestation	overt, covert
Outcome	positive, negative

Note: Taken from Jarvis and Pavlenko (2008, p. 20).

2.1.2 Cross-linguistic Influence

Inspired by Gundel and Tarone's (1983) term 'L1 influence', Sharwood Smith (1983) introduced the term of Cross-linguistic influence (CLI) in order to replace the term transfer, i.e., a process that leads to the incorporation of elements of one language into another (Sharwood Smith & Kellerman, 1986), which has a negative behaviourist connotation. Sharwood Smith (1983) employed CLI for the influence of L2 or other non-native languages on a speaker's L1. Therefore, CLI was studied in just one manner for an extensive period of time, i.e., in the direction of the influence of L1 on L2 acquisition. Nevertheless, it was shown that the L1 is not so immutable as supposed to be and that also an L2 may have an influence on the L1. Therefore, in contemporary studies, CLI may also refer to the influence of L2 on L1 (cf. Pavlenko, 2000).

CLI may be defined as the influence of one of a speaker's languages on another of their languages (cf. Jarvis & Pavlenko, 2008), where the word 'influence' refers to transfer as well as other kind of effects (Pavlenko, 2000). CLI is linked to the concept of interference, i.e., an involuntary influence of one language on the other in bilingual competence and performance (Pavlenko, 2000). Hence, the three terms mentioned previously, i.e., cross-linguistic influence, interference, and transfer, emphasise all the idea of "spilling over" of one language into another one in bilinguals (Sůčková, 2020, p. 15).

Jarvis and Pavlenko (2008) listed ten dimensions of CLI in order to classify the CLI according to these dimensions (see Table 2.1). The dimension *Area of language knowledge/use* indicates the linguistic domain in which the CLI was studied. In the dimension *Directionality*, 'forward' refers to the influence of L1 on L2, 'reverse' means the influence of L2 on L1, 'lateral' designates CLI between two languages acquired after the L1 (i.e., L2, L3, L4 etc), and ‘bi-directional’ means either synchronous forward and reverse influence (i.e., L1 to L2 and L2 to L1) or synchronous bidirectional lateral influence (e.g., L2 to L3 and L3 to L2). Concerning the dimension *Cognitive level*, for explaining the difference between ‘linguistic’ and ‘conceptual’ CLI, the authors use the following example:

> *“Swedish-speaking learner of English [who] refers to only human collision but not to vehicular collisions with the calque phrasal verb run on; the form of the phrasal verb appears to represent CLI at the linguistic level, whereas the meaning that the language learner ascribes to the phrasal verb appears to reflect CLI at the conceptual level.”* (Jarvis & Pavlenko, 2008, p. 23)

Concerning the dimension *Type of knowledge*, ‘implicit’ refers to the knowledge of a language, while ‘explicit’ designates the knowledge about a language. The dimension *Intentionality* describes if the CLI was made by the speakers intentionally or unintentionally. Phonetic CLI is usually considered to be unintentional (Jarvis & Pavlenko, 2008; Sůčková, 2020). The dimension *Mode* indicates whether CLI occurs in language production or perception. In the latter, they may occur in the L2 speech perception, but also in the perception of written text, i.e., text comprehension (cf. Jarvis & Pavlenko, 2008). The dimension *channel* brings the opposition between ‘aural’ CLI, i.e., CLI that involve speech and ‘visual’ CLI, i.e., CLI that concern writing and other forms of nonspoken verbal communication. The dimension *Form* distinguishes ‘verbal’ performance, i.e., how the speaker’s language influences the speaker’s verbal performance in his other language, and ‘nonverbal’ performance, i.e., how one speaker’s language influences the speaker’s use of gestures in communication. In the dimension *Manifestation*, ‘overt’ refers to “interlingual identification between patterns, structures, forms, or meanings in the source language and those in the recipient language” made by the speaker, whereas ‘covert’ means that the speaker “either relies on patterns, structures, forms, or meanings from the source language that do not exist in the recipient language, or omits or avoids structures that exist in recipient but not in the source language” (Jarvis & Pavlenko, 2008, p. 25). In the dimension *Outcome*, ‘negative’ CLI causes digression from the norm of the given language (Sůčková, 2020), while ‘positive’ CLI helps to reach the norm in the given language.

In addition to the CLI classification, Pavlenko (2000) distinguishes five types of CLI in the context of the influence of L2 on L1. These are:

- *Borrowing transfer* consisting in adding L2 elements to the L1.
- *Convergence* consisting of creating a unitary system, distinct from both L1 and L2.

- *Shift* which is a move away from L1 structures or values to approximate L2 structures or values.

- *Restructuring transfer* which is an incorporation of L2 elements into L1 resulting in some changes or substitutions, or a partial shift. The "existing L1 elements are reanalysed, and their function within the system may change" (Ulbrich & Ordin, 2014, p. 29).

- *L1 attrition* as a loss of some L1 elements due to L2 influence or inability to produce these L1 elements.

Pavlenko (2000) illustrates each type by an example. In the following paragraphs, I will, at first, present an example for each type, then, I will offer an example of phonetic CLI for the given CLI type, which could occur in CF's L1 speech (further details about the phonetic systems of Czech and French will be provided in chapter 3.)

The first type, *borrowing transfer*, is illustrated with lexical CLI in Pavlenko (2000). The author discusses lexical borrowing, whereby new items are added to the lexicon. For this thesis, to illustrate this type of CLI we can refer to the use of the stuck schwa, typical for southern French. CF would stick the schwa at the end of Czech words mainly when finishing with a consonant. For the second type, *convergence*, Pavlenko (2000) uses the example of the production of consonants as situated at the midpoint between LI and L2 values. This example might also be applied to our CF, mainly to the production of CF's L1 and L2 rhotic, which would be situated between the Czech and French rhotic. Nevertheless, for the identification of *convergence*, one must examine the element in both a speaker's L1 and L2, which is beyond the scope of this thesis. The third type, *shift*, is illustrated in Pavlenko (2000) in the example of semantic extension whereby lexical items in LI have the meanings of their L2 translation equivalents. For this type, we might suggest the example of CF's L1 [ɪ] that spectral properties would shift towards the spectral properties of French /i/ and CF's L1 [ɛ] that spectral properties would shift towards the spectral properties of French /ɛ/ and /e/. For the fourth type, *restructuring transfer*, the author gives an example of a syntactic restructuring whereby L2 rules are incorporated into L1 grammar. I would like to illustrate this type by CF's prosody in L1. Some rules of French prosody would be incorporated into their L1 prosody, which would change or partially shift toward French prosody rules. The final type, *L1 attrition* is illustrated in Pavlenko (2000) by the acceptance of syntactically deviant L1 sentences under the influence of L2 constraints. For this type, I would like to give examples of any changes that may occur in CF's L1 consonants that do not exist in French. More precisely, what these consonants might be, for example, CF's L1 [ɦ] and [x], two consonants that exist only in Czech, and it is not possible to substitute them by any French consonants in Czech word without changing the meaning of the word or making the word meaningless.

The distinction of CLI into the five types by Pavlenko (2000) might be of relevance for this thesis as it demonstrates different types of effects of one language on another. Nevertheless, some limitations of this distinction are also obvious. First, among the author's five types of CLI, none correspond to the so-called dissimilation effect (see De Leeuw, 2019a), which was found in certain studies (see section 2.3). Secondly, one may object to the absence of a clear difference between *shift* and *restructuring transfer*, because *restructuring transfer* is also a partial shift. Finally, one may be surprised by the author's consideration of L1 attrition as a type of CLI. Ulbrich and Ordin (2014) explain that, for Pavlenko (2000), L1 attrition are only the changes in a L1 system which "imply a simplification" of "the [L1] system due to the loss of specific features or elements" leading into "a reduction of the [L1] system's complexity" (Ulbrich & Ordin, 2014, p. 29). However, such a conception of L1 attrition is not shared by all the authors. For example, L1 attrition as defined by Schmid (2011) also "includes at least processes such as convergence or shift" (Ulbrich & Ordin, 2014, p. 29). Therefore, the possible definitions of first language attrition are presented in the following subsection.

2.1.3 First language attrition

In essence, there are two points of view through which first language attrition may be considered (Schmid, 2008). From the first point of view, it may be understood as a process, meaning a non-pathological declining of L1 skills previously possessed by the speaker (cf. Köpke & Schmid, 2004). Schmid (2008, 2011) states that first language attrition is a process of loss, of deterioration of L1 elements and of the total or partial forgetting of an L1 by a healthy speaker. Jessner (2003) understands this process as the negative or inverse language growth causing the loss of access to linguistic structures or features that had been already acquired (Schmid, 2011). However, note that the term loss may also refer to language shift, language death within communities, and aphasia. Moreover, in the context of attrition, it could lead to a misunderstanding as a sudden, all-or-nothing event, whereas the disintegration of L1 skills is more a gradual, and sometimes almost imperceptible (Schmid, 2011).

From the second point of view, first language attrition may also be considered as a phenomenon within the meaning of "an apparent difference which exists between pre-attrition stage A [of an L1] and [its] attrited stage B caused by the process of attrition" (Schmid, 2008, p. 10). In fact, there are two stages of L1 knowledge, 'A' which refers to the stage before the beginning of L1 attrition, and 'B', which could be considered as a moment when the process of L1 attrition is occurring (cf. Schmid, 2008). Obviously, as mentioned in Schmid (2008), there is a question when 'A' and 'B' are sufficiently different for being allowed to speak about L1 attrition, and this question remains without an exact answer. More recently, Schmid (2011) states a preference for using the term 'linguistic circumstance' when speaking about language attrition, rather than the term 'linguistic phenomenon'. This is because the linguistic performance of speakers who underwent attrition (so-called attriters) varies with the context, as it is impossible to discern whether the changes in their language skill will be permanent or are only temporary, and the speakers will regain their skill with increasing L1 input and use.

As mentioned by Cook (2003), the word attrition may have a negative connotation. Obviously, there are some negative effects of L2 on L1 during first language attrition, but also some positive effects, and effects that cannot be labelled as either good or bad (cf. Sůčková, 2020). Another term without negative connotation might be used for speaking about language attrition, but as stated by Schmid and Köpke (2017) to continue to use the term language attrition enables us to maintain research tradition and a cohesion in the studies from this research field.

Even if, for some authors, first language attrition is an "extreme situation" (Costa & Sebastian Galles, 2014, p. 6) happening only after several tens of years of very reduced L1 exposure (cf., e.g., Dussias et al., 2007) and when the speaker is very proficient in L2 (see, e.g., Kroll & Bialystok, 2013; Tsimpli, Sorace, Heycock, & Filiaci, 2004), for Schmid and Köpke (2017), first language attrition is more common. According to these authors, first language attrition may start from the beginning of L2 acquisition, meaning that it is a universal phenomenon to all L2 learners.

Systematic language attrition research began in the 1980s (Köpke & Schmid, 2004). Previous to this, first language attrition in bilingual speakers was largely ignored or at least, not commonly studied, even if some language observations were made by Czech linguist Mathesius (1935), a member of Prague Linguistic Circle, about Czechs living in Slovakia (cf. Sůčková, 2020). Roman Jakobson, also a member of the Linguistic Circle, can be considered to have laid the groundwork for first language attrition research due to his regression hypothesis (1941/1968), i.e., the progression of language loss mirrors the process of language acquisition, however, formulated with respect to pathological language loss (see Sůčková, 2020). From 1980 to the present day, research in language attrition is found in different linguistic disciplines and countries. The most recent book about language attrition is Schmid and Köpke (2019) edited by Schmid and Köpke.

2.1.4 Phonetic first language attrition

Given the definition of L1 attrition above, phonetic attrition may be defined as changes that occur in the L1 phonetic system of a healthy bilingual linked to decreased L1 use or input (cf. De Leeuw, 2019b). Therefore, in the area of phonetic attrition, a researcher's goal is usually the description of these changes and/or the explanation of their occurrence (De Leeuw, 2019b). In a review of studies on phonetic attrition, De Leeuw (2019b) also includes studies of changes in a dialect as the consequence of the attrition in the bidialectal speakers. Chang (2019a, p. 192) suggests the use of the term phonetic attrition for "long-term L1 changes" in L1 speech of late bilinguals "which are unlikely to be due to recent L2 experience only" because the changes remain, for example, after a decrease of L2 exposure contrary to phonetic drift which according to the author may refer to "ostensibly short-term L1 changes" in late or early bilinguals' L1 speech "attributable to recent L2 experience". Thus, according to this distinction proposed by Chang (2019a), phonetic attrition (1) remains at least during some time after L2 exposure, (2) concerns only late bilinguals, and (3) should not be linked only to a recent L2 experience. If one defines phonetic attrition as changes, one might associate it directly to the Schmid (2008) conception of attrition as a phenomenon, i.e., the difference between the pre-attrition and attrited stage (see above). However, some longitudinal studies of phonetic attrition may help us to understand it also as a process (see, e.g., De Leeuw, 2019a; Kartushina & Martin, 2019; Kornder & Mennen, 2021; Mayr et al., 2012).

De Leeuw (2019b) states that SLM can be used to explain not only L2 acquisition but also L1 attrition and to predict how L1 attrition will take place. According to Flege (2007, p. 366), "the phonic elements making up the L1 sound system and the phonic elements comprising the L2 system [...] exist in a 'common phonological space', and so will mutually influence one another", either through the process of assimilation or dissimilation. SLM states that assimilation will occur when "the L2 learner continues indefinitely to judge the instances of an L2 category to be instances of an L1 category" (Flege, 2007, p. 359), whereas dissimilation means that "bilinguals strive to maintain phonetic contrast between all of the elements in their L1/L2 phonetic space", similarly to the monolinguals who make effort to keep phonetic contrast among the elements existing in their L1 phonetic space (Flege, Schirru, & MacKay, 2003, p. 470). Assimilation (i.e., assimilation effect) means, in the context of phonetic attrition, that L1 sounds shift towards L2 sound's norms, while dissimilation (i.e., dissimilation effect) means that the speaker tries to maintain a difference between L1 and L2 sound, which leads to deepening of the acoustic distance between these two sounds (cf. De Leeuw, 2019b). Note that none of the five types of CLI given by Pavlenko (2000) designate the dissimilation effect (see, subsection 2.1.2). Indeed, Pavlenko's (2000) *shift* means only moving away from L1 values and approximating L2 values. Therefore, in the present thesis, I will hereafter use the term 'shift', not written in italics, for a general movement, including both moving away from L1 values to approximate L2 values (assimilation), and moving away from L1 and L2 values (dissimilation). I will use the term *shift* in italics, when referring to the type of CLI of Pavlenko (2000), and consequently meaning only an assimilation effect.

Finally, even if one may more spontaneously associate phonetic attrition with changes in L1 production, phonetic attrition may also occur in L1 perception. However, as claimed by Major (2010), there are now several studies on phonetic language attrition and CLI in L1 production (we present them more in detail in section 2.3), while studies of L2 impact on L1 perception are less frequent. Celata and Cancila (2010); Major (2010); Ventureyra et al. (2004) is the only study, and, given the focus of the present thesis on CF's L1 production, it will not be explored in great depth.

Concerning the studies of phonetic attrition with Czech as L1 or L2, we find Sůčková's (2020) study concerning Anglophone Expatriates in the Czech Republic, followed by her PhD thesis on phonetic and lexical L1 attrition of the same speakers (Sůčková, 2020). In the context of speakers living in an L1 environment, Sreková (2020) focused on phonetic CLI in L1 speech of Czech students of translation and interpreting English. Other studies of first language attrition with Czech as an L1 or L2 do not focus on phonetics. They focus on lexicon (Kříž, 2020; Šašková-Pierce, 1995)[2], grammar (Šašková-Pierce, 1995), morphology (Bolonyai & Dutková-Cope, 2001; Zajícová, 2010)[3] or the sociological aspects (Ngo, 2016)[4].

2.1.5 Phonetic drift

Phonetic drift is defined as "the effects of exposure" (Tobin, Nam, & Fowler, 2017, p. 46) of an L2 on an L1, at phonetic level. During the exposure, the L1 is not used by the speaker (Tobin et al., 2017). Chang (2012) defines phonetic drift as "cases of subtle phonological restructuring in the L1 as a consequence of L2 experience" Chang (2012, p. 249). Chang (2019a, p. 192) specifies that phonetic drift refers to "short-term L1 changes" "attributable to recent L2 experience" and therefore, he distinguishes it from phonetic attrition (see above).

Other terms may be used for speaking about phonetic drift. Tobin et al. (2017) study 'phonetic accommodation' of L1 to L2. Note that Tobin et al. (2017) examined L1 of bilinguals which I would like to classify as early bilinguals because of their onset of learning the L2. Sancier and Fowler (1997) speak about gestural drift for the changes in L1 of their late bilingual speaker.

All the studies concerning phonetic drift (with or without using precisely this term) focus on speakers staying in an L2 environment for less than one year. Their length of exposure to L2 varies from several hours of training of L2 pronunciation to some months of stay in the L2 country (see Chang, 2012; Kartushina, Hervais-Adelman, Frauenfelder, & Golestani, 2016; Lang & Davidson, 2019; Sancier & Fowler, 1997). Some authors study phonetic drift in the L1 of L2 learners, generally

[2] Kříž (2020) focused on Slovaks living in the Czech Republic. Šašková-Pierce (1995) focused on Czechs living in Nebraska.

[3] Bolonyai and Dutková-Cope (2001), focused on Czechs living in Texas, and Zajícová (2010) focused on Czechs living in Paraguay.

[4] The study of (Ngo, 2016) concerned Vietnamese community in the Czech Republic.

university students with various levels in L2 proficiency, living in an L1 environment (see Herd et al., 2015; Lord, 2008).

Based on the assumption of Flege (1995, p.239) that "phonetic categories established in childhood for L1 sounds evolve over the lifespan" with L1 and L2 input and the results of more than ten studies of phonetic CLI, Kartushina, Hervais-Adelman, et al. (2016) state that, concerning phonetic drift, there are the following three possible effects of L2 on L1 categories at phonetic level:

a) No change

b) Drift toward the L2 category

c) Deflection away from the L2 category, to maximise opposition with it which is called 'dissimilatory drift' by Chang (2012)

Figure 2.1 illustrates the three possibles effects. Note that the L2 sounds are also likely to undergo modifications, but for illustration purposes, these are shown as being static (Kartushina, Hervais-Adelman, et al., 2016). We may observe on fig. 2.1 that picture *b* resembles what De Leeuw (2019b) calls assimilation, while picture *c* resembles dissimilation. In opposition to what Chang (2012) terms 'dissimilatory drift', we might call picture *a* in the fig. 2.1 'assimilatory drift'.

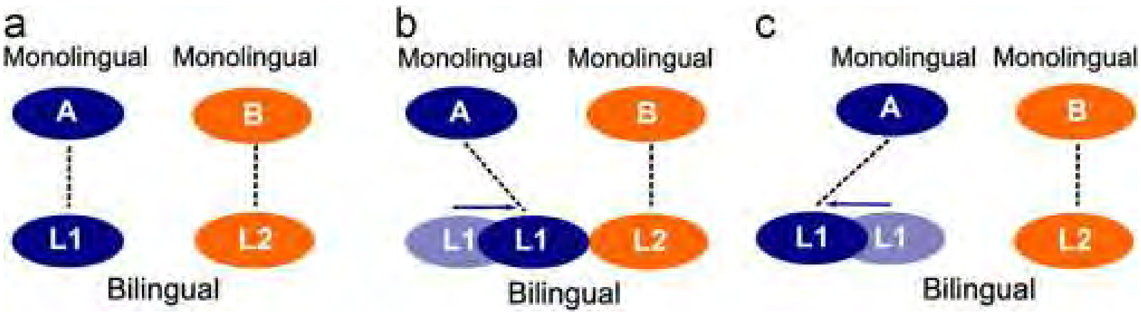


Figure 2.1: Three possible effects of L2 on L1 categories at phonetic level.

Note: A and B are monolinguals categories of the given languages, L1 and L2 are the categories of the bilingual speakers. L2 sounds are also likely to undergo modifications, but these are shown as static for illustration purposes. Taken from Kartushina, Hervais-Adelman, et al. (2016, p. 23).

Furthermore, Kartushina, Hervais-Adelman, et al. (2016) compare the results of Sancier and Fowler (1997) with the results of Flege (1987) and Major (1992). In all three studies, voice onset time (*VOT*) of selected voiceless stops was analysed with English as either the L1 or L2 of the bilingual. In Sancier and Fowler (1997), a late L2 bilingual was immersed in an L2 linguistic environment for a limited period, differing from Flege (1987); Major (1992) where late L2 bilinguals were immersed in an L2 linguistic environment for prolonged periods (see section 2.3 for more detail about these studies). Kartushina, Hervais-Adelman, et al. (2016, p. 24) conclude

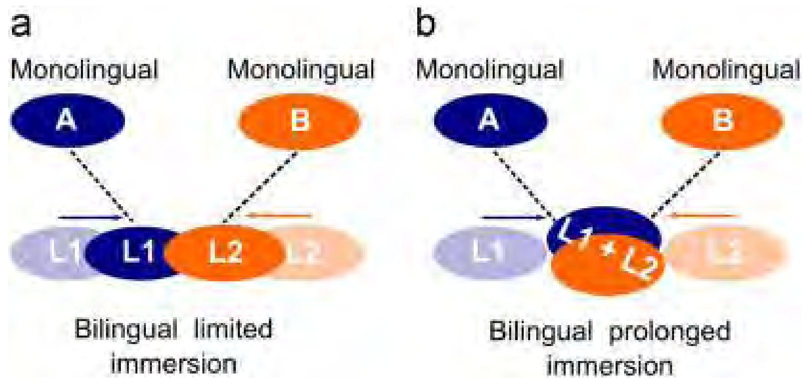


Figure 2.2: Assimilatory drift in L1 and L2 categories in late L2 speakers who have been immersed in an L2 linguistic environment for limited versus prolonged periods of immersion.

Note: A and B are monolinguals categories of the given languages. Taken from Kartushina, Hervais-Adelman, et al. (2016, p. 23).

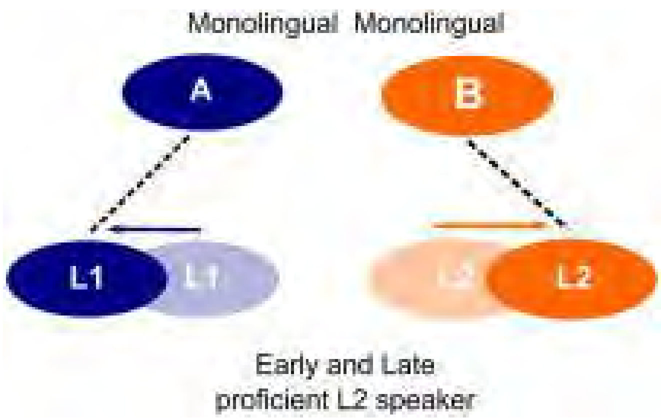


Figure 2.3: Dissimilatory drift in L1 and L2 categories in proficient L2 speakers.

Note: A and B means monolinguals categories of the given languages. Taken from Kartushina, Hervais-Adelman, et al. (2016, p. 24).

that (1) existing L1 categories of L2 speakers remain malleable and may be modified even after a short time of immersion in an L2 country (see picture *a* on fig. 2.2), and that (2) late bilinguals who use the L2 in everyday life "create intermediate, possibly even merged phonetic categories" in which the pertinent acoustic properties of both L1 and L2 are combined (see picture *b* in fig. 2.2).

Finally, Kartushina, Hervais-Adelman, et al. (2016) inspected the results of studies of Flege and Eefting (1987a, 1987b); Major (1992). In all three studies, the focus was on *VOT* in stops produced by either early or late bilinguals whose L1 or L2 was English. The authors conclude that in the case of the dissimilatory effect, the bilinguals' values in L1 and L2 sounds moved away from the monolinguals' values of these sounds, in the way that the bilinguals exaggerated the difference between their L1 and L2 sounds (see fig. 2.3).

All these description of assimilatory and dissimilatory drift of Kartushina, Hervais-

Adelman, et al. (2016) are obviously equivalent to the distinction between assimilation and dissimilation effect (see, e.g., De Leeuw, 2019a, and SLM). Above, I considered that graphical representations of these two effects (drifts) provided by Kartushina, Hervais-Adelman, et al. (2016) illustrate assimilation and dissimilation particularly well. Moreover, as based on the empirical studies, they allow the authors to distinguish two possible situations which may happen in the assimilation effect (creation of intermediate L1 and L2 categories or complete merging of the categories), and were not explicated by SLM.

Why does phonetic drift occur? One possibility of explaining it, in addition to the models of L2 speech production and perception discussed in chapter 1, is by using the Direct Realist Theory (Fowler, 1986) inspired by 'Motor Theory'. According to Motor Theory, when speakers perceive a produced speech, they perceive not only the sound as an acoustic cue but also the vocal tract gesture (cf. Liberman & Mattingly, 1985). For Liberman and Mattingly (1985, p. 2), the objects of speech perception are "the intended phonetic gestures of the speaker, represented in the brain as invariant motor commands that call for movements of the articulators through certain linguistically significant configurations". The gestural commands correspond to the articulatory properties of the required sound (e.g. tongue backing, lip rounding). Fowler (1986) shares the point of view that the objects of speech perception are articulatory rather than acoustic events. However, Motor Theory considers the articulatory objects of perception as events causally antecedent to vocal tract movements, such as neuromotor commands or intended gestures, for Fowler (1986), they are actual, phonetically structured, vocal tract movements, or gestures. Thus, according to Fowler (1986), for example, [b] will be directly perceived as a labial stop gesture without any transformation of sound to phoneme before access to the lexicon. As a consequence, by the linking of speech perception to speech production, we can suppose that during speech perception, the sound is directly perceived as a set of vocal tract gestures and its articulatory properties, which will be available to listeners when they produce their speech. Consequently, this means that speakers might imitate the phonetic forms they hear (cf. Pardo, 2016) and that the phonetic drift can be understood as "perceptually-guided changes in speech-production" (Sancier & Fowler, 1997, p. 421) that were most likely caused by the tendency of listeners/speakers to imitate the speech they hear (Sancier & Fowler, 1997). In other words, the speakers tend to imitate the ambient language, and this could explain why their speech in L1 and L2 productions drifts according to the phonetic norm of the ambient language of the country where the speaker is living.

2.2 Studies of phonetic L1 influence on L2

Even if phonetic influence of L1 on L2 acquisition is not the direct focus of this thesis, I will provide the main findings of studies on phonetic L2 acquisition in the present subsection. From these findings, we propose how CF might acquire French at phonetic level. Then, by focusing on studies of phonetic acquisition of French by Czech monolinguals, I will refine these speculations.

Many studies of phonetic L2 acquisition focused on stops. Because VOT values differ across languages and VOT is easily measurable, it was probably the most studied element in the works on phonetic L2 acquisition. To summarise the main findings, many studies found that if two languages (L1 and L2) differ in VOT values of stops, learners' L2 stops VOT values will be somewhere between the norm values of L1 and L2 (see, e.g. Antoniou, Best, Tyler, & Kroos, 2010; Flege, 1991; Fowler, Sramko, Ostry, Rowland, & Hallé, 2008). Hazan and Boulakia (1993); L. Williams (1977) found that L1 phonetic patterns are not necessarily transferred in L2 to the same degree. Learners of English as L2 whose L1 contrasts long-lag unaspirated stops with prevoiced stops, for example native Spanish or native French learners tend to produce English voiceless aspirated stops as target-like, i.e. with a long lag, but they produce English voiced stops as prevoiced, showing transfer from the L1. Curtin, Goad, and Pater (1998) showed that L1 transfer plays a role in the perception of L2 VOT contrasts as well as in their production. Moreover, Flege and Eefting (1987b) found that the amount of L2 experience can have a positive impact on acquisition of L2 VOT. In this study, the most experienced learners produced the most native-like L2 VOT values. Finally, even if, according to Schmidt and Flege (1996), the speaking rate can have an important impact on L2 native-like VOT production, Magloire and Green (1999) found no impact of speaking rate on accuracy of L2 VOT production.

The phonetic acquisition of L2 vowels by L2 learners was studied mainly by measurement of L2 vowels $F1$, $F2$, and duration, as vowels differ in these acoustic features among several languages. Several studies showed that learners' L1 strongly influences both the perception and the production of L2 vowels by L2 learners. Learners' perceptual difficulties with novel L2 vowels contrasts can be reflected in production difficulties (see, e.g., Best, 1995; Flege, Takagi, & Mann, 1995; Kuhl & Iverson, 1995; Levy & Strange, 2008; Rochet, 1995). For example, in the Levy and Strange (2008) study, the native English speakers learning French perceived the French /y/ as /u/, and thus produced it as /u/. Moreover, it was found that, as a contrast for discrimination, L2 learners can use some L2 vowels properties (i.e., the properties of vowels that they want to acquire) that are different from properties used by native speakers of L2 (cf. Bohn, 1995; Ylinen et al., 2009). For instance, the difference between English /iː/ and /ɪ/ may be perceived by certain learners of English as a difference in duration, contrary to native English speakers who may perceive it as the difference in height. Piske, MacKay, and Flege (2001) showed that quantity vowels distinction is harder to learn for mid vowels than non-mid vowels. Finally, Levy and Strange (2008); Oh (2008) found that both accuracy of L2 production and perception of vowels also depended on the place of vowels in the word or their phonological context (i.e., the surrounding phonemes).

The studies of phonetic acquisition of L2 liquids seem to be less numerous than studies on vowels or stops, even if several languages also differ in the properties of liquids. Concerning the phonetic differences in liquids across languages, an earlier study by Major (1986) focused on acquisition of the Spanish apical tap /ɾ/ and trill /r/ by native English speakers. Major (1986) states that errors made in L2 production due to L1 influence are numerous at the beginning of learning but decrease over time. However, the errors in L2 production caused by developmental factors, due to universal language acquisition processes (i.e., deletion or insertion of segments, approximation, assimilation, overgeneralisation) increase over time and decrease as acquisition is attained (Major, 1986). Phonetic acquisition of L2 liquids was also examined, for example, by Colantoni and Steele (2007) in the L2 production of native English speakers learning French. The authors focused on acquisition of French rhotic /ʁ/ by intermediate- and advanced-proficiency learners. The results let the authors conclude that phonetic salience plays a role on the degree of difficulty of L2 sound acquisition.

Concerning the phonetic acquisition of L2 at suprasegmental level, several authors studied L2 stress attainment. It was shown that if L1 and L2 are stressed languages, the L2 acquisition is easier for the learner, even when the placement of stress is different in both languages than when one of the languages is stressed language and another is not (cf. Altmann, 2006). Kijak (2009) showed that in the acquisition of L2 Polish, a language with fixed penultimate stress, learners whose L1 included the penultimate stress as a possible option (English, German, Italian, Russian and Spanish) showed an initial advantage over those whose L1 which allowed only final stress (French) or initial stress (Czech), or was a tone language (Mandarin). Moreover, it was shown that the acoustic cues used for L1 stress can be transferred in L2, and thus, L2 stress production remains erroneous due to the use of L1 acoustic cues for its realisation and no L2 acoustic cues (Aoyama & Guion, 2007). It was found that production of L2 stress according to L1 stress rulers seems to be the most common error in L2 learners' production (Archibald, 1993, 1994, 1995; Kijak, 2009; Youssef & Mazurkewich, 1998). Nevertheless, Kijak (2009) showed that the transfer of an L1 stress system to the L2 is more significant in L2 perception than in L2 production. Other authors have focused on acquisition of L2 tone, pitch accent, and intonation. For example, Wang, Sereno, and Jongman (2006) studied the production of Mandarin tones by native English speakers learning Mandarin, Hirano-Cook (2011) studied the acquisition of Japanese pitch accent by native English speakers learning Japanese and Santiago and Delais-Roussarie (2015) researched the acquisition of question intonation by Mexican Spanish learners of French. Moreover, Lee, Vakoch, and Wurm (1996); So and Best (2010) showed that an L1 system in which pitch is used to realise lexical contrasts confers some advantage in tone perception. Vogel (1991) showed that the prosodic information may be transferred from learners' L1 to their L2.

From this rapid and not exhaustive overview of findings in phonetic L2 acquisition, I would like to highlight two following points most relevant to the acoustic analyses conducted in the present thesis:

- As learners' perceptual difficulties with novel L2 vowels contrasts can be reflected in production difficulties, CF with low proficiency in French might have difficulty to perceive several French vowels and produced them correctly. We might suppose that in the case of Czech learner of French, it may occur the same situation as in Levy and Strange's (2008) study: the native Czech speakers learning French perceived the French /y/ as /u/, and consequently, they produced it as /u/ (see subsection 3.2.1 for the description of Czech and French vocalic systems).

- As the production of L2 stress according to L1 stress rules was found to be a very common error in L2 production, we might suppose that the native Czech speakers learning French will speak French by using the Czech stress rules at least at the beginning of the French acquisition. As French stress and Czech stress importantly differ, this error in L2 production might be particularly salient (see section 3.3 for the description of Czech and French phonetic suprasegmental systems).

Studies of acquisition of the French phonetic system by native Czech speakers allow us to learn slightly more about these suppositions even if these studies are unfortunately extremely restricted. Paillereau (2015) examined the perception and production of French oral vowels /i, e, ɛ, a, u, o, ɔ, y, ø, œ/, in isolation and in different consonant contexts by ten native Czech women, studying French at university with the goal to become teachers of French in the Czech Republic. In this acoustic and perceptual study, it was shown that phonetic proficiency in vowels depends on their spellings and consonant context. It was also found that vowels /i, y, u/ and /a/ are generally mastered with authenticity while the ability to hear contrasts between the vowels /e/ and /ɛ/, /ø/ and /œ and /o/ and /ɔ/ and pronounce them is limited for the majority of speakers. Moreover, it was found that French vowels /ø/ and /ɛ/ were produced with authenticity by most of the Czech speakers, future French teachers while /e/ and /o/ were authentically produced only by a single speaker. In sum, this study suggests that although one might suppose that teachers of French as a foreign language in the Czech Republic have a very good proficiency in the production and perception of French vowels, this is not the case. Consequently, we may suppose that CF did not perfectly master the production and perception of French vowels before moving to France. However, when living in France and being exposed to French, their proficiency in production and perception of French vowels might significantly improve.

Hradecká (2020) observed the errors in pronunciation of French by Czech students around 17-18 years old learning French in a Czech grammar school. She found that the most difficult phonemes to accurately produce by the students were the oral vowels /y/, /œ/, /ø/ and the four French nasal vowels. The problematic acquisition of French nasal vowels by Czech learners was further studied by Dohnalová (2020), who, in her work, provides some pedagogical activities to be done during French languages classes in order to facilitate the acquisition of French nasal vowels. Therefore, we might suppose that the acquisition of French nasal vowels may also be difficult for CF. However, the present thesis does not focus on the French nasal vowels. Indeed, in Toulouse French these vowels may be denasalised and the CF may therefore be exposed to these denasalised vowels (see chapter 3).

Vychopňová (2014) studied the vocalic duration of French vowels produced by Czech learners of French and native French speakers. The author found that the subsequent consonants are a source of variation of vocalic duration in L1 speech of native French while they are not in French speech of Czech learners of French. Then, the author examined the effect of final and initial stress and the effect of the syllable type on duration of French vowels in the production of native French speakers and Czech learners of French. It has been observed that the initial stress is an important quantitative element for the group of Czech speakers but not for the group of native French speakers. For CF, we might suppose that, at the beginning of their French acquisition, they might also ignore the variation of vocalic duration according to subsequent consonants and produce the initial stress as a significantly quantitative element, however, it is likely to change with longer exposure to French when living in France.

Concerning the suprasegments themselves, Duběda (2009) also focused on the realisation of initial stress in French by Czech learners of French. In both French and Czech, the initial stress exists, however, with different properties. The author found that Czech learners of French produced the initial French stress differently from native French speakers because of the transfer of the properties of the Czech initial stress to French. Czech learners stressed words which would not be stressed by native French speakers. The author observed a slight tendency to overemphasise dissyllabic words by Czech learners. Moreover, Czech learners used the tonal configuration HL*, L*H, S* for the realisation of initial stresses, which was rarely used by native French speakers. Tylečková (2015) analysed prosodic segmentation in French speech obtained by reading aloud a text by native French speakers and native Czech speakers learning French. The author observed the tendency of Czech learners to segment utterances into smaller intonation units than those of native French speakers, which can be explained by the lower level of language and textual skills in the group of native Czechs learning French than in the group of native French speakers. Hence, we might suppose that CF's initial stress in French was, at least at the beginning of their French learning, dissimilar to that of French native speakers. We should not make claims concerning about CF's segmentation of utterances into intonation units because of the mentioned possible explanation of Tylečková's (2015) results.

2.3 Studies of phonetic L2 influence on L1

As this thesis focuses on L1 speech production of CF, i.e., late-bilinguals living in the L2 country, the present section consists of studies of phonetic influences of L2 on L1 investigated in various L1 speech production of late-bilinguals living in various L2 environments. Therefore, the studies of phonetic L2 influence on L1 speech perception are not included (we have already mentioned only three existing studies about that topic above), as well as the studies of phonetic CLI in L1 speech of early bilinguals. CF also represent a group of speakers with various LORs ranging from a few months spent in France to several years. Hence, among studies presented in this section, we also include one focusing on phonetic L2 influence on L1 of speakers with a very low LOR even if these studies may be longitudinal that our thesis is not.

By examining the extant studies of phonetic L2 influence on L1 stops, fricatives, liquids, vowels, intonation and stress, this section tries to answer the following questions:

- According to the results of the presented studies, does more phonetic L2 influence on L1 occur in informal L1 production than in formal L1 production?
- What are the most studied languages, phonetic features, and founded effects in the research field of phonetic influence of L2 on L1?
- Has any author found a phonetic influence of L2 on L1, which might be classified as *borrowing transfer* as defined by Pavlenko (2000)?

2.3.1 Studies of stops

VOT of stops is the most commonly studied phonetic feature in the field of phonetic L2 influences on L1. This is probably for the same reasons that it seems to be the most studied feature in phonetic L2 acquisition (see above). Table 2.2 presents eight

Table 2.2: Studies of phonetic influence of L2 on L1 stops *VOT* produced by late bilinguals.

Study	L1 - L2	Phonetic feature	Speech task	Results
Flege & Hillenbrand (1984)	French - English	*VOT* of /t/	Reading of phrases, making a sentence with the read phrase, making a story with the read phrases	Assimilation in *VOT* of /t/
Flege (1987)	English - French, French - English	*VOT* of /t/	Reading of phrases, making a sentence with the read phrase	Assimilation in *VOT* of /t/
Major (1992)	English - Portuguese	*VOT* of /p/, /t/, /k/	Reading of word-list, making a sentence with the read word, informal conversation with the examiner	Assimilation in *VOT* of /p/, /t/, /k/
Sancier & Fowler (1997)	Portuguese - English	*VOT* of /p/ and /t/	Translation of heart sentences	Assimilation in *VOT* of /p/, /t/
Chang (2012)	English - Korean	*VOT* of stops	Reading of words-list	Assimilation in *VOT* of /p/, /t/, /k/
Mayr, et al (2012)	Dutch - English	*VOT* of stops	Carrier sentence filled by monosyllabic words	Assimilation in *VOT* of /p/, /t/, /k/
Kupske & Alves (2016)	Portuguese - English	*VOT* of /p/, /t/, /k/	Reading of words	Assimilation in *VOT* of /p/, /t/, /k/ if LOR 8–11 years
Stoehr et al. (2017)	German - Dutch	*VOT* of /p/, /t/, /k/, /b/, /d/	Picture naming test	Assimilation in *VOT* of /p/, /t/, /k/
Suckova (2020)	English - Czech	*VOT* of stops	Reading of word-list and verbal fluency task	Assimilation in *VOT* of /p/, /t/, /k/ and potentional assimilation in /b/, /d/, /g/

Note: The second column indicates the L1 and L2 of the bilinguals. The third indicates studied phonetic features. The light grey rows indicate case studies, the white rows mean studies of groups.

studies of phonetic CLI in stops' *VOT*.[5] In this table, we may observe that these studies focus on English as L1 or L2 as the English stops differ in *VOT* from *VOT* of stops of several languages. We may also observe that all seven studies reported assimilation in *VOT* of fortis stops, i.e., in /p/, /t/, /k/, if the three phonemes were studied, while there was no significant shift in *VOT* in /b/, /d/, /g/ when these phonemes were studied (Chang, 2012; Mayr et al., 2012; Stoehr et al., 2017) except from the one found by Sůčková (2020). However, because of "the lack of precise characterisation of Czech word-initial plosives" (Sůčková, 2020, p. 84), it is not clear if shift found in lenis plosive by Sůčková (2020) is related to the influence of the Czech language (L2) and Czech-accented English to which the late English-Czech bilinguals were exposed.

In table 2.2, we may also observe that reading of word-list or reading of sentences was often used for studying phonetic attrition in *VOT* of stops. For example, Chang (2012) recorded the reading of a word-list by 19 American English learners of Korean, enrolled in a 6-week Korean course, living in an L2 environment and attending a Korean language course 4 hours per weekday, and Mayr et al. (2012) recorded the reading of carried sentence filled by target monosyllabic words. In this study, the authors compared the production of a late Dutch-English bilingual who had moved to the UK 34 years before the time of the study with her monozygotic twin sisters, a Dutch monolingual, who had lived her whole life in the Netherlands. A more novel approach can be found in a study by Sůčková (2020), who examined the production in a so-called verbal fluency test of 18 late English-Czech bilinguals. In this test, the bilinguals were first asked to name as many words as they could from the semantic category of animals in a period of one minute. Then, they were asked to produce as many words as they could starting with a given letter. Major (1992) also did not only focus on the stops' *VOT* in the bilinguals' production in reading. After the reading task, the five late English-Portuguese bilinguals underwent an informal conversation with the examiner. Another interesting speech production task was used in Sancier and Fowler's (1997) study. In this study, a late Portuguese-English bilingual paid more attention to what she said, rather than how she spoke. This was achieved by one Portuguese native speaker and one native English speaker eliciting sentences from the bilingual speaker by asking her to translate a sentence heard moments before. Moreover, in this study, the bilingual was a 27-year-old female Brazilian with an advanced level of proficiency in American English who began learning English at age 15 and had moved from Brazil to US, then from the US to Brazil, then back to the US. Her speech was recorded three times, i.e., after 4.5-month stay in US, upon returning from Brazil to US after a 2.5-month stay in Brazil

[5] I included in table 2.2 the study of Stoehr et al. (2017) even though one of the authors' 23 late German–Dutch bilinguals started to learn Dutch at the age of 8 when he moved to the Netherlands and might, therefore, be considered as early bilingual rather than a late bilingual. Another, began to learn Dutch at the age of 13, with another beginning after the age of 15.

and before leaving for Brazil after 4 months in the US. The authors found that *VOT* of /p/ and /t/ produced in both languages (English and Portuguese) were shorter after a stay of several months in Brazil than after a stay of several months in the United States, meaning an assimilation effect of English on Portuguese when staying in US.

In Flege and Hillenbrand (1984); Flege (1987); Major (1992), the phonetic CLI in L1 production in reading and in more spontaneous speech was compared. Major (1992) found that the influence of L2 was more prevalent in speech elicited during the informal conversation of L1, than in the reading of a word-list and sentences made with the read words. Conversely, both studies Flege and Hillenbrand (1984) and Flege (1987) did not find any significant effect of speech production tasks on *VOT* values of the bilinguals' L1 /t/. In Flege and Hillenbrand (1984), the L1 speech of late French-English bilinguals was elicited by three production tasks, i.e., reading of phrases, production of a made sentences with the read phrase and telling an invented story containing the phrases read directly before, while Flege (1987) studied only the L1 speech of the bilinguals elicited by two speech production tasks, i.e., reading of phrases and production of a made sentences with the read phrase directly before. Flege's (1987) study analysed the production of 42 female speakers, including a group of French monolinguals, a group of English monolinguals, three groups of late English-French bilinguals with differing learning experiences of French, and one group of late French-English bilinguals, who had been living in Chicago for an average of 12.2 years at the time of the study. Concerning fortis stops, Sůčková (2020) studied *VOT* only of /k/ produced in a verbal fluency task and *VOT* of /p/ and /t/ produced by reading a word-list. Thus, it is impossible to know whether there was more phonetic CLI in *VOT* of fortis stops produced by reading the word-list or the verbal fluency task. Concerning *VOT* in lenis stops, the author does not compare the results in both tasks because methodological issues related to a limited number of analysed speech tokens taken from verbal fluency task did not allow it.

Both Sancier and Fowler (1997) and Kupske and Alves (2016) focused on late Portuguese-English bilinguals and obtained the same results (see table 2.2). Interestingly, Kupske and Alves (2016) studied L2 influence on L1 *VOT* of stops produced by 12 native Brazilian Portuguese speakers whose LOR in London was wide ranging, this allowed the authors to obtain very stimulating results. *VOT* of /p/, /t/, /k/ in L1 production of bilinguals living in London 0–3 years did not statistically differ from one of the Portuguese monolinguals. On the other hand, bilinguals with an LOR between four and seven years produced *VOT* values of /t/ and /k/ as statistically different from those produced by Portuguese monolinguals. Finally, bilinguals who had lived in London between eight and eleven years showed statistical differences in *VOT* of all voiceless plosives (/p/,/t/,/k/) compared those produced by Portuguese monolinguals.

Table 2.3: Studies of phonetic influence of L2 on L1 stops produced by late bilinguals (not VOT studies).

Study	L1 - L2	Phonetic feature	Speech task	Results
Chang (2012)	English - Korean	$f0$ onset of stops	Reading of word-list	Assimilation in stops $f0$ onset
Dmitrieva et al. (2010)	Russian - English	realisation of word-final stops	Reading of word-list	Borrowing in realisation of word-final stops
Suckova (2020)	English - Czech	realisation of word-final voiced stops	Reading of word-list and verbal fluency task	Dissimilation in realisation of word-final voiced stops

Note: The second column indicates the L1 and L2 of the bilinguals. The third indicates studied phonetic features. The white rows means studies of groups.

Chang (2012); Dmitrieva, Jongman, and Sereno (2010); Sůčková (2020) also studied other phonetic features of stops than the VOT (see table 2.3). Chang (2012) measured $f0$ at the onset of the vowel after the stop and found that its values in all English stops produced by late English-Korean bilinguals approached the values of Korean stops produced by Korean monolinguals. Dmitrieva et al. (2010); Sůčková (2020) examined the stops in the word-final position as Czech and Russian language have devoicing of obstruents in the word-final position, while it is not a typical feature for English. For example, minimal pairs such as *bad* and *bat* are distinct in the majority of accents of English. Sůčková (2020) adds that native speakers of English tend to perceive Czech-accented English as heavily-accented when the devoicing of word-final consonants, in positions where voicing is mandatory, occurs. Interestingly, Sůčková (2020) predicted that word-final stops produced by late English-Czech bilinguals will be completely desonorized, because of the influence of Czech word-final devoicing and the exposure of late English-Czech bilinguals to Czech-accented English, in which final-word devoicing is supposed to be widely present. Despite this, late English-Czech bilinguals showed a lesser degree of desonorization in the word-final stops than in the English monolinguals speakers, who were used as a control group. This finding may be explained as due to late bilinguals producing word-final lenis stops more carefully, even with a slightly exaggerated pronunciation. This could be due to a special enunciation effort employed during the recording or because of their will to maintain this feature of their mother tongue in order fight again Czech-accented English (cf. Sůčková, 2020).

Table 2.4: Studies of phonetic influence of L2 on L1 fricatives produced by late bilinguals.

Study	L1 - L2	Phonetic feature	Speech task	Results
Dmitrieva et al. (2010)	Russian - English	realisation of word-final fricatives	Reading of word-list	Borrowing in realisation of word-final fricatives
Suckova (2020)	English - Czech	realisation of dental fricatives	Reading of word-list and verbal fluency task	No CLI

Note: The second column indicates the L1 and L2 of the bilinguals. The third indicates studied phonetic features.

2.3.2 Studies of fricatives

Dmitrieva et al. (2010) investigated the word-final devoicing not only in stops but also in fricatives (see table 2.4), and found that late Russian-English bilinguals used two additional duration parameters compared to those used by Russian monolinguals, for the distinction of voiced and voiceless obstruents in word-final position. The bilinguals used vowel duration, closure/frication duration, duration of voicing into closure, and duration of release portion, while the monolinguals employed duration of the closure/frication and release portion (Dmitrieva et al., 2010). These findings suggest that late bilinguals employed two additional duration parameters, which are used in English, meaning that they borrowed them from their L2 for use in their L1 (cf. Dmitrieva et al., 2010).

The phonetic influence of L2 on L1 fricatives was further examined by Sůčková (2020). Sůčková (2020) compared the English dental fricatives /θ/ and /ð/ produced by late English-Czech bilinguals with those produced by English monolinguals, categorising them as "either canonical, affricate, fronting (i.e. the manner of realisation was closer to or identical with labiodental fricatives), stopping (i.e. the manner of realisation was that of plosives) and sibilance, with voiced and voiceless realisation for the phonologically voiced dental fricative" (Sůčková, 2020, p 118). The categorisation was based on the visual inspection of the waveform and spectrogram, and auditory impression made by the author. The author found no differences in the manner of dental fricatives realisation by bilinguals and by monolinguals.

2.3.3 Studies of liquids

Phonetic influence of L2 on L1 liquid consonants was studied by Bergmann et al. (2016); De Leeuw (2008); De Leeuw, Tusha, and Schmid (2018); De Leeuw, Tusha, Zhao, Helke, and Greenfield (2018); Ulbrich and Ordin (2014) (see table 2.5). Concerning the lateral liquid consonant, we may observe that in both De Leeuw (2008)

Table 2.5: Studies of phonetic influence of L2 on L1 liquids produced by late bilinguals.

Study	L1 - L2	Phonetic feature	Speech task	Results
Bergmann et al. (2016)	German - English	$F1$ and $F2$ of /l/	Retelling of a watched fragment of a Charlie Chaplin film	Assimilation in $F1$ of /l/
De Leeuw (2009)	German - English	$F1$ and $F2$ of /l/	Reading of word-list	Assimilation in $F1$ of /l/
De Leeuw et al. (2017)	Albanian - English	$F1$ and $F2$ of /l/ and /ɫ/	Reading of word-list	Merging of /l/ and /ɫ/ by one speaker
Ulbrich & Ordin (2014)	German - English	$F2$ and $F3$ of post-vocalic /r/	Reading of text	Assimilation in /ar/ and /ar/C contexts
De Leeuw et al. (2018)	German - English	$F2$ and $F3$ of /r/	Reading of word-list	Assimilation in $F2$ and $F3$ of /r/

Note: The second column indicates the L1 and L2 of the bilinguals. The third indicates studied phonetic features. The light grey rows indicates case studies, the white rows means studies of groups.

and Bergmann et al.'s (2016) studies, $F1$ of German /l/ shifted toward $F1$ of the English /l/ in late German-English bilinguals, while there was no shift in its $F2$. Thus, the result in De Leeuw (2008) and Bergmann et al. (2016) study is the same even if the two studies did not investigate the speech elicited by the same production task (cf. table 2.5). Concerning the found shift in $F1$ of /l/ compared with no shift in its $F2$, one might suppose that the shift in $F1$ of /l/ is more likely to occur because, in general, the human auditory system is more sensitive to differences between lower frequencies than higher frequencies (cf. Goldstein & Brockmole, 2016). More precisely, one might suppose that bilinguals proficiency in $F1$ of L2 liquids will be more native-like than that in $F2$ because they cannot easily perceive the difference in $F2$ between L1 and L2 liquids. Consequently, because of better proficiency in $F1$ in L2 liquids, there might be more phonetic influence of $F1$ of L2 liquids on the one of L1 liquids. De Leeuw, Tusha, and Schmid (2018) also studied phonetic CLI in lateral liquid consonants in the L1 speech of ten late Albanian-English bilinguals. This study focused on the contrast between light /l/ and dark /ɫ/, which is phonemic in Albanian but allophonic in southern British English. The impressionistic and acoustic analyses showed that one late bilingual totally neutralised the phonemic contrast in her L1 production (De Leeuw, Tusha, & Schmid, 2018).

Concerning the rhotics, Ulbrich and Ordin (2014) studied post-vocalic /r/ in the production of seven groups of speakers, i.e., German monolinguals of non-rhotic variety of German, English monolinguals of non-rhotic variety of English spoken in

Oxford, English monolinguals of rhotic variety of English spoken in Belfast, and late German-English bilinguals living in Oxford and Belfast, both native speakers of a non-rhotic variety of German. The study compared the production of post-vocalic /r/ in L1 and L2 by the speakers of the seven groups, and showed that late German-English bilinguals living in Belfast produced a post-vocalic /r/ as constrictive in their mother tongue, i.e., non-rhotic variety of German. This was probably a result of the influence of rhotic variety of English spoken in Belfast, to which they were exposed, on their German. De Leeuw, Tusha, Zhao, et al. (2018) investigated the production of the rhotic consonant in the onset position by ten late German-English bilinguals through an 'impressionistic' analysis. In this impressionistic analysis, two native English speakers with German as an L2 judged the production of the words containing the rhotic consonants in the onset position produced by the ten bilinguals in order to examine whether one of these bilinguals differed from the others. Given the positive result, the speech of the one bilingual was acoustically examined. Thus, it was shown that this bilingual is an exemplar case of extreme attrition in /r/, which underwent an assimilation effect.

2.3.4 Studies of vowels

Table 2.6 provides an overview of the studies of phonetic influence of L2 on L1 vowels. Only six studies focused on phonetic influence of L2 on L1 vowels. We did not include the studies with L2 English bilinguals who started to learn English before 13 years as this seemed to represent early bilingualism rather than the late bilingualism. Among these studies, we might cite Jiang (2008); Oh et al. (2011), which focused on a group of bilinguals who started to acquire L2 when they were around 9 to 13 years old. [6]

The earliest study on phonetic CLI in vowels was by Flege and Hillenbrand (1984) who analysed the first three formants of /u/ and /i/ produced by late French-English bilinguals in L1 speech elicited by reading phrases, by making sentences with the phrase read directly before, and by making the story with the phrases read directly before. The assimilation occurred in $F2$ of /u/ in these three production tasks, and interestingly, the late bilinguals showed a similar degree of phonetic influence of L2 on $F2$ of their L1 /u/ in all these tasks.

Flege (1987) examined the first three formants of three vowels, /i/, /u/ and /y/, in the production of 42 female speakers among which there was a group of late

[6] Jiang (2008) focused on Mandarin-English bilinguals who, in acoustic analysis were shown to deviate from the norm in the production of Mandarin vowel Iii. In the perception experiment, their production of Iyl, a Mandarin vowel with no counterpart in English was perceived as significantly different from Mandarin monolinguals by Mandarin monolinguals. Oh et al. (2011) compared the phonetic CLI in child and adult production after a one year stay in an L2 country. Children produced the L2 vowels more accurately than adults, but also showed phonetic CLI in their L1 vowels, whereas the adults did not.

Table 2.6: Studies of phonetic influence of L2 on L1 vowels produced by late bilinguals.

Study	L1 - L2	Phonetic feature	Speech production task	Results
Flege & Hillenbrand (1984)	French - English	$F1$, $F2$, $F3$ of /u/ and /y/	Reading of phrases, making a sentence with the read phrase, making a story with the read phrases	Assimilation in $F2$ of /u/
Flege (1987)	English - French, French - English	$F1$, $F2$, $F3$ of /u/, /i/ and /y/	Reading of phrases, making a sentence with the read phrase	Assimilation in French-English $F2$ of /u/
Chang (2012)	English - Korean	$F1$ and $F2$ of vowels	Reading of monosyllables words	Assimilation of $F1$ in all vocalic system
Mayr et al. (2012)	Dutch - English	duration, $F1$ and $F2$ of vowels	Carrier sentences filled by monosyllabic words	Assimilation of $F1$ in all vocalic system
Bergmann et al. (2016)	German - English	$F1$ and $F2$ of /aː/, /ɛ/, /ɔ/	Retelling of a watched fragment of a Charlie Chaplin film	Assimilation in $F2$ of /aː/
Lang & Davidson (2019)	English - French	$F1$ and $F2$ of vowels	Reading of sentences with target word in their middles containing target vowels	No CLI in the production of learners but assimilation of $F1$ in all vocalic system of bilinguals

Note: The second column indicates the L1 and L2 of the bilinguals. The third indicates studied phonetic features. The light grey rows indicate case studies, the white rows are studies of groups.

French-English bilinguals. (See above. All 42 female speakers at first read aloud phrases in L1 and in L2 and then created an original sentence with the phrase read directly before.) Interestingly, Flege (1987) did not find any differences between the studied sounds (the 3 vowels and /t/) produced in the two different speech production tasks (reading of phrases *versus* production of created sentence). However, Flege (1987) found that $F2$ of the French /u/ produced by the late bilinguals was higher than its value obtained for the French monolinguals. Therefore meaning that the value of $F2$ of the French /u/ produced by the late bilinguals, was shifting towards $F2$ value of /u/ produced by English monolinguals. This result may be considered as an assimilation effect. Nevertheless, one should take into consideration that in the author's group of the late bilinguals, four of them were originally from Paris, one was from Annecy, and two were from Belgium. Consequently, one may notice that the bilinguals' native French did not represent the same dialect, which might be seen as a limitation of the study.

Chang (2010, 2012) also examined the phonetic influence of L2 on L1 vowels. In 2012, Chang measured $F1$ and $F2$ at Korean and English vowel midpoints in the production of 19 American English learners of Korean (3 males and 16 females). Chang (2012) compared their vowels produced in a reading aloud task of Korean and English monosyllable words with the vowels of 9 native Korean monolingual speakers. The author found phonetic CLI in $F1$ of English vowels produced by female learners (male learners were not sufficiently numerous for being allowed to conclude a statistical significance) after 5 weeks of the Korean language course. Of particular interest, the CLI found may be considered only as an assimilation effect of the whole vocalic system but not as an assimilation effect of each vowel. Indeed, there was a general unidirectional shift of all vowels; the mean $F1$ in all learners' L1 vowels decreased and, consequently, approached the Korean vocalic system whose general mean $F1$ was lower than that of English. As a consequence of the shift, an assimilation effect occurred between some English and Korean vowels and dissimilation effect between another which, according to the author, SLM might not fully predict:

> *"In the case of female learners, for example, the raising of the English /ʊ/ brought it closer to the nearby Korean /ɨ/, but the raising of the English /u/ took it farther away from both Korean /ɨ/ and /u/, the two closest L2 vowels. Similarly, the raising of the English /e/ was convergent with the closest Korean vowel, /i/, while the raising of the English /ɪ/ was divergent from the closest Korean vowel, /ɛ/. The existence of many such contradictory patterns in the phonetic drift of individual vowels indicates that the observed vowel shifts cannot be accounted for coherently in terms of cross-linguistic influence at the level of individual vocalic segments. [Phonetic drift may be predicted by] SLM and the PAM-L2, but only*

partly [...] since these models do not address cross-linguistic perceptual relations beyond the segmental level." (Chang, 2012, p. 262-264)

Concerning this result of a general unidirectional shift in $F1$ of vowels, we may speak about 'systemic' assimilation of vocalic space (cf. Chang, 2011).

Similar findings were made by Mayr et al. (2012) in the study of monozygotic twin sisters (see above). The authors provided an automatic measurement of $F1$ and $F2$ at the monophthongal vowel mid-point. In the production of vowels by the bilingual sister, there also occurred an assimilation of all L1 vocalic system as in Chang's (2012) study; $F1$ increased in all the speaker's Dutch vowels meaning that it got nearer to the mean $F1$ value of the English vocalic system. Assimilation also occurred in some individual vowels, which were similar to L2 norms, as expected according to SLM. However, assimilation also occurred in some vowels that had no counterparts in L2, a finding which is less easily explainable. Moreover, in their study, Mayr et al. (2012) explain that the systematic shift in vocalic system is more likely to occur in $F1$ than in $F2$, even if L1 and L2 vocalic system may differ in their mean $F2$ values, as, in general, the human auditory system is more sensitive to differences between lower frequencies than higher frequencies (cf. Goldstein & Brockmole, 2016, see above for the detailed explanation of this argument).

One might generalise the findings of the last two studies to suppose that phonetic shift in L1 vowels of late-bilinguals will still be systemic and unidirectional, i.e., consisting of the unidirectional movement of the whole L1 vocalic system of late-bilinguals. Nevertheless, the study of Bergmann et al. (2016) does not allow us to validate that supposition. Bergmann et al. (2016) studied three L1 vowels, /aː/, /ɛ/ and /ɔ/ in the production of late German-English bilinguals compared to their production by German monolinguals. Prior to the acoustic analysis of these vowels, Bergmann et al. (2016) made a perceptual experiment allowing the authors to divide the late-bilinguals into two groups, one with the bilinguals who were perceived as more native-like sounding by German monolingual listeners, and another with bilinguals perceived as less native-like sounding. The speech production of 33 German monolinguals and 33 late German-English bilinguals residing in the USA or Canada was used for the perception experiment. Following this, the speech of 10 monolinguals and 20 bilinguals (10 from each group) was chosen for the acoustic analysis of $F1$ and $F2$ of the three vowels. Contrary to the studies presented above, $F1$ and $F2$ measured at the intensity peak occurring near the midpoint of the vowels were normalised by Lobanov's (1971) speaker-intrinsic method. Interestingly, Bergmann et al. (2016) found phonetic CLI only in one of the three vowels and only in one of both formants. CLI occurred in $F2$ of L1 /aː/ in more native-like sounding bilinguals. $F2$ of L1 /aː/ in more native-like sounding bilinguals had lower values than the monolinguals and approximated the English reference value meaning an assimilation effect. There were no other significant CLI. Consequently, this result does not validate the two possible suppositions coming from studies of Chang (2012); Mayr et al. (2012), i.e., (1) that phonetic shift always occurs in all vocalic system and is unidirectional and (2) that more phonetic CLI occurs in $F1$ than in $F2$ of vowels. Moreover, these two suppositions are not confirmed by the longitudinal study of De Leeuw (2019a) which investigated Stephanie Graf's L1 production over several decades. In that study, only two L1 vowels were examined. The author found an assimilation effect in $F2$ of the speaker's /i/ and no changes in $F2$ of speaker's /a/. Concerning $F1$, the author found it decreased in /i/ and increased in /a/, meaning an opposite movement in these two vowels in the vocalic space. However, the changes in $F1$ were probably more related to ageing than to the L2 influence on L1 (cf. De Leeuw, 2019a).

Lang and Davidson (2019) examined if it is possible to generalise the findings of Chang (2010, 2011, 2012) involving rapid phonetic drift occurrence, i.e., after few weeks of L2 intensive learning. Lang and Davidson (2019) analysed the vowels in L1 production of 11 American-English learners of French in Paris and 11 late American-English-French bilinguals living in Paris between 9 and 48 years. The learners attended a six week study abroad program in Paris. $F1$ and $F2$ of vowels of both were measured at vowel midpoints and normalised by the Nearey method (Kendall & Thomas, 2010). No significant phonetic drift was found in learners' L1 vowels after six weeks of the study abroad program. Thus, there is a discrepancy between this study and the study of Chang (2012), which could be explained by the fact that phonetic drift depends on cross-linguistic dissimilarities of the examined pair of languages and that cross-linguistic dissimilarities between English and Korean are more drastic than between French and English. Another explanation may be the number of hours of L2 learning classes because Lang and Davidson (2019) L2 learners had only 6 hours of L2 classes per week, while in Chang's (2012) study the learners had 20 hours per week.[7]

On the other hand, Lang and Davidson (2019) found a significant CLI in vowels produced by late American-English-French bilinguals. There was a general shift of the mean $F1$ of a whole vocalic system meaning a general decrease in $F1$ and the assimilation of vocalic space by approaching it to the mean $F1$ of French vocalic space. This result is similar to the systemic assimilation effect of vocalic spaces found by Chang (2012); Mayr et al. (2012) mentioned above. For $F2$, there is no significant systemic shift of vowel space. Moreover, shifts in $F1$ or $F2$ occurred in some individual English vowels of late American-English-French bilinguals. Some of these shifts may be interpreted as assimilation effect, as for example in $F2$ of /ɑ/ where the values approached the French /a/, and the shift upward and forward of /æ/ and /ɛ/ demonstrated movement toward the closest French categories of /a/

[7]Note that Kartushina, Frauenfelder, and Golestani (2016) showed that phonetic drift can also be a result of one hour of intensive training of target foreign vowels.

and /ɛ/.

2.3.5 Studies of intonation and stress

The studies of phonetic influence of L2 on L1 at the suprasegmental level are summarised in table 2.7. We may see that eight of these studies investigated whether late bilinguals L1 speech may be perceived as foreign-accented by L1 monolinguals, while only two studies examined the intonation of late bilinguals in their L1, knowing that Leeuw, Mennen, and Scobbie (2011) is a publication from De Leeuw's (2008) PhD thesis. Phonetic CLI in L1 intonation was also studied by Mennen (2004) however, only on late bilinguals living in the L1 environment.

The first authors who examined how the late bilingual's L1 speech is perceived by monolinguals was Sancier and Fowler (1997). The authors investigated whether Brazilian-Portuguese monolinguals could tell whether a pair of sentences of the late Brazilian-Portuguese-American-English bilingual was produced by the bilingual after a stay in Brazil or after a stay in the US. The perception experiment was composed of pairs of sentences produced by the bilingual in the translation task mentioned above. Thirteen Brazilian-Portuguese monolinguals participated in this perception experiment by listening to the pairs of sentences, judging them and commenting on them. Their comments suggested the presence of hyperarticulation, changes in intonation, and changes in nasality in the bilingual's sentences produced after the speakers stay in the US. The bilingual's speech was also commented as sounding 'explosive' by her father, which, alongside with the hyperarticulation, was one of the reasons that led the authors to examine late bilingual's VOT acoustically. In the perception experiment, on average, listeners selected the Brazilian-Portuguese sentences produced just after the stay in US as more foreign accented than those produced just after the stay in Brazil on 66% of trials leading the authors to conclude that the bilingual's "Portuguese was detectably more accented after several months of exposure to American English" (Sancier & Fowler, 1997, p. 426).

De Leeuw (2008); De Leeuw, Schmid, and Mennen (2010) were the first studies to use foreign accent rating (FAR) in the phonetic attrition research field, and the results obtained were used in De Leeuw (2008) for determining the group of bilinguals which the author focused on acoustically. FAR is Moyer's (1999) global foreign accent assessment of German second language learners adapted for phonetic attrition research (see De Leeuw et al., 2010). Thus, it was largely used in phonetic attrition studies in order to examine perceptually the L1 speech of late bilinguals (cf. Bergmann et al., 2016; Mayr et al., 2020; Schmid, Köpke, & De Bot, 2013; Sůčková, 2020). FAR in phonetic attrition research generally consists of two judgements made by the listeners with respect to a given speech item. The first judgement is generally the selection of native versus non-native speaker status. When asked the question of whether a heard speech item is produced by a native speaker of a spoken language,

Table 2.7: Studies of phonetic influence of L2 on L1 intonation and stress produced by late bilinguals.

Study	L1 - L2	Phonetic feature	Speech task	Results
Sancier & Fowler (1997)	Portuguese - English	perception of foreign accent	Translation of heart sentences	Perceived L2 influence
De Leeuw et al. (2010)	German - Dutch, German - English	perception of foreign accent	Retelling of a watched fragment of a Charlie Chaplin film	Bilinguals perceived as sounding as less natives
Schmid & Hopp (2013)	German - English, German - Dutch	perception of foreign accent	Retelling of a watched fragment of a Charlie Chaplin film	No statistical significant difference
Bergmann et al. (2016)	German - English	perception of foreign accent	Retelling of a watched fragment of a Charlie Chaplin film	Bilinguals perceived as sounding as less natives
Mayr et al. (2020)	Spanish - English	perception of foreign accent	picture-based narrative	Bilinguals who taught their L1 perceived as sounding as less natives
Suckova (2020)	English - Czech	perception of foreign accent	Retelling of a watched fragment of a Charlie Chaplin film	No statistical significant difference
Suckova (2012)	English - Czech	perception of foreign accent	Informal conversation with the examiner	Bilinguals perceived as sounding as less natives but statistical significance was not analysed
De Leeuw et al. (2012)	German - English	Tonal alignment of pre-nuclear rise	Reading of sentences	Assimilation in beginning of $f0$ rise
De Leeuw (2008)	German - English	Pitch range	Reading of story	No significant changes

Note: The second column indicates the L1 and L2 of the bilinguals. The third indicates studied phonetic features. The light grey rows indicate case studies, the white rows studies of groups.

the listeners reply either yes or no. The second judgement shows the listeners' confidence in the first judgement on a three-point scale, to the question "how certain are you of your judgement?", the listeners may reply "very certain, somewhat certain or uncertain" (cf. Bergmann et al., 2016; De Leeuw et al., 2010; Mayr et al., 2020; Schmid et al., 2013; Sůčková, 2012). These two judgements are converted to a six-point Likert scale indicating the native status of the speaker (6=certain of non-native speaker status, 5=semi-certain of non-native speaker status, 4=uncertain of non-native speaker status, 3=uncertain of native speaker status, 2=semi-certain of native speaker status, and 1=certain of native speaker status). Additionally, Sůčková (2020) also asked the listeners to indicate on a scale from 1 to 5 whether the speaker is easy or hard to understand, to indicate the country of origin of the speaker and to write a comment on how they had arrived at their judgments and what they were based on. A retelling of a fragment of a Charlie Chaplin film watched by the speakers was used as a speech elicitation task by the authors for obtaining the speech items to be used in FAR (cf. table 2.7).

Interestingly, the five studies using FAR and the same speech elicitation task i.e., Bergmann et al. (2016); De Leeuw et al. (2010); Schmid et al. (2013); Sůčková (2020) did not revealed the same results. Sůčková (2020) elaborated FAR by following De Leeuw (2008); De Leeuw et al. (2010). In both Sůčková (2020) and De Leeuw et al. (2010)) the same scene from the Charlie Chaplin film was used for speech items. However, there was no statistically significant difference between the score obtained in FAR by the late English-Czech bilinguals and the English monolinguals in Sůčková (2020), De Leeuw et al. (2010) found that both late German-Dutch and German-English bilinguals FAR scores significantly differed from German monolinguals. Schmid et al. (2013) also studied late German-Dutch and German-English bilinguals. Contrary to (De Leeuw et al., 2010; Sůčková, 2020), in this study, the speech items used for FAR described different parts of the film. Moreover, contrary to De Leeuw et al. (2010), Schmid et al. (2013) did not find any significant difference between the FAR score of German monolinguals and that of German-English bilinguals, either between the FAR score of German monolinguals or of German-Dutch bilinguals.

Similarly to Schmid et al. (2013), Bergmann et al. (2016) chose to use speech items with different semantic content. In this study, "two successive excerpts never described exactly the same movie fragment" (Bergmann et al., 2016, p 75). On a six-point scale ranging from 1 (clearly non-native-like) to 6 (clearly native-like), the German monolinguals received an average rating of 5.05, while late German-English bilinguals received an average rating of 4.05. Thus, the authors concluded that bilinguals globally sounded less native-like than monolinguals speakers as almost 40% of the bilinguals "received lower ratings" than the monolinguals with the "lowest rating" (Bergmann et al., 2016, p 76). In this study, the authors used the results of

FAR for dividing the bilinguals into two groups, i.e., bilinguals perceived as more native-like, and bilinguals perceived as less native-like, that phonetic CLI in L1 production was after compared acoustically.

FAR was also used by Mayr et al. (2020). In this study, L1 speech of two groups of late Spanish-English bilinguals was examined. The first group of bilinguals (non-teachers) was composed of speakers who practised a diverse range of professions except teaching their L1, ranging from social work to accountancy and nursing. They did not habitually use Spanish in their communication at work or at home. The speakers from the second group (teachers) taught their L1 either in schools or in universities. The speakers from both groups of bilinguals had lived continuously in the UK for at least five years. Interestingly, the authors found that the L1 teachers' speech was perceived as more foreign-sounding by the Spanish monolinguals than that of non-teachers. Moreover, there was no significant difference between the FAR score of non-teachers and Spanish monolinguals who constituted the control group.

However, FAR was not used by Sůčková (2012) who examined perceptually phonetic changes in L1 speech of Anglophone Expatriates living in Czech republic. The author used a perception test of her own consisting of 3 questions. The first question, "does this speaker sounds foreign (in terms of accent, intonation)?", the listeners replied on a 5-point scale where 1 meant "not foreign at all" and 5 meant "very foreign". To the second question, "what is the speaker's country of origin", the listeners chose one of the possibilities in the given list. For the third question, the listeners were invited to write comments on any strange/foreign/unusual features they noticed in the speaker's speech. Concerning the results of the first question, in this study, the mean score of Czech monolinguals was 2.8, the mean of English monolinguals was 1.5, and the mean of late English-Czech bilinguals was 2.0, suggesting that the bilinguals' speech was perceived as more foreign-accented than one of English monolinguals. However, no other statistical analyses were done in this study, so we cannot know whether there was a statistical difference between the mean score of bilinguals and English monolinguals.

Concerning the studies of phonetic L2 influence on L1 intonation, De Leeuw (2008); Leeuw et al. (2011) examined tonal alignment of prenuclear rise in L1 of ten late German-English bilinguals. The authors predicted that the assimilation effect, i.e., tonal alignment of both tonal elements of the prenuclear rise (its beginnings and its end) would occur significantly earlier in L1 of bilinguals than in L1 of the control groups of German monolinguals because both the beginning and the end of prenuclear rise occurs later in German than in English. Interestingly, it was confirmed only for the beginning of $f0$ rise but not for the end of $f0$ rise. This result may be understood as an assimilation effect in bilinguals' beginning of prennuclear rise. Moreover, in this study, two bilinguals exceeded the monolingual German norm of the end of prenuclear rise, meaning that they underwent the dissimilation effect in the end of prenuclear rise in their native language (cf. De Leeuw, 2008). By contrary, De Leeuw's (2008) comparison of pitch range in L1 of late German-English bilinguals with the one in L1 of German monolinguals did not reveal any significant difference between the two groups of speakers.

To return to the questions raised at the start of this chapter, I have shown that only three studies compared phonetic CLI in different speech production tasks, and that only Major (1992) found the significant difference in phonetic CLI across speech style with more CLI in informal speech style. One might suppose that the difference was not found in the two other studies due to the format of the experiment, that is, telling an invented story containing phrases read directly before and the production of a sentence again containing the phrases read directly before. One may consider that these tasks are probably not sufficiently spontaneous enough for more CLI in them may appear. We saw that phonetic CLI was the most examined in VOT, and widely studied using FAR, and that, in some studies, a perception of L1 speech of late bilinguals by the L1 monolinguals was examined prior to the acoustic analysis of L1 speech of the bilinguals in order to give directions to the acoustic analyses according to the results of perception experiments (e.g., Bergmann et al., 2016; De Leeuw, 2008; Sancier & Fowler, 1997). We also saw that the majority of studies focused on English as bilinguals' L1 or L2. The languages studied with English as L1 or L2 were French, Korean, German, Dutch, Albanian, Czech, Portuguese, and Russian. Concerning the languages pair not including English, there were three studies, which concerned bilinguals who had German as L1 and Dutch as L2 (De Leeuw, 2008; Schmid et al., 2013; Stoehr et al., 2017). No other language pairs were investigated.

Concerning the found effects, we may observe from tables 2.2 – 2.7 that phonetic L2 influence on L1 was very often found as an assimilation effect. That is probably linked to the fact that the studies often investigated L1 and L2 sounds or suprasegments, which can be considered as similar. The studies that reveal a dissimilation effect are rarer (cf., also, De Leeuw, 2019b). We mentioned the result of Sůčková (2020) concerning the realisation of word-final stops, which may be interpreted as a dissimilation effect, and the dissimilation effect found in two bilinguals in Leeuw et al. (2011). Moreover, the latter result suggests that in a group of bilinguals, some may undergo an assimilation effect, while others may undergo a dissimilation effect, which might be related to the fact that perception of sounds or suprasegmental features as new or similar varies among bilinguals (cf. SLM-r). We also noticed that Dmitrieva et al. (2010) found an original borrowing of phonetic L2 feature into L1 phonetic system, a result which may be consider as the *borrowing* according to Pavlenko (2000) types of CLI.

2.4 Extralinguistic factors

This section first provides the definition and a general consideration of extralinguistic factors. Secondly, I shall discuss the results of the studies that investigated relationships between extralinguistic factors and phonetic CLI. I also highlight the concrete methodological issues of studying extralinguistic factors and present how the authors of studies of phonetic CLI dealt with them.

2.4.1 Defining extralinguistic factors

Various factors are involved in attrition (cf. Köpke, 2007). One particular group, extralinguistic factors, are "equally problematic in terms of definition and measurement, as [these] factor[s] set cover a wide range of aspects of the bilingual experience and is therefore as varied as are the bilingual individuals themselves" (Schmid & Yılmaz, 2018, p 2). I propose to define them, in opposition to the intralinguistic variables defined as "within-language factors which may contribute to first language attrition" by De Leeuw (2008, p 35), as factors external to the language as a system, but related to the bilingual as a person, which may contribute to first language attrition. In an early study, Pavlenko (2000, p. 196) proposed 10 "specific constraints" under which the L2 influence on L1 "operates", comprising both extralinguitic and intraliguistic factors. Despite the age of this article and its basis on old studies, one of the ten "constraints" outlined is helpful for our understanding of phoentic CLI. It is the individual differences in imitation abilities. This factor is especially fundamental for phonetic CLI studies as it suggests that higher imitation abilities of speakers will lead to more native-like L2 at phonetic level, which has the potential to cause more L2 influence on L1. More recently, Schmid (2011) distinguishes three categories of extralinguistic factors: (1) personal background factors including, for example, bilingual's age at immigration, LOR, education, job, socio-economic status, (2) factors linked to the bilingual's languages use and exposure (3) factors linked to the bilingual's attitude towards, affiliation with, integration to L2 and L1 country, culture, mentality and L1 and L2 themselves.

Extralinguistic factors may be either composed of quantitative variables or composed of qualitative variables. They may have an impact on the amount of attrition and the type of attrition (Köpke, 2007). In the first language attrition research field, some extralinguistic factors have been already studied, for example, age of onset of acquisition of an L2 (AoA), LOR, input of L1 and L1 use, whereas others have received less attention. I shall provide general considerations (i.e., not only related to phonetic CLI) about these factors in the following paragraphs.

Concerning LOR, AoA and age at immigration in L2 environment, Schmid et al. (2013) mention AoA as an incontestable impact on L1 attrition as it allows us to distinguish earlier from late bilinguals. Schmid and Hopp (2014) adds that L1 attrition observed in L1 speech of late bilinguals is usually limited. However, it is not certain that first language attrition is more likely to occur in speakers aged below 11 years (as was stated, for example, by Pavlenko (2000) given the results of earlier studies) as these speakers may have not entirely acquired their L1 at the time of immigration (Bylund, 2019). Indeed, an imperfection of their L1 may result in an incomplete L1 acquisition and not necessarily from first language attrition. For LOR, even if one might easily suppose that a longer stay in L2 country causes more phonetic attrition, this may not necessarily be so. After having reviewed the studies examining the link between LOR and L1 attrition, Schmid (2011) concluded that studies on L1 attrition that investigated late bilinguals with an LOR higher than ten years often found little or no link between LOR and L1 attrition.

Schmid and Köpke (2007) note that it has long been assumed that the frequency of L1 use has a strong influence on L1 attrition. According to Bergmann et al. (2016); Opitz (2019), L1 attrition is linked to the absence of or decrease in L1 use and L1 input that helps the maintenance of an L1. Similarly, Köpke (2019, p. 26) highlights that L1 "attrition appears, in the light of usage-based theories, to be the natural consequence of a decrease" in L1 use of the speaker. However, as Sůčková (2020) notes the amount of L1 use is challenging to measure, as it is usually based on the speaker's self-assessment and self-reporting.

Nevertheless, other factors related to language use and exposure are also important, such as, L2 proficiency, frequency of using languages other than the L1, dominant language mode in the L2, areas of bilingual life in which the languages are used. Concerning the last factor, several studies showed that bilinguals speaking their L1 mostly in their professional life are less affected by attrition than bilinguals speaking their L1 mostly in their family and private life (De Leeuw, Schmid, & Mennen, 2010; Yilmaz & Schmid, 2012). Concerning L2 proficiency, Jarvis and Pavlenko (2008, p. 201) state that studies of phonetic CLI "suggest that L2 effects are most visible in L2 users with high levels of L2 fluency and proficiency". However, L2 proficiency has rarely been studied in the research field of L1 attrition (Köpke, 2007).

Regarding language mode, findings suggest that the mode in which L1 is activated and used is more important than the frequency of its use (cf. Grosjean, 2001). Mainly, code-switching may result in more changes in L1 as claimed by Grosjean and Py (1991):

> *"Frequent use of the L1 within a community where code-switching is the norm may thus trigger an accelerated process of contact-induced L1 change."* (Grosjean & Py, 1991).

Moreover, code-switching may impact L1 input; imagine two groups of immigrants in the L2 environment. The immigrants from the first group have no contact with other immigrants in the L2 country and live alone. They use the L1 only when communicating with someone from their country of origin, and they are exposed to the L1 only by media or reading. The second group of immigrants are all members of an immigrant community in which code-switching is frequently used. In the first group, as a confirmation for their L1 production, the bilinguals are exposed to the L1 norm in the L1 monolingual speech. In the second group, the community of immigrants become the source of the confirming evidence for bilinguals who are exposed to a new L1 norm, i.e., the L1 spoken by the community living in an L2 environment. In this sense, in the second group, L1 changes might be explained not necessarily by a lack of L1 use, but also by a lack of confirming evidence corresponding fully to the native L1 norm (cf. Smith & Buren, 1991).

Attitudinal extralinguistic factors, i.e., the third category of factors (Schmid, 2011, see above) may also be linked to a social environmental estimation of L1 and L2 values or dominant opinions in the immigrants' community. The factors of this category may have some influence on the motivation to acquire L2 or to maintain L1, which may be impacted by, for example, the socio-economic or ideological context of the L1 or L2 country, bilinguals life situation or whether they feel the need to be a 'perfect' speaker of L1 and L2 or a 'perfect' member of an L2 country (cf. Köpke, 2007). Bernaus, Masgoret, Gardner, and Reyes (2010) found that positive attitudes towards the L2 speech community or to individual speakers of L2 lead to higher proficiency levels in L2. Nevertheless, even if one should suppose that an L2 immersion and L1 disuse results in better L2 acquisition, integration in L2 culture and more dramatic first language attrition, as bilingualism and biculturalism have often been examined separately, it cannot be affirmed for now (cf. Yılmaz, 2019).

2.4.2 Extralinguistic factors in studies of phonetic L2 influence on L1

In the field of phonetic CLI, LOR and L1 use are the most examined extralinguistic factors. Other factors such as amount and frequency of L2 use, L2 proficiency, exposure to L1, code-switching and attitudinal factors are rarely or never studied. The relationship between LOR and phonetic CLI is probably the easiest to analyse as LOR is a continuous variable. This relationship was examined in the studies of phonetic CLI (cf. Bergmann et al., 2016; Dmitrieva et al., 2010; Kupske & Alves, 2016; Lang & Davidson, 2019; De Leeuw, 2008; Sůčková, 2020). The authors studied the link of LOR to the phonetic CLI examined using FAR as well as to the phonetic CLI examined by acoustic analyses on selected phonetic features (cf. section 2.4.2). Lang and Davidson (2019); Kupske and Alves (2016) separated the bilinguals into groups according to their LOR, and analysed the relationships between group effect and phonetic CLI, whereas Bergmann et al. (2016); De Leeuw (2008); Sůčková (2020) analysed the relation of phonetic CLI to LOR as a continuous variable. Lang and Davidson (2019) had two groups of speakers. The LOR of the speakers from the first group was six weeks, and there was no significant phonetic CLI in their L1 speech. The speakers from the second group lived in the L2 country for between 9 to 48 years, and there were significant phonetic CLI in their L1 speech. Kupske and Alves (2016) divided the bilingual speakers into three groups, i.e., bilinguals with an LOR of 0–3 years, bilinguals with an LOR of 4–7 years and bilinguals with an LOR of 8–11 years. No phonetic CLI occurred in the first group, there was a phonetic CLI in VOT of two stops in the second group, and VOT of all three voiceless stops of the speakers of the third group underwent phonetic CLI.

As section 2.4.2 shows, LOR rarely correlated with phonetic CLI. Bergmann et al. (2016) was the only study that found the significant effect of LOR on the score that the bilinguals obtained in FAR. The authors used the linear mixed-effects model to examine the relation between score obtained by the speaker in FAR and speaker group, L1 use, and LOR. In this analysis, LOR had a significant influence on the speaker's score obtained in FAR, meaning that the longer the bilinguals lived in an L2 country the more their L1 speech was perceived as foreign-sounding. However, when analysing the significance of these effects on $F1$ and $F2$ of vowels, the LOR was not significant. The authors add "this may partly be due to the fact that there were no significant differences between controls and attriters on the majority of the formants" (Bergmann et al., 2016, p. 76). By contrast, there was no significant effect of LOR on bilinguals' FAR score in the work of De Leeuw (2008) as well as in the work of Sůčková (2020). De Leeuw (2008) examined the relationship between LOR and FAR scores by using multiple regression analyses including the factors age of arrival into L2 country and amount of contact with L1. The author found an inverse correlation between age of arrival and FAR score, meaning that the earlier speakers moved to Canada, the more likely their L1 was perceived as foreign-accented. Moreover, age of arrival significantly correlated with LOR in both groups of bilinguals, i.e., late German-English bilinguals and late German-Dutch bilinguals.

Dmitrieva et al. (2010) did not analyse the direct relationship between LOR and phonetic CLI, but they analysed the relationship between L2 Experience Score and phonetic CLI. L2 Experience Score was calculated for each late Russian-English bilingual by making the sum of the number of years that the bilinguals studied English and the number of years they spent in a English-speaking country. The authors found that with phonetic CLI increased with higher LOR: an important exposure to English (L2) which is missing final devoicing and considerably employs vowel length to mark the voicing of the subsequent consonant, impacted the bilinguals in their ability to produce final devoicing like Russian monolinguals (Dmitrieva et al., 2010). Similarly, Lang and Davidson (2019) studied the effect of the amount of exposure to L2 on phonetic CLI. The authors divided the group of late bilingual speakers whose L1 speech revealed attrition (i.e., speakers who lived in L2-country from 9 to 48 years) into those who had less than 20 years of cumulative experience with French, including classroom instruction, and those with 20 years of experience or more. Nevertheless, the results showed very few differences between these two groups of speakers: the groups differed only in /u/ production, which underwent more phonetic attrition in the group of speakers with L2 exposure of 20 years or more.

We may observe that the studies in which LOR had a significant impact on phonetic CLI also included speakers with an LOR lower than 10 years (cf. section 2.4.2). Schmid's (2011) suggestion that "attrition studies investigating subjects with a period of residence of more than ten years generally find little or no time effects" (Schmid, 2011, p. 79) seems to be confirmed by our overview as all studies including minimal LOR higher than 10 years did not found a significant impact of LOR on phonetic CLI (see section 2.4.2).

The relationship between phonetic CLI and amount of L1 use was only examined by De Leeuw (2008); Bergmann et al. (2016); Sůčková (2020) probably because of the methodological difficulty of measuring the amount of L1 use and its statistical analysis. To begin with a rapid zoom on how the authors deal with these difficulties, Bergmann et al. (2016) write that by using "a sociolinguistic questionnaire", they collected "self-reported data of L1 use in different contexts (work, home and other)" (Bergmann et al., 2016, p. 75). The authors add that "on average", bilinguals "reported using their L1 for 20.72% of the time (SD 18.8, range 0–76.7)" (Bergmann et al., 2016, p. 75) but do not give any other specific information neither about the questionnaire nor about how the average of L1 use was calculated and from which questions in the questionnaire the data were collected. De Leeuw (2008) describes her constitution of factor concerning amount of L1 use as follow:

> *"A number of background variables pertaining to language contact, use and environment were gathered through the original questionnaire for each speaker. All questions were on a five-point Likert scale, which was later converted to an interval variable between 0 and 1. For each variable, 0 referred to no use or presence of the L1 in that particular type of situation, while 1 referred to extremely frequent use or presence of the L1."* (De Leeuw, 2008, p. 54)

The "original questionnaire" was based on the questionnaire proposed by Schmid (2002) for L1 attrition research. De Leeuw (2008) explains that she computed the variable CONTACT by making an average of the following subvariables: 1. amount of contact with German at work; 2. amount of German spoken with present partner; 3. frequency of visits to Germany since migration; and 4. overall estimate of amount of contact with German. The link between the variable CONTACT and the FAR score obtained by the bilingual was examined. For the analysis of link between L1 use and phonetic CLI examined by acoustic analysis, De Leeuw (2008) constituted the variable amount of contact with the L1. For constitution of this variable, the questions in the questionnaire "Could you please indicate to what extent you use English with the following people? Also, to what extent do these people speak English with you?" (De Leeuw, 2008, p. 86) with a given list of "people" (partner, children, grandchildren, friends, relatives, colleagues) gave to the bilinguals the possibility to reply 'Always', 'Usually', 'Sometimes', 'Rarely', or 'Never' which were latter encoded as 1, 0.75, 0.5, 0.25, and 0 and the average was calculated. Sůčková (2020, p. 56) used for bilinguals' extralinguistic data collection a "sociolinguistic questionnaire" based on Dostert (2009); Keijzer (2007). She computed a factor "language used at home" (Sůčková, 2020, p. 219) from the four items. Two items asked what language or languages does the bilingual mostly use when talking to his/her (ex)partner and what language or languages does the (ex)partner mostly use when talking to the speaker. Another two items asked the same but concerning the bilingual's communication with his/her children. To reply, the bilinguals had the choice between only English, both Czech and English, but mostly English, both Czech and English, without preference, both Czech and English, but mostly Czech, only Czech, and other or no answer. The answers were coded on a scale from 0 (= only Czech) to 1 (= only English) (in accordance with Schmid, n.d.a), and then the average was calculated. Sůčková (2020, p. 278) also computed the average of L1 use of bilinguals with L1 speakers and the average of L1 use of bilinguals with L2 speakers. For that, she used the percentage obtain from two items in the sociolinguistic questionnaire. The two items were:

- How much of your spoken communication takes place in English? Please indicate in . . . %. Out of this . . . . % with other expats . . . . % with not very proficient Czech speakers . . . . % with rather proficient Czech speakers
- How much of your spoken communication takes place in Czech? . . . . %

After that, the author used non-parametric Kendall rank correlation to investigate the relationship between these variables and phonetic CLI.

As section 2.4.2 shows, the relationship between L1 use and phonetic CLI was rarely found to be significant. Bergmann et al. (2016) found that lower L1 use was, more the bilingual's L1 speech was perceived as foreign-sounding, and De Leeuw (2008), concerning her variable CONTACT, found that the less contact bilinguals had with their native language, the more likely they were to be perceived as non-native speakers by the L1 monolinguals.

The relationship between L2 proficiency and phonetic CLI was studied by Major (1992); Sůčková (2020). For collecting data about L2 proficiency of bilinguals Sůčková (2020) used a multiple-choice test and a close test. The relationship between L2 proficiency and phonetic CLI was not significant in this study (cf. section 2.4.2). To study the L2 proficiency of bilinguals, Major (1992) examined bilinguals VOT values in L2 stops and how their approach to the one produced by L2 monolinguals. Concerning the speech produced during the informal conversation, Major (1992) found that higher the L2 proficiency, i.e., the more native-like the bilinguals' L2 VOT values were, the more phonetic CLI in their L1 VOT values occurred. This relationship was not significant for the speech produced by reading or making a sentence with the word read directly before.

Chang (2013) reported findings which are contrasting with those of Major (1992). In Chang (2013), phonetic CLI in L1 of American learners of Korean in Korea, divided into two groups, was compared. The first group was composed of novice learners, whereas the second group comprised learners with previous experience of Korean. (The learners followed the same Korean course as in Chang (2012), see above.) Chang (2013) found that the phonetic drift was greater in the L1 speech of the novice learners than in the learners with previous experience in Korean, meaning that, contrary to the Major (1992) finding, higher proficiency in L2 would be linked with lower phonetic CLI. However, note that in Chang's study (2013) among the learners with a previous experience in L2 were some early bilinguals. We suggest that this had an impact on Chang's results as we suppose that there might be important differences between phonetic drift of early bilinguals and late bilinguals.

Concerning code-switching, two studies examined its relationship with bilinguals' score obtained in FAR. The results of De Leeuw et al. (2010) studies suggest that lower use of code-switching leads to lower phonetic CL1, i.e., phonetic influence of L2 on L1 (De Leeuw et al., 2010). Mayr et al. (2020) studied confirmed this statement from the opposite direction. In this study, more code-switching was associated with being perceived as less native. More precisely, L1 speech of teachers of their L1 to L2 native speakers was particularly affected by phonetic CLI. This is likely as the teachers often co-activated their L1 and L2 during the teaching and were regularly exposed to non-native L1 speech produced by their students (cf. Mayr et al., 2020).

To the best of our knowledge, no author has investigated the relationship between phonetic CLI and bilinguals' exposure to the L1, i.e., their passive contact with the L1 through reading, watching TV, listening the radio or music in L1 as well as the relationship between phonetic CLI and bilinguals' attitude towards, affiliation with, integration to L2 and L1 country, culture, mentality and L1 and L2 themselves.

Table 2.8: Impact of extralinguistic factors on phonetic influence of L2 on L1 as found in the studies.

Phonetic feature	Study	LOR range	LOR	L1 use	L2 use	L2 prof.
accent (FAR)	De Leeuw (2008)	14–51	no	yes		
accent (FAR)	Bergmann et al. (2016)	6.5–34	yes	yes		
accent (FAR)	Suckova (2020)	1–23	no	no	no	no
/l/	De Leeuw (2008)	18–55	no	no		
/l/	Bergmann et al. (2016)	7–34	no	no		
vowels	Bergmann et al. (2016)	7–34	no	no		
vowels	Lang & Davidson (2019)	0.12; 9–48	yes			
/p/, /t/, /k/ (VOT)	Kupske & Alvez (2016)	0–11	yes			
/t/ (VOT)	Suckova (2020)	1–23	no	no	no	no
word-final devoicing	Dmitrieva et al. (2010)	0–5	yes			
prenuclear rise	De Leeuw (2008)	18–55	no	no		
/p/, /t/, /k/ (VOT)	Major (1992)	12–35				yes

Note: 'Phonetic feature' is an element whose attrition was studied in relation to the extralinguistic factors. LOR range is the LOR range of all bilinguals speakers investigated in the study. L2 prof. mean L2 proficiency. The columns LOR, L1 use, L2 use and L2 prof indicates if in the given study, there was found significant impact of the given extralinguistic variable on phonetic L1 attrition (yes) or not (no) or the impact was not studied (gray colour of the cell).

2.5 Summary and significance of the chapter for our research

The definitions of concepts related to the studies of phonetic CLI were given at the beginning of the chapter. We propose to retain the following considerations:

- Bilingualism is mainly defined in terms of the speaker's L1 and L2 proficiency, L1 and L2 use, need of L1 and L2. According to the age of onset of acquisition of an L2 by the speaker, simultaneous early bilingualism, successive early bilingualism and late bilingualism may be distinguished.

- CLI is as any kind of effect that one language of the speaker can have on another speaker's language and may take shape of one of its five types according to Jarvis and Pavlenko (2008); Pavlenko (2000). Czech and French are such different languages that all five types of CLI might be found in L1 speech of CF. CLI may be described through ten dimensions (Pavlenko, 2000). With respect to these ten dimensions, the present thesis focuses on CLI which is phonetic, reverse, linguistic, implicit, unintentional, productive, oral, verbal, both overt and covert, and negative (cf Part I).

- L1 attrition is defined as the non-pathological decline of speaker's L1 skills previously possessed, linked to less frequent L1 use or its disuse (Köpke & Schmid, 2004; Köpke, 2019). It may be understood as a phenomenon or as a process (Schmid, 2008). Therefore, phonetic L1 attrition refers to phonetic changes in L1 speech of a bilingual linked to the decrease of L1 use (cf. De Leeuw, 2019b; Köpke, 2019). Phonetic L1 attrition may occur as assimilation (L1 values approaches L2 norms) or as dissimilation (L1 values moves away L1 and L2 norms).

- Phonetic drift means the effects of exposure to an L2 causing subtle phonetic changes in L1, which are short-term in opposition to long-term changes in phonetic attrition.

- As already mentioned in Part I, in the present thesis, the term phonetic CLI was and will continue to be used for all phonetic L2 influence on L1, including phonetic L1 attrition and phonetic drift.

We provided a large overview of studies of phonetic influence of L2 on L1. The most essential points for our thesis coming from this overview are:

- Very few studies compared the amount 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.
- FAR was usually used in order to determine the directions which the acoustic analyses should take.
- 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 $F3$.

We saw that, similarly to the studies of phonetic influence of L2 on L1, the studies of phonetic L1 influence on L2 seems to also very often focus on VOT, L2 vowels and L2 stress. From the overview of studies of phonetic influence of L1 on L2, we suggested that (1) some Czech learners of French might have difficulty to perceive and produce the contrast between French /y/ as /u/, and (2) native Czech speakers learning French might speak French by using the Czech stress rules at least at the beginning of the French acquisition. (1) might be particularly probable as also /y/ was found as one of the most problematic phonemes for being accurately produced by Czech students learning French in Hradecká (2020). The study of Paillereau (2015) allowed us to add that acquisition of contrasts between French vowels /e/ and /ɛ/, /ø/ and /œ/ and /o/ and /ɔ/ might also be particularly difficult for Czech learners of French.

Extralinguistic factors were defined as factors external to the language as a system but related more to the bilingual as a person, which may contribute to phonetic CLI. Concerning LOR, we saw that the suggestion of Schmid (2011) that the link between LOR and phonetic CLI is rarely significant when a study focuses on bilinguals with an LOR higher than ten years, seems to be confirmed by the results of the studies of phonetic CLI. Moreover, we saw that it might be suggested that a link exists if bilinguals with low LOR are included in the study. We saw that some authors found an important impact of L1 use on phonetic CLI. Our general claim that L2 proficiency impacts phonetic CLI was rarely studied was confirmed as the majority of these studies reviewed here did not focus on the impact of L2 proficiency.

The claim of Grosjean (2001) concerning the impact of the use of code-switching on L1 attrition seems to be confirmed by studies of De Leeuw et al. (2010); Mayr et al. (2020) whose results suggest that code-switching triggers phonetic CLI.

We also highlighted the methodological difficulties of studying extralinguistic factors and that, in the domain of phonetic CLI, the methodology and analyses chosen for extralinguistic factors' examination are far from homogeneous. Thus, in brief, there is a lack of investigation into extralinguistic factors' impact on phonetic CLI. At the same time, there a solid methodological approach and methodological tools are missing. These would allow the authors to investigate that impact. One might argue that the questionnaire proposed in Schmid (2002) (and used with the modification, for example, by (De Leeuw, 2008)) is an important methodological tool for studying the phonetic CLI. Even if, in our opinion, this argument cannot be rejected, we must highlight that there are several issues with processing the collected data using this type of questionnaire, because, the conversion of replies 'Always', 'Usually', 'Sometimes', 'Rarely', or 'Never' in De Leeuw (2008), and 'only English', 'both Czech and English, but mostly English', 'both Czech and English', 'without preference, 'both Czech and English, but mostly Czech', and 'only Czech' in Sůčková (2020) into numeric variable and making an average is statistically not a correct way of proceeding (for more detail, see chapter 7).

The presented studies about phonetic CLI allow us also to make a bridge between them and the models about L2 speech production and perception presented in section 1.2. We would like to underline the following three points:

- The presented studies based their predictions on previous models to the SLM-r as the SLM-r was not available at the time of the studies. With the arrival of the SLM-r, it is supposed that speakers of the same L1 differ in learning of the same L2 because due to the many factors related to them as individuals. Consequently, they may also differ in their L1 and L2 phonetic categories and phonetic CLI. This point may be an interesting clue for an explanation of results of De Leeuw (2008) concerning the phonetic CLI in the end of the prenuclear rise where two bilinguals showed a dissimilation effect while another eight showed an assimilation effect. (see subsection 2.3.5 for the reminder).

- SLM-r explains changes in L1-L2 phonetic categories are due to the input of both L1 and L2 during the same period, while the L2LP predicts the changes in L1 to occur only in the case of insufficient L1 input. The studies of phonetic CLI which revealed code-switching as a trigger of phonetic CLI seems to confirm more the vision of the SLM-r about the changes than the vision of the L2LP as a code-switching may be supposed to be accompanied by L1 and L2 input.

- L2LP predicts phonetic CLI only as depending on L1 input. Nevertheless, the studies of phonetic CLI showed that these may be also linked to L1 use. However, the accent of the L2LP on L1 input is interesting: an L1 exposure should consequently be a relevant variable in phonetic CLI. Unfortunately, the link between L1 exposure and L1 phonetic CLI was near to never studied (cf. subsection 2.4.2) and thus merits to be investigated in the future research.

This bridge between the presented studies to the models confirm to us that SLM-r might be particularly pertinent model for studying phonetic CLI as its supposition mentioned in the first and second point seems to be in agreement with the results of the presented studies.

Chapter 3

Comparison of Czech and French phonetic systems

The models of L2 speech production and perception presented in chapter 1 and studies of phonetic CLI discussed in chapter 2, demonstrated that to understand the differences and similarities between the phonetic systems of L1 and L2 is essential for studying phonetic CLI. The present chapter will focus on the differences and similarities between Czech and French phonetic systems as this thesis concerns CF, i.e., speakers of Czech (west Slavic language) and French (Romance language). Starting by defining the terms language variety and standard language, this chapter shall, at first, determine which spoken variety of French and Czech CF may be exposed to. Consequently, the phonetic systems of these language varieties will be compared. The comparison will not contain details about acoustic properties of Czech and French phonetic features, because several of these are described and analysed in chapter 6. Finally, in this chapter, I will present the hesitation markers in French and Czech.

3.1 Varieties and standard language

Sapir (2014, p. 147) states that "everyone knows that language is variable" meaning that variability of a language linked to, for example, geographical place, a social category, or a class of age is an experience of all people who use and listen to a language (f. Milroy & Milroy, 2017). As summarized by Honda (2008), even within one language community, significant differences can exist in the language spoken and differences are a common experience for speakers. The study of this phenomenon is termed variationist linguistics, the foundation of which is attributed to Labov (2006).

Variationist linguistics aims to relate linguistic variations in the language to the external variations of the language (social, geographic, temporal variations, etc.)

and seeks to establish causal relationships between these two types of variations. Variation may be defined as an element of the variability of languages, employed by speakers which expresses their geographical or social identity (Gadet, 2007), and may occur on the different linguistic levels of the languages (phonetic, syntactic, semantic, lexical...). Boutet (1987) lists that each language is:

- Historically diversified due to linguistic change: a language state at one temporal point is different from a language state at another temporal point.
- Socially diversified according to the geographical and/or social origin of the speakers.
- Stylistically diversified as speakers may alter their ways of speaking according to social situations where they find themselves.

Conversely, standard language may be defined as what the society considers to be correct (see Hornby, 2010), a norm (see, e.g., Crystal, 2008), an approved model or the reference to which all the other language varieties may be compared.[1] The standard language is usually used by the majority of people (Hornby, 2010), and means the opposite of regional language varieties which are not structured by State authorities but by intuition or the linguistic ideas of speakers (Elroy, 1995; Labow, 1977). For example, for Jespersen (1964), 'standard' is linked to regional neutrality, and Crystal (2008, p. 450) considers standard language to be a "prestige variety" that goes over regional differences and provides a "unified means of communication". In this sense, for Garmadi (1981, p. 122), the standard "represents the implicit linguistic consensus which permits mutual intelligibility within any speech community". The standard language is also often the language used in media, and by people in public discourse (Finegan, 2004). Similarly, P. Léon (1978) speaks about the standard pronunciation, which is represented, for example, by radio announcers and interviewers.

Rey (1972) focuses on the concept of standard language, and distinguishes the subjective and objective norm. The former depends on the constraints of the language system and the statistical convergence of language use, whereas the latter involves the notions of prescription and the linguistic imaginary, i.e., the mental and intuitive representations that the speakers have of their language.

The diatopic variation of language, i.e., the variety of language spoken in a given geographical zone, may also be at phonetic level. The different so-called 'accents', i.e., differences in pronunciation of the given language, may be specific for particular geographical zones of the country where one language is spoken. That is crucial for this study, due to the focus on L1 speech of CF who have been primarily living in

[1] Cf. definition of 'standard' on http://dictionary.reference.com/browse/standard, accessed 11/02/2021.

the same geographical area in France at the time of data collection, and who had previously lived in the same geographical area in the Czech Republic. Hence, for making predictions about phonetic CLI in CF's L1 speech, it is relevant to know the phonetic differences between language variety spoken in the different geographical zones mentioned.

Nevertheless, as said in Blanchet (1992), language variation is not frozen in time or in the expression of an identity, but bears traces of its linguistic environment, where language is continuously constructed and adapted. This is why a language variety, which is linked to one geographical place, may change when new speakers speaking a different variety move into this place. It is possible for more than one language variety to co-exist in the same geographical place. The majority of CF were living in the Toulouse area, a city located in southern France, at the time of data collection and in the Bohemia region, before moving to France. Thus, the two following subsections attempt to describe the language variety(ies) of French spoken in the Toulouse area, and the Czech variety(ies) spoken in Bohemia.

3.1.1 Varieties of French spoken in the Toulouse area

Toulouse is the second university city in France. The urban area of Toulouse has around 20,000 new inhabitants each year,[2] and it had 58,100 new inhabitants in 2014[3]. A INSEE[4] report published in 2019 shows that a large proportion of the new inhabitants are students aged between 17 and 23 years. In addition, according to the report published in 2021 by INSEE, the population aging from 15 to 29 years old represented the largest part of the Toulouse population in 2007, 2012 and 2017.[5]

Toulouse is situated about 670km south from Paris and about 140km north from the Spain border. The report of INSEE[6] stated that in 2014, 16% of the new inhabitants of the Toulouse urban area came from foreign countries, 16% from the Paris region (Île-de-France) and one third from other geographical areas in the region Occitania, primarily from areas very close to Toulouse. Nearly 20% of Toulouse's population has Hispanic origins most likely due to Toulouse's geographical proximity with Spain.[7]

For a firmer understanding of the varieties of French spoken in France, a glimpse

[2] According to https://toulouse.latribune.fr/economie/2019-10-28/attractivite-qui-sont-les-nouveaux-arrivants-a-toulouse-831772.html, accessed 11/02/2021, published 28/10/2019.

[3] Cf. https://www.insee.fr/fr/statistiques/4237602#figure2, accessed 11/02/2021, published 25/10/2019.

[4] INSEE is French national institute of statistics and economic studies (*Institut national de la statistique et des études économiques.*

[5] https://www.insee.fr/fr/statistiques/2011101?geo=COM-31555#chiffre-cle-4, accessed 11/02/2021, published 21/04/2021.

[6] Cf. https://www.insee.fr/fr/statistiques/4237602#figure2, accessed 11/02/2021, published 25/10/2019.

[7] Cf. https://www.lepetittou.com/toulouse-la-plus-espagnole-des-villes-francaises/, accessed 11/05/2021.

into the linguistic history of France is helpful. As described in Dohalská (2015); Dufková (2012); Walter (1993), in Antiquity, France was inhabited by the Gauls who communicated in Gaelic. Around the year 58 BC, the Romans settled in Gaul and brought Latin into the region. The Gauls were in contact mainly with vulgar Latin, spoken by soldiers, merchants and the general population. When Latin became the official language in Gauls were required to learn it. In addition to the Romans, other language groups were present in Gaul. From about the 3rd century AD, Germanic tribes were present, and, since the 5th century, other nations such as Burgundy, Visigoths and Franks, had also settled there. Vulgar Latin spoken in Gaul began to change and develop, mostly by influence of Galician and also Germanic languages, resulting in a formation of a new language. At the end of the 8th century, due to feudal fragmentation, the new language split into dialects (Dohalská, 2015). Since the 9th century, three basic dialect branches have been distinguished: language *oc*, language *oil* and Franco-Provencal. In the territory of each of these three basic dialects, sub-dialects existed.

In 1539, by the Edict of Villers-Cotterêts, the government installed in Paris, François 1st imposes *francien* (also called *francilien*, referring to French) originating from *oil* language for being used in the rest of the French territory (Antoine, Helgorsky, & Depecker, 2001). French began to spread southwards in the early to mid 15th century, but inhabitants of southern France did not speak it fluently until the 19th century. As mentioned in Coquillon and Turcsan (2012), Occitan continued to be the mother tongue of much of the population, until the beginning of the 20th century, especially those who did not live in cities. Today Occitan is rarely spoken. Compulsory schooling which prohibited the use of Occitan contributed, among other factors, to the near loss of Occitan (Coquillon & Turcsan, 2012). At the very beginning of the 2000s in France, 'Parisian French' was no longer limited to Paris but was the norm in the French language, a universal French (i.e., Standard French), that does not indicate to the listener any regional belonging of the speaker.[8]

However, the process of losing Occitan in southern France was preceded by a long-lasting situation of diglossia, which explains an important substrate influence of Occitan on French spoken in the southern French regions (Blanchet, 1984; Lonnemann & Meisenburg, 2009). Courdès-Murphy (2018); Detey, Durand, Laks, and Lyche (2016); Durand (2009); A. Thomas (2006, among others) showed that French spoken by particular speakers born and living in southern France (hereafter southern French, also called Midi French, cf. Coquillon & Turcsan, 2012) differ from Standard French in several points, even if, as claimed by A. Thomas (2006), the traces that the Occitan left in southern French are decreasing, due to the growing power of Standard French. It has also been shown that more than one variety of southern French exists, and that southern French differs mainly according to the geographical

[8]https://www.verbotonale-phonetique.com/norme-phonetique-francais/, accessed 12/02/2021.

area. In this regard, Meisenburg (2013, p. 39), defines southern French as varieties of French spoken in the southern third of the hexagon which "roughly coincides with the territory in which, over many centuries, dialects of Occitan constituted the first and often only language of the indigenous population", (for the limits of this territory, see fig. 3.1).

Taking all this into consideration, we may suppose that CF living in Toulouse area are exposed to the different varieties of French, even if a statistical distribution of Toulouse inhabitants according to their geographical origins is not available, to the best of our knowledge. It should be mentioned that 7 of the CF in this study were university students, which may suggest that these speakers were in contact with various varieties of French at university. In addition, we might infer that university students and teachers in Toulouse come from various regions in France and foreign countries. Moreover, four of the CF were in Toulouse for Erasmus suggesting that they may be in contact with other Erasmus students who commonly spoke in English (see Appendix F). It should also be mentioned that several of our CF lived in other French cities before arriving in Toulouse. Five of them lived in the Paris region (see Appendix F). Finally, all of them except one learnt French before arriving in France (see *idem*).

Due to the universality of Standard French, and its growing power and influence on southern French, the influx of people from the Paris region to Toulouse, and that 6 of the 19 CF previously or still lived in the Paris region, I propose that the CF may have been exposed to Standard French. Additionally, it is likely that CF learnt Standard French before moving to France, which is the norm. The CF would also have been exposed to Czech accented French. As the work of Paillereau (2015) showed, even if the future Czech teachers of French in Czech Republic produced several French vowels identically to those produced by native Standard French speakers, they cannot perfectly master all the vowels (see section 2.2).

Nevertheless, numerous students arrive from geographical zones near to Toulouse area, where southern French might be spoken, and, as the research has shown, there are some differences between southern French and Standard French and speakers of southern French still exist. Thus, we may presume that CF may be exposed to the varieties of southern French, most likely to the variety spoken in Toulouse area (hereafter Toulouse French), as studied by Courdès-Murphy, Durand, Ratier, and Rossi-Gensane (2016). However, to ensure precision, we must also consider that language varieties influence one another when existing in the same geographical area, as in Toulouse, where varieties of southern French coexist with Standard French, but also, with foreign-accented French of internationals living in Toulouse. We must also consider inhabitants coming from French geographical zones other than southern France or the Paris region, who bring additional varieties of French to Toulouse. For simplicity and as the most common varieties of French in the Toulouse area, we

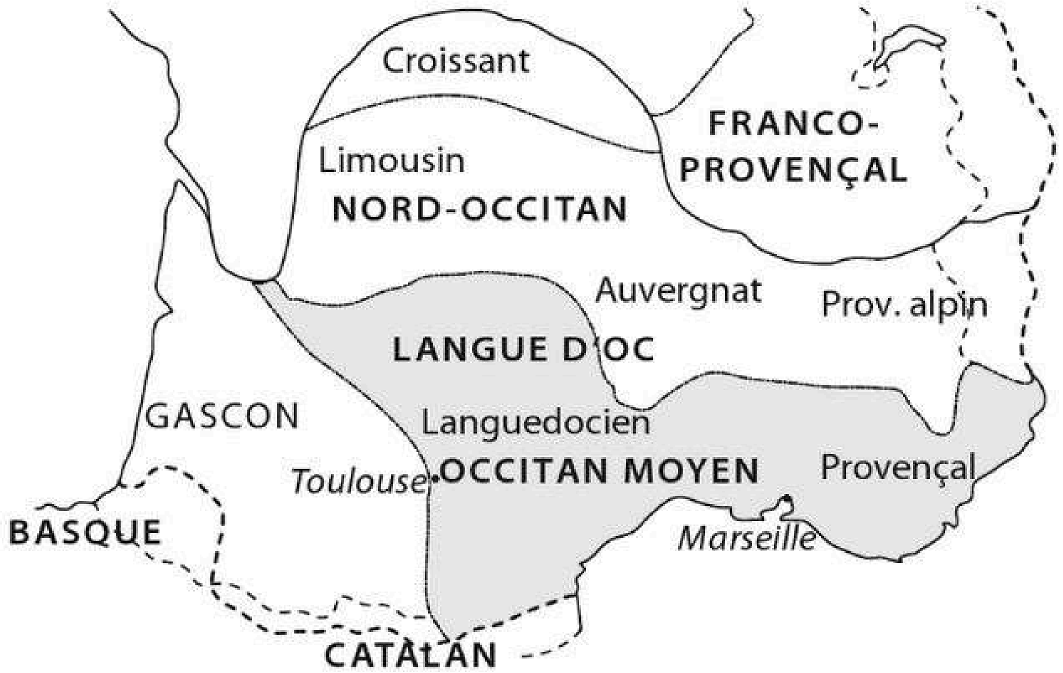


Figure 3.1: Map of Occitan dialects.

Note: According to Bec (1995), taken from Coquillon and Turcsan (2012, p. 106).

will focus on the description of Toulouse French and Standard French in the present chapter. Noting that Standard French has the potential to strongly influence CF's L1 speech, though remaining conscious that the Toulouse area is a place impacted by continual encounters between many languages and language varieties of French.

3.1.2 Czech spoken in Bohemia

A geographical perspective can also be applied to the language varieties of Czech (Cvrček, 2010; Šimáčková, Podlipský, & Chládková, 2012). The pronunciation of Czech in the western part of the Czech Republic (Bohemia region and western Moravia) "is relatively homogeneous" (Šimáčková et al., 2012, p. 225) compared to the east part of country (the rest of Moravia region), where several dialects can be distinguished (Cvrček, 2010). Bohemian Czech is spoken by more than six million Czechs, while Moravian Czech is spoken by around three-and-a-half million citizens (Šimáčková et al., 2012). As proposed by Šimáčková et al. (2012), Moravian dialects differ from Bohemian Czech by a number of features that are shared by all Moravian dialects, meaning that native Czechs are able to identify someone as either Bohemian or Moravian. Cvrček (2010) provides a map illustrating where Bohemian and Moravian Czech is spoken (see fig. 3.2). Šimáčková et al. (2012) use the term Bohemian Czech and Moravian though these terms are not used by Cvrček

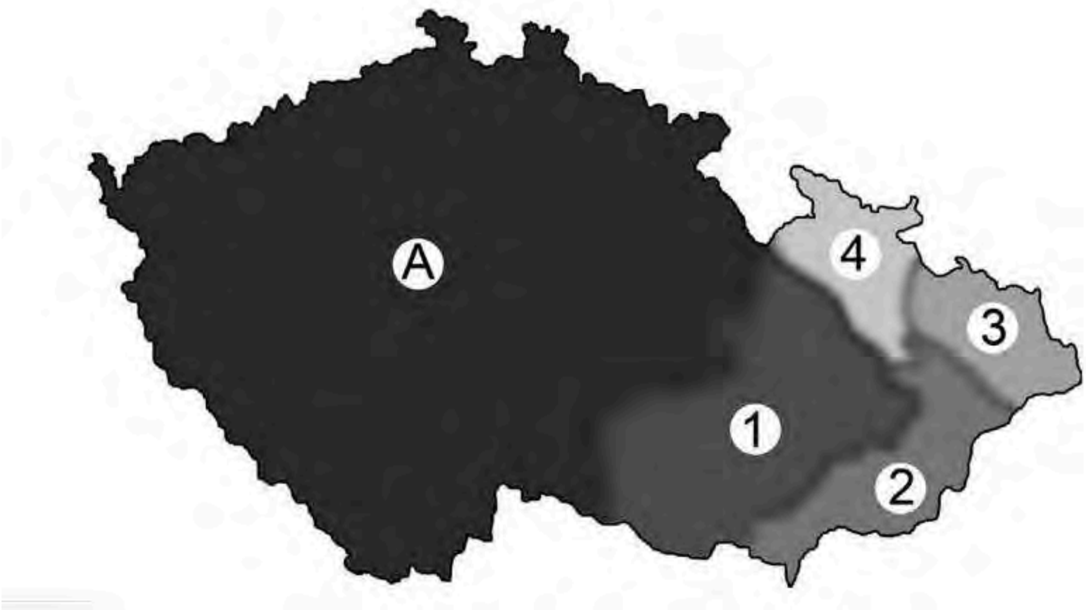


Figure 3.2: Map of varieties of Czech spoken in the Czech Republic.

Note: A-area of Common Czech, 1-area of Central Moravian dialect, 2-area of East Moravian dialect, 3-area of Silesian dialect, 4-border area of north Moravia without traditional dialectal bedrock. The situation of big cities may significantly differ from the surrounding territories. Taken from: Cvrček (2010, p. 29).

(2010), who instead uses the term 'Common Czech' (*obecná čeština* in Czech) as an equivalent of Bohemian Czech in Šimáčková et al. (2012).

In the 1930s, members of the Prague Linguistic Circle perceived Common Czech as a language form able to become the primary means of spoken communication throughout the Czech language (Cvrček, 2010). The term Common Czech was already in use by 1934 in Havránek (1934), it designated a universal language which, contrary to dialect, does not have a narrow local definition. The author characterizes Common Czech as a Central Bohemian dialect (in the main features), which, however, crossed a certain territory and spreads beyond the borders of the Czech Republic, making it more a social dialect than a local dialect (Havránek, 1934). Havránek (1934) also points out that in comparison to the other dialects, Common Czech is a 'superior form' of language, and sometimes coincides with the spoken form of Standard language. However, Standard Czech language may also refer to formal, highly codified Czech language which is very different from that used in everyday situations (Šimáčková et al., 2012). Common Czech evolved and expanded naturally without the direct intervention of linguists. Nowadays, its expansion is so much greater than the expansion of other territorial varieties that its speakers do not usually consider territories in which Common Czech is not used (Cvrček, 2010). Hence, Common Czech is, in general, considered to be regionally and socially neutral (Krčmová, 2017), even if the authors studying it are aware that near to the boundary of the Czech Republic, regional elements may be more dominant (see fig. 3.3[9]). Nevertheless, the process of leveling (balancing the remaining differences) dialects continues in the Czech Republic. Moreover, the remaining differences across dialects continues to be lost under the influence of population migration, literacy, media and modern communication technologies (Cvrček, 2010). As a basis of Common Czech, researchers usually consider the very leveled Common Czech spoken in Central Bohemia, mainly in Prague, as having a high influence on other varieties of the Czech language (Krčmová, 2017). Cvrček (2010) adds that contemporary Common Czech changes in syntax and vocabulary under the influence of English.

To define Standard Czech, Cvrček (2010) uses the following definition:

> *"Standard in a certain type of text and/or language form are those variants of means that are not marginal in it. It therefore makes sense to consider standardity (or non-standardity) only in relation to a certain time (the situation may change with development)."* (Cvrček, 2010, p. 28, our translation)

This definition allows us to conclude that Common Czech is very near to Standard Czech, supported by the considerations discussed above. Therefore, I will henceforth use the term Standard Czech, as, for example, Skarnitzl and Volín (2012) does, when speaking about Common Czech and about the written form of Standard Czech. I will consider the term Standard Czech to be an equivalent to Standard French.

To determine which variety of Czech CF were exposed to France and before moving to France is thus simpler than their exposure to varieties of French. At the time of data collection, all CF stated that they did not speak a variety of Czech or a dialect when living in the Czech Republic, except for one speaker who indicated to speak Pilsen dialect. Moreover, they stated not to speak Czech with a specific accent such as a Moravian accent (see also Appendix F and questions 19 and 20 of the extralinguistic questionnaire in Appendix F). The towns or villages in the Czech Republic where CF lived for at least one year, are geographically located where Standard Czech is spoken according to fig. 3.2, except for one CF who spent in total 6 years in geographical zones where Moravian Czech is spoken, however, he also spent 17 years in zones where Standard Czech is spoken (see table 3.1). Therefore, we may speculate that this CF speaker was primarily exposed to Standard Czech, rather than to Moravian Czech. Additionally, the towns, villages and/or regions where the CF spend the majority of time when they return to the Czech Republic are geographical zones where Standard Czech is spoken according to fig. 3.2 (see table 3.1). Moreover, 13 of 19 CF had been living in Prague for at least one year (cf. table 3.1).

[9] Figure retrieved from http://www.ujc.cas.cz/miranda2/export/sitesavcr/ujc/sys/galerie-obrazky/publikace-obalky/mapa-nareci.jpg, accessed 12/02/2021.

Table 3.1: Localities in Czech Republic where CF lived before moving to France and where they stay when visiting Czech Republic.

speaker	Sex	Age	LOR	CzTown	TownVisitCR
CF1A	F	42	15.3	Hradec Králové-22 Stračov-4	Jičín
CF1E	F	23	0.17	Prague-23	Prague
CF2A	F	37	7.00	Domažlice-13, Pilsen-8, České Budějovice-2, Prague-1	Domažlice
CF2E	F	22	0.17	Rokytnice nad Jizerou-14, Víchová nad Jizerou-6, Prague-2	Region of Liberec
CF3A	F	22	7.00	Ústí nad Labem-15	Prague, Ústí nad Labem
CF3E	F	25	4.25	Pardubice-18, České Budějovice-2	Pardubice
CF4A	F	37	15.33	Mladá Boleslav-10, Prague-2	Prague
CF4E	F	36	3.00	Prague-33	Prague, rural area near to Kraslice
CF5A	F	38	9.00	Rumburk-29	Rumburk, Prague
CF5E	F	37	4.00	Prague-33	Prague
CF6A	F	49	28.25	Liberec-18, Prague-3	Liberec
CF6E	F	23	3.25	Mstišov/Teplice-19, Prague-1	Mstišov, Prague
CF7A	F	42	22.42	Prague-19	Prague
CF7E	F	26	1.42	Prague-23	Prague
CF8A	F	31	8.33	Milevsko-20, Pilsen-3, Prague-2	Milevsko
CF8E	F	21	0.25	Bašť-11, Prague-10	Prague
CF9A	F	49	23.33	Prague-26	Prague
CF9E	F	20	0.23	southern Bohemian region-20	southern Bohemian region
CF10A	M	34	10.33	Choceň-10, Prague-7, Uherské Hradiště-5 Olomouc-1	Prague

Note: M=male, F=female, LOR=length of residence. CzTown=geographical localities where CF lived in Czech Republic before moving to France, the numbers in this column indicate the number of years spent in that locality by the speaker. Only stays lasting at least one year have been included. TownVisitCR=geographical locality where CF spent the most time when visiting the Czech Republic. Data collected by extralinguistic questionnaire (see chapter 7 for more detail about this questionnaire.)

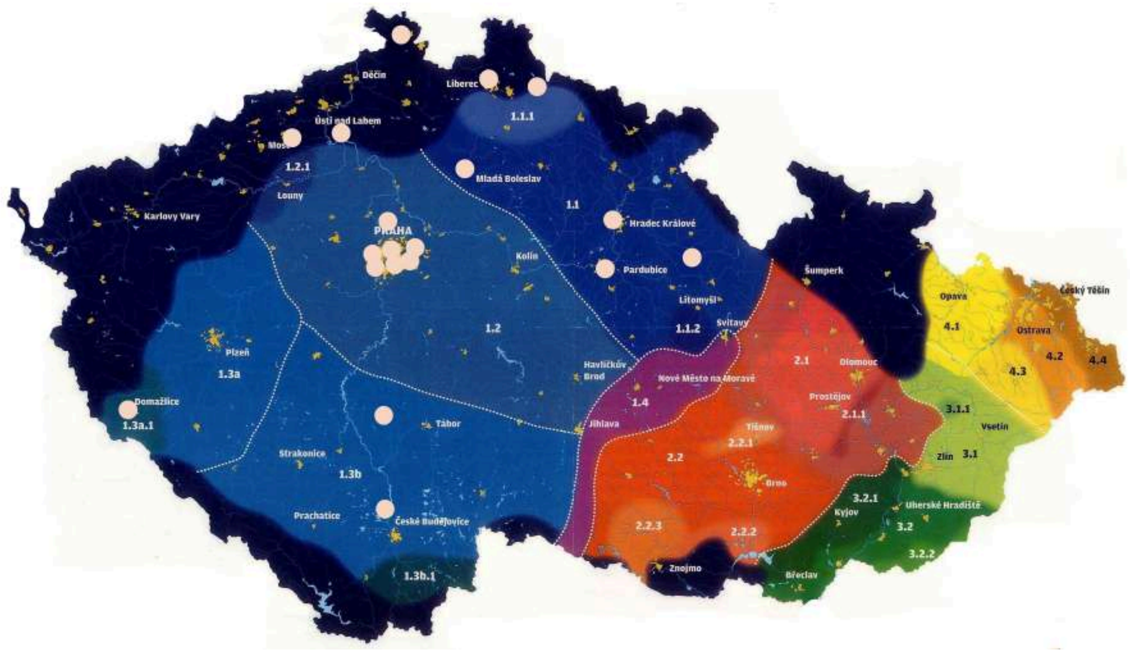


Figure 3.3: Detailed map of dialects spoken in Czech Republic and places of main stay of CF.

Note: Taken from *Ústav pro jazyk český Akademie věd České republiky in Czech*. The colours and numbers indicates different dialects. The larger circles indicate the places where the CF lived the longest before moving to France.

Several CF spent the majority of their time living in the Czech Republic in a geographical area near or very near to the Czech borders where regional elements may occur in spoken Czech (Krčmová, 2017, see, figure 3.3). We examined these regional elements, from the areas where these CF lived for the longest periods, as they are described by the Institute for the Czech language of the Academy of Sciences of Czech Republic[10]. At the phonetic level, in the Czech variety spoken in area 1.3a.1 (fig. 3.3) reduction of vowels in syllables *ný* and *ní* may occur, in the Czech variety spoken in area 1.3b the syllable *mě* may by pronounced as [mjɛ], and in the Czech variety spoken in area 1.1, *í* and *ú* in the final position of the word which may be shortened. Given that I did not note the use of these regional elements in the recording of CF, I consider that our CF represented a group of Standard Czech speakers before moving to France.

The following sections will compare Standard Czech, Standard French and Toulouse French at a phonetic level as I have demonstrated that these are the language varieties to which CF are/were most probably exposed. In the case of the limited studies of Toulouse French, I will focus on the findings about southern French. The phonetic systems of what we call Standard Czech, Standard French and Toulouse French were mainly described by Courdès-Murphy et al. (2016); Derivery (1997); Dufková (2012); Durand (2009); Léon (1992); M. Léon (1997); Skarnitzl, Šturm, and

[10]Called in Czech: *Ústav pro jazyk český Akademie věd České republiky.*

Volín (2016); Volín (2010).

3.2 Comparison of phonetic systems at segmental level

The present section provides comparison of Standard Czech, Standard French and Toulouse French vowels and consonants.

3.2.1 Vowels

Standard Czech and Standard French vocalic systems differ importantly in several ways. Primarily, they differ in the number of vowels they contain (see table 3.2 giving the inventories of Standard Czech, Standard French and Toulouse French). Without /ə/, a neutral vowel not having a phoneme status in Czech, but used in Standard Czech (Volín, 2010), Standard Czech comprises 13 vowels (Skarnitzl et al., 2016), while, Standard French, with French mid central unrounded /ə/ having a phoneme status in French, counts 16 vowels (cf. Dufková, 2012; Léon, 1992; M. Léon, 1997). However, according to Munot and Nève (2002), the French /ə/ may nowadays be considered as an equivalent of French non-stressed oral rounded open-mid front /œ/, in which case, we may count 15 vowels in Standard French. To determine the number of vowels that exist in Toulouse French is more complex as more than one variety of Toulouse French exists (cf. Durand, 2009; Courdès-Murphy, 2018). Some speakers from Toulouse may not realise the phonological differences between four pairs of vowels of Standard French, i.e., between /e/ and /ɛ/, /a/ and /ɑ/, /o/ and /ɔ/, and /œ/ and /o/, while another may (Courdès-Murphy, 2018; Durand, 2009). Let us, therefore, suppose that the number of vowels existing in Toulouse French may vary from 12 to 16 when /ə/ is included. Figure 3.4 shows vocalic quadrangles of Standard Czech, Standard French and southern French. We are aware of the limitations of these vocalic quadrangles in terms of the exact $F1$ and $F2$ values of the vowels. The exact $F1$ and $F2$ values of the vowels of Standard French and Standard Czech vowels will be presented in chapter 6.

As table 3.2 shows, French contains only monophthongal vowels while the Czech comprises of three diphthongal vowels, that is /a͡u/, /e͡u/, and /o͡u/ (cf. Skarnitzl et al., 2016). Diphthongal vowels do not also exist in Toulouse French. Moreover, Standard Czech and Standard French vocalic systems differ in the nasality. Four nasal vowels, i.e., /ɑ̃/, /ɛ̃/, /œ̃/, /ɔ̃/ exist in Standard French (Derivery, 1997) while Standard Czech contains only the oral vowels. (Note that vowels in Czech may also be nasalised because of the coarticulation effect when they are preceded or followed by the nasal consonant. Nevertheless, they do not have a phonological signification in Czech.) Durand (1988) studied the four nasal French vowels in

Table 3.2: Inventory of vowels in Standard Czech, Standard French and Toulouse French.

		Standard Czech	Standard French	Toulouse French
Monophthongs	Oral	ɪ, iː, ɛ, ɛː, o, oː, u, uː, a, aː, ə	i, e, ɛ, a, ɑ, u, o, ɔ, y, ø, œ,	i, (e, ɛ), E, (a, a), A, u, (o, ɔ), O, y, (ø, œ), Ø, (ə)
	Nasal	NA	ɑ̃, ɛ̃, œ̃, ɔ̃	(ɑ̃), (ɛ̃), (œ̃), (ɔ̃), aN, ɛN, ɔN, œN
Diphthongs	Oral	a͡u, e͡u, o͡u	NA	NA

Note: Source: Durand (2009); M. Léon (1997); Volín (2010); Skarnitzl et al. (2016). Vowels in the brackets mean that they may be pronounced by some Toulouse speakers but not by all Toulouse speakers. Toulouse French vowels without brackets are noticed with the same symbols as in Durand (2009).

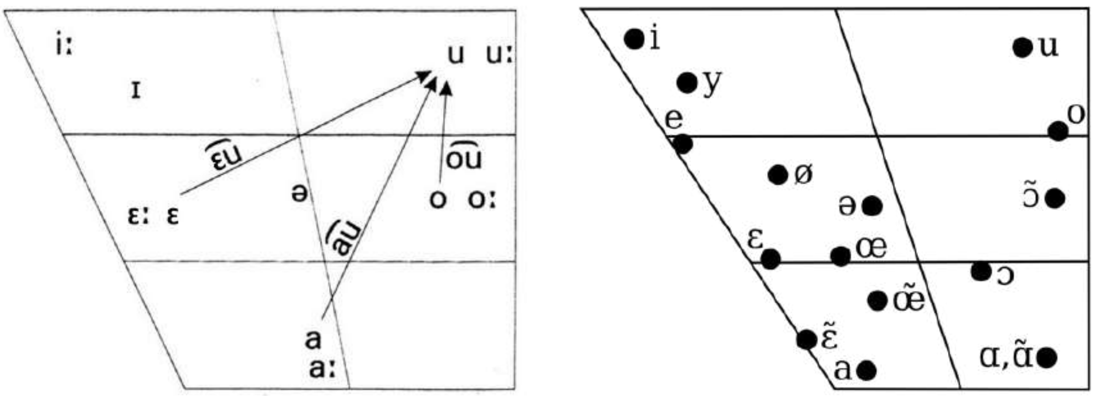


Figure 3.4: Vocalic quadrangle of Standard Czech and Standard French.

Note: Vocalic quadrangle of Standard French (right) is taken from Collins (2013, p. 226). Vocalic quadrangle of Standard Czech (left) is taken from Volín (2010, p. 43)

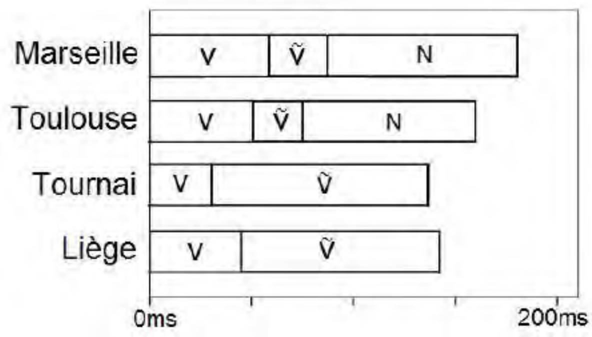


Figure 3.5: Mean duration of French nasal vowels produced by speakers from Toulouse, Marseilles, Tournai, and Liège.

Note: Taken from Delvaux et al. (2012, p. 2684). V, Ṽ and N are the components of nasal vowel. V is a portion of oral vowel, Ṽ is a portion of a nasalised vowel, and N is a plain nasal segment.

southern French. According to Durand (1988), the vowels followed orthographically by nasal consonant lack nasalisation in the speech of some southern French speakers. The French nasal vowels were more recently studied by Delvaux, Kathy, Piccaluga, and Harmegnies (2012), who investigated their exact composition, i.e., the exact portion of an oral vowel followed by a portion of a nasalised vowel followed by of a plain nasal segment (so-called nasal 'appendix'). Delvaux et al. (2012) found that in Toulouse French, French spoken in Marseilles, Tournai and Liège (Belgium) and found that speakers from the north (Tournai and Liège) used a long nasalised vowel in French nasal vowels' production while the speakers from south (Marseilles and Toulouse) produced French nasal vowels with short nasalised vowel and long plain nasal segment (see fig. 3.5). Finally, from table 3.2, we see that Standard French and Standard Czech vowels also differ in length. Czech distinguishes short and long vowels, thus presenting five pairs of one short and one long vowel, /a/ and /aː/, /ɛ/ and /ɛː/, /ɪ/ and /iː/, /o/ and /oː/, and /u/ and /uː/. Note that in the pairs /ɪ/ and /iː/ and /u/ and /uː/, the difference between short and long vowel is not only in length but also in position of the tongue during their articulation (cf. Bořil & Veroňková, 2020; Podlipský, Chládková, & Šimáčková, 2019). On the contrary, neither in Standard French nor in Toulouse French vocalic length is a phonological feature.

As shown in table 3.3, Standard Czech and Standard French vowels differ in the number of degrees of aperture. The Czech vocalic system is described by three degrees of aperture (close, mid and open), whereas Standard French comprises four degrees of aperture, i.e., close, close-mid, open-mid and open (cf. Derivery, 1997; Paillereau, 2015) meaning that mid vowels are missing in Standard French. As some Toulouse French speakers may not phonologically distinguish Standard French vowels in four pairs (/e/ and /ɛ/, /œ/ and /ø/, /a/ and /ɑ/, and /ɔ/ and /o/), the Toulouse French might contain only three degrees of aperture and, at this point,

Table 3.3: Articulatory properties of Standard Czech and Standard French oral monophthongal vowels.

	Anterioriry	Front			Central	Back	
	Lip shape	unr.		r.	unr.	r.	
	Language	Cz	Fr	Fr	Cz	Cz	Fr
Degree of aperture	Close	ɪ, iː	i	y		u, uː	u
	Close-mid		e	ø			o
	Mid	ɛ, ɛː				o, oː	
	Open-mid		ɛ	œ			ɔ
	Open		a		a, aː		ɑ

Note: Cz=Standard Czech, Fr=Standard French, unr.=unrounded, r.=rounded. Vowel noted by the same IPA symbol, but different articulatory properties are in grey. Source: Dufková (2012); Paillereau (2015); Meunier (2007).

become more similar to Czech. Moreover, from the careful reading of the articulatory classification of Standard Czech and Standard French vowels in Derivery (1997); Léon (1992); M. Léon (1997), one may suppose that the vowels of the languages also differ slightly in anteriority because the Standard Czech considers /a/ as a central vowel while Standard French /a/ is considered as front vowel. The difference between Standard French front /a/ and back /ɑ/ seems to disappear in Standard French. In Toulouse French, only one /a/ exists for the speakers who do not make a phonological difference between Standard French front /a/ and Standard French back /ɑ/. Table 3.3 also shows that Standard French also has rounded front vowels which do not exist in Standard Czech. Two of these rounded vowels, i.e., /œ/ and /ø/ may not be differentiated in Toulouse French. Thus, as written in Dufková (2012), in general, the participation of the lip in the articulation of Czech vowels is relatively passive; it is limited to slight rounding of the back vowels. Finally, Standard Czech and Standard French vowels differ in tenseness. French vowels represent typical "tense vowels (especially in comparison with Czech vowels), i.e., they are articulated by energetic activities of all speech muscles" Hála (1960, p. 74, our translation). Hála (1960) adds that their tenseness is the most evident on the tongue and lips and that, the articulation of individual French vowels must be far more precise and tense than in Czech, because the slightest inaccuracy in pronunciation can cause confusion of words. This is why, we may consider that all Standard Czech vowels are not tense or, more precisely less tense, i.e., formed without extraordinary articular muscle tension, while Standard French vowels, on the other hand, are quite tense (Dufková, 2012).

3.2.2 Consonants

The consonants of Standard Czech differ importantly from those of Standard French (see Figure 3.6). Standard Czech comprises 32 consonants but glottal stop /ʔ/, velar fricative /ɣ/, alveolar affricate /d͡ʒ/, voiceless postalveolar fricative trill /r̝̊/, and labiodental and velar nasals /ɱ/ and /ŋ/ do not have a status of phoneme in Standard Czech (cf. Volín, 2010). By contrast, Standard French has only 19 consonants, /j/ and /ŋ/ included (cf. Dufková, 2012; M. Léon, 1997). As claimed by Durand (2009), the consonant system of southern French does not seem to be importantly different from that of Standard French. Standard Czech consonants which do not exist in French are nasal labiodental stop /ɱ/, glottal oral stop /ʔ/, velar fricatives /x/ and /ɣ/, glottal fricative /ɦ/, oral palatal stops /c/ and /ɟ/, postalveoral affricates /t͡ʃ/ and /d͡ʒ/, prealveoral affricates /t͡s/ and /d͡z/, and postalveoral fricatives trills /r̝/ and /r̝̊/. By contrast, only the French uvular /R/ does not exist in Standard Czech, which may be produced also as a uvular fricative /ʁ/ (see above). French has three glides (central approximants) which may be considered as semi-consonants as well as semi-vowels (cf. M. Léon, 1997). Two of them, i.e., /ɥ/ and /w/, do not exist in Czech. As semi-vowels, the three French approximants have the following characteristics: /j/ is front unrounded, /ɥ/ is front rounded and /w/ is back rounded (see M. Léon, 1997). As semi-consonants, /j/ and /ɥ/ are labio-palatal, while /w/ is labio-velar, and /j/ is palatal (Dufková, 2012; Léon, 1992).

The classification of alveolar nasal and oral stops, and lateral approximant varies among authors as illustrated on fig. 3.6. For example, on the one hand, Derivery (1997); Léon (1992); M. Léon (1997) classifies Standard French /t/, /d/ and /n/ as dental, in which case they should slightly differ from Czech /t/, /d/, and Czech /n/ classified as alveolars (cf. Volín, 2010). On the other hand, in Dufková (2012), these French consonants are classified as alveolar and not dental. Note also that even if Czech /v/ is classified on fig. 3.6 as a fricative, it is often produced as an aproximant mainly when it occurs in an intervocalic position (Skarnitzl et al., 2016).

As noted by Léon (1992), several articulatory variants of r-sound occur in the French language. Similarly Fougeron and Smith (1999) stated that French has one rhotic, whose pronunciation varies significantly with speaker, and phonetic context. The traditional descriptions of variants of French rhotic consonant in Léon (1992); M. Léon (1997) seem to us limited because they are not founded directly on collected data. For this reason, I focus on the variants of French rhotic found in wide speech corpus by Ramasse (2017). In the speech corpus of his study, the author found seven possible phonetic realisations of the letter ‘r’ in French: it was produced as a voiced or voiceless uvular approximant ([ʁ̞] and [ʁ̞̊]), a voiced or voiceless uvular fricative ([ʁ] and [χ]), a voiced tap and voiceless uvular tap, or realised by elision. The rhotic was the most often produced as fricative uvular [ʁ] and then, as approximant uvular [ʁ̞]. Similarly, Fougeron and Smith (1999), observing the r-sound production in the speech of a young Parisian female, found the most frequent realisation of rhotic as a uvular fricative, which was sometimes reduced to an uvular approximant. According to Meunier (2007), the French rhotic in the intervocalic position is generally

	bilabial	labiodental	dental	Alveolar	postalveolar	palatal	velar	uvular	glottal
Oral stop	p b		t d	t d		c ɟ	k g		ʔ
Nasal stop	m	ɱ	n	n		ɲ	ŋ		
Trill				r					
Fricative		f v		s z	ʃ ʒ		x, ɣ	ʁ	ɦ
Approximant (glides)						j ɥ	w		
Lateral approximant				l					
Fricative trill					r̝̊ r̝				
Affricate				t͡s d͡z	t͡ʃ d͡ʒ				

Figure 3.6: Inventory of Standard French and Standard Czech consonant systems

Note: Czech and French consonants with different articulatory properties are coloured in green (Czech consonants) and blue (French consonants). Black contour indicates the pairs of consonants in which the French consonants are classified differently among authors. Consonants with the same articulatory properties in Czech and French are without highlight. Source: Derivery (1997); Dufková (2012); M. Léon (1997); Volín (2010).

produced as approximant while in the other positions, it is produced as a fricative. Contrastingly, Ramasse (2017) found that the French rhotic is realised as a voiced fricative generally in initial and medial positions, as voiced approximants in the final position, as a voiceless fricative after a voiceless consonant, and as a voiceless approximant before a voiceless consonant. Note also that the French rhotic may be also classified as an uvular trill by some authors, but that is much more by tradition than by the results of studies of its real production (Meunier, 2007).

In all cases, the place of articulation of the French rhotic remains uvular (Meunier, 2007) except for a its particular variant as apical alveolar trill mostly linked to the age and geographical area of the speaker, and occurring in Toulouse French. A brief overview of the Toulouse r-sound's historical evolution may be found in Courdès-Murphy (2018). However, r-sound in Toulouse French was rarely investigated. Hence, I will now consider several studies about r-sound in southern and southwestern French. The southern French apical alveolar trilled [r] may be considered as the residue from Occitan, and in 1950, Séguy reported that apical alveolar trilled [r] is widely attested in Toulouse and southwestern France. In 1975, Borrell wrote that we may hear less and less often the apical alveolar trilled [r] in Toulouse. The author suggests that the apical alveolar trilled [r] can still appear in the production of elderly Toulouse speakers or in the production of speakers living in the areas next to Toulouse and not being in contact with Toulouse city. In 1982, Walter reported two main types of rhotics in southern French: voiced and voiceless uvular [ʁ], [ʁ̥]. In 1987, Tranel and Bernard claimed that the r-sound is often realised as a voiceless uvular fricative [χ] in southwestern France. In 2009, Woehrling examined in detail r-sound speech production of southern French speakers living in different cities (Toulouse was not included). He found that four particular elderly speakers from Douzens used the most apical alveolar trilled [r] in their production compared to the other variants of rhotic consonant used by them, i.e., [χ] and [ʁ]. The most recently, in 2016, a speaker living in suburban area of Toulouse had recourse to the uvular [ʁ] for r-sound production in Courdès-Murphy et al.'s (2016) study. Therefore, we may consider that, nowadays in Toulouse, apical alveolar trilled [r] may not be heard or used very often, whereas r-sound realised as uvular fricative or approximant may occur more frequently.

Similarly to French, there is more than one possible phonetic realisation of the letter 'r' in contemporary Czech. It may be produced as the alveolar trill [r] as well as the alveolar tap [ɾ] (cf. Skarnitzl et al., 2016). (Note that /r/ is a phoneme in Czech and this is why we will note it into slashes when speaking about Czech rhotic consonant.) Machač (2017) study confirmed Šimáčková's (2003) finding that nowadays, it is the most often produced with one tongue cycle, i.e., as alveolar tap [ɾ] and not as an alveolar trill [r]. Nevertheless, note also that in Czech, an existing type of rhotatism consisting in change of /r/ from apical to dorsal and exaggeration of its vibrant aspect is regarded as speech defect (Šimáčková, 2002), called *ráčkování* in Czech. By naive listeners, it may be judged similar to the French r-sound, nevertheless, experts rarely judged it as uvular (cf. Šimáčková, 2002). Moreover, with respect to syllability, we distinguish in Czech syllabic and nonsyllabic /r/. A syllabic /r/ is a nucleus of the syllable, and thus, it has a function similar to the vowel while the nonsyllabic /r/ cannot be the nucleus of the syllable. Indeed, contrary to the French whose consonants cannot be syllabic, the Czech /r/ and /l/ may be a nucleus of the syllable (Dohalská, 2015; Dufková, 2012).

Fricative trills /r̝/ and /r̝̊/ are extremely rare in the languages of the world, and this is why they are sometimes referred to as typically Czech sounds (Volín, 2010). Their articulation is particularly difficult as it involves both tongue tip/blade trilling and frication. During /r̝/ and /r̝̊/ production, the tip of the tongue oscillates most often two or three times. Variants with more oscillations are less common and therefore can be conspicuous in speech. Many Czech speakers are not even aware of the existence of the voiceless [r̝̊], because it is mere allophon of /r̝/ (Volín, 2010).

In Czech, the glottal stop /ʔ/ is used for signaling the word boundary, which otherwise begin with a vowel, i.e., it may appear as the onset of an otherwise vowel-initial syllable. The glottal stop /ʔ/ helps the listener separate the meaning-bearing units from the continuous speech flow (Volín, 2010). The most commonly, glottal stop, /ʔ/, ensures the separation of the initial vowel of the word from the last consonant of the previous word (e.g., Czech expression *k ovoci* is easier to understand for the Czech listener when produced as [kʔovocɪ] than when produced as [kovocɪ]). The glottal stop may also occur inside the Czech word for the separation of two neighbouring vowels or between a word ending with a vowel and a following word with vowel in the onset position. It ensures the two vowels do not merge into a diphthong (e.g., Czech word *neučit* may be produced as [nɛʔut͡ʃɪt]). From the phonetic point of view, glottal stop is most frequently produced as a canonical plosive or creaky voice (Skarnitzl, 2004).

On the contrary, glottal stop /ʔ/ does not exist in French as that language uses linking (called 'liaison' in French) for connecting the word-final consonant with the initial vowel of the following word (Skarnitzl et al., 2016). There are five main types of latent consonants, which can appear in the case of *liaison* in French (Léon, 1992; Mallet, 2008). These five consonants phonetically can be represented by different letters in the word. Note that these letter of the word may not be pronounced in certain cases when the word is not used in liaison situation. The five consonants are:

1. /z/, e.g., *chez eux* produced as [ʃeø]

2. /t/, e.g., *petit ami* produced as [p(ə)titami]

3. /n/, e.g., *son ennemi* produced as [sɔ̃nenəmi]

4. /r/, e.g., *dernier ami* produced as [dɛʁnjeʁami]
5. /p/, e.g., *beaucoup aimé* produced as [bokupeme]

Another two consonants can be considered by liaison, i.e., /g/ and /k/. Both represent the two possible pronunciations of letter <g>, however, they occur in liaison very rarely, i.e., only in the expression *sang impur* produced as [sɑ̃kɛ̃pyʁ] of the Marseillaise and the expression containing the word *long* as, for example, *long été* produced either as [lɔ̃gete] or [lɔ̃kete] (Mallet, 2008).

Variation in realization of liaison seems to be associated with the speaker's age. It appears that older speakers (over 60) tend to produce more variable liaisons than younger speakers, especially speakers under 30 according to the data of Eychenne (2011); Mallet (2008). Concerning the diatopic variations in liaison in France, in 2008, Durand and Lyche (2008) observed the realization of the liaison in the contexts "*est* + word starting with a vowel" and "*était* + word starting with a vowel". They found that the proportion of these liaisons was much higher in the recordings made in a village in the south of France (Douzens, in department of Aude), than in those made in a village in the north (Brécey, in the department in Manche). Nonetheless, the diatopic variation in liaison was re-examined by Coquillon, Durand, Eychenne, and Lyche (2010). In that study, the authors examined more types of liaison than the one of /t/ in speech production of 67 speakers from different northern geographical area (Dijon, Vendée, Paris, Brécey, Domfront, Brunoy, Puteaux) and 67 speaker from the southern areas (Douzens, Rodez, Aix-Marseille, Toulouse, Lacaune). The result showed no significant difference between the realisation of liaison in northern zone and the one in southern zone letting the authors conclude that north and south of France constitute a relatively homogeneous space in terms of the liaison.

The fundamental difference between Czech and French consonants is that French consonants are articulated much more firmly, with more energy (with greater tension of the articulatory muscles) and, consequently, with greater accuracy (especially at the end of words) than Czech consonants; therefore, their intelligibility is greater. This greater tension is manifested mainly in the shape of the tongue and lip (Hála, 1960). This tenseness and accuracy of pronunciation of French consonants is manifested primarily by distinguishing between voiced and unvoiced consonants at the beginning or in the middle of words and at the end of words (for example French word *vite* is pronounced as [vit] and French word *vide* is pronounced as [vid] (Dohalská, 2015)). Thus, unlike in Czech, where there is a loss of voicedness at the end of words, i.e., the last consonant of the word is devoiced (for example, Czech word *lov* is pronounced as [lof]), French voiced consonants at the end of the word are pronounced voiced (Dufková, 2012).

Assimilation of voicedness exists in both French and Czech, and for both, the most common is regressive (anticipatory) assimilation, meaning that the first consonant takes over the quality of the second consonant. This assimilation occurs within words, but also within rhythmic groups (Dufková, 2012). In addition, in both languages, there is also progressive assimilation, in which the previous phone affects the next phone. Progressive assimilation is typical for Moravian Czech (Volín, 2010; Šimáčková et al., 2012). In both languages, assimilation may occur as sonorisation or disonoration of a given phone. Contrary to Czech, in French, consonants lose their voicedness when they are desonorized, but they mostly retain their articulatory tenseness. Therefore, in French, the voiced phone does not have to become directly the equivalent voiceless phone of the consonant pair, as it is in Czech (Dohalská, 2015). Additionally, in Czech, articulatory assimilation is found which is a consequence of the convergence of articulatory movements (Dufková, 2012). It is necessary to distinguish assimilation of place of articulation and assimilation of manner of articulation (cf. Volín, 2010). The former mainly concerns Czech nasal phonemes. For instance, instead of bilabial /m/, labiodental /ɱ/ is pronounced when it is followed by /f/ or /v/. This assimilation occurs inside the word (e.g., Czech word *komfort* is pronounced as [koɱfort]) as well as across the interword boundary (e.g., Czech sentence *Tam fouká.* will be pronounced as [taɱfo͡ukaː]). Concerning the latter, sometimes the merging of /t/ and /s/ in /t͡s/ or /t/ and /ʃ/ in /t͡ʃ/ in Czech (e.g., the word *kratší* in Czech pronounced as [krat͡ʃiː]), is understood as an example of assimilation in manner of articulation (Dufková, 2012; Volín, 2010), and according to Volín (2010), this assimilation is referred to as reciprocal. Nevertheless, (Volín, 2010) underlines that cases when one phone transmits its articulatory trait to another should be evaluated separately from cases where two phones are formed and merge into one phone.

3.3 Comparison of phonetic systems at suprasegmental level

This section consists of the comparison of intonation, stress and rhythm in Standard Czech, Standard French and Toulouse French. The phenomenon I term stuck schwa, typical for Toulouse French is also explained.

3.3.1 Intonation

Before comparing Czech and French intonation, some clarification of the meaning of the terms that will be used in the present thesis is needed. I will use the term intonation by its narrowest meaning, i.e., referring to speech melody which is acoustically the most related to $f0$ course in the speech, and not with its larger meaning of prosody (cf. Skarnitzl et al., 2016). Then, I will use the term intonation pattern for a set of cadences (melodic schemes) that are used in a given language for the same function, i.e., as a relevant characteristic of the same type of sentences (Palková, 2017). Some authors also call intonation patterns intonation tone (see, e.g., Delongová, 2013). With respect of the multiplicity of the terms used for units of prosodic hierarchy (Skarnitzl et al., 2016), following Gendrot and Gerdes (2010), I will use the term accentual phrase for unit inferior of one degree to the intonational phrase. Accentual phrase is also called stress group in older literature of Czech prosody but Volín and Skarnitzl (2020) highlight the limit of the use of this term for Czech accentual phrase. Accentual phrase may also be phonological word (cf. Skarnitzl et al., 2016), and Volín and Skarnitzl (2020) discuss the potential use of the term accent-group for this unit in Czech. Finally, following Gendrot and Gerdes (2010), the term intonational phrase will be used for the unit upper of one degree that accentual phrase. This unit is also sometimes called tone unit or prosodic phrase (Duběda, 2012; Skarnitzl et al., 2016). From Tones and Break Indices (ToBI), which is a manner of phonological annotation of intonation, the following abbreviations with the following meanings will be used: H+!H* for downstepped accent, L for low tone, H for high tone, L% or H% for boundary tone, L* or H* for Pitch accent, L- or H- for phrase accent, ! for downstep, L*+H for scooped accent (Beckman & Hirschberg, 1994).

Concerning intonation patterns, three basic patterns are traditionally distinguished in Czech (Skarnitzl et al., 2016; Volín, 2010), i.e., falling conclusive pattern, rising conclusive pattern and non-conclusive pattern. Each of these three patterns may be realised by different cadences (see fig. 3.7). The first pattern is typical for declarative sentences, imperatives and wh-questions. It is characterized by a decrease in the melody from the syllable bearing the sentence accent to the end of the utterance. This decrease can be gradual or stepwise and the minimum difference of $f0$ is 8 ST (Palková, 1994; Hruška, 2016). The second pattern is used for Yes/No questions. Delongová (2013, p. 30) writes that "it is characterised by a relatively steep rise of $f0$". Thus, it is characterized by a sudden rise of the melody (7-9 ST) (Palková, 1994; Hruška, 2016). The last implies "a continuation of the utterance (used either at the end of sentences or independent sentence members)" (Delongová, 2013, p. 30). Chamonikolasová (2013) study confirmed the validity of this basic distinction on the corpus of Czech dialogues. Moreover, many studies investigated the Czech intonation pattern in detail and tried to schematised pitch movements which may occur in each type. Volín (2008) found that non-conclusive pattern is very often realised by slightly rising cadences (see section 6.6.1 for more detail). According to Skarnitzl et al. (2016), falling conclusive pattern is very often realised by rising-falling cadences (second cadence on picture a) in fig. 3.7) and not only falling intonation (first cadence on picture a) in fig. 3.7). Skarnitzl et al. (2016) states that when falling conclusive pattern is produced with emphasis, it can be realised with very rising cadence or very rising-falling cadences (see two last cadences in picture a), fig. 3.7). In Pešková, Colantoni, and Meisenburg (2018) study, that

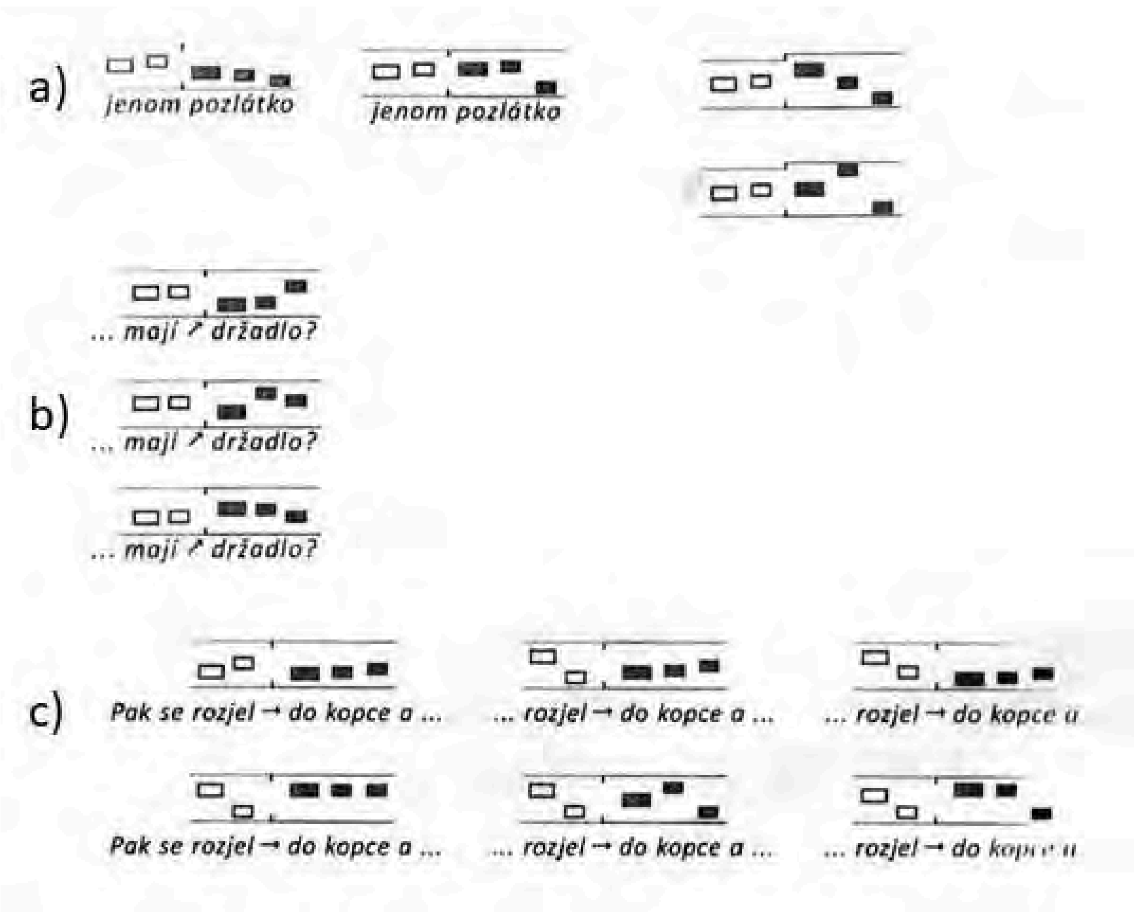


Figure 3.7: Three basic intonation patterns in Czech

Note: Taken from Skarnitzl et al. (2016, p. 135-137). a)=cadences of falling conclusive pattern, b)=cadences of rising conclusive pattern, c)=cadences of non-conclusive pattern.

Tonal event	Bohemia (*N*=36)	Moravia (*N*=48)
H* LH%	22%	6,5%
L* H%	11%	21%
L*+H !H%	53%	64%
L*+H H%	11%	0%
L*+H LH%	3%	8,5%

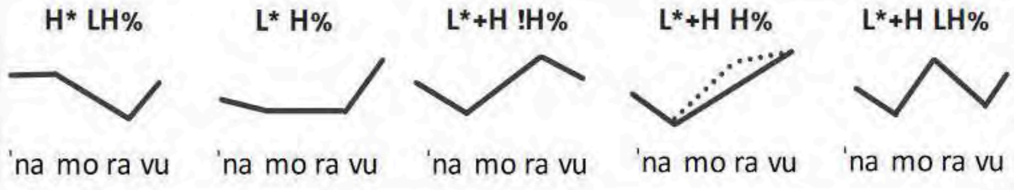
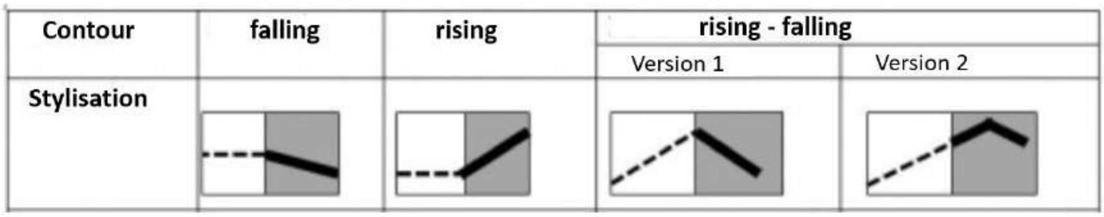


Figure 3.8: Cadences in Czech yes-no question and percentage of their production.

Note: Table indicates how many percent of the speakers patterns were realised by the given cadence. Bohemia=Bohemian Czech speakers, Moravia=Moravian Czech speakers. L=low tone, H=high tone, L% or H%=boundary tone, L* or H*=Pitch accent, L- or H-=phrase accent, L*+H=scooped accent, !=downstep. Taken from Pešková et al. (2018, p. 53).

pattern was realised the most often as (H)*L% when the statement was produced neutrally, and as L*+H L% when the statement was produced during more emphatic reading. For rising conclusive pattern, Skarnitzl et al. (2016) states that it may be realised by rising intonation, rising-falling intonation or flat-rising intonation (see picture b), fig. 3.7). They were recently re-examined by Pešková et al. (2018) who showed that, in the speech production by reading of sentences, the rising conclusive pattern predominantly were produced as L*+H !H%, i.e., falling-rising-falling intonation by both, Bohemian Czech and Moravian Czech speakers (see fig. 3.8).

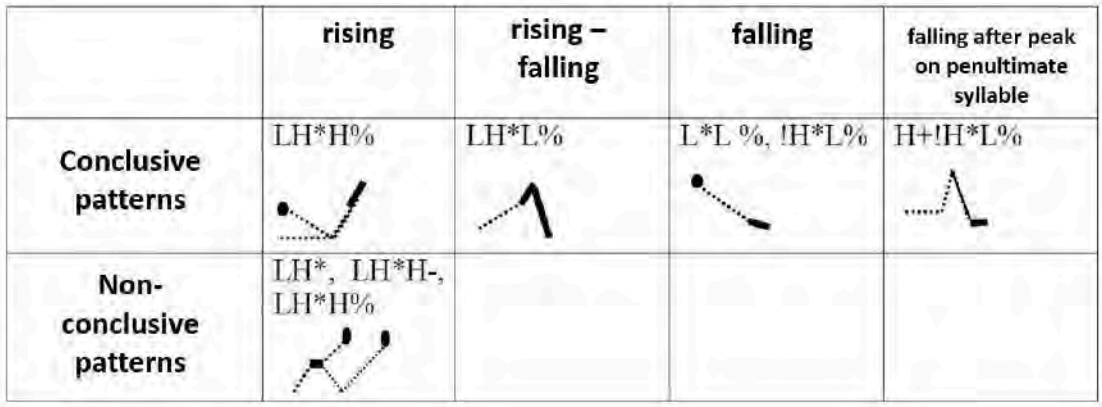
Intonation patterns in French were recently studied detail in Di Cristo (2016). The authors examined all possible types of patterns and proposed various cadences by which they may be realised. To summarise these findings and the findings of Delais-Roussarie et al. (2015); Post (2000), Santiago (2019) proposes four patterns for teaching French Foreign Language (see fig. 3.9). Delais-Roussarie, Post, and Yoo (2020) proposes same three patterns as Santiago (2019) but splits the fourth into two, and specifies the most typical cadences (see fig. 3.10). The French conclusive falling pattern is typical for expression of conclusion, assertion and order (Santiago, 2019) and are characterized by falling $f0$ (Delais-Roussarie et al., 2020; Santiago, 2019). The French non-conclusive rising pattern is used for enumerations, and when the speech is expected to continue (Santiago, 2019). The French conclusive rising patterns are typical for yes-no questions, whereas it still remains unclear for the authors whether wh-question are mainly produced by using conclusive rising or falling pattern (cf. Santiago, 2019). The two versions of French rising-falling pattern



Contour	falling	rising	rising - falling	
			Version 1	Version 2
Stylisation				

Figure 3.9: Four intonation patterns intended for teaching French L2.

Note: Taken from Santiago (2019, p. 7). The white space in rectangle means penultimate syllable. The grey space mean the last syllable.



	rising	rising – falling	falling	falling after peak on penultimate syllable
Conclusive patterns	LH*H%	LH*L%	L*L %, !H*L%	H+!H*L%
Non-conclusive patterns	LH*, LH*H-, LH*H%			

Figure 3.10: French intonation patterns and their cadences.

Note: Taken from Delais-Roussarie et al. (2020, p. 150) with indication of possible cadences for each pattern. L=low tone, H=high tone, L% or H%=boundary tone, L* or H*=Pitch accent, L- or H-=phrase accent, H+!H*=downstepped accent, !=downstep.

are typically used for expression of conviction, exclamation, implication, doubts and evidence (Santiago, 2019, see fig. 4.9).

Comparing Czech and French intonation patterns, we may see that falling-rising-falling intonation of yes-no question found for Czech by Pešková et al. (2018) seems not to be typical for yes-no question in French (cf. Santiago, 2019; Delais-Roussarie et al., 2020, and figures 3.9 and 3.10). In both Czech and French the wh-question may be realised by falling intonation pattern even if it is still to be discussed if a rising pattern may be also used for that question in French (Santiago, 2019; Skarnitzl et al., 2016). For declarative sentences, falling cadence is typical for both Czech and French when comparing the results of Pešková et al. (2018) with Delais-Roussarie et al. (2020); Santiago (2019, figure 3.9 and 3.10). Concerning non-conclusive pattern, the cadences seem to rise most (very) in French while only slightly in Czech (Delais-Roussarie et al., 2020; Santiago, 2019; Skarnitzl et al., 2016; Volín, 2008, see figure 3.7, 3.9, and 3.10).

Concerning pitch range, several studies reported that it may differ among languages (see, e.g. Andreeva et al., 2017; Keating & Kuo, 2012; Mennen, Schaeffler,

Table 3.4: Mean $f0$ values in Czech and in French

		Male	Female
Czech	Volin et al. (2015)	107	165
French	Hirst (2003)	142	262
	Zimmerer et al. (2015)	119	209

Note: In Hz. Source: Hirst (2003); Volín et al. (2015); Zimmerer et al. (2017)

& Docherty, 2007). Pitch range in Czech and in French may be compared by using the results of Hirst (2003); Volín, Poesová, and Weingartová (2015); Zimmerer, Andreeva, Jügler, and Möbius (2017). Hirst (2003) used French recordings from a multilingual corpus *Eurom1* for pitch analysis containing a number of different types of read speech. Volín et al. (2015) studied pitch in Czech from recordings of news bulletins from the Czech National Radio read by 8 male and 8 female Czech professional news readers. In the study of Zimmerer et al. (2017), pitch range of French native speakers and beginners in German was obtained from the recording of their production in reading in French. As table 3.4 shows, the mean value of $f0$ in speech produced by reading seems to be higher in French than in Czech. We can also observe that the difference in mean $f0$ in Czech and in French is higher in female production than in male production. Even if we are conscious that mean $f0$ changes with speakers' age as shown by (Tykalová et al., 2020 in Press), these studies suggest that mean $f0$ is higher in French than in Czech and that particularly in female production.

In his study, Duběda (2012, p. 175) compared the prosody of Standard Czech and Standard French. He highlighted the following principal differences between the languages at the level of intonational phrase:

- Intonational phrases are longer in Czech than in French.
- Intonational phrase are more melodic in French than in Czech while Czech is more monotonous than French as "tonal intervals" are bigger in French than in Czech and "intonational inversions" are more frequent in French than in Czech.

A "tonal interval" is considered by the author to be a difference between two successive targets, where target refers to the methodology used for studying intonation by Hirst (2003), i.e., description of intonation movements by succession of targets points that when relied by quadratic curves leads to an intonation perceptually equivalent to the original intonation. The term "intonational inversions" refers to the changes in intonation as rising and falling (cf. Duběda, 2012).

The prosody of southern French may differ slightly from Standard French's prosody due to the hyper-pronunciation of the final schwa, i.e., the schwa at the end of French words (cf. Coquillon, 2005). The hyper-pronunciation of this schwa is typical for southern French. Hence, we present it more in detail below. Concerning pitch range, to the best of our knowledge, there is no study about it in Toulouse French. Nevertheless, it was studied in French spoken in Marseilles (southern French city) by Coquillon (2003) who found that the speakers from Marseilles tended to use a wider range than the speakers from northern France.

3.3.2 Stuck schwa in Toulouse French

As claimed by Coquillon (2005), non-southern French speakers rarely to never produced the final schwa while its pronunciation is typical for southern French speakers. Consequently, this schwa may indicate the speaker's geographical origin, mainly if the speaker is from southern France (Coquillon, 2005). As very well said by Brun (2000), in southern France, this schwa called the dumb 'e' ('e-muet') in French, is not dumb because of its not silent pronunciation.

In southern French, the final schwa may be defined as sound [ə] stuck to the end of the word. It may correspond to the presence of the letter 'e' at the end of the French word, but it may also be pronounced even without this letter (cf. Coquillon, 2005). To illustrate the first case, Pustka (2011) gives the example of the French phrase 'bonne mère' which, according to her study, may be pronounced as 'bonnE mèrE'. To illustrate the second case, Carton, Rossi, Autesserre, and Léon (1983) states that French words 'alors' and 'avec' may be pronounced as [alɔRə] and [avɛkə].

The added schwa to the end of the word is usually stuck to the last pronounced consonant of the word (Coquillon, 2005; Durand, Slater, & Wise, 1987), however Carton et al. (1983) have also spotted the schwa stuck to the last pronounced vowel of the word. In southern French, it makes a new syllable, as illustrated by fig. 3.11. Consequently, southern French's stress is not on the last syllable of the accentual phrase, i.e., on the new syllable created by added final schwa, but it is on the penultimate syllable, i.e., the syllable previous to the syllable containing the final schwa. Hence, one of the characteristics of the final schwa is that it is not stressed.

As mentioned by Coquillon (2005), final schwa production is practically systematic in Toulouse French. Coquillon (2005) found that the final schwa produced by Toulouse French speakers is generally longer in duration than the one produced by speakers from Marseilles, meaning that the final schwa seems to be very important in Toulouse French. Since it is added to the end of the word, we will call this final schwa hereafter the 'stuck schwa'.

In the larger geographical context of France, the stuck schwa was examined by Nemoto and Adda-Decker (2013). The authors based their study on the recording of spontaneous speech (more exactly, free and guided face-to-face conversations) and reading of a text. The speech was produced by two groups of French speakers, i.e., a

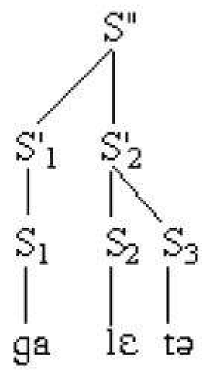


Figure 3.11: Syllabic composition of French word 'galette' as it may be pronounced by southern French speaker.

Note: S_1, S_2 and S_3 indicates the level of syllable, S_1' and S_2' the level of metric foot and S" is the level of word. Taken from Coquillon (2005, p. 70).

group of 32 speakers from 'north' living in 7 different geographical areas (Aveyron-Paris, Brunoy, Dijon, Lyon-Villeurbanne, Roanne, Vendée, Nyon), and a group of 18 speakers from 'south' living in 4 geographical zones in the south of France (Biarritz, Douzens, Lacaune, Rodez). All words ending in a phonemic consonant in the recordings were considered as potentially ending by stuck schwa. The study focused on analysis of only lexical words. The finding confirmed that speakers from south realised more stuck schwas than the group of speakers from north, and interestingly, showed that in both spontaneous speech and reading, southern speakers realised twice as many of stuck schwa as northern speakers. The results also showed that, if there are differences in acoustic realisation of stuck schwa by speakers from north and south, they should appear more clearly in spontaneous speech than in reading.

3.3.3 Stress and rhythm

The main difference between Standard Czech and Standard French concerns their dominance. Generally, two types of languages are distinguished: languages with the left dominance with a preference for descending accentual phrases and languages with right dominance preferring ascending accentual phrases (see fig. 3.12). Czech is a language with left dominance (Skarnitzl et al., 2016), while French is a language with right dominance (Delais-Roussarie & Di Cristo, To appear). Also, Duběda (2012) arrived to the similar conclusion by his comparative study of recording of Standard French native speakers and Standard Czech native speakers. The author states that the accentual phrase is ascending or bidirectional in French while it is descending in Czech. The author adds that the syllabic length of accentual phrase in French and Czech is similar while he found number of words per accentual phrase to be higher in French than in Czech.

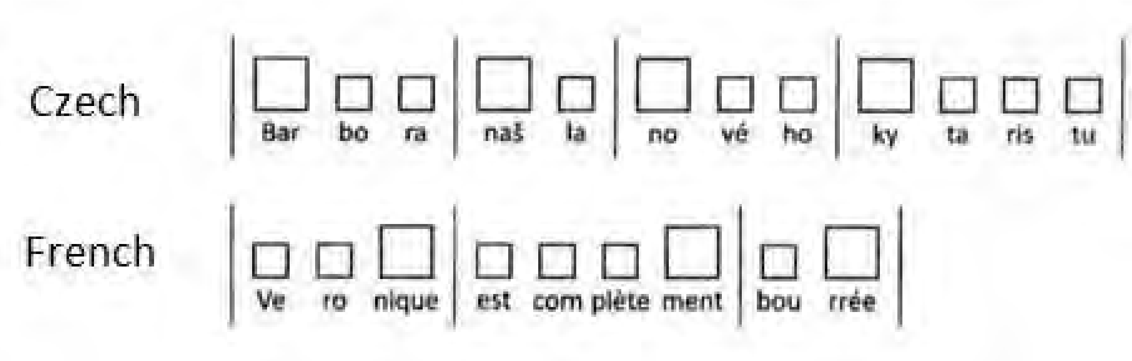


Figure 3.12: Illustration of place of lexical stress in Czech and in French.

Note: Bigger squares corresponds to stressed syllables, smaller squares means unstressed syllables. Horizontal lines designates the boundaries of accentual phrases. Taken from Skarnitzl et al. (2016, p. 141).

Both Standard Czech and Standard French have fixed stress. In Czech, perceptual determination of stress is not linked to higher acoustic values of the stressed syllable but is linked to the specific course of the acoustic properties in the entire accentual phrase (cf. Skarnitzl et al., 2016). Even if it may be traditionally taught in Czech schools that the Czech stress is on the first syllable of the accentual phrase, it was shown that the second syllable of the accentual phrase is the one with higher acoustic values (Skarnitzl et al., 2016). By contrast, in Standard French, three types of stresses may be distinguished according to (Delais-Roussarie & Di Cristo, To appear): one secondary initial stress, and two primary final stresses, i.e., final non-nuclear stress and final nuclear stress (Delais-Roussarie & Di Cristo, To appear; Duběda, 2012). The first one concerns first syllable of the words, accentual phrases and intonational phrases. It may occur on the second syllable when the prosodic unit starts by preposition or article (cf. Delais-Roussarie & Di Cristo, To appear). The second one occurs in last syllable of accentual phrases while the third type of stress occurs in last syllable of intonational phrases (Delais-Roussarie & Di Cristo, To appear). Both French final stress may be on a penultimate syllable in southern French because of the presence of the stuck schwa, i.e., on the syllable preceding the stuck schwa (cf. Chabot, 2008).

Czech and French stress also differ in their acoustic correlates. According to (Duběda, 2012), Czech stress is characterized mainly by intonation. The syllable lengthening never manifests the stress in Czech, while the final stress in French may be perceived through the longer duration of the last syllable of accentual and intonational phrase (Duběda, 2002). According to Delattre (1966b), lengthening is the most stable component of a stressed syllable in French. Delais-Roussarie and Di Cristo (To appear) found stressed syllables at the end of accentual phrases to be shorter than those at the end of intonational phrases which allows the two French final stresses to be distinguished. This was empirically shown by the study

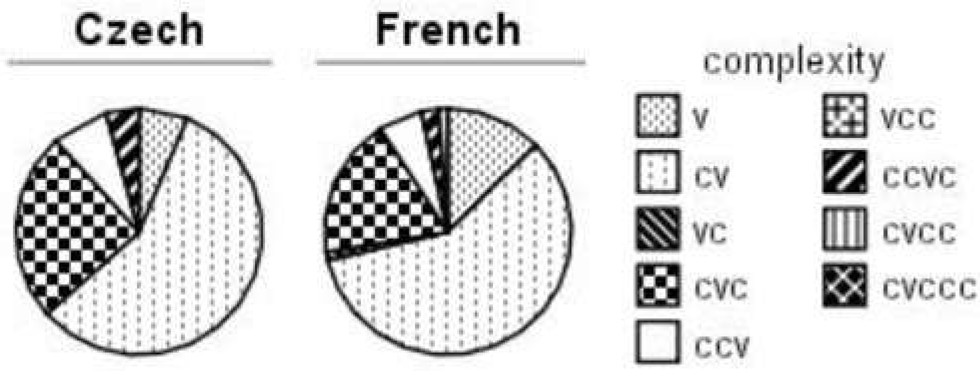


Figure 3.13: Syllable complexity in Czech and in French.

Note: Obtained by comparison of the same read text, written in Czech and in French. C=consonant, V=vowel. Taken from Dačovicová and Dellwo (2007, p. 1242).

of Gendrot, Gerdes, Yoo, and Delais-Roussarie (2009) comparing a vowels duration in the final position of the syllable, word, accentual phrase, and intonational phrase. Final stresses of Standard French are also characterised by an intonation movement (Delattre, 1966b; Duběda, 2012; Duez, 1987), and final stressed syllable may also be associated with higher intensity even if is not always a systematic acoustic correlate of the stressed syllable in French (Duběda, 2002). For the realisation of French initial stress, the speakers use the intensity and intonation (Duběda, 2012). Delais-Roussarie and Di Cristo (To appear) adds that tonal peak characterizes French initial stress.

Concerning the rhythm, Standard French and Standard Czech are syllabically isochronic languages (cf. Duběda, 2012; Skarnitzl et al., 2016), i.e., syllable-timed, meaning they do not importantly differ in rhythm. However, Czech may sometimes appear as stress-timed depending on speech style or on individual customs of native Czech speakers (Skarnitzl et al., 2016). Concerning Toulouse French, it may be supposed that it may also be considered as syllabically isochronic language variety, but the phenomenon of stuck schwa will slightly affect the regularity of syllables (cf. Coquillon, 2005; Durand, 2009). Dačovicová and Dellwo (2007) examined rhythm in native speech of nine Czechs living in Prague and native speech of five French speakers whose recordings were available in *BonnTempo* corpus (see Dellwo, Steiner, Aschenberner, Dankovičová, & Wagner, 2004). The speech for both was obtained by reading the same text, written in their native languages. First, the authors focused on comparison of the syllable complexity of the text read in native languages. As fig. 3.13 shows, the number of syllables composed by CV (consonant, vowel) was higher in French than in Czech, while the number of syllables composed of CVC was higher in French than in Czech. French also had a higher number of syllables composed by a single vowel than Czech. The authors noticed that “simple syllable structures (syllables composed of V, CV, or VC) are represented by 65% of syllables in Czech, which is higher than in stress-timed” languages such as English or German, but clearly lower than in syllable-timed languages such as French or Italian (Dačovicová & Dellwo, 2007, p. 1242). After that, the authors measured four descriptors of rhythm allowing them to distinguish stress-timed languages from syllable-timed languages. These descriptors are %V, VarcoC, nPVI, and rPVI where the first represents the overall percentage over which speech is vocalic, VarcoC refers to ΔC divided by the mean duration where ΔC is standard deviation from mean duration of consonants intervals, and nPVI and rPVI are normalised and row values of pairwise variability index designating the mean in difference in duration of two neighbouring elements (Dačovicová & Dellwo, 2007; Skarnitzl et al., 2016). The analysis of %V showed that Czech is in between syllable- and stress-timed languages, more precisely between German and French when these languages examined together with English and Italian. On the one hand, there was no statistically significant difference between nPVI in Czech and French allowing the classification of Czech as clearly syllable-timed. On the other hand, there was a significant difference in rPVI and in varoC in Czech and in French showing that Czech is closer to traditionally stress-timed languages such as English and German than to traditionally syllable-timed languages such as French and Italian.

3.4 Comparison of hesitation markers

Hesitation is a paralinguistic element (Rose, 1998) which may be understood in its narrow or large sense (cf. Průchová, 2016). In the first one, it may be considered as hesitation sounds which we may classify as filled pauses (Fraundorf & Watson, 2011; Swerts, 1998) also including the fillers consisting in one or more words. In that case, according to Maclay and Osgood (1959), the fillers are used to inform that the turn of speech has not yet been completed (Maclay & Osgood, 1959) and indicate the desire of the speakers to keep their turn of speech. By contrary, hesitation in its large sense refers to the disfluency, i.e., discontinuity of speech (Yilmaz & Schmid, 2012), thus meaning for Rose (1998) any disturbance of the speech signal. In this sense, hesitation may be understood as a variety of disfluent features, phenomena which slow the transfer of information (Rose, 1998). As mentioned by Průchová (2016), in that case, we can question what can still be considered a disfluent element as such. Hesitation in its large sense can take on a variety of meanings in speech, and be a bearer of a specific pragmatic function (Rose, 1998). Thus, it may serve the communication rather than revealing shortcomings in it (Rose, 1998).

Rose (1998) distinguishes six types of hesitation: false starts, repeats, restarts, self-corrections, lengthening, and pauses. The pauses may be divided into two categories: silent pauses and filled pauses (cf., e.g. Leech & Svartvik, 2002). According to Rose (1998), the filled pauses may be either lexicalized, i.e., consisting in one or more words (e.g., *so, well, like, you know*) or vocalized, i.e., consisting in vocalic or/and consonantic sound(s)). The researchers agree that hesitation markers and their use may vary with a language (see, e.g. Maclay & Osgood, 1959; Levelt, 1983; Clark & Tree, 2002). Hesitation in French was studied in detail by Candea (2000), whereas, as Průchová (2016) mentions, the studies about hesitation in Czech seems to be extremely rare and few authors give a detailed description of hesitation in Czech.

Hesitation in Czech is marginally mentioned in a study of Skarnitzl and Machač (2012) focusing on parasite sounds in Czech. The authors claims that "hesitation sounds are above all the well-known long vowels of indeterminate quality, which the speaker inserts, for example, in moments when he does not know exactly how to continue, and feels that a silent pause would be a worse solution" (Skarnitzl & Machač, 2012, our translation). The authors add that "hesitation sounds differ from parasitic ones in that they are not tied to a specific phone and their occurrence in speech is very difficult to predict" (Skarnitzl & Machač, 2012, our translation). This vowel of "indeterminate quality" (Skarnitzl & Machač, 2012, our translation) may be understood as schwa in Czech used for hesitation (Volín, 2010). In this case, it has a long duration (in Volín (2010), it is marked by symbols /əː/ and /əːː), and it is separated from the word by the silences. Průchová (2016) found a high occurrence of these schwa in synchronous corpus of spoken Czech ORAL2013, composed of spontaneous conversation in completely informal communication situations and covering the whole territory of the Czech Republic (most speakers were from Central Bohemia, the least from the Moravian borderland). She analysed 79,835 recordings containing in total 2 785 189 words and found 17 888 pauses filled by more vocalic element and 8 347 pauses filled by more consonantic element. To compare with English, in the study of Rose (1998) on the corpus of spoken English the the fillers containing vocalic element and transcribed as *era* and *erm* were observed to be among the most characteristic features of spoken language. On the same speech corpus with some extensions, Šulecová (2015) arrived into the same result concerning the filler composed of vocalic element. Šulecová (2015) also showed the high occurrence in that corpus of the words *prostě* (which might be imperfectly translated as 'just', 'simply', 'in sum'), *v podstatě* (which might be imperfectly translated as 'in fact'), *jakoby* (which might be translated as 'like') and *čili* (which might be translated as 'that is'). Průchová (2016) underlined the high occurrence, for example, of *no* meaning 'well' *tak* meaning 'well' or 'o.k.'[11].

Concerning hesitation in French, Candea (2000) examined five elements: auto-

[11]Note that *vlastně* meaning 'as a matter of fact' is another important Czech filler even if its frequency in the corpus was not examined by Šulecová (2015) nor by Průchová (2016).

corrections, repetitions, vowels lengthening, the *euh*, and the silent pauses. For her study, she used the corpus of 13 stories told in French during a French class by native French students. The silent pauses were the most frequent element in the corpus followed by *euh*, than by vowels lengthening. The autocorrections were the less frequent element in the corpus preceded by repetitions. The following paragraphs explain how the silent pauses, *euh* and vowels lengthening were analysed, counted, and give some further more detailed results. In her study, Candea (2000) decided against using the term hesitation and chose to use the term 'work of formulation'. This is defined as the work the speaker does when searching a formulation of the following speech. I will use this term when speaking about her study.

Concerning the silent pauses, Candea (2000) distinguished two types of pauses: 'structuring' and 'non-structuring' pauses. When the pause occurred immediately after an unambiguous mark of work of formulation, i.e., *euh* or lengthening indication work of formulation, it was considered as non-structuring pause by the author. Contrarily, when the pause follows after a sound sequence not ending with a mark of work of formulation, it was be considered as structuring pauses (Candea, 2000). The author found that duration of structuring pauses was on average significantly higher than that of non-structuring pauses. The silent pauses after *euh* were significantly longer than all the others, while the silent pauses separating two words of a repetition were significantly shorter than all the others.

Concerning the *euh*, Candea (2000) chose to distinguish *euh* of support and *euh* mark of work of formulation. The *euh* of support were considered to be all vowels added in the end of the word, i.e., stuck to the end of the word that fulfilled the following free conditions:

1. They were not predictable from the linguistic point of view meaning that the 'dumb e' (see subsection 3.3.2 for this term) produced by southern French speakers was not annotated as *euh*. However, when they were produced by non-southern French speakers and when they were not obligatory in French, they were annotated as *euh*.

2. Their duration did not exceed the threshold of a long syllable located at the end of rhythmic group (in general, about 200ms) and they were not endowed with a continuous intonation with respect to the previous syllable.

3. Their intensity was not stronger than that of the stressed vowel which preceding then.

On the contrary, the *euh* of work of formulation were considered to be *euh* stuck to the end of the word that did not fulfil these three conditions or the *euh* which were preceded by a silent pauses. The results showed that 87% of all annotated *euh* were realised as *euh* of work of formulation, and 13% of all *euh* were *euh* of support. The duration of *euh* of work of formulation varied approximately between 150 ms and 500 ms, but the author also noted a number of *euh* of work of formulation that may reach almost a second.

To summarize the studies concerning vowels lengthening, Candea (2000) reminds us that a vowel begins to be abnormally lengthened when its duration is between 180 and 220ms depending on the speakers, and that the maximum duration of vocalic lengthening marking the work of formulation can reach 800ms, but most of the lengthenings are between 300 and 400ms. Therefore, Candea (2000) considers vowel lengthening to be in the corpus any abnormal vocalic lengthening in final or initial word position manifesting the work of formation in progress. The author found that the structure of the preceding syllable has a strong influence on the appearance of the lengthenings: only 1.6% of lengthenings occurred in syllables composed of CVC (consonant-vowel-consonant), while the others occurred in CV syllables. Regarding the lexical context, approximately one grammatical word per 25 carried the lengthening, whereas only one full meaning word per 143 contained the lengthening.

3.5 Summary and significance of the chapter for our research

At the beginning of the chapter, it was revealed that CF are likely to be in contact with three varieties of languages: Standard Czech, Standard French and Toulouse French. Hence, after comparing phonetic systems of Standard Czech, Standard French and Toulouse French, I propose to retain the following similarities and differences between the systems:

- 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. Consequently, Toulouse French vocalic system seems to be nearer to the one Standard Czech than vocalic system of Standard 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. Standard French has more rounded vowels than Czech meaning its vocalic system requires more precise and tense articulation than the Czech vocalic system.

- Czech consonant system is richer than the one of Standard French and Toulouse French, which are similar. /ɱ/, /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.

- Czech may use glottal stop /ʔ/ for dividing the final consonant of one word from initial vowel in the following word, whereas French may link the final consonant of one word with initial vowel in the following word in the case of *liaison*. Because of their tense pronunciation of French consonants, the final consonant devoicing does not occur in Standard French. However, it is common phenomenon in Standard Czech. Moreover, in some specific Czech words, two consonants may merge in one pronounced consonant, as it is the case of /t/ and /ʃ/ in the word *kratší*.

- Standard French and Toulouse French are more melodic language varieties than Standard Czech which is more monotonous. The cadence of intonation used the most for yes-no questions differs in Czech and in French. 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. Moreover, speakers from Marseilles, a southern French city, tended to use a wider range than the speakers from northern France.

- 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. Moreover, French contains clearly more CV syllables than the Czech. The rhythm of Toulouse French may be slightly affected by potentially numerous stuck schwa.

It was shown that studies about hesitation in Czech are rare and insufficient for a detailed description of hesitation used in Czech, whereas the hesitation in French has been studied in detail. In both languages, filled pauses are very frequently composed of a vocalic element. Interestingly, the filler composed of a vocalic element is separated from the words by the silences in Czech. By contrast, in French, the filler composed of a vocalic element is usually added to the end of the word and has a specific properties in its duration and intensity. It may be suppose that two types of stuck schwa might occur in Toulouse French, the first being an expression of language variety, the second being an expression of speaker's hesitation. Duration appears to be a potential criterion for distinguishing both types. Vowel lengthening is often used in French as a hesitation marker.

Chapter 4

Research questions, design and significance

In chapter 2, I gave an overview of studies on phonetic CLI and demonstrated forms of phonetic impact of late bilinguals' L2 on their L1 at both segmental and suprasegmental level. We saw that when phonetic CLI were examined by perception experiments, not all authors reported a significant difference between late bilinguals' and monolinguals' L1 speech. In addition, we noted that the most common acoustic measurements were VOT of stops. However, this does not mean that VOT is the specific phonetic feature most prone to impact by phonetic CLI, as VOT was primarily examined because it is easily measurable. Moreover, the occurrence of phonetic CLI seems to depend on differences between given L1 and L2 and among individual speakers than on a given phonetic feature (see chapter 1 and chapter 2). In other words, from chapter 1 and chapter 2, we cannot consider that phonetic CLI is phonetic feature specific but is more likely to be language and speaker specific. We also saw that the studies of Flege and Hillenbrand (1984) and Major (1992) bring opposite findings with regard to the question of whether more phonetic CLI occurs in informal than formal speech styles. We saw that phonetic CLI may be related with several extralinguistic factors, even if it remains impossible to affirm that phonetic CLI are always linked with LOR, L1 use and L2 proficiency as the studies reported heterogeneous results. I highlighted that there are no studies investigating the link between phonetic CLI and attitudinal factors. In chapter 1, I discussed how the models and hypotheses of L2 speech acquisition might be used to predict phonetic CLI. At the end of chapter 2, by making a bridge between these models and the results of the studies, I demonstrated that SLM-r is the most suitable model for studying phonetic CLI. The comparison of Standard French, Standard Czech and Toulouse French phonetic systems provided in chapter 3 showed that several speech segments and suprasegments are not identical in these three language varieties. Furthermore, I highlighted the significant difference between Standard Czech and Standard French and Toulouse French at a phonetic level. Building upon this analysis, I shall now outline my general hypothesis, research questions concerning L2 phonetic impact on CF's L1 and research design, before highlighting the significance of the present thesis as research design allows to reveal it.

4.1 General hypothesis and research questions

Regarding the presumptions given by SLM-r, many factors (phonetic, extralinguistics, endogeneous) should be considered when predicting phonetic influence of bilinguals' L2 on their L1 (see subsection 1.2.6). The models of L2 speech acquisition (mainly SLM and SLM-r, see chapter 1) and the results of studies of phonetic CLI (chapter 2) share a common presumption that when phonetic systems of L1 and L2 spoken by a late bilingual are not identical the phonetic L2 influence on L1 can occur. As Czech and French differ significantly in their phonetic systems (cf. chapter 3), for the present thesis, we propose the following **general hypothesis** concerning L1 speech of CF[1]:

Phonetic CLI will occur in CF's L1 speech.[2]

From this general hypothesis, three particular ***research questions*** arise. They are:

1. ***Is CF's L1 speech perceived by Czech monolinguals as less native-like because of the presence of the phonetic CLI?*** As shown in subsection 2.3.5, several authors focused on the perception of L1 speech of late-bilinguals by L1 monolinguals. Bergmann et al. (2016); De Leeuw (2008); Mayr et al. (2020); Sancier and Fowler (1997) found that the bilinguals' L1 speech was perceived as less native-like sounding than L1 monolinguals' speech. However, Schmid and Hopp (2014); Sůčková (2020) found no significant difference in the perception of bilinguals' L1 speech and L1 monolinguals' speech by L1 monolinguals.

2. ***In which phonetic features of the CF's L1 speech does CLI occur and can it be revealed by acoustic measurements?*** As shown in section 2.3, many studies revealed phonetic CLI in particular phonetic features of bilinguals' L1 speech by acoustic measurements (see, e.g., Bergmann et al., 2016; Chang, 2010; Dmitrieva et al., 2010; Kupske & Alves, 2016; De Leeuw, 2008; Mayr et al., 2012; Sancier & Fowler, 1997; Sůčková, 2020; Ulbrich & Ordin, 2014). In chapter 1 and chapter 2, we saw that when using the models of L2 speech acquisition it may be assumed that phonetic CLI will mainly occur in

[1] Remind that Czech is L1 of CF, and French is their L2.

[2] Note that when we speak about phonetic CLI in CF's L1 speech, we mean the influence of French on the CF's Czech, which might be mainly the influence of Standard and Toulouse French on the CF's Standard Czech (cf. section 3.1).

features which are not identical in L1 and L2. that when used the models of L2 speech acquisition suggest

3. ***How are extralinguistic factors related to phonetic CLI in the CF's L1 speech?*** In chapter 1, we saw that some models of L2 speech acquisition, mainly SLM-r, also consider several extralinguistic factors when predicting interactions between learner's L1 and L2 phonetic systems. That means that extralinguistic factors are also important when studying phonetic CLI in L1 speech of late bilinguals. In subsection 2.1.3, we saw that, in the research field of phonetic CLI, some studies investigated mainly one or two of these extralinguistic factors, but the results vary between the studies (see section 2.4.2).

4.2 Research design

To investigate these three research questions, the present thesis involves three studies. The first (chapter 5) is a perpetual study consisting in perception experiment, referred henceforth as the perceptual test, which aims to answer to the first research question. The second (chapter 6) is an acoustic study aiming to answer to the second research question. The third (chapter 7) focuses on extralinguistic factors, and aims to answer the third research question. Figure 4.1 shows how these three studies are organised in the present thesis and the links between them.

The first study, the perceptual test, consists of rating speech items taken from the L1 speech of CF and C in two speech production tasks: a 'reading aloud' task and semi-spontaneous speech. The C's and CF's speech items were rated by Czech monolingual listeners indicating how much they perceive them as typically Czech or typically French (for more detail, see section 5.2). In addition to answering the first research question, the perceptual test had a secondary role. Listeners were asked to add comments with their rating, and we were therefore able to compile a list of phonetic features of segments and suprasegments of CF's L1 speech, perceived as phonetic CLI, that were mentioned by the listeners. These were then used for examination by acoustic measurements in the following study. Indeed, without the perceptual test, it would be more difficult to make a selection of phonetic features for examination by acoustic measurements as many phonetic segments and suprasegments differ in Czech and French (cf. chapter 1).

For the acoustic study, I also used CF's and C's L1 production in the reading aloud task and semi-spontaneous speech. The study involved a speech corpus of 17 C and 17 CF speakers, representing two equal groups sufficiently numerous for being statistically comparable.[3] Three sets of phonetic segments and two suprasegments

[3]For constituting this speech corpus, I took the same speech corpus as that used for the perceptual test, removed two CF speakers (one because of a difference in sex from the other CF, another because she lived in another geographical area than the other CF), and enlarged the corpus by

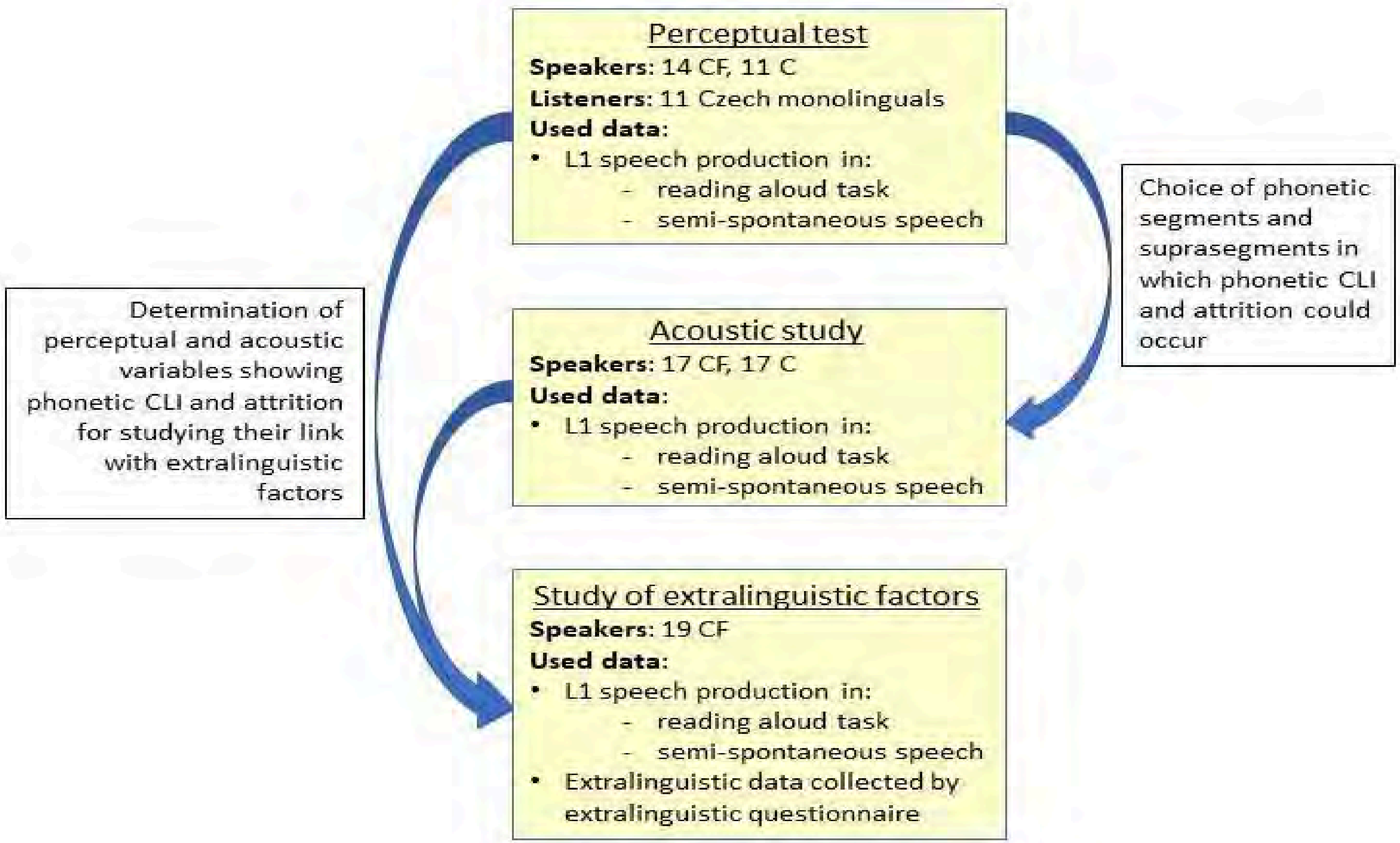


Figure 4.1: Schema of research

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

were determined in the end of the perceptual test for being examined acoustically: vowels, rhotics, glottal and velar fricatives, non-conclusive intonation patterns and stuck schwa. Concerning the first three, we examined their spectral characteristics; the temporal characteristics were studied in addition on rhotics. In non-conclusive intonation patterns, we focused on $f0$ movements, and for the stuck schwa, we examined its occurrence in CF's L1 speech. We examined these properties of segments and suprasegments as the listeners comments in the perceptual test often mentioned them and, as shown in chapter 3, they differ in Standard Czech, Standard French and Toulouse French.

The third study focused on extralinguistic factors. Using an extralinguistic questionnaire, we collected extralinguistic data about CF. The study consisted of an examination of relationships between extralinguistic factors and acoustic and perceptual variables which indicated phonetic CLI in CF speakers' L1. To establish these variables, we used the results from two previous studies. From the first study, we chose the speech production task in which CF were perceived as significantly differing in their L1 speech from C by Czech monolingual listeners, and considered the results in that task as a perceptual variable for the study of extralinguistic factors. From the second study, we chose the acoustic features in which phonetic CLI was found to be significant and considered them as acoustic variables. Therefore, the extralinguistic study resulted from the two previous studies (because of the use of their results as variables). In addition, it focused on extralinguistic factors that previous studies on phonetic CLI reported heterogeneous or had no results. We examined LOR, L1 use, L2 proficiency and a variable which belongs to the attitudinal factors.

4.3 Research significance

The presented research design has outlined the important intervention this thesis makes to the phonetic CLI research field. Primarily, its focus on Czech and French languages, a language pair that has never been studied before in the research field of phonetic CLI. At the beginning of this chapter, I highlighted that as phonetic CLI is language specific it varies with a studied pair of languages. Furthermore, phonetic CLI may occur in the phonetic features that are not identical in the L1 and L2. It is important to expand upon the pairs of languages previously studied, as, each pair has original differences at phonetic level, thus, through expanding language pairs we may find unknown occurrences of phonetic CLI. We saw in chapter 3 that Czech and French have more original differences at phonetic level than usually found by authors in *VOT* between English stops and the one of other language. Thus, the

adding five new CF speakers and the necessary number of C speakers, see section 6.1 for more detail).

acoustic and phonetic features that the thesis focuses on are novel. Fricatives and intonation are rarely investigated in the studies of phonetic CLI (cf. section 2.3). Moreover, the unique phenomenon of the stuck schwa in southern French has yet to be included in phonetic CLI research before. In section 2.3, we saw that many authors focused on formants and VOT as acoustic features when studying phonetic CLI. The spectral characteristics such as HNR and spectral moments which have not been measured in studies on phonetic CLI before will also be examined.

The research design above indicated two different speech production tasks used for data collection in the present thesis. In section 2.3, we saw that Major (1992) was the last author to compare phonetic CLI in formal and informal speech. Unfortunately, to the best of my knowledge and as shown in section 2.3, no other author has compared the phonetic L2 influence on L1 in different speech styles since the Major's study, i.e., since 1992.[4] Thus, the present thesis, in which phonetic CLI from the reading aloud task and the semi-spontaneous speech are compared, may be beneficial for discussing whether Major's (1992) findings, i.e., that the phonetic CLI occur more in informal speech than in formal speech, might be overgeneralized. Moreover, Major (1992) examined the phonetic CLI only acoustically. Consequently, there is a missing knowledge whether the phonetic CLI occur more in informal speech than in formal speech when examined perceptually. In addition, all the perceptual studies of phonetic CLI focused on speakers' L1 informal speech (narration, informal conversation, translation tasks, see table 2.7). As the perceptual test used speech obtained in the reading aloud task, representative of formal speech, the present thesis additionally fills this gap and brings new findings to the research field of phonetic CLI.

The present thesis is among the first studies on phonetic CLI (i.e., phonetic L2 influence on L1) with predictions established from the new presumptions brought by the SLM-r, rather than SLM.

Finally, studies on phonetic CLI usually focus on a group of expatriates (e.g., De Leeuw, 2008; Sůčková, 2020) who thus may have the possibility to speak one with another, or on a group of L2 learner (e.g., Chang, 2010) who follow all the same L2 classes, or on one individual speaker showing attrition (e.g., De Leeuw, Tusha, Zhao,

[4]Note that this statement concerns only the research field of phonetic L2 influence on L1, i.e., this also includes studies on phonetic L1 attrition and phonetic drift in L1 speech of late bilinguals. It is certain that studies concerning L2 pronunciation of L2 learners in different speech styles exist. However, these studies do not fully clarify whether phonetic L2 influence on L1 occurs more in spontaneous speech than in speech production in the reading of the late bilingual, as these studies do not concern phonetic L2 influence on L1. In addition, if one compares the L2 learners' pronunciation, for example, in reading and in spontaneous speech, it should be considered that in the reading, the learners might have to read L2 words unknown to them, which might impact the accuracy of their pronunciation, whereas in spontaneous speech, the learners cannot produce words they do not know. Even if these studies may, for example, show that native-likeness of L2 learners' pronunciation varies with the speech style, I do not consider that such a result should directly mean that phonetic L2 influence on L1 varies also with speech styles.

et al., 2018; Mayr et al., 2012; Sancier & Fowler, 1997). The thesis concerns CF who, in the time of data collection, could not be described as members of a community of 'expats'. They were, in the time of data collection, individuals living in the same French city with the same L1 and L2 who did not have knowledge of each other and knew only one or two other CF. Moreover, their L1 (Czech) is never or very rarely spoken in L2 geographical area they lived. In this point, they significantly differ, for example, from Sůčková (2020) expatriates who were very often exposed to their L1 (English) spoken by Czechs in Czech Republic (see subsection 2.3.1). Therefore, the CF in this study represent a very original group of individuals that has not often been a focus in the research field of phonetic CLI.

Thus, the present thesis involves studying an important set of new aspects in the research field of phonetic CLI.

Part III

Experimental investigations

Chapter 5

Perceptual test

In section 2.3, we saw that many studies used perception experiments (Bergmann et al., 2016; De Leeuw, 2008; Mayr et al., 2020; Sancier & Fowler, 1997; Schmid & Hopp, 2014; Sůčková, 2012, 2020) in order to investigate the extent L1 speech of late bilinguals may be perceived as non-native, due to the presence of phonetic CLI in their speech. In that section, I also highlighted that the perception experiments may be used prior to the acoustic analyses of L1 speech of late bilinguals in order to determine, for the acoustic analyses, the phonetic features to be examined, the group of bilinguals to be studied, or groups of bilinguals to be compared (cf. Bergmann et al., 2016; De Leeuw, 2008; Sancier & Fowler, 1997). Similarly, by the perceptual test, the focus of the present chapter, we wanted (1) to investigate whether, phonetic CLI may be perceived in the CF's L1 speech by Czech monolingual listeners, and (2) to know which specific segmental and suprasegmental phonetic features in the L1 speech of CF seem to be affected by phonetic CLI according to Czech monolingual listeners.

Thus, after the hypotheses and methodology, the results in the present chapter will assess (1) and (2). The results are related to the models of L2 speech acquisition (chapter 1) and are discussed in relation to chapter 3 in order to ascertain whether phonetic features of CF's L1 speech, in phonetic CLI seems to occur according to Czech monolingual listeners, genuinely are not identical in Czech and in French. Finally, the results of the perceptual test are compared to the results of studies of phonetic CLI examined by the perception experiments (see section 2.3). In particular, I shall discuss the results of the perceptual test with those of Major (1992) on the higher occurrence of phonetic CLI in formal speech, in contrast to informal speech. I shall then note which phonetic segments and suprasegments should be analysed acoustically in chapter 6 with respect to comments made by the listeners during the perceptual test.

5.1 Hypotheses

For the present perceptual test, there are three hypotheses:

1. L1 speech of CF will be perceived as less typically Czech sounding than L1 speech of C by Czech monolingual listeners because of the possible phonetic CLI occurrence in CF's L1 speech. We saw in section 2.3 that the same was found in the studies of Bergmann et al. (2016); De Leeuw (2008); Mayr et al. (2020); Sancier and Fowler (1997) on L1 speech of late bilinguals.

2. 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 because the informal speech was found to be more prone to be affected by phonetic CLI than the formal speech in acoustic study of phonetic CLI of Major (1992), see section 2.3.

3. 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. We saw in chapter 1 and chapter 2 that phonetic CLI may occur in phonetic feature that are not identical in late bilinguals' L1 and L2. At the same time, we saw in section 2.3 that, in some studies, not all phonetic features that differ in bilingual L1 and L2 have been found to be affected by phonetic CLI (see, e.g., realisation of dental fricatives in Sůčková (2020), $F2$ of /l/ in Bergmann et al. (2016), duration of vowels in Mayr et al. (2012), $F2$ of vowels in Lang and Davidson (2019), pitch range in De Leeuw (2008), cf. tables 2.2 – 2.7).

5.2 Methodology

This section focuses on the methodology of the perceptual test.

5.2.1 Speakers

For the perceptual test, we used L1 speech from 14 CF and 11 C speakers, divided into two groups of speakers, C and CF. (Therefore, *group* refers hereafter to whether the speaker is C or CF.) In addition, for the distractors in the perceptual test (see below), we used Czech speech produced by one native female French speaker, and Czech speech obtained using by speech synthesis 'Amazon Polly'[1]. C were native Standard Czech speakers (2 males, 9 females, mean age=34.82 years, SD=8.2) living all in the Central Bohemian region of the Czech Republic. CF were native Standard Czech speakers similarly aged as C (1 male, 13 females, mean age=34.43 years,

[1]Text-to-Speech on AWS, https://aws.amazon.com/polly/

SD=9.02) living mainly in the Toulouse area (n=13). One CF lived in Paris (n=1). The native French speaker was 21 years old studying in Toulouse. Her family was living in the Toulouse area but the speaker also lived in other geographical areas of France before. All C, CF and the French native speaker were aged only between 20 and 50 years (see Appendix A), because as shown by Hollien and Shipp (1972), the age from 20 to 50 years matches the period of $f0$ stability. From the speech synthesis 'Amazon Polly', we used two voices, one female and one male, both representing typical French speakers.

The mean LOR of CF in France was 6 years (min=0,17 years, max=28,25 years, SD=2.45 years). For speakers' coding, I use letters 'CF' in the beginning of the speakers' codes. Henceforth, following Kupske and Alves (2016) who divided the bilinguals into groups according to their LOR (see section 2.3), I decided to use the letter 'A' into the codes of the CF whose LOR in France was 5 years or more, and the letter 'E' in the codes of the CF whose LOR in France was less than 5 years. Note that letters 'A' and 'E' had only coding function and CF will not be divided in the present thesis according to this code. C speakers' speech recordings were taken from speech corpus (Volín, Tykalová, & Bořil, 2017; Tykalová et al., 2020 in Press) possessed by the Institute of Phonetics of Faculty of Arts of Charles University in Prague. Thus, we respected their codes in that corpus. Consequently, the codes of all C speakers started by letters 'HC'. Nine of CF involved in the perceptual test had been living in other geographical areas of France previously living in their actual cities. For more information about CF collected with the extralinguistic questionnaire, see Appendix F.

5.2.2 Speech data collection

Speech data collection consisted in recording of C's and CF's L1 semi-spontaneous speech and their L1 production in the reading aloud task. For the recordings of L1 semi-spontaneous speech, the CF were asked to talk for one minute and a half in Czech about one or several of topics such as plans for holidays or the next week-end, describing a typical day, job, studies, family, hobbies, etc. The paper with the instructions for these topics was given to the speakers before recording (see Appendix B). First, the examiner gave this paper to the CF, and explained the task in Czech, the examiner then let the speaker read the paper and asked in Czech whether the speaker understood the instructions and/or had any some questions which the examiner answered. CF speakers were asked not to mention that they lived in France because of the use of these recordings for the perceptual test. Thus, listeners in the perceptual test were unaware of where the speakers are living. L1 semi-spontaneous speech of C was elicited similarly to the L1 semi-spontaneous speech of CF.

The recording of the semi-spontaneous speech produced in Czech by CF was preceded by that produced in French. The instructions and procedure of recording the semi-spontaneous speech in French was similar to that in Czech though CF were allowed to mention they were living in France when speaking in French. The recordings of semi-spontaneous speech in French were not used for the perceptual test. However, asking CF speakers to talk first in French and then in Czech allowed us to induce a natural situation of switching from French to Czech which is frequently experienced by several CF in their daily life in France (see chapter 7 and Appendix F). Indeed, Sancier and Fowler (1997) mention in their study that the late bilingual's family mainly noticed phonetic CLI in her L1 speech when she switched from one language environment to another.

The recording of semi-spontaneous speech in Czech was followed by the recording of CF's L1 speech production in the reading aloud task. All CF were asked to read a short paragraph chosen from Čapek (1960), a well-known Czech author. The chosen paragraph (see Appendix B) did not present any particular difficulty for the reading and is commonly used by the Institute of Phonetics in Prague for phonetic researches. By this reading aloud task, we obtained about 30 seconds of speech from each speaker. C read the same text during their recording. For obtaining the distractors, the text was transcribed so that French native speakers, and the speech synthesis, would be able to read the text with segmental characteristics as close as possible to those of Standard Czech. However, as they are French, it will always be read with French prosody (see Appendix B). Thus, the native French speaker and the speech synthesis produced exactly the same text as C and CF but the prosody of their speech production was closer to French. The synthesis and the French native speaker also read another text transcribed in the same way as the previous. This second text contained several Czech sentences. By their semantic content, they were considered to be equivalent to the semantic content of the C's and CF's semi-spontaneous recorded speech. This semantic equivalence aimed to ensure that a listener in the perceptual test could not differentiate between the speech produced by the French native speaker or the synthesis on the basis of semantic content from the speech items produced by C or CF.

The speech production of CF and the native French speaker was recorded by the author between 2018 – 2020. The speech production of C was recorded by the employees of the Institute of Phonetics and Czech Technical University in Prague mainly in 2016.[2] All recorded speakers received a small reward for participation on the research. CF and French native speaker were recorded in a quiet recording studio (PETRA) at University Toulouse Jean-Jaurès using a Neumann TLM 49 microphone and sound card MOTU ULmk3. Audio files obtained from the speech synthesis 'Amazon Polly' were played in high-quality loudspeakers and recorded with the same material. This procedure aimed to reduce the slightly artificial sound

[2]Project No. GA16-19975S "Age-related changes in acoustic characteristics of adult speech", supported by the Czech Science Foundation.

background of speech synthesis sound files and render these sound files as more authentic. C were recorded in a quiet, comfortably furnished office with a low level of ambient noise and short natural reverberation in Prague. A head-mounted condenser microphone (Bayerdynamic Opus 55) was plugged directly into a pocket recorder set to uncompressed 48 kHz 16-bit mode. In addition, CF, at the beginning of the speech data collection, after the recording procedure was explained by the author, signed a written consent for expressing their agreement to participate in this research. Hereafter, I will use the word *task* to refer to the type of the C's and CF's recorded speech i.e., whether their L1 production in the the reading aloud task or their L1 semi-spontaneous speech.

5.2.3 Speech items

Flege (1984) examined native English listeners' ability to perceive the foreign accent in the English speech produced by native French speakers learning English. The listeners judged the speech items in forced-choice tests. They were able to detect the foreign accent accurately and independently of the length of the speech items. These were entire phrases, syllables, portions of syllables as well as the sounds of only 30 ms. They were chosen from the production in reading aloud task as well as production of spontaneous stories. The claim that native speakers can be highly accurate at identifying non-natives in speech items as short as 30ms, as found in Flege's (1984) study, could be extrapolated from the results. However, a more critical and detailed examination of Flege's (1984) study reveals that the very short items used in this study (i.e., items containing only one syllable, one phoneme or one release burst of one stop) all contained phonemes or a part of a phoneme which strongly differing in English and French at phonetic level. For example, the author used the item /ti/ pronounced by French speakers. The English and French /t/ differ importantly in their VOT which suggests that the French speakers produced the /t/ with VOT typical for Standard French and meaning their items were easily identified as foreign-accented by English listeners. In short, Flege's (1984) study does not allow the conclusion that every 30ms speech items produced by non-native speakers will be perceived as foreign-accented by native speakers. On the contrary, 30ms speech items produced by non-native speakers could be perceived as foreign accented by native speakers if they contain a given phonetic element (a phoneme or part of phoneme) which in a non-native language differs in their native language. Taking this into consideration, we decided to use speech items with full sentences or clauses varying in duration from 1.2 to 13.28 seconds for the perceptual test, (average 5.23s, see Appendix C for the detailed duration of the items).

The recordings of C, CF, the French native speaker and that obtained from the synthesis were orthographically transcribed in Praat (Boersma & Weenink, 2019), and segmented into tier 'phrase'. The speech items for the perceptual test were then extracted from the C's and CF's L1 production in the reading aloud task and semi-spontaneous speech. We added some items from the Czech production of the French native speaker and the speech obtained from the synthesis, which we used as distractors in the perceptual test. From the CF's production, we chose the items containing some phonetic features unusual for Standard Czech but not rare in the CF's production. These untypical phonetic features were considered to be caused by the influence of French on CF's Czech. We chose them because in order for Czech monolinguals listeners to list the phonetic features that they perceive as not typically Czech in the perceptual test (see above) and hence, to determine the phonetic features in CF's production in which phonetic CLI might to occur (see the beginning of the present chapter). Each of the CF's items did not contain any grammatical, syntactic or lexical errors. From the C's speech recordings, we chose items that were judged as well representative of Standard Czech, which was the case for the majority of C's recordings. Both C's and CF's items did not contain any information about where the speaker was living. The original 44.1 kHz CF items and distractors were resampled to 48 kHz according to the original 48 kHz C's items. This resampling was necessary for running the perceptual test in Praat. We also adjusted the loudness of items in Audacity in a way that all items were perceptually similar in loudness.

Regarding general practice for perception experiments in the research of second language acquisition, Flege and Fletcher (1992) showed that, with a higher proportion of native items, the non-native items appear to be heavily foreign-accented to the listener. However, to the best of our knowledge, no studies investigate whether the proportion of bilinguals' and monolinguals' items in perceptual experiments influences the perception of phonetic CLI. For this reason the proportion of bilinguals' versus monolinguals' items in perceptual experiments in studies of phonetic CLI is usually varied, and there is no one rule for the right proportion (see, e.g., De Leeuw, 2008; Schmid & Hopp, 2014). We chose to follow Schmid and Hopp (2014), who used four times more speech items produced by bilinguals than those produced by monolinguals. Thus, the perceptual test comprised 77 items. There were 56 items produced by CF, 14 items produced by C, and 7 items of distractors. table 5.1 details the number of items per *task* and per *group* of speakers (here, the group of C or CF speakers or the distractors). We extracted at least one item for each speaker and at most six items (for the exact number of items per speaker and per *task* see Appendix C).

5.2.4 Listeners

The perceptual test was administered to 17 native Czech monolingual speakers, students at Charles University in Prague, aged between 18 and 30 years. Sixteen of them were students in their first year of the Bachelor of phonetics, and one was

Table 5.1: Number of items in perceptual test per *task* and speakers' *group*.

	CF	C	distractors	Total
RT	18	5	2	25
SS	38	9	5	52
Total	56	14	7	77

Note: RT=reading aloud task, SS=semi-spontaneous speech

a Ph.D. student in phonetics. None reported any speech or hearing disorders. As these listeners had prior knowledge of phonetics they could be considered experts and had an understanding of perceptual tests. This was considered a benefit to this study as it was expected the general phonetic knowledge would allow the listeners to name phonetic features with precision, rather than provide very vague comments more likely from non expert listeners. Thus, by using these specific students as the listeners we hoped to gain a list of phonetic features that might be very probably affected by phonetic CLI in CF's L1 speech.

5.2.5 Experimental procedure

The total duration of the perceptual test (each item presented only once) was approximately 25 min. The testing took place in a quiet room using headphones. A forced-choice identification test (for the typology of perceptual experiments, see McGuire, 2010) was created in the Praat multiple forced-choice (MFC) environment. Listeners had to rate whether the item seemed to be "absolutely Czech" or "absolutely French" from the phonetic point of view on a 5-degree scale. Figure 5.1 illustrates how the items were presented to the listeners for the rating. Hereafter, we will call the number attributed by the listener on the 5-degree scale to the item 'response'. The exact instructions given to the listeners were:

> *"You will hear Czech items that can be produced by a French, a Czech living in the Czech Republic or by a Czech living in France. On the scale from 1 to 5, rate to which extent the item corresponds to typically Czech pronunciation: 1 = absolutely Czech, 5 = absolutely French. If you hear a phonetic feature unusual for Czech, please list it in "List of features" in the Excel sheet (only for ratings from 2 to 4). Write each feature only once - it is a summary collection of observations without linking to specific items."*

These observations helped us to establish the list of phonetic features to be examined in the acoustic study. In a training session previous to the perceptual test and involving seven items, we checked the comprehension of these instructions. Then, in the perceptual test, the listeners were allowed to replay each item five times with

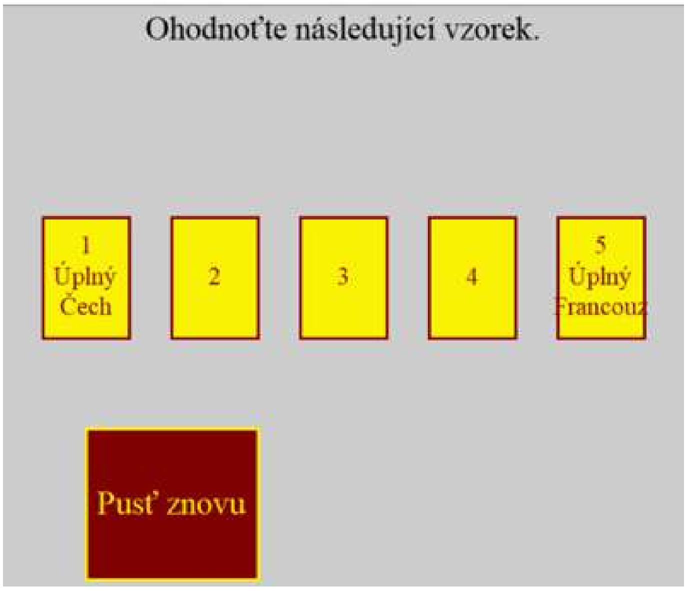


Figure 5.1: Praat MFC environment used for the perceptual test - example of speech item for being rated.

Note: 1=Absolute Czech, 5=Absolute French, the replay button is in red: *pusť znovu*=replay again, the instruction is on the top:*ohodnoťte následující vzorek*=rate this speech item.

the replay button, pass over to the next item with the 'Next' button, or correct their response with the 'Oops' button. Items were randomised and separated by a desensitisation beep. The listeners were invited to take a short break every twenty items, where they could listen to a short song (approximately 30 seconds).

5.2.6 Analyses

The data obtained by the perceptual test were analysed in R (R Core Team, 2019) using the packages *lme4* (Bates, Mächler, Bolker, & Walker, 2015), *dplyr* (Wickham, François, Henry, & Müller, 2020), *rPraat* (Bořil & Skarnitzl, 2016), and *ggplot2* (Wickham, 2016). As we had extracted one or more speech items from the production of each speaker in each task *task* (see above), for the statistical analyses, it was necessary to first compute the *meanResponse*. The *meanResponse* was an arithmetical mean of the listeners' responses for the speech item(s) of a given speaker in a given *task*. We computed the *meanResponse* from the responses of the 17 listeners based on the use of the Central Limit Theorem approximation, leading to a numeric scale with a roughly normal distribution behavior. The 17 listeners rated the speech items similarly (i.e., after examination of listeners' responses, we saw that any listener was not nor excessively severe neither excessively soft in the rating compared to the rating of the other listeners).

Following this, we analysed the relationship between the *group* of speakers (i.e., C or CF) and speakers' *meanReponse(s)* by using a linear mixed-effects model with intercepts for *speaker* and *listener* as random effects, *task* and *group* as fixed effects, and *task* as a random slope in both random effects. Visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality, and p-value was obtained by likelihood ratio tests of the full model with the fixed effect *group* against the model without this effect. In the end, comparison of estimated means across levels of the effects was carried out with the package *emmeans* (Lenth, 2021) on the full model with interaction between *group* and *task*.

Distractors were excluded from the statistical analyses. For their analysis, only *meanResponse* were computed for each speech item in order to verify that the distractors were rated as sounding absolutely French. The observations noted by the listeners during the perceptual test were gathered in an Excel table. We listed phonetic features in the L1 speech of CF that the listeners perceived as not typically Czech, wrote next to each feature the comments the listeners made about it, and counted how many listeners mentioned the given feature. From that table, we visualised in bar plot by using R for the phonetic features (or a segments and suprasegments) noted by more than three listeners.

5.3 Results

Results revealed that the *meanResponse* (i.e., how the speaker's item(s) from the given *task* was rated by a listener) was affected by *group*, that is if the speaker was C or CF ($x^2(1)$=11.451, p=0.0007). The comparison of estimated means revealed a significant difference between the groups of speakers in semi-spontaneous speech (t=-3.881, p=0.0011) where the *group* affected the *meanResponse* increasing it by about 0.791 ±0.204 (standard errors) and no difference between the groups in reading aloud task. Figure 5.2 visualises the results and shows that C were generally evaluated as speakers whose production was closer to typical Czech pronunciation than the CF's production. Distractors were rated as very close to "absolutely French" pronunciation (see table 5.2 giving the *meanResponse* that each distractor received from the listeners).

Figure 5.3 displays the phonetic features or speech segments and suprasegments that more than three listeners mentioned as not typically Czech sounding. We may observe that the listeners mentioned the most often vowels' quality. Characteristics of /ɦ/, /x/ and /r/, and rising intonation were all mentioned by 10 listeners of 17. The detailed listeners comments about speech segments and suprasegments are given in Appendix E. The listeners also made comments about phonotactic of the speech items though we do not include these in Appendix E as the present thesis does not focus on phonotactics. In the following paragraph, I present the listeners' comments about the most mentioned phonetic features, segments or suprasegments given above, i.e., vowels' quality, /ɦ/, /x/ and /r/ and intonation.

Concerning the vowels' quality, the listeners commented on /ɛ/ and /ɪ/ as

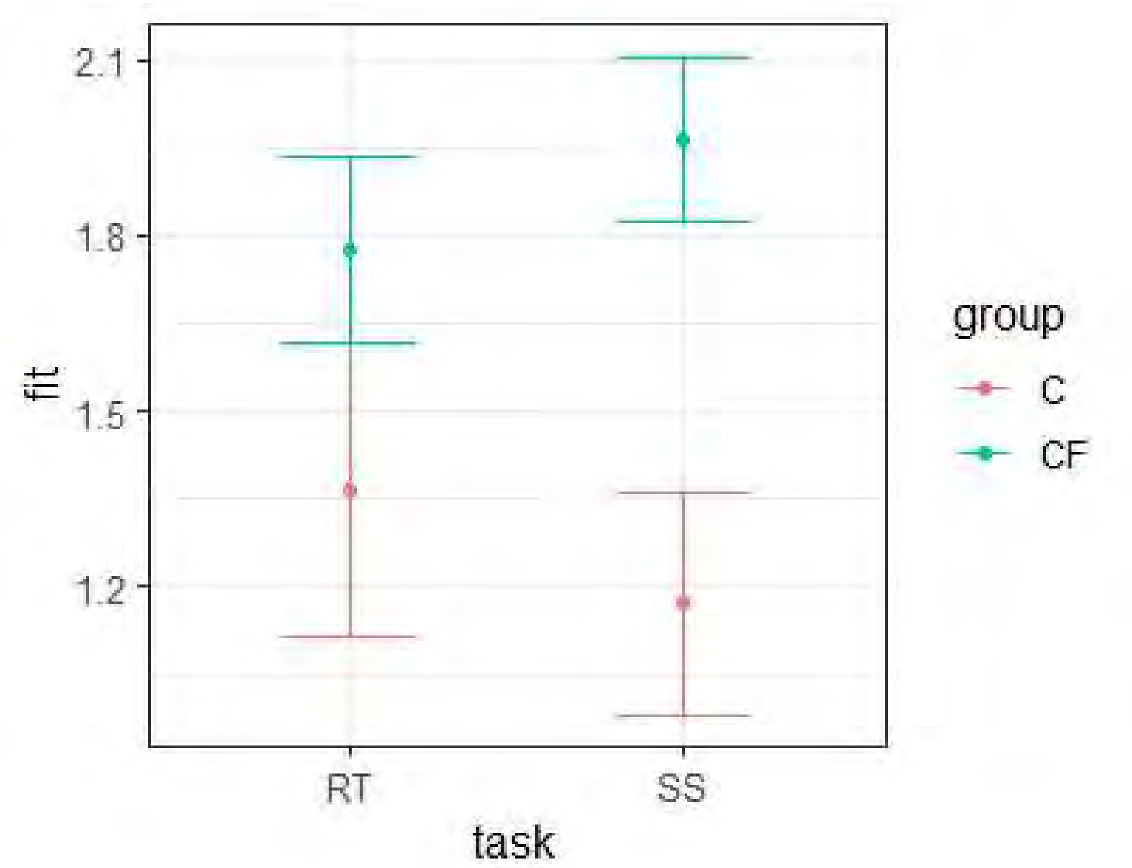


Figure 5.2: Error bar of the *meanResponse* per *group* and per *task*.

Note: RT=reading aloud task, SS=semi-spontaneous speech. The error bar visualises the model used for comparison of estimated means and was obtained thanks to the package *effects* (Fox & Weisberg, 2019)

Table 5.2: *meanResponse* obtained by distractors

Speech item	Task	*meanResponse*
57G_D_F-E4_3	RT	5
58G_D_I2_6	RT	4.82352941
38M_D_I2_1	SS	4.94117647
39M_D_I2_2	SS	4.94117647
40M_D_I3_4	SS	4.88235294
41M_D_F-E8_5	SS	4.94117647
42M_D_F-E7_6	SS	5

Note: RT=reading aloud task, SS=semi-spontaneous speech. In the code of the speech items: F=speech item taken from the production of the French native speaker, I=speech item taken from the speech production obtained from the speech synthesis ‘Amazon Polly’: I2=female voice, I3=male voice.

"French", "with different quality", and "closer". The adjective "closer" was used for all vowels by one listener. /ɪ/ was also perceived as "more soft" and /ɛ/ as "strange" and having "something wrong in its pronunciation". /o/ was perceived as being near to /u/. The listeners commented mainly on /ɛ/ and /ɪ/, the vowels as /a/ and /o/ were commented on only few times. Very few listeners made comments about vowels' rounded or unrounded character. Note that, concerning the vowels, the adjective "closer" occurred often in the listeners comments while more vague adjectives as "strange" were rarer. When a listener commented on the vowel as "strange", "French" or having "something wrong in its pronunciation", it was counted as a comment concerning the vowel quality and not quantity though it is possible that a vowel might be also "strange" because of its unusual quantity. I decided to categorise it as quality because the listeners comments about vowel quantity were very precise suggesting that the listeners had less difficulty explaining when the vowel was unusual in its quantity. Moreover, as Czech and French vowels differ more distinctly in their quality (see subsection 3.2.1 and subsection 6.3.1) than in their quantity this seemed the more suitable categorisation.

Concerning the /ɦ/ and /x/, the listeners noted that "/ɦ/ was replaced by /x/". Other listeners noted that it was not pronounced. /x/ was perceived by some listeners as "not pronounced" or having "untypical" or "wrong pronunciation" and "not being Czech". Another listener perceived /x/ as unvoiced /h/. Concerning the /r/, it was commented as "uvular", "with rhotacism", "different", "multi-cycle", "untypical", "not being Czech", and being "French". Finally, the intonation was widely commented by the listeners. One particular listener made a precise comment about pitch range and another made a precise comment about intonation pattern used for question, however, the listeners generally commented on intonation with little precision, using general terms. The intonation was perceived as "very rising" with "more importantly rising pattern", "strange", "French", but "not Czech", that is, "untypical for Czech". One listener mentioned that there were "intonation rises in the ends", and another noted "rising ends of the phrases". One listener also used the adjective "singing" for describing his perception of the intonation, others considered the intonation to be "fine" and "variable".

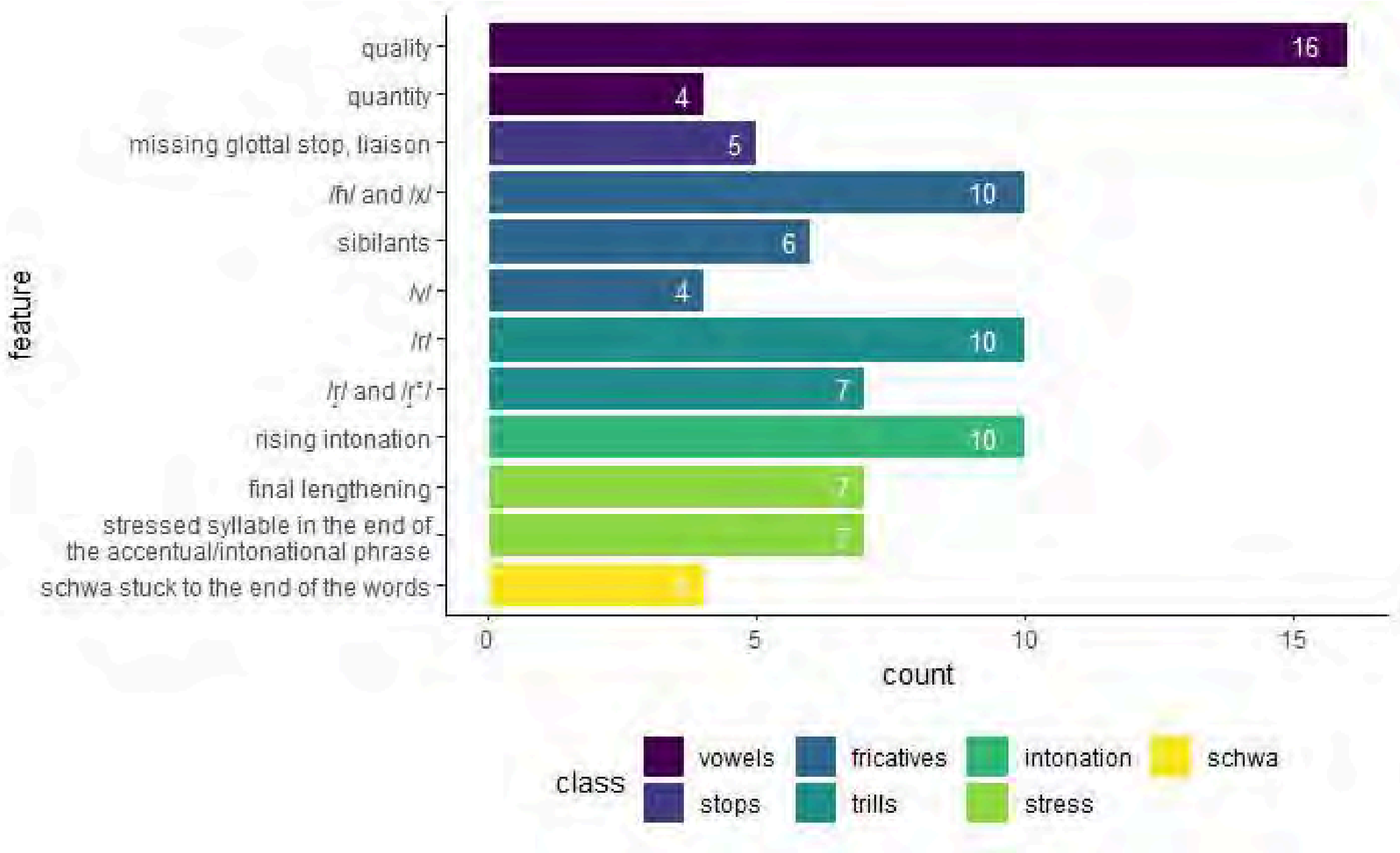


Figure 5.3: Bar plot of phonetic features mentioned by the listeners in the perceptual test.

Note: The listeners noted the phonetic features in the speech items that they not perceived neither as typically Czech sounding nor as typically French sounding. y-axis specifies the particular feature of the speech segment/suprasegments indicated by the color. x-axis indicates how many listeners of 17 in total mentioned the given feature.

5.4 Discussion of perceptual test

From the present perceptual test, we investigated whether phonetic CLI may be perceived in the CF's L1 speech by Czech monolingual listeners, and in which specific segmental and suprasegmental phonetic features of the CF's L1 speech phonetic CLI might occur. The first hypothesis, i.e., CF's L1 speech will be perceived as less typically Czech sounding than the one of C's L1 by the listeners was confirmed when the perception of C's and CF's semi-spontaneous speech was compared but not when the perception of their L1 speech obtained from the reading aloud task was compared. I suggest that CF's speech production in reading aloud task was more formal thus the CF were likely to be more concentrated on their production than when speaking freely during the semi-spontaneous speech. It is likely that it is for this reason that phonetic CLI might occur more frequently in CF's semi-spontaneous speech than in the L1 production in reading aloud task. This also may explain why CF's speech items extracted from the semi-spontaneous speech were rated as less typical sounding by the listeners than speech items extracted from the production in reading aloud task. This results seems to go in the direction of the finding of Major (1992) who found that acoustically examined phonetic CLI occurred in informal speech of the late bilinguals more frequently than in their formal speech. Thus, the second hypothesis made for the perceptual test, that is, CF's L1 production in reading aloud task will be perceived by the listeners as more typically Czech sounding than their L1 semi-spontaneous speech, was confirmed.

The third hypothesis for the perceptual test was that some phonetic features of segments and suprasegments which are not identical in Czech and French will be mentioned by Czech listeners as less typically Czech sounding in CF's L1 speech. We saw above that the listeners commented most on vowels' quality, Czech glottal and velar fricatives, Czech /r/ and intonation when they did not rate the speech item as typically Czech (number 1 on the scale) or as typically French sounding (number 5 on the scale). Concerning the vowels' quality, the listeners mentioned the most vowels /ɛ/ and /ɪ/. Indeed, these two phonemes differ importantly in Czech and in French. We saw in subsection 3.2.1 that French /i/ seems to be closer and more front than Czech /ɪ/. Additionally, French /i/ differs from Czech /ɪ/ in the value of its F3 subsection 6.3.1. We saw in subsection 3.2.1 that French has /e/ and /ɛ/ and that according to their articulatory properties as traditionally described in the literature, French /e/ should be closer more front than Czech /ɛ/, whereas French /ɛ/ should be more open and less front than Czech /ɛ/. However, we will see in subsection 6.3.1, that when plotting acoustic values of $F1$ and $F2$ of Czech /ɛ/ and French /ɛ/ and /e/ found in recent studies into $F1/F2$ planes both French /ɛ/ and /e/ are more front closer than the Czech /ɛ/. That may explain why the listeners commented the Czech /ɛ/ in the perceptual test every time as closer and never as more open.

Concerning the glottal and velar Czech fricatives, we saw in subsection 3.2.2 that they do not exist in French. The difference between Czech and French rhotic consonant was presented in the same subsection. We mainly highlighted that in both Czech and French the rhotic may be produced in multiple ways. In spite of that, its pronunciation differs in Czech and in French. In Czech it is most often produced as an alveolar tap while in Standard French, it is produced as a fricative or an approximant (cf. Ramasse, 2017), and in Toulouse French, its production may vary between uvular /ʁ/ apical rolled [r] and voiceless fricative /χ/ (cf. subsection 3.2.2). For the intonation, we saw in subsection 3.3.1 that non-conclusive intonation patterns involve more rising in French than in Czech and that according to Duběda (2012) French is more “melodic” than Czech. Relating all this with the comments made by the listeners about vowels, intonation, /ɦ/, /x/ and /r/, we may conclude that (1) these speech segments and suprasegment are far from being identical in Czech and French phonetic system and therefore the third hypothesis was fully confirmed, and (2) the listeners comments are going in the direction of differences in these segments and suprasegment in French and Czech as described in the literature and remind here. We saw in chapter 1 and chapter 2 that phonetic CLI seems to occur in the phonetic features which are not identical in the L1 and L2 spoken by a late bilingual. Hence, we may suppose that phonetic CLI in CF’s L1 speech will occur in these segments and suprasegments.

In section 2.3, we saw that not all studies that investigated L1 late bilinguals’ speech by a perception experiment found a significant difference in the perception of the speech items produced by bilinguals and L1 monolinguals. In this present study, the difference was significant in semi-spontaneous speech. The perceptual test differed from others studies in that the CF’s speech items were chosen because they contained something untypical for Standard Czech at phonetic level and at the same time common in CF’s L1 production. One could argue that the significant difference in perception of the speech items of the two groups of speakers by the listeners is due to this fact. On the one hand, CF’s speech items taken from their L1 production in the reading aloud task had to contain few examples of phonetic CLI, as they were not perceived as significantly different from the C’s speech items by the listener. Indeed, it was more difficult to choose the CF’s speech items from their L1 production in the reading aloud task than from their semi-spontaneous speech, as less phonetic features untypical for Standard Czech were perceived in their production in the reading aloud task than in their semi-spontaneous speech by us. On the other hand, an insignificant result in perception experiment does not necessarily mean zero phonetic CLI in L1 speech of the bilinguals. See in section 2.3 that even if the results of the FAR was not significant in Sůčková (2020), she found a significant phonetic CLI in VOT and realisation of word-final voiced stops when studied acoustically. As acoustic analyses may capture fine grained changes in the bilinguals’ L1 which when examined perceptually may not reach a statistical significance. Therefore, despite no statistically significant difference in speech items extracted from C's and CF's L1 production in the reading aloud task, it was decided to continue to study the CF's L1 production in the reading aloud task acoustically with the expectation that acoustic analyses might reveal a significant CLI in some segment or suprasegments in their production in reading aloud task.

As previously noted, the adjective "closer" was often used by the listeners in the perceptual test when commenting on the vowels. However, the adjective "more front" was never used. This could be explained by the likelihood of more changes in CF's vowels' degree of aperture than in their anteriority. In section 2.3, we saw that similar findings were made by Chang (2011); Mayr et al. (2012); Lang and Davidson (2019) who found a systemic changes in $F1$ (referring to degree of aperture), but no in $F2$ (referring to anteriority). These authors argued that $F1$ is more prone to be affected by phonetic CLI than $F2$ as the changes in $F2$ are more difficult to be perceived by a human ear. The authors suggested that the late bilinguals showed a greater shift in $F1$ than in $F2$ because they cannot perceive well $F2$ of new L2 vowel while the perception of their $F1$ was easier for them (see the same subsection). This hypothesis might be valid also for our CF. However, one might suppose that also the listener in our perceptual test may have more difficulties perceiving the changes in $F2$ in CF's L1 speech as the changes in $F2$ are more difficult to perceive in general, and thus, it might be why their comments concerned mainly $F1$. Consequently, the phonetic CLI might affect vowels' $F2$ in CF's L1 speech but it may be difficult for listeners to perceive it naturally. As a result, I found it particularly interesting to investigate both $F1$ and $F2$ of vowels acoustically in order to confirm this hypothesis about listeners perception difficulty or to validate Chang's (2011) supposition of systemic shift in $F1$ of vowels of late bilinguals.

Therefore, we decided to investigate in the following acoustic study in chapter 6, the spectral characteristics of vowels by measuring vowels' formant values. As noted, /ɦ/, /x/ and /r/ were frequently mentioned by the listeners in the perceptual test, and as they are far from identical in Czech and French, these were also investigated in chapter 6, with particular focus on their spectral characteristics, and on the temporal characteristics of /r/. As shown above, according to some listeners for /ɦ/ and /x/, "/ɦ/ was replaced by /x/" in some speech items and /x/ by an unvoiced /h/. The listeners also mentioned the "wrong pronunciation" of both. These potential changes in CF's L1 velar and glottal fricatives may be revealed by measuring their spectral moments (see section 6.5). Concerning the Czech /r/, we saw in chapter 3, that Czech and French rhotic seems to mainly differ in the place of articulation. Additionally, the listeners commented the Czech /r/ in some speech items as "uvular". Hence, I decided to measure its spectral moments in section 6.4 and its first three formants, these values may help to identify the uvular (see subsection 6.4.1).

I decided to also examine its duration, which might indicate whether the /r/ was realised more as a tap or more as a “multi-cycle” trill as noted by the listeners. The values of HNR may help to identify whether the rhotic was realised as a fricative (cf. subsection 6.4.1). Hence, its values will be also studied in section 6.4. Concerning the intonation, we saw in chapter 3 that non-conclusive patterns are probably with more rising intonation in French than in Czech. Thus, I suggest that listeners perceived the “rising intonation” and “singing”, according to their words, mainly in the non-conclusive patterns. Hence, in section 6.6, Therefore, I decide to examine $f0$ course in the non-conclusive patterns which may reveal the level of rising intonation they contain.

Finally, we saw in chapter 3, that stuck schwa is typical for southern French and that it study in CF’s L1 speech may be particularly interesting as it represent a type of CLI which might be classified as *borrowing* according to Pavlenko (2000) because an element from L2 is insert to and used in L1 (see subsection 2.1.2). In section 2.3, we saw that, in the research field of phonetic CLI, only Dmitrieva et al. (2010) studies such a CLI that might be considered as *borrowing.* Consequently, despite stuck schwa being mentioned only by 4 listeners in the perceptual test, I decided to investigate it in chapter 6 as it is a particular phonetic element. Stuck schwa was commented on by the listeners as “hesitation schwa stuck to the last consonant of the word” and “not Czech hesitation” (cf. Appendix E). Thus, I decided to investigate the number of stuck schwa in CF’s L1 speech (see section 6.7).

We may see that the results seem to confirm the common presumption of SLM, PAM-L2 and SLM-r that L1 and L2 sounds of the late bilinguals exist in the same phonetic space discussed in (chapter 1). As such, they can interact one with another, and by these interactions provoke changes that were probably perceived in the L1 of CF by the listeners in the perceptual test. We saw in subsection 1.2.6 that according to Flege and Bohn (2021), L2 learners L2 speech production and perception will never perfectly correspond to one of native L2 monolinguals because the phonetic elements constituting the bilingual’s L1 and L2 phonetic subsystems necessarily interact with one another. We might suppose in addition, that, because of these interactions of L1 and L2 phonetic subsystems, late bilinguals’ L1 speech production will rarely correspond perfectly to one of native L1 monolinguals. This is what the result concerning CF’s L1 semi-spontaneous speech seems to support.

5.5 Summary of the chapter

This chapter presented the perceptual test by which I examined the perception of CF’s L1 speech by Czech monolingual listeners. Speech items obtained from the L1 semi-spontaneous speech and L1 production in reading aloud task of 11 C and 14 CF, and these obtained from the reading in Czech by a native French speaker and speech synthesis containing French speakers, were evaluated by 17 listeners, i.e., Czech students of phonetics in Prague. The results showed that the speech items extracted from CF's L1 semi-spontaneous speech were perceived by the listeners as significantly less typically Czech sounding than the one extracted from C's L1 semi-spontaneous speech. The listeners mainly commented the vowels' quality, velar and glottal fricatives, /r/ and intonation in the speech items that they evaluated as not typically Czech nor as typically French sounding but in between the two.

Given these results, the differences between Czech and French presented in chapter 3, and the specific comments made by the listeners in the perceptual test, I decided to acoustically analyse the spectral characteristics of vowels, velar and glottal fricatives, /r/, temporal characteristics of /r/ and the intonation in non-conclusive intonation patterns, which shall be discussed in the following chapters. I decided to further examine stuck schwa as it is a particular phonetic element in southern French (see subsection 3.3.2) which might represent a particular type of CLI (see subsection 2.1.2) and was mentioned by four listeners in the perceptual test. Given that the phonetic CLI may occur when examined acoustically, even if the findings were not statistically significant when examined by a perception experiment (cf. Sůčková, 2020). Thus, I decided to examine the previously listed phonetic features of segments and suprasegments in both CF's L1 semi-spontaneous speech and production in the reading aloud task.

Chapter 6

Acoustic study

Chapter 5 presented the perceptual test and outlined how the results provide a basis for the acoustic study, which is a focus of this chapter. We saw that in the perceptual test the segments mentioned by listeners as sounding less typically Czech were mainly vowels, /ɦ/, /x/ and /r/ (section 5.3). The listeners comments about these segments were in agreement with their differences in Czech and French phonetic systems (section 5.4). Concerning suprasegments, the listeners the most often mentioned perceiving a rising intonation in speech items that they rated as not typically Czech sounding (section 5.3). This may be linked to a more rising intonation in the French non-conclusive intonation patterns than in Czech non-conclusive intonation patterns (subsection 3.3.1). Finally, the decision to include a stuck schwa in the acoustic study (cf. section 5.4), is as it is an original phonetic element occurring abundantly in Toulouse French (see subsection 3.3.2) and might represent an interesting type of CLI (see section 5.4). Hence, the characteristics of these five i.e., vowels, /r/, /ɦ/ and /x/, non-conclusive intonation patterns and stuck schwa will be examined aiming to investigate whether they differ in the C's L1 speech and CF's L1 speech and whether these differences might be considered as a consequence of phonetic CLI.

Thus, starting with the presentation of two hypotheses made for the acoustic study, and the presentation of speech corpus used, the present chapter is then organised into five separated sections. Each of them examines one of the aforementioned speech segments, group of segments or suprasegments, i.e., vowels, /r/, /ɦ/ and /x/, non-conclusive intonation patterns and stuck schwa. In each of the five sections, the comparison of the acoustic properties of the given segment(s) or suprasegment(s) in Czech and French is provided at first, if it is possible, and allows us to make particular predictions for its/their study. In each of the five sections, I will provide the methodology, followed by the results, these will be discussed in relation to the comparison of the acoustic properties provided in the beginning of the section. The focus shall be on whether the phonetic CLI occurred or not and if they may be considered as an assimilation effect or as a dissimilation effect. Finally, at the end of the chapter, I will provide a discussion of all results by reviewing them in the light of models of L2 speech production and perception (mainly SLM and SLM-r), comparing them to the results of phonetic CLI of studies presented in section 2.3, and discussing the two hypotheses made at the start of the chapter.

I already specified in section 5.4 which acoustic properties of vowels, /r/, /ɦ/, /x/, and non-conclusive intonation patterns will be examined in the present chapter and why. Additionally, how stuck schwa will be examined and why was explained. The focus will be on spectral characteristics of vowels, /r/, /ɦ/ and /x/, temporal characteristic of /r/, intonation in non-conclusive intonation patterns and the occurrence of the stuck schwa (see section 5.4).

6.1 Hypotheses

The results of the perceptual test confirms our general assumption that some phonetic features of CF's L1 segments and suprasegments which are not identical in Czech and French may be affected by phonetic CLI (see, e.g., section 1.3, beginning of chapter 4). We saw that the listeners in the perceptual test mentioned as not typically Czech sounding mainly the segments and suprasegments which differ in their phonetic features in Czech and French (cf. section 5.4). The studies presented in section 2.3 found the phonetic CLI occurred in some segments and suprasemgments which differ in their phonetic features in the bilinguals' L1 and L2. Moreover, on the basis of SLM, it is supposed that either an assimilation or a dissimilation effect, between phonetic features which are not identical in the bilinguals' L1 and L2, may occur (see, e.g., De Leeuw, 2019a, and subsection 3.1.4), even if the effect may vary with an individual speaker as claimed by SLM-r (cf. subsection 1.2.6). Taking the above into consideration, I make a primary hypothesis for the present acoustic study, that:

> **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.**

Herein, this primary hypothesis provides a basis for our predictions for the particular phonetic features of the vowels, /r/, /ɦ/, /x/, non-conclusive intonation patterns and stuck schwa.

The results of the perceptual test also show that CF's L1 speech items taken from their semi-spontaneous speech were perceived as less typically Czech sounding than those taken from their production in the reading aloud task (see section 5.3) which agrees with the Major's (1992) finding of more prevalent phonetic CLI in an informal L1 speech than in L1 formal speech (see section 5.4). As the Major's study is based on acoustic analyses (see section 2.3), the secondary hypothesis for the present acoustic study is that:

> **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.**

6.2 Speech corpus used for the acoustic study

For the speech corpus of the acoustic study, we used recordings of only female speakers' speech in order to reduce the physiological differences between speakers which may, for example, alter the results of acoustic measurements of formants and fundamental frequency. Similarly, we chose to study only the L1 speech production of the CF's speakers who lived in Toulouse area at the time of data collection in order to have a group of speakers living in the same language variety environment. Hence, from the speech corpus used for the perceptual test, one CF speaker who lived in Paris and one male speaker were removed. In order to enlarge the corpus, we recorded the L1 speech of 5 new CF, both their semi-spontaneous speech and L1 production in the reading aloud task (the speech data collection was conducted as described in subsection 5.2.2). We also added L1 semi-spontaneous speech and L1 production in the reading aloud task of a necessary number of C speakers from the speech corpus possessed by Institute of Phonetics in Prague (Volín et al., 2017; Tykalová et al., 2020 in Press) in order to obtain a speech corpus with the same number of speakers per *group* and with similar ages. Thus, the final corpus involved the Czech speech produced by 17 female C (*mean* age=31.94 years, SD=8.47 years, range: *min*=21 years, *max*=49 years) and 17 female CF (*mean* age=31.23 years, SD=9.08 years, range: *min*=21 years, *max*=49 years). As all speakers were aged between 20 to 50 years the stability of their $f0$ stability was guaranteed (cf. Hollien & Shipp, 1972). See Appendix A for the detailed age of the speakers. The *mean* LOR of the 17 CF speakers was 5.05 years (SD=4.67 years, *min* LOR=0.17 years, *max*=28.25 years). For more detailed information about CF, collected with the extralinguistic questionnaire, see Appendix F.

The recordings of all 17 C and CF were orthographically transcribed into TextGrids in Praat. For their semi-automatic segmentation, the recordings and TextGrids were automatically cut using Praat script into shorter sound files according to the speech's semantic sense and prosodic compactness. Each sound file contained one or more accentual phrases including one or more clause. In total, 667 sound files and 667 TextGrids were compiled. Their semi-automatic segmentation and labelling were done using by Prague Labeller (Pollák, Volín, & Skarnitzl, 2007) and corrected manually according to rules of placement of boundaries recommended by Macháč and Skarnitzl (2009). Thus, for example, for vowels, the boundary placement in

TextGrids of C's and CF's recordings was guided by the presence of full vowels formant structures. Initial glottal stops and final voice decay time were not considered to be part of the vowel. We obtained 3 basic tiers in each TextGrid called 'phone', 'word', and 'phrase'. When analysing speech segments, we excluded the speech segments in foreign words in semi-spontaneous speech from the analyses such as English names of movies or names of French cities. Unpronounced and semi-pronounced segments (as, for instance, both /o/ in the Czech word 'protože') were excluded from the analyses of speech segments too.

6.3 Spectral characteristics of vowels

This section examines phonetic CLI in spectral characteristics of vowels in CF's L1 speech.

6.3.1 Spectral characteristics of vowels in Czech and French

Spectral characteristics of vowels are linked to the values of their formants. Regarding the link between articulatory and acoustic properties of vowels, $F1$ is traditionally determined by the degree of aperture and $F2$ by the anteriority and the lip articulation – labialiazation (Skarnitzl et al., 2016; Meunier, 2007). Not only $F2$, but also $F3$ may be determined by the lip articulation (Meunier, 2007), and its value may have a critical role in the languages where $F1$ and $F2$ values are the same and do not allow vowels to be distinguished. For example, according to Vaissière (2011), in French, $F1$ and $F2$ of /i/ and /y/ can be similar for some speakers, hence $F3$ is necessary for their distinction. Also, Gendrot, Adda-Decker, and Vaissière (2008) highlighted the particularity of the French /i/ in the study of continuous speech. According to this study, French /i/ has the highest $F3$ and the highest $F4$, as well as the smallest distance between $F3$ and $F4$ compared to English, German, Spanish, Portuguese, Arabic and Mandarin /i/. Given the observations made by the listeners in the perceptual test, which might concern the phonetic CLI in anteriority and degree of aperture of CF's vowels (see section 5.3), and the articulatory differences between Czech and French vowels described in subsection 3.2.1, $F1$ and $F2$ of vowels in the CF's L1 speech will be analysed. Similarly, as the listeners, in the perceptual test, often mentioned /i/ as less typically Czech sounding (see section 5.3) and because of the particularity of $F3$ of the French /i/, $F3$ of /i/ in the CF's L1 speech will be analysed too.

Hence, based on the studies of Skarnitzl and Volín (2012); Tubach (1989); Paillereau and Chládková (2019); Gendrot and Adda-Decker (2005), table 6.1 compares and fig. 6.1 displays $F1$ and $F2$ reference values of Standard Czech and Standard French oral monophthong vowels produced by female speakers. In Skarnitzl and Volín's (2012) study, 48 Czech women aged from 20 to 30 years read a continuous text. In their article, the authors provide formant values of the vowels produced by female speakers only in a $F1/F2$ plane's plot, but at personal request they provided me with the exact mean formant values of the vowels produced by female speakers (see, table 6.1). In Tubach's (1989) study, French vowels in the production of 9 French women reading the monosyllables formed by either /pV1/, where V1 was /e/, /o/, /u/, /y/, or /ø/, or /pV2R/ where V2 was /i/, /ɛ/, /a/, /ɔ/, or /œ/ were examined. In Paillereau and Chládková (2019), $F1$ and $F2$ of Czech vowels were obtained from the production of 10 Czech women aged 25–34 years who spontaneously commented on 20 objects. In Gendrot and Adda-Decker (2005), French vowels in the speech of 15 French women, mainly extracted from broadcast news, were analysed. Concerning $F3$ of Czech and French i-sounds, Paillereau (2015) studied vowels produced in isolation by Czech women from Bohemia region and French women who had lived for a long time in Paris region (see, table 6.2, note carefully that these values are obtained from vowels produced in isolation and not in a reading aloud task). $F3$ of Standard French /i/ produced in the reading aloud task was 2976 Hz in Tubach's (1989) study. Concerning Toulouse French, to the best of our knowledge, there is no acoustic study of Toulouse French vowels (cf. Coquillon, 2005; Courdès-Murphy, 2018). However, concerning the vowels of southern French, Eychenne (2015) measured the formant values of the vowels produced only by one speaker from Figeac, and Woehrling (2009); de Mareüil, Woehrling, and Adda-Decker (2013) studied French vowels in a large corpus containing speakers from the whole of France. In de Mareüil et al. (2013), $F1$ and $F2$ of only some French vowels were analysed, whereas Woehrling (2009) provided $F1$ and $F2$ of all French vowels. Woehrling (2009) examined the vowels in a reading aloud task and spontaneous speech produced by more than 100 speakers of Standard, southern or eastern French[1]. The speakers from southern France were from Biarritz, Douzens, Lacaune, Rodez and Marseille. See vocalic quadrangles in fig. 6.2 for the results of this study which we will consider as formant reference values of southern French vowels.

We are conscious that the formant values in tables 6.1 and 6.2, and figures 6.2 and 6.3 are taken from the studies which have the limitations. For example, Vaissière (2007) reproaches Tubach (1989) for the /ʁ/, used in a coda position, could lengthen the previous vowel, and consequently increase $F1$ value and decrease $F2$ value. Additionally, the methods of formant measurements vary between studies. For example, Paillereau and Chládková (2019) analysed the vowels in their midpoint while Gendrot and Adda-Decker's (2005) measurements were taken at $1/3, 1/2, 2/3$ of the vowel segment, which might have a subtle impact on the results. Nevertheless,

[1]For more details about the production tasks, see the protocol of recording of project PFC, https://www.projet-pfc.net/.

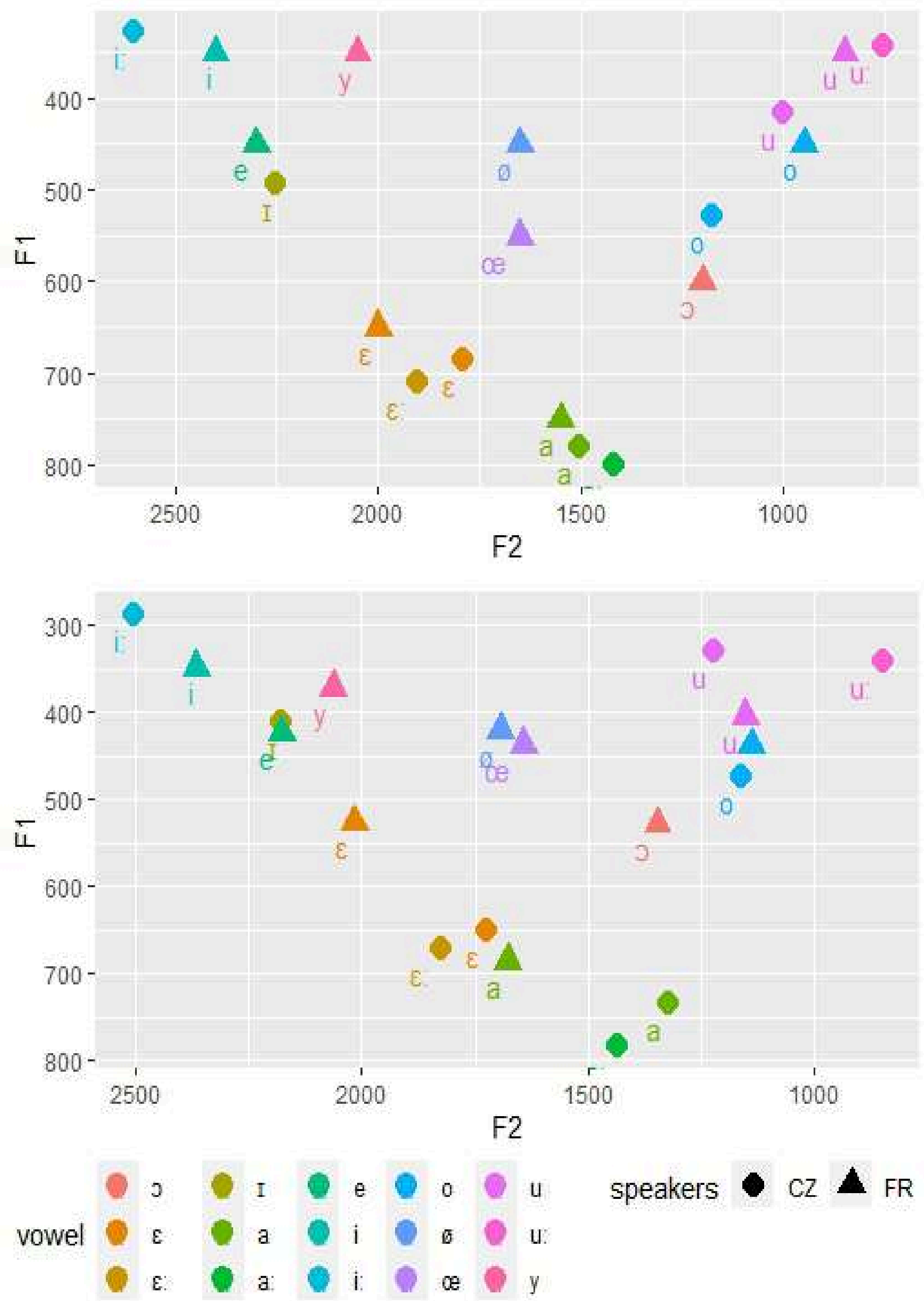
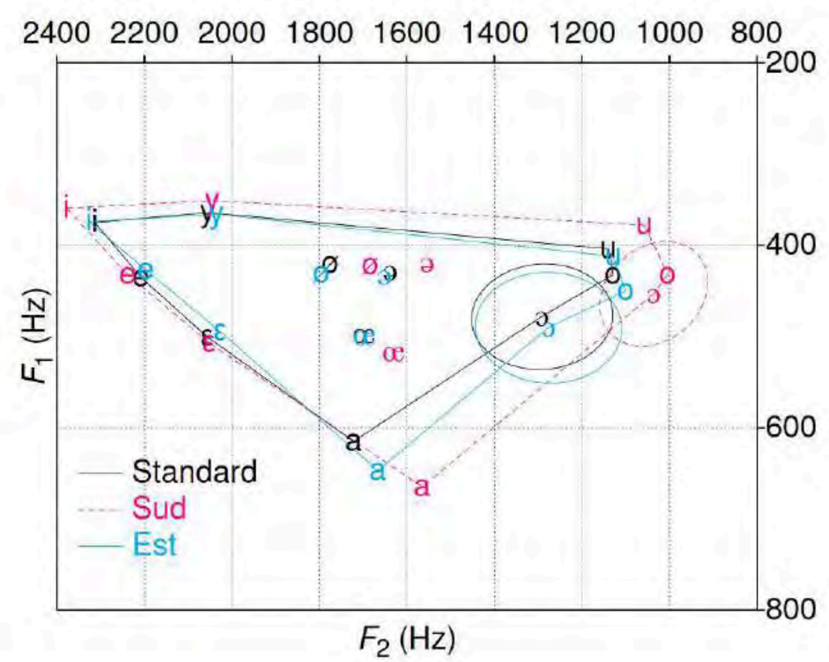
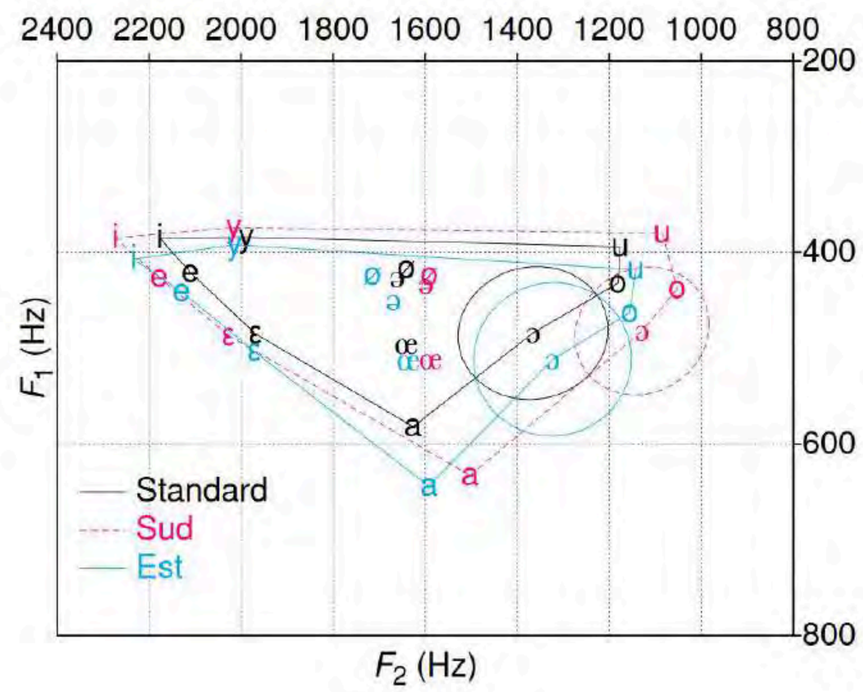


Figure 6.1: Vocalic quadrangles of female speakers of Standard French and Standard Czech in their semi-spontaneous speech and production in a reading aloud task.

Note: Circles=Standard Czech speakers, triangles=Standard French speakers. Top plot=vowels produced in a reading aloud task, bottom plot=vowels produced in semi-spontaneous speech. $F1$ and $F2$ values in Hz. Source: Skarnitzl and Volín (2012); Tubach (1989); Paillereau and Chládková (2019); Gendrot and Adda-Decker (2005). Obtained by using *ggplot* package in R. /oː/ not included, as it occurs rarely in Czech speech.



(a) Reading aloud task.



(b) Spontaneous speech.

Figure 6.2: Vocalic quadrangles of female speakers of Standard, southern and eastern French in their semi-spontaneous speech and production in a reading aloud task.

Note: Ellipses around /ɔ/ represent 20% of data. Taken from Woehrling (2009, p. 80-81).

Table 6.1: $F1$ and $F2$ values of Standard Czech and Standard French vowels for female speakers produced in a reading aloud task and semi-spontaneous speech.

	Reading aloud task				Semi-spontaneous speech			
	$F1$		$F2$		$F1$		$F2$	
	St Czech	St French	St Czech	St French	St Czech	St French	St Czech	St French
i	NA	350	NA	2400	NA	348	NA	2365
iː	328.5	NA	2603	NA	287	NA	2504	NA
ɪ	492.1	NA	2251.2	NA	411	NA	2177	NA
y	NA	350	NA	2050	NA	371	NA	2063
e	NA	450	NA	2300	NA	423	NA	2176
ɛ	686.3	650	1823	2000	650	526	1726	2016
ɛː	709.5	NA	1904.3	NA	671	NA	1825	NA
a	780.9	750	1480.2	1550	733	685	1322	1677
aː	801.2	NA	1417.6	NA	784	NA	1436	NA
ø	NA	450	NA	1650	NA	420	NA	1693
œ	NA	550	NA	1650	NA	436	NA	1643
u	415.3	350	1003.6	850	330	404	1221	1153
uː	343.6	NA	757	NA	341	NA	851	NA
o	528	450	1166.2	950	474	438	1161	1140
ɔ	NA	600	NA	1200	NA	528	NA	1347

Note: In Hz. St=Standard. Values in second and fourth column taken from Skarnitzl and Volín (2012), values in the third and fifth column taken from Tubach (1989), values in the sixth and eighth column taken from Paillereau and Chládková (2019), values in the seventh and last column taken from Gendrot and Adda-Decker (2005). Light grey=difference between $F1$ of Standard Czech and Standard French vowel from 30 to 60 Hz, or difference between $F2$ of Standard Czech and Standard French vowel from 100 to 200 Hz. Dark grey=difference between $F1$ of Standard Czech and Standard French vowel higher than 60 Hz, or difference between $F2$ of Standard Czech and Standard French vowel higher than 200 Hz. Colours chosen with respect to frequency difference limen – DLF, i.e., difference in the frequency values perceptible by the human ear (Paillereau, 2015). DLF for an $F1$=10–30 Hz, DLF for an $F2$=20–100 Hz (Flanagan, 1972). /oː/ not included, as it occurs rarely in Czech speech.

Table 6.2: $F3$ values of Standard Czech and Standard French i-sounds produced in isolation by female speakers.

	$F3$
Standard French /i/	3787
Standard Czech /ɪ/	3087
Standard Czech /iː/	3599

Note: In Hz. According to Paillereau (2015).

despite their potential limitations, these studies give us an idea of the spectral characteristics of Standard Czech, Standard French and southern French vowels, and consequently, allow us to suppose that the vowels in these three language varieties differ in their spectral characteristics as follows:

- $F1$ of Standard Czech /ɪ/ is importantly higher than $F1$ of Standard and southern French /i/, its $F2$ is slightly lower than $F2$ of Standard and southern French /i/, and its $F3$ is significantly lower than $F3$ of Standard and southern French /i/.
- $F1$ of Standard Czech /ɛ/ is higher than $F1$ of Standard and southern French /ɛ/ but its $F2$ is lower than the one of Standard and southern French /ɛ/.
- $F1$ of Standard Czech /a/ is slightly higher than $F1$ of Standard French /a/ but $F1$ of southern French /a/ is higher than Standard French /a/. $F2$ of Standard Czech /a/ is lower than $F2$ of Standard French /a/ but $F2$ of southern French /a/ is lower than $F2$ of Standard French /a/.
- Concerning /u/, there seem to be some differences between its $F1$ and $F2$ in Czech and French, but the studies do not allow us to affirm them. Indeed, the studies, which analysed $F1$ and $F2$ of /u/ produced in semi-spontaneous speech, and the studies, which analysed it when produced in a reading aloud task, do not show the same differences between the first two formants of /u/ in Czech and French.
- $F1$ of Standard Czech /o/ is higher than the one of Standard and southern French /o/.

To summarise, Standard Czech differs from Standard and southern French mainly in the spectral characteristics of its /ɪ/ (mainly $F1$ and $F3$), /ɛ/ ($F1$ and $F2$), and /o/ ($F1$).

6.3.2 Predictions

The highlighted differences in spectral characteristics of Standard Czech, Standard French and southern French vowels above enable us to make the five following predictions.[2]:

1. Phonetic CLI will occur in $F1$, $F2$ and $F3$ of CF's L1 [ɪ] as Standard and southern French /i/ mainly differ from Standard Czech /ɪ/ in its $F1$ and $F3$ and slightly in its $F2$.

[2]For the link of these predictions to the theoretical background, see primary hypothesis in section 6.1.

2. Phonetic CLI will occur in $F1$ and $F2$ of CF's L1 [ɛ] as Standard and southern French /ɛ/ have lower $F1$ and higher $F2$ than Standard Czech /ɛ/. Also, Standard French /e/ has lower $F1$ and higher $F2$ than Standard Czech /ɛ/ and thus may affect together with Standard and southern French /ɛ/ the CF's L1 /ɛ/.

3. Phonetic CLI will occur in some formants of CF's L1 long vowels as they do not exist in French.

4. Phonetic CLI will occur in some formants of CF's L1 /a/ and /u/ as their $F1$ and $F2$ may differ slightly in Standard Czech, Standard French, southern French even if the differences are not always straightforward.

5. Phonetic CLI will occur in $F1$ of CF's L1 /o/ as its $F1$ in Standard Czech /o/ is higher than the one of Standard and southern French /o/.

6.3.3 Methodology

For the analyses of formants of vowels, vowels in the recordings of semi-spontaneous speech ending with a stuck schwa were excluded from the analysis. Vowels preceded or followed by nasal consonants in all recordings were also excluded from the analysis, since nasal context coarticulation may lead to uncontrolled extra formants. Following Rubovičová (2014), the Czech conjunction 'a', meaning 'and' in English, longer than 150 ms was considered as a hesitation and excluded from the analysis. The conjunction 'a' with a duration lower than 150 ms was labelled as a short Czech vowel /a/ and included in the analysis. In total, the analysis involved 13 011 vowels. $F1$, $F2$ and $F3$ of vowels in Hertz were automatically measured using Praat script to compute the mean formant values from the second third of the vowel duration. In this way, the coarticulation effect on the formant value was avoided. Following this, a vocalic quadrangle of each speaker in each *task* was visualised in R using the packages *ggplot2* and *dplyr* in order to observe variability of vowel space among speakers.

The studies focusing on vowels in the field of phonetic CLI are not homogeneous concerning normalisation of formant values of vowels. While some of them prefer non-normalised values (see Chang, 2012; Flege, 1987), others chose the normalization (see Bergmann et al., 2016; Lang & Davidson, 2019). Lang and Davidson (2019) chose to normalise the formants because the number of male and female speakers in each of their groups was different. They "felt" that the normalisation was "necessary" (Lang & Davidson, 2019, p. 39) and used *Nearey1* formula implemented in the R package *vowels* (Kendall & Thomas, 2010). Note the goal of normalisation is to reduce the differences in the vowel space of speakers due to the differences in length of vocal tract among speakers. Therefore, I consider the use of normalisation justified only due to the difference in number of male and female speakers as done by Lang and Davidson (2019) is insufficient. According to Bergmann et al. (2016), "for cross-linguistic comparison, it is advisable to normalise measured values (in Hertz) of both vowel systems" Bergmann et al. (2016, p. 77). These authors used the Lobanov normalisation method Lobanov (1971), which is, according to Adank, Smits, and Van Hout (2004) and Flynn (2011), one of the best for preserving cross-linguistic differences. For studying Czech vowels, Volín and Studenovský (2007) showed that the Lobanov method performed the best for their normalisation compared to other methods. However, as highlighted by E. R. Thomas, Kendall, Yeager-Dror, and Kretzschmar (2007), the Lobanov method, as with all other vowel-extrinsic methods, may be disrupted when languages or language varieties with different vowel systems are compared. In Rankinen and de Jong's (2020) study, the use of the Lobanov method removed the difference between Finnish- and Italian-heritage American English speakers. E. R. Thomas et al. (2007) recommend the Bark Difference Metric method for cross-linguistic studies, which is unaffected by differences in the vowel systems of languages and language varieties, as with all other vowel-intrinsic method.

Overall, we decided to study C's and CF's vowels by using 3 different 'types of analysis':

1. The analysis of non-normalised formant values of C's and CF's vowels as carried out by several authors named above.

2. The analysis of normalised formant values using the Lobanov method following Bergmann et al. (2016) given the differences in vowel spaces of C and CF speakers which we observed.

3. The analysis of normalised formant values using the Bark Difference Metric method (Syrdal & Gopal, 1986) given its recommendation by E. R. Thomas et al. (2007) noted above.

We analysed C's and CF's vowels in R using the same packages as in the perceptual test. In addition, the package *phonTools* (Barreda, 2015) was used for the Lobanov normalisation, and the package *vowels* (E. R. Thomas et al., 2007) was used for the Bark Difference Metric method normalisation. The Lobanov normalisation method may be presented as follows:

> *"Lobanov method finds the mean and standard deviation for each formant. Formant frequencies are then standardised (in the statistical sense) using these estimated parameters for each speaker, for each formant. The average is found for each vowel category within-speaker before calculating the overall mean. As a result, the data from each speaker may contain*

unequal numbers of each vowel category. However, all speakers must be represented by the same vowel categories or the result will be (possibly) subtle differences in normalised vowel spaces dues to the possibly differing estimates of means and standard deviations of the different formants." (Barreda, 2015, p. 32)

In Bark Difference Metric method, the formant values are at first converted to bark values (Z) using the following formula:

$$Z_i = 26.81/(1 + 1960/F_i) - 0.53$$

Where F_i is the value for a given formant i. Then, the differences $Z3-Z1$, $Z3-Z2$, and $Z2-Z1$ are computed[3].

In order to analyse the relationship between *group* and formant values (normalised or not), linear mixed-effects models were performed for each formant of each pair of Czech vowels (i.e., short and long vowel). As fixed effects, *group*, *task* and *length* with interaction term were entered into the model. As random effects, we had intercepts for *speakers* and *words* of the occurrence of a vowel, as well as by-*task* random slope for the effects *words* and *speakers*, and by-*length* random slope for the effect *speakers*. For instance, the model used for the analysis of $F1$ of /a/ and /aː/ was:

$$lmer(F1 \sim (group{*}task{*}length)+(length+task|speaker)+(1+task|word), \text{dataA})$$

Some models encountered convergence issues. In this case, the necessary adjustments were made in random slopes to reach the convergence, i.e., we deleted one or more random slopes so the model converged. The /oː/ rarely occurs in Czech speech. Consequently, it was excluded from the analysis. Therefore, the model for /o/ was without *length* effect. Visual inspection of residual plots of each model separately rejected any obvious deviations from homoscedasticity or normality of the data used in each model. For each separate model, the comparison of estimated means was carried out across effects levels with the *emmeans* package, confidence level set at 95%.

6.3.4 Results and discussion

The statistically significant results of the analyses of $F1$ of vowels are given in table 6.3. Note that negative Estimate values obtained by the Bark Difference Metric method are equivalent to positive Estimate values obtained by the Lobanov method, or the analysis of non-normalised formant values. This is because the Bark Difference Metric method converts the formant values into inverse values. Therefore,

[3]See https://www2.ling.su.se/staff/hartmut/bark.htm, accessed 11/02/2021.

similarly, positive Estimate values obtained by the Bark Difference Metric method are equivalent to negative Estimate values obtained by the Lobanov method or by analysis without normalisation (see Figure 6.3). All three types of analysis, i.e., the analysis of non-normalised formant values as well as the analysis of values normalised by the Lobanov and Bark Difference Metric methods showed a significant difference between C's and CF's $F1$ of [aː] in the reading aloud task where the [aː] of CF was significantly more open than the [aː] of C. The *group* affected non-normalised $F1$ of [aː] $(z - ratio = -3.764, p = 0.0002)$ increasing its CF's value by 103.1 Hz $\pm$ 27.4 Hz (standard errors). It affected $F1$ of [aː] normalised by the Lobanov method $(z - ratio = -2.704, p = 0.0069)$ increasing its CF's value by 0.2876 $\pm$ 0.1064 (standard errors). It affected $F1$ of [aː] normalised by the Bark Difference Metric method $(z - ratio = 2.365, p = 0.0069)$ decreasing its CF's value by 0.612 $\pm$ 0.259 (standard errors). Concerning $F1$ analyses, there were no other significant results reported by the three types of analysis.

However, another significant result concerning $F1$ of vowels was reported by one type of analysis. The analysis of the non-normalised $F1$ showed that there is a significant difference between C's and CF's [aː] in semi-spontaneous speech. In this *task*, the *group* affected the non-normalised $F1$ of [aː] $(z - ratio = -2.534, p = 0.0113)$ increasing its CF's value by 69.2 Hz $\pm$ 27.3 Hz (standard errors) which means that the non-normalised CF's [aː] was also more open than the one of CF. The analysis of $F1$ of vowels normalised by the Bark difference Metric method showed a significant difference between C's and CF's [iː] in semi-spontaneous speech. The *group* affected $F1$ of [iː] normalised by the Bark difference Metric method $(z - ratio = -2.802, p = 0.0082)$ increasing its CF's value by 0.4160 $\pm$ 0.148 (standard errors). This result suggests that the CF's [iː], when normalised by the Bark difference Metric method, was closer than that of C in this *task*.

The analysis of $F1$ of vowels normalised by the Lobanov method showed a significant difference between C's and CF's [ɛ] in semi-spontaneous speech, C's and CF's [ɛː] in both tasks (i.e., the reading aloud task and semi-spontaneous speech), and C's and CF's [u] in the reading aloud task. The *group* affected $F1$ of [ɛ] normalised by the Lobanov method $(z - ratio = 2.531, p = 0.0164)$ decreasing its CF's value by 0.097601 $\pm$ 0.0386 (standard errors) in semi-spontaneous speech. It affected $F1$ of [ɛː] normalised by the Lobanov method in the reading aloud task $(z - ratio = 2.583, p = 0.0117)$ and in semi-spontaneous speech $(z - ratio = 2.147, p = 0.0359)$ decreasing its CF's value by 0.229492 $\pm$ 0.0888 (standard errors) in the reading aloud task and by 0.255959 $\pm$ 0.1192 (standard errors) in semi-spontaneous speech. These results suggests that, when normalised by the Lobanov method, CF's [ɛː] was closer than that of C in both tasks, and, in the reading aloud task, their [ɛ] was closer than the one of C. The *group* affected $F1$ of [u] normalised by Lobanov method $(z - ratio = -2.309, p = 0.0256$, model

Table 6.3: Statistically significant differences between C's and CF's $F1$ of vowels in each *task*

v	norm	task	Estimate	SE	z-ratio	p
aː	null	reading aloud task	-103.1	27.4	-3.764	0.0002
		semi-spontaneous speech	-69.2	27.3	-2.534	0.0113
	Lobanov	reading aloud task	-0.2876	0.1064	-2.704	0.0069
	BDM	reading aloud task	0.612	0.259	2.365	0.0180
ɛ	Lobanov	semi-spontaneous speech	0.097601	0.0386	2.531	0.0164
ɛː	Lobanov	reading aloud task	0.229492	0.0888	2.583	0.0117
		semi-spontaneous speech	0.255959	0.1192	2.147	0.0359
iː	BDM	semi-spontaneous speech	-0.4160	0.148	-2.802	0.0082
u	Lobanov	reading aloud task	-0.1039	0.0450	-2.309	0.0256

Note: $p < 0.05$. Estimated values indicate the contrast between the groups, C – CF. Estimates of non-normalised values (norm=null) are in Hz. v=vowel, norm=normalisation method, BDM=Bark Difference Metric, SE=standard errors.

Table 6.4: Statistically significant differences in C's and CF's $F2$ of vowels in each *task*.

v	norm	task	estimate	SE	$z - ratio$	p
ɛ	Lobanov	reading aloud task	0.0923	0.0392	2.358	0.0239
ɛː	BDM	semi-spontaneous speech	0.412	0.195	2.107	0.039
ɪ	null	semi-spontaneous speech	-102.8	43.6	-2.356	0.0245
	Lobanov	reading aloud task	0.1374	0.0547	2.510	0.0145
	BDM	semi-spontaneous speech	0.2207	0.0972	2.271	0.0293
iː	null	semi-spontaneous speech	-83.6	40.9	-2.045	0.0478

Note: $p < 0.05$. Estimated values indicate the contrast between the groups, C – CF. Estimates of non-normalised values (norm=null) are in Hz. v=vowel, norm=normalisation method, BDM=Bark Difference Metric, SE=standard errors.

converging only without *length* as a random slope in the random effect *speakers*) increasing its CF's value by 0.1039 ± 0.0450 (standard errors) in the reading aloud task, meaning that CF's [u] was more open than the one of C in this *task*.

Table 6.4 gives the results of analyses of $F2$. There were no significant results reported in all three types of analysis. Two types of analysis, i.e., the analysis of non-normalised values and the analysis of values normalised by the Bark Difference Metric method showed a significant difference between C's and CF's $F2$ of [ɪ] in semi-spontaneous speech where the [ɪ] of CF was significantly more front than the [ɪ] of C. The *group* affected the non-normalised $F2$ of [ɪ] ($z - ratio = -2.356, p = 0.0245$, model converging only without *task* as a random slope in the random effect *word*) increasing its CF's value by 102.8 Hz ± 43.6 Hz (standard errors), and it affected $F2$ of [ɪ] normalised by the Bark Difference Metric method ($z - ratio = 2.271, p = 0.0293$, model converging only without *length* as a random slope in the random effect *speakers* and without *task* as a random slope in the random effect

Table 6.5: Statistically significant differences between C's and CF's $F3$ of [ɪ] and [iː] in each *task*.

v	norm	task	estimate	SE	$z - ratio$	p
ɪ	Lobanov	reading aloud task	0.2339	0.1072	2.182	0.0303
	BDM	semi-spontaneous speech	-0.403	0.190	-2.119	0.0419
iː	null	reading aloud task	-141.8	53.7	-2.640	0.0122
	null	semi-spontaneous speech	-216.2	51.2	-4.224	0.0002
	Lobanov	semi-spontaneous speech	-0.5449	0.1293	-4.212	$<.0001$

Note: $p < 0.05$. Estimated values indicate the contrast between the groups, C – CF. Estimates of non-normalised values (norm=null) are in Hz. v=vowel, norm=normalisation method, BDM=Bark Difference Metric, SE=standard errors.

words) decreasing its CF's value by 0.2207 ± 0.0972 (standard errors). Slightly divergent result was reported for $F2$ of [ɪ] normalised by the Lobanov method in the reading aloud task. The *group* affected $F2$ of [ɪ] normalised by the Lobanov method ($z - ratio = 2.510, p = 0.0145$, model converging only without *task* as a random slope in the random effect *words*) decreasing its CF's value by 0.1374 ± 0.0547 (standard errors), meaning that the [ɪ] of CF was significantly less front than the [ɪ] of C in this *task*.

Three other significant results concerning $F2$ were reported by one type of analysis. Analysis of the non-normalised $F2$ showed a significant difference between C's and CF's [iː] in semi-spontaneous speech where CF's [iː] was more front than that of CF. The *group* affected the non-normalised $F2$ of [iː] ($z - ratio = -2.045, p = 0.0478$, model converging only without *task* as a random slope in the random effect *words*) increasing its CF's value by 83.6 Hz ± 40.9 Hz (standard errors). Analysis of $F2$ of vowels normalised by the Bark difference Metric method showed a significant difference between C's and CF's [ɛː] in semi-spontaneous speech. The *group* affected $F2$ of [ɛː] normalised the Bark difference Metric method ($z - ratio = 2.107, p = 0.039$) decreasing its CF's value by 0.412 ± 0.195 (standard errors), meaning that the [ɛː] of CF was significantly more front than the [ɛː] of C. Again, slightly divergent results were reported for $F2$ of [ɛ] normalised by the Lobanov method in the reading aloud task. The *group* affected $F2$ of [ɛ] normalised by the Lobanov method ($z - ratio = 2.358, p = 0.0239$, model converging only without *task* as a random slope in the random effect *words*) decreasing its CF's value by 0.0923 ± 0.0392 (standard errors), meaning that the [ɛ] of CF was significantly less front than [ɛ] of C in this *task*.

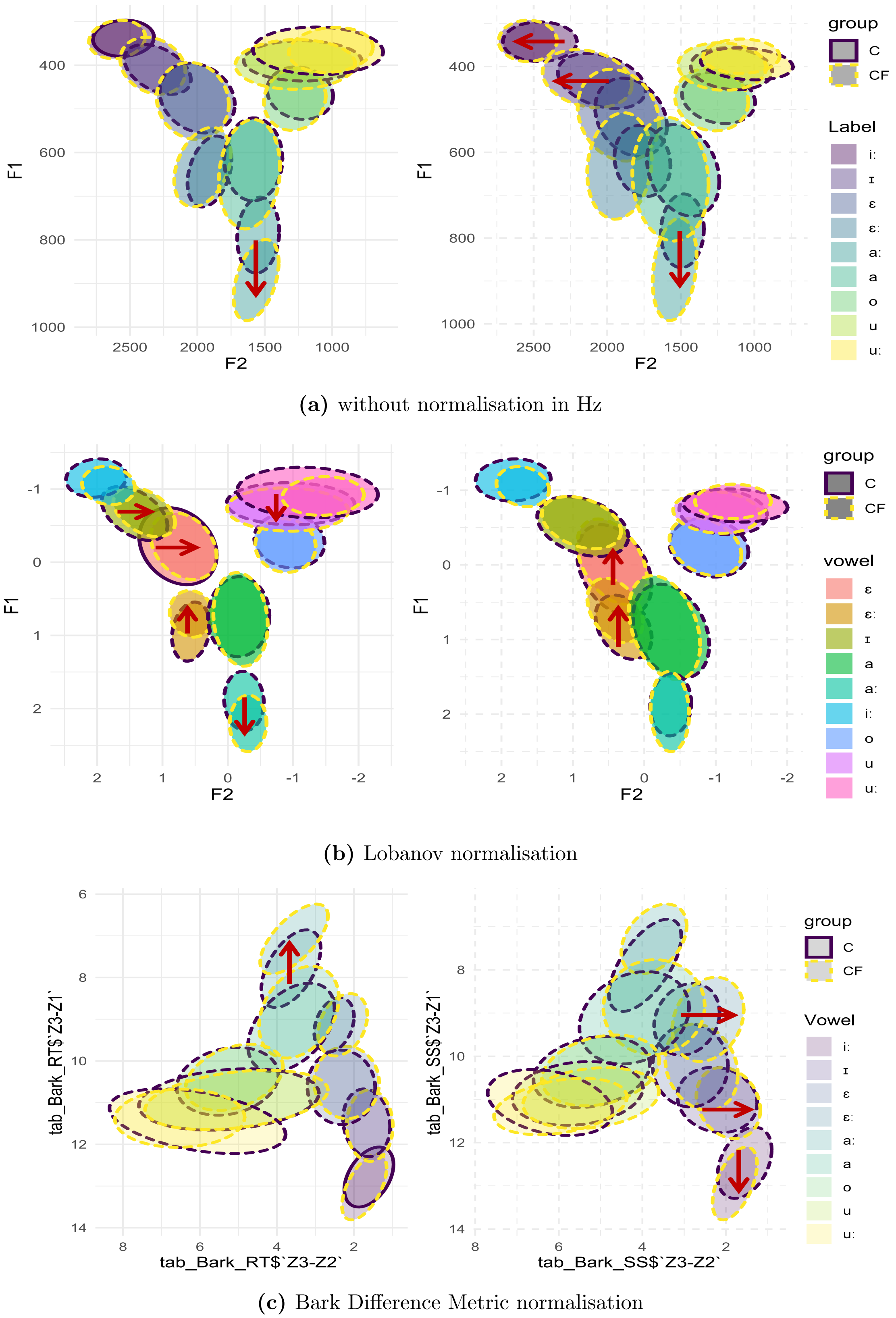
Table 6.5 gives results of the analyses of $F3$ of [ɪ] and [iː]. There were no significant results reported in all three types of analysis. Two types of analysis, i.e., the analysis of non-normalised values and the analysis of values normalised by the Lobanov method showed a significant difference between C's and CF's $F3$ of [iː]. The *group* affected non-normalised $F3$ of [iː] ($z - ratio = -4.224, p = 0.0002$) increasing its CF's value by 216.2 Hz ± 51.2 Hz (standard errors), and it affected $F3$ of [iː] normalised by the Lobanov method ($z - ratio = -4.212, p < .0001$, model converging only without *length* as a random slope in the random effect *speakers*) increasing its CF's value by 0.5449 ± 0.1293 (standard errors) in semi-spontaneous speech. Similarly, there was a significant difference between C's and CF's non-normalised $F3$ of [iː] in the reading aloud task. The *group* affected the non-normalised $F3$ of [iː] ($z - ratio = -2.640, p = 0.0122$) increasing its CF's value by 141.8 Hz ± 53.7 Hz (standard errors) in this *task*. Thus, these types of analysis showed that CF's $F3$ of [iː] was significantly higher than that of C.

Two types of analysis showed the contrary for CF's $F3$ of [ɪ]. The analysis of its normalised value by the Bark difference Metric method showed a significant difference between C's and CF's $F3$ of [ɪ] in semi-spontaneous speech. The *group* affected $F3$ of [ɪ] normalised by the Bark difference Metric method ($z - ratio = -2.119, p = 0.0419$) decreasing its CF's value by 0.403 ± 0.190 (standard errors). Similarly, there was a significant difference between C's and CF's $F3$ of [ɪ], normalised by the Lobanov method, in the reading aloud task. The *group* affected this normalised $F3$ ($z - ratio = 2.182, p = 0.0303$, model converging only without *length* as a random slope in the random effect *speakers*) decreasing its CF's value by 0.2339 ± 0.1072 (standard errors).

Figure 6.3 shows C's and CF's vowels produced in the reading aloud task and semi-spontaneous speech plotted in $F1$-$F2$ plane. From the arrows on this figure, which indicate all significant shifts found in $F1$ and $F2$ of CF's vowels, we may see that both the analysis of non-normalised vowels and normalised vowels using the Bark Difference Metric method reported significant shifts in /aː/ and /ɪ/. In contrast, the analysis of non-normalised vowels and normalised vowels by the Lobanov method reported a significant shift only in /aː/. Thus, the results obtained by analysis of vowels normalised by the Lobanov method differ from those obtained by the other two types of analysis.

Though the results vary depending on the type of analysis used, I wish to relate the results of all types of analysis taken together to the predictions for CF's vowels given in subsection 6.3.2. The first prediction, which concerned phonetic CLI in $F1$, $F2$ and $F3$ in CF's L1 [ɪ], was partially confirmed. Phonetic CLI[4] were noted in its $F2$ and its $F3$. No phonetic CLI were found in its $F1$. The second prediction concerned phonetic CLI in $F1$ and $F2$ in CF's L1 [ɛ]. This prediction was only partially confirmed as only two phonetic CLI were found in CF's L1 [ɛ], one in its $F1$ in semi-spontaneous speech and the other in its $F2$ in the reading aloud task. The third prediction concerned phonetic CLI in some formants of CF's long vowels. It seems to be confirmed as phonetic CLI occurred in $F1$ of CF's /aː/, /ɛː/, and

[4]Note that in this chapter, we consider phonetic CLI as any found differences in properties of C's and CF's speech segments or suprasegments.



(a) without normalisation in Hz

(b) Lobanov normalisation

(c) Bark Difference Metric normalisation

Figure 6.3: C's and CF's vowels in the reading aloud task (left) and in semi-spontaneous speech (right) plotted in $F1/F2$ plane.

Note: The ellipses indicate 50% of data, the arrows show the direction of significant shifts of CF's vowels.

/iː/, $F2$ of CF's /ɛː/, and /iː/, and $F3$ of CF's /iː/. Thus, there were phonetic CLI in at least one formant of three long vowels of four analysed long vowels. The fourth prediction concerning phonetic CLI in some formants of CF's L1 /a/ and /u/ was only partially confirmed as only a phonetic CLI in $F1$ of CF's /u/ was found. Finally, the fifth prediction concerning /o/ was not confirmed as no significant phonetic CLI was found in the formants of CF's /o/.

The significant shifts displayed in fig. 6.3, may be interpreted either as assimilation or dissimilation effects. The first main shift concerns $F1$ of CF's /aː/. The mean value of non-normalised $F1$ of CF's /aː/ computed in R was 890 Hz in the reading aloud task and 862 Hz in semi-spontaneous speech. These values are significantly higher than $F1$ of Standard Czech /aː/ and Standard French /a/ and than $F1$ of southern French /a/ given in subsection 6.3.1. Therefore, this shift may be considered as a dissimilation effect because the CF's /aː/ is moving away from Standard Czech /aː/, and the Standard and southern French /a/. The second main shift revealed by the Lobanov method in the reading aloud task and semi-spontaneous speech concerns $F1$ of CF's /ɛː/. The mean value of $F1$ of non-normalised CF's /ɛː/ computed in R was 642 Hz in both tasks. This value is lower than the value of $F1$ of Standard Czech /ɛː/ and close to the value of $F1$ of the Standard French /ɛ/ given in subsection 6.3.1. These results suggest an assimilation effect. For similar reasons, the shift in CF's $F1$ normalised by the Lobanov method of /ɛ/ in semi-spontaneous speech may be considered as an assimilation effect. The two last main shifts concern $F3$ of CF's /ɪ/ and /iː/. The mean $F3$ of CF's /iː/ was 2577 Hz in the reading aloud task and 2522 Hz in semi-spontaneous speech when computed from non-normalised values in R. These values are lower than those of the C's /iː/ and close to $F3$ value of the Standard French /i/ found by Tubach (1989) which allows us to consider this shift as an assimilation effect. The shift in $F3$ of CF's /ɪ/ was found only in normalised vowels. Hence, it does not make sense to compare its non-normalised values with the non-normalised value provided by (Paillereau, 2015) or Tubach (1989). However, we may consider this shift as a dissimilation effect as the CF's $F3$ of /ɪ/ is lower than that of C. Another shift, but not the primary shift, is found in the CF's $F2$ of /ɪ/ in the reading aloud task, revealed by analysis of its normalised values by the Lobanov method. As the CF's /ɪ/ is moving away from the placement of C's /ɪ/ and the normal placement of the Standard and southern French /i/ in the vocalic space (see subsection 6.3.1), it may be considered as a dissimilation effect.

6.4 Spectral and temporal characteristics of rhotics

This section examines phonetic CLI in spectral and temporal characteristics of Czech /r/ in CF's L1 speech.

6.4.1 Spectral and temporal characteristics of rhotics in Czech and French

In order to examine the place and manner of articulation of Czech and French rhotic consonant, several authors have studied the spectral characteristics such as the first three formants (see, e.g., Ramasse, 2017; Šimáčková, 2002), harmonicity (e.g., Gendrot, Kühnert, & Demolin, 2017), and its temporal characteristics such as duration (Šimáčková, 2002; Vernerová, 2006). The link between $F1$, $F2$ and $F3$ values of a rhotic consonant and its articulatory properties may be understood similarly to the link between $F1$, $F2$ and $F3$ of vowels and their articulatory properties. Harmonicity (HNR) compares the energy of tone and noise components of the sound. Stronger tone components mean a higher HNR, while weaker tone components mean a lower HNR. Gendrot et al. (2017) validated the use of HNR for the acoustic analyses of the French rhotics. Duration may be used for distinguishing the rhotic consonant produced as a tap from its production as a trill in Czech (cf. Šimáčková, 2002).

Also four spectral moments, i.e., center of gravity (COG), *standard deviation*, *skewness* and *kurtosis*, help to identify the place and manner of articulation of rhotic consonants (cf. Fu, Rodman, McAllister, Bitzer, & Xu, 1999; Jongman, Wayland, & Wong, 2000). The studies of Fu et al. (1999); Jongman et al. (2000) confirmed that the first and the third spectral moment is affected by the place and manner of articulation, while the fourth spectral moment is affected only by the manner of articulation. As shown by Fu et al. (1999)'s study of fricatives, by analysing spectral moments, three or four places of articulation may be distinguished. The importance of the second spectral moment for the distinction of places of articulation was proved in Shadle and Mair's (1996) study on fricatives. Technically speaking, COG is the weighted average of the frequencies present in the spectrum by their magnitudes, calculated using the Fourier transform. *Standard deviation* of a spectrum is the square root of the second central moment of this spectrum. *Skewness* is of a spectrum is the third central moment of this spectrum, divided by the 1.5 power of the second central moment. *Kurtosis* of a spectrum is the fourth central moment of this spectrum, divided by the square of the second central moment, minus 3 (cf. Pavlíková, 2013).

According to Macháč and Skarnitzl (2009), "the alveolar trill [r] is neither a typical obstruent nor a typical sonorant sound" as "an obstacle is formed to the airstream in the vocal tract", but, at the same time, the "[r] has a salient formant structure" (Macháč & Skarnitzl, 2009, p 40). These authors consider that the $F1$ of Czech alveolar trill [r] is approximately 450 Hz, its $F2$ is between 1300 and 1400 Hz, and its $F3$ is slightly above 2000 Hz.[5] Their estimation of $F1$ and $F3$ are in agreement with the findings of Šimáčková (2002) who studied Czech /r/ in one

[5]Note that Macháč and Skarnitzl (2009) provide these approximate formant values without specifying if they obtained them from an experimental study.

healthy speaker's production. Concerning $F2$, Šimáčková (2002) found its values to be approximately between 1200 and 1300 Hz. Moreover, the author showed that in the case of speaker with a particular type or rhotacism (speech deficit in Czech called *ráčkování*, see subsection 3.2.2), the $F2$ of Czech /r/ is higher, i.e., above 1400 Hz, its $F3$ is lower, i.e., in general inferior to 2000 Hz, and the value of its $F1$ is similar to the one of the Czech /r/ produced by a healthy speaker. Most recently, Howson, Komova, and Gick (2014) studied Czech trills and provided their ultrasound EEG analysis followed by acoustic analysis. However, in this study, the analysed speech corpus consisted of recordings of Czech speech of 10 Czech native speakers living in Vancouver, British Columbia, originally from all three regions of Czech Republic. We may suppose that when living in Vancouver, they may have undergone phonetic CLI in their Czech /r/. As a result, we cannot, unfortunately, consider the results of this study as formant reference values for Czech /r/.

Ramasse (2017) studied $F1$, $F2$ and $F3$ values of the French rhotic consonant produced as an uvular approximant in the speech of 25 native French women living in France. The author gives their median values. The median of the $F1$ was 530 Hz, the median of the $F2$ was 1363 Hz, and that of the $F3$ was 2781 Hz. Similarly, concerning the pharyngeal rhotic, the Delattre's (1970) study showed high $F1$ (up to 700 Hz), low $F2$ (about 1000 Hz), and slightly high $F3$ of French /ʁ/. Moreover, Ladefoged and Maddieson (1996) considered that "there is a consistent distinction in the spectral domain between uvular and apical trills, with the uvular trills showing a much higher third resonance (between 2500 and 3000 Hz)" (Ladefoged & Maddieson, 1996, p. 226) and Al-Masri and Jongman (2004); Bin-Muqbil (2006) showed that the acoustic correlates of pharyngealisation and uvularization in sonorants lower $F2$ (the tongue positional becomes more back) and raise$F1$ (the sound becomes more open). Concerning the formant values of the Toulouse French r-sound, there has been no exploration to the best of our knowledge. To compare all these with the values given by Macháč and Skarnitzl (2009); Šimáčková (2002) mentioned just above, it could be argued that $F1$ and $F3$ of Standard French rhotic uvular approximant or uvular fricative are notably higher than $F1$ and $F3$ of Czech /r/, and its $F2$ may be similar to or lower than $F2$ of Czech /r/.

Duration of Czech /r/ was measured by Šimáčková (2002); Vernerová (2006). Vernerová (2006) focused on duration of syllabic /r/ produced in the reading of a continuous text, normalised by speech rate. On fig. 6.3, which shows her results, we see that the syllabic /r/ is generally longer than the nonsyllabic in the production in the reading aloud task. There is no significant difference between normalised duration of nonsyllabic /r/ with respect to its position in the word according to the results of Vernerová (2006). While there are some differences between normalised duration of the syllabic /r/, with respect to is position in the word (see Vernerová, 2006). Šimáčková (2002) found that Czech /r/ when produced as alveolar tap by

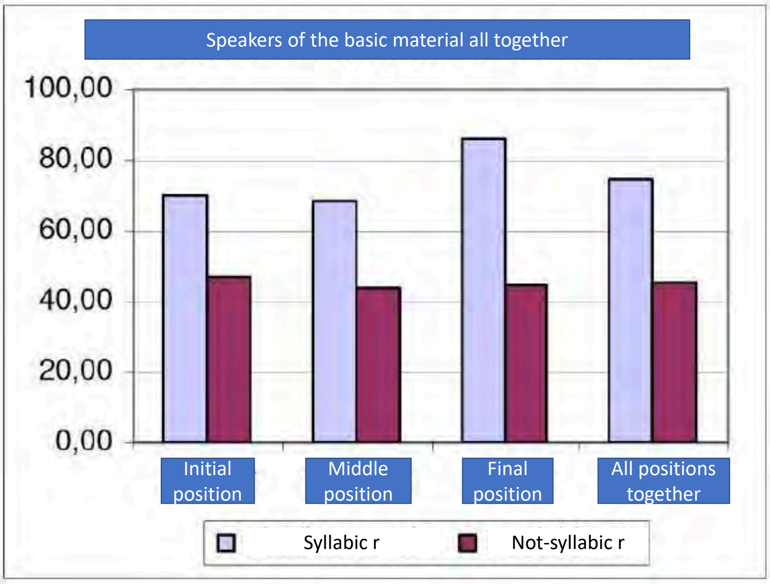


Figure 6.4: Normalised duration of syllabic and nonsyllabic /r/ in different positions in the word.

Note: Taken from Vernerová (2006, p. 47). Normalised duration was computed as follows: The mean value of non-normalised duration of /r/ of each speaker was multiplied by the mean articulatory rate of speakers of speech corpus. From the obtained values, the mean value was computed for all speakers together for syllabic and nonsyllabic /r/ in each word position.

a Czech healthy speaker is shorter than when produced as a trilled [r] by a Czech speaker suffering from a form of rhotacism. In her study, the mean duration of Czech /r/ produced by the healthy speaker was 41 ms while the one of Czech /r/ produced by the speaker with a rhotacism was 72 ms.

Concerning HNR of Czech /r/ and its spectral moments have yet to be studied, as far as we am aware. Wu, Gendrot, Hallé, and Adda-Decker (2015) studied the acquisition of the French /r/ by Chinese learners on their production of the syllables with /r/ in onset position followed by the vowel inserted in the model sentence "Je dis ... deux fois" (I say... two times"). For the acoustic analyses, recordings of the same sentences produced by one French phonetician, a native French speaker of Standard French, were used to obtain reference values of HNR and COG for French /r/. The mean HNR value in /r/ produced by this French speaker was about 13 dB with the confidence interval between around 7 and 17 dB. Its mean COG value was 500 Hz with confidence interval of 250 to 750 Hz.

6.4.2 Predictions

With respect to the differences in spectral characteristics between the Standard Czech and Standard French rhotic consonant, as discussed above, and with respect to the possible articulatory realisation of rhotic consonant in Standard Czech, Standard

French and Toulouse French detailed in subsection 3.2.2, we make four following predictions concerning Czech /r/ in CF's L1 speech:

1. Phonetic CLI will occur in HNR of /r/ in CF's L1 speech as the rhotic consonant may often be produced as a fricative in French (see subsection 3.2.1) but not in Czech.

2. Phonetic CLI will occur in duration normalised by articulatory rate of /r/ in CF's L1 speech as /r/ in Czech is very often produced an alveolar tap but not so often in French (cf. subsection 3.2.1).

3. Phonetic CLI will occur in spectral moments of /r/ in CF's L1 speech as the most common variants of rhotic consonant in Standard French and Standard Czech differ in place and manner of articulation (see subsection 3.2.1).

4. Phonetic CLI will significantly occur in $F1$ and $F3$ of /r/ in CF's L1 speech and less significantly in its $F2$ as French uvular rhotic consonant has higher $F1$ and $F3$ than the Czech /r/ and slightly lower $F2$.

These predictions are related to the primary hypothesis put in section 6.1 based on the theoretical background of the present thesis.

6.4.3 Methodology

For the analyses of the spectral and temporal characteristics of CF's /r/, there were in total 1478 /r/. $F1$, $F2$, $F3$, four spectral moments, HNR in [dB] and duration in [sec] of /r/ were measured automatically using Praat script. For formants, firstly, we removed the outlying formant values over the entire duration of /r/ in the Praat Formant object, i.e., $F1$ higher than 900 Hz, $F2$ lower than 900 Hz or higher than 1900 Hz and $F3$ lower than 1800 Hz or higher than 3100 Hz. These values were chosen with respect to the possible formant values of Czech and French rhotic consonant listed in subsection 6.4.1. When outlying the formant values which had been removed, mean formant values were computed from the entire /r/ duration. The values of spectral moments and HNR were extracted for the entire /r/ duration. Spectral moments were measured with the power set at 2, and mean HNR value with the settings 'To Harmonicity (cc)... 0.01 75 0.1 1'.

As shown in section 2.3, studies on phonetic CLI occurring in rhotics are scarce. Moreover, in only two existing studies, the authors do not normalise formant values of the rhotics (see De Leeuw, Tusha, Zhao, et al., 2018; Ulbrich & Ordin, 2014). Nevertheless, Czech /r/ usually contains a vocalic component. As we saw in the spectral characteristics of vowels (subsection 6.3.3, the C and CF speakers likely vary in the length of their vocalic tract. Hence, we considered that it was necessary to normalise the formant values in /r/ of the speakers. We decided to normalise them using the Lobanov method for the reasons exposed in subsection 6.3.3. The normalisation was done in R, using the same package as for the vowels. The mean formant values were normalised for the entire duration of /r/ simultaneously with the mean formant values of vowels computed from the second third of vowels duration, as described in subsection 6.3.3, in order to allow the algorithm to understand the vocalic spaces of speakers and normalise /r/ in accordance.

Concerning duration of /r/, one may suppose that its non-normalised values in seconds in CF's L1 speech may be higher than that in C's L1 speech because CF's might speak slowly, i.e., have a lower speech rate as they might undergo attrition. In order to avoid this effect, the /r/ duration was normalised by the articulatory rate (i.e., the number of produced syllables per second) of the speaker. To do so, the mean articulatory rate of each sound file was computed, directly into its TextGrid using by *SlabikovacAR* developed by Bořil and Oceláková[6]. Secondly, the mean articulatory rate was computed in R, for each speaker in each *task* as follows:

$$mean\ AR = length(\mathrm{AR})/sum(1/\mathrm{AR})$$

Where *mean AR* is the speaker's mean articulatory rate in the given *task* and *AR* are the mean articulatory rates of his/her sound files of this task. The /r/ duration was normalised in R. Similarly to Vernerová (2006), we computed, at first, the *coefficient of relative duration*, for each *task* and each speaker, which is the mean articulatory rate of the speaker divided by 5.5. 5.5 was used as the reference for the articulatory rate in Czech because, as claimed by Skarnitzl et al. (2016), in Czech, the normal articulatory rate is between 5 and 6 syllables per second. Then, we computed normalised duration of /r/ using the following formula:

$$\text{normalised duration [ms]} = (duration[s] \times coefficient\ of\ relative\ duration) \times 1000$$

Where *duration* is non-normalised duration of /r/ and the multiplication by 1000 gives us the conversion of values in seconds to the values in milliseconds.

The statistical analyses of /r/ were done in R using the same packages as in the perceptual test. First, the relationship between the *group* and HNR was analysed. For that, we excluded the /r/ with NA values in HNR (16 occurrences). In total, we analysed HNR in 1462 /r/. The linear mixed-effect model was used to compute the relationship between *group* and *task*. We had intercepts for *speakers* and *words* of the /r/ occurrence as random effects, *group* and *task* as fixed effects in interaction, and *task* as random slope for random effects *words* and *speakers*. Thus, the model was:

$$lmer(HNR \sim (group * task) + (1 + task|word) + (1 + task|speaker),\ \mathrm{dataNoNA})$$

[6] Available on https://fonetika.ff.cuni.cz/vyzkum/skripty-a-nastroje/

Second, the relationship between *group* and normalised duration of /r/ was analysed. The analysis of normalised duration of /r/ involved all 1478 occurrence of /r/ in C's and CF's L1 speech. The same linear mixed-effect model as for HNR analysis was used. HNR was replaced by normalised duration in that model. This statistical analysis of normalised duration of /r/ was done for both the syllabic and nonsyllabic /r/ simultaneously. As Vernerová's (2006) results show, there is an important difference between duration of syllabic and nonsyllabic /r/. Due to that, we visualised normalised duration of both /r/ (syllabic and nonsyllabic) separately in order to inspect if the general results obtained by *emmeans* remained the same when the syllabic and nonsyllabic /r/ are inspected separately. Third, we analysed the relationship between *group* and the spectral moments of /r/. By visual inspection of COG values, we saw that deleting some outliers is necessary. We decided to exclude from analyses the /r/ with a COG higher than 1400 Hz and lower than 100 Hz, i.e., 9 occurrences in the visualisation of COG values in the plot which represented clear outliers. Thus, the analysis of spectral moments involved 1469 /r/. We computed four linear mixed-effect models with interaction, i.e., one model for each spectral moment, identical to the model used for HNR analysis, with the given spectral moment instead of HNR. Finally, we analysed the relationship between *group* and the formant values of /r/. To ensure the analysis is exhaustive, we examined non-normalised values of /r/ formants and their normalised values. Hence, we computed six linear mixed-effect models with interaction, i.e., one model for each formant (normalised or not), identical to the model used for HNR analysis, with HNR substituted by the given formant.

The models used for the analysis of HNR, normalised duration, COG, *standard deviation*, *kurtosis*, and for formants of /r/ converged without issues. There was a convergence issue in *skewness* model, which was resolved by deleting the random slope *task* in the random effect *words*. Then, the model converged correctly. Visual inspection of residual plots of all models did not reveal any obvious deviations from homoscedasticity or normality of the data. Comparison of estimated means across effects levels was carried out with the *emmeans* package, with the confidence level set at 95%.

6.4.4 Results and discussion

The results of the analysis of HNR in /r/ showed no significant difference between groups of speakers. In this sense, our first prediction concerning HNR of /r/ was not confirmed. For more detailed analysis, we visualised the C's and CF's values of HNR in /r/ in a boxplot (see fig. 6.5). Thus, we may observe that HNR values of CF /r/ are slightly but not significantly lower than the C's values, mainly in semi-spontaneous speech. We may also observe that HNR values found in production of both C and CF are similar to those found by Wu et al. (2015) (see subsection 6.4.1)

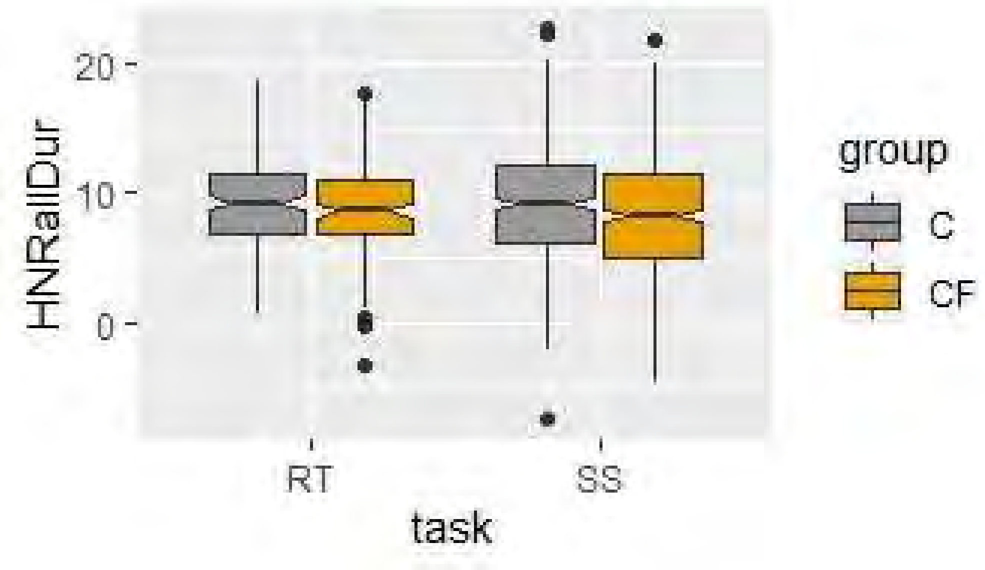


Figure 6.5: HNR of /r/ per *task* and *group*.

Note: The plot shows HNRallDur, i.e., the values of HNR of /r/ automatically measured in Praat from the entire /r/ duration.

meaning that they may be considered as possible.

The analysis of normalised duration of all /r/ showed a significant difference between groups in both tasks. The *group* affected normalised duration of /r/ in the reading aloud task ($t - ratio = -3.426, p = 0.0017$) increasing its CF's value by 7.62 ms ± 2.22 ms (standard errors). It also affected normalised duration of /r/ in semi-spontaneous speech ($t - ratio = 3.086, p = 0.0042$) decreasing its CF's value by 7.06 ms ± 2.29 ms (standard errors). Thus, the second prediction concerning duration of /r/ was confirmed. Figure 6.6 shows normalised duration of syllabic and nonsyllabic Czech /r/ in C's and CF's production per *group* and *task*. We may observe that a significant difference still remains between groups in normalised duration of nonsyllabic /r/ when the syllabic and nonsyllabic Czech /r/ separated. In the reading aloud task, the CF's nonsyllabic /r/ is longer than that of C but, in semi-spontaneous speech, it is shorter than that of C. We may observe the contrary in normalised duration of syllabic /r/, but there was a very small number of occurrences of the syllabic /r/ (only 82). Hence, no conclusion for the difference in groups in normalised duration of the syllabic /r/ can be made.

In the reading aloud task, normalised duration of the Czech nonsyllabic /r/ of C was significantly shorter than that of CF. This result may be interpreted as an assimilation effect: we might suppose that C produced more alveolar taps than CF which may have produced other variants of rhotic consonant because a rhotic consonant is rarely realised in French as an alveolar tap, whereas it is often realised this way in Czech (see subsection 3.2.2). Duration seems to be helpful in distinguishing the rhotic consonant realised as alveolar tap from other variant of its realisation

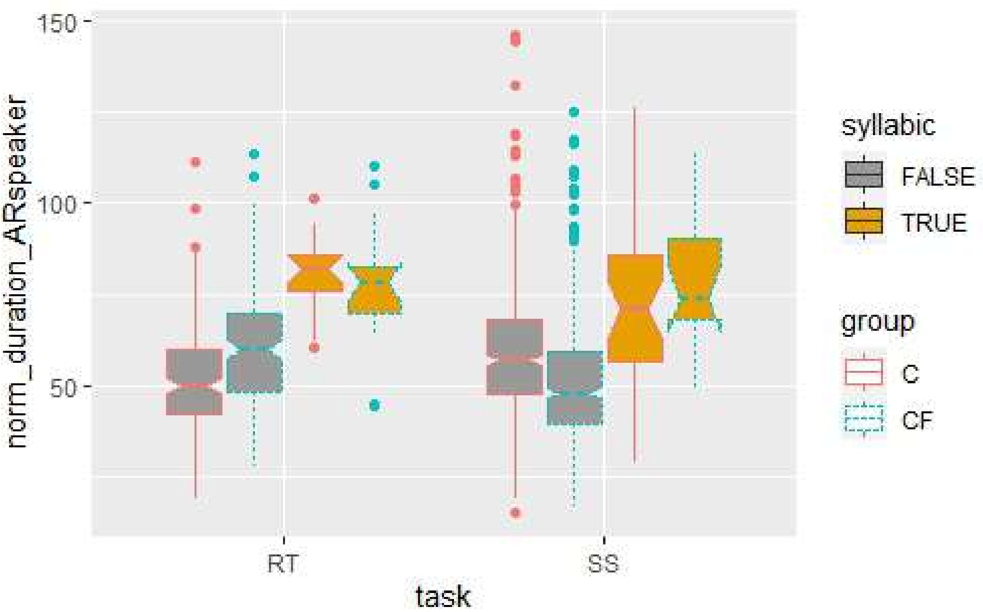


Figure 6.6: Normalised duration of syllabic and nonsyllabic /r/ per *task* and *group*.

Note: In ms. Obtained using by *coefficient of relative duration* computed from the speaker's mean articulatory rate in the given *task*.

(see subsection 6.4.1). Moreover, the values of normalised duration of syllabic and nonsyllabic /r/ of C for the reading aloud task in fig. 6.6 are similar to the values found by Vernerová (2006) (compare with fig. 6.4) and by Šimáčková (2002) in the production of the healthy speaker (see subsection 6.4.1). Thus, we may suppose that in the reading aloud task, duration of the /r/ of C's speakers is a good representation of the usual duration of the Czech nonsyllabic /r/. By contrast, the result found in semi-spontaneous speech was reversed: the Czech nonsyllabic /r/ there was significantly longer when produced by C than when produced by CF. Consequently, we might interpret this result as a dissimilation effect.

The analysis of spectral moments of /r/ showed a significant difference between the groups of speakers in both tasks and in all four spectral moments. The *group* affected *COG* in the reading aloud task ($t-ratio = -7.477, p < .0001$) increasing its CF's value by 163 Hz ± 21.28 Hz (standard errors), and in semi-spontaneous speech ($t - ratio = -5.553, p < .0001$) increasing its CF's value by 137 Hz ± 24.27 Hz (standard errors). The *group* also affected *standard deviation* of /r/ in the reading aloud task ($t-ratio = -7.351, p < .0001$) increasing its CF's value by 231 Hz ± 31.4 Hz (standard errors), and in semi-spontaneous speech ($t-ratio = -6.332, p < .0001$) increasing its CF's value by 267 Hz ± 42.4 Hz (standard errors). The *group* also affected *skewness* of /r/ in the reading aloud task ($t - ratio = 7.441, p < .0001$) increasing its C's value by 7.34 ± 0.986 (standard errors), and in semi-spontaneous speech ($t - ratio = 5.535, p < .0001$) increasing its C's value by 7.77 ± 1.403 (standard errors). Finally, the *group* affected *kurtosis* of /r/ in the reading aloud

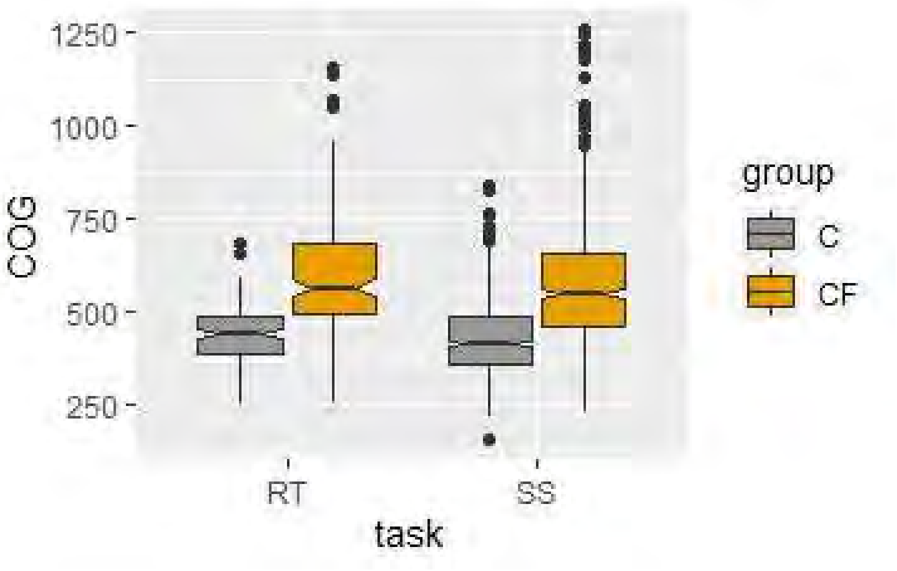


Figure 6.7: *COG* of /r/ per *group* and *task*.

Note: In Hz.

task ($t - ratio = 7.355, p < .0001$) increasing its C's value by 439 ± 59.7 (standard errors), and for semi-spontaneous speech ($t - ratio = 6.140, p < .0001$) increasing its C's value by 533 ± 86.7 (standard errors).

Thus, the third prediction concerning the spectral moment of the Czech /r/ in CF's L1 speech was fully confirmed; the C's and CF's Czech /r/ significantly differed in all spectral moments in the reading aloud task as well as in semi-spontaneous speech. These results may be be understood as due to the significant difference in the manner and place of articulation of Czech /r/ between the C and CF. We may suppose that these differences are caused by the influence of the French rhotic consonant on the Czech /r/ of CF. Figure 6.7 shows *COG* values of /r/ per *group* and *task*. Given the *COG* value of the French /r/ found in Wu et al. (2015), i.e., mean value of 500 Hz, confidence interval of 250 to 750 Hz, (see subsection 6.4.1), we may suppose that *COG* in /r/ of CF is higher than that of C as the CF approached the pronunciation of the French rhotic consonant, i.e., they produced /r/ with a more French like *COG* value. This result may be classified as an assimilation effect.

The analysis of the non-normalised $F1$ of /r/ showed a significant difference between groups in the reading aloud task. The *group* affected the non-normalised $F1$ of /r/ in the reading aloud task ($t - ratio = -2.516, p = 0.0170$) increasing its CF's value by 32.7 Hz ± 13 Hz (standard errors). Similarly, there was a significant difference in normalised $F1$ of /r/ between groups in the reading aloud task ($t - ratio = -2.873, p = 0.0071$) where CF's normalised $F1$ value of /r/ increased by 0.1411 ± 0.0491 (standard errors). Concerning $F2$ of /r/, a significant difference occurred between groups only with normalised $F2$ values in the reading aloud task. The *group* affected normalised $F2$ of /r/ ($t-ratio = 2.858, p = 0.0134$) decreasing its

Table 6.6: $F1$, $F2$ and $F3$ of C's and CF's /r/ in each *task*.

Reading aloud task						
	$F1$		$F2$		$F3$	
group	emmean	95% c.i.	emmean	95% c.i.	emmean	95% c.i.
C	489	433–545	1654	1612–1695	2678	2620–2735
CF	522	465–579	1624	1581–1666	2616	2558-2674
Semi-spontaneous speech						
	$F1$		$F2$		$F3$	
group	emmean	95% c.i.	emmean	95% c.i.	emmean	95% c.i.
C	501	482–519	1616	1588–1644	2689	2646–2733
CF	507	489–526	1655	1624–1685	2664	2620–2708

Note: Estimated mean $F1$, $F2$ and $F3$ values in Hz and 95% confidence intervals were obtained using the package *emmeans* in R.

CF's value by 0.1708 ± 0.0597 (standard errors). Concerning $F3$ of /r/, a significant difference between groups occurred only for normalised $F3$ values in the reading aloud task. The *group* affected normalised $F3$ of /r/ ($t - ratio = 2.465, p = 0.0198$) decreasing its CF's value by 0.377 ± 0.153 (standard errors). Given these analysis results of formants, the fourth prediction concerning the Czech /r/ formants in CF's L1 speech was only partially confirmed.

Both when normalised or not, $F1$ of /r/ was higher in CF's L1 speech, but only in the reading aloud task. Given that $F1$ of French rhotic consonant is higher than that of the Czech /r/ (subsection 6.4.1), this result may be understood as an assimilation effect. We might understand the CF produced /r/ as more open as is characteristic for a uvular rhotic consonant. Moreover, we may see in table 6.6 that the non-normalised $F1$ of /r/ generally has values from 400 Hz to 600 Hz in both groups of speakers and in each *task*, which are characteristic for $F1$ of both French and Czech /r/ (see subsection 6.4.1 for reminder). Normalised $F2$ values of /r/ was significantly lower when produced by CF than when produced by C in the reading aloud task. This result may be interpreted as an assimilation effect, as a lower $F2$ is characteristic of the French uvular rhotic (see subsection 6.4.1). We may understand this result as the CF produced Czech /r/ being more back in the reading aloud task than C. However, concerning the C's and CF's non-normalised $F2$ values of /r/, the values were around 1600 Hz, a surprising result which is far from $F2$ value of French and Czech /r/ given by the named authors in subsection 6.4.1. Normalised $F3$ of /r/ was significantly higher when produced by C than by CF in the reading aloud task. This result may be considered as a dissimilation effect as the CF's $F3$ of /r/ seems to be lower than $F3$ of French rhotic consonant and is lower than that of C when normalised. Nevertheless, the non-normalised $F3$ of /r/ in both groups of speakers and tasks generally takes values around 2600 Hz, which is a possible value of $F3$ of the French uvular rhotic but not for the Czech /r/. Thus, this result might be understood for the CF's L1 speech but remains surprising for the /r/ in C's L1 speech.

6.5 Spectral characteristics of glottal and velar fricatives

This section examines phonetic CLI in spectral characteristics of glottal and velar fricatives in CF's L1 speech.

6.5.1 Spectral characteristics of glottal and velar fricatives in Czech

As mentioned in chapter 3, Czech contains a glottal fricative voiced /ɦ/, a fricative velar voiceless /x/ and a voiced /ɣ/, i.e., three consonants which do not exist in Standard French or Toulouse French. Thus, these fricatives may remain disused when the CF speak French. As discussed above, according to L2LP, L1 attrition occurs in the case of the lack of a rich L1 input. We may suppose that CF received a small L1 speech input of these three consonants as these consonants do not exist in French. Consequently, these consonants might be affected by phonetic CLI. Simultaneously, as these three consonants do not exist in French, we cannot predict more precisely the phonetic CLI that will occur in these consonants in CF's L1 speech on the basis of differences between Czech and French. Therefore, predictions can only be made on the basis of listeners' comments made on speech items that did not sound typically Czech during the perceptual test, i.e., /ɦ/ was replaced by /x/, /x/ was pronounced as a voiceless /h/, and there was an atypical pronunciation of /x/. Thus, these comments indicate to us that there may be some differences in the place of articulation between C's and CF's /ɦ/, and in the place of articulation between C's and CF's /x/. Hence, their spectral moments merit examination. The voiced velar fricative /ɣ/ rarely occurs in Czech (only 3 occurrences found in the production by the 17 C and 17 CF in the reading aloud task and semi-spontaneous speech), and thus this consonant will not be explored further.

As far as we know, the spectral moments of the voiced Czech /ɦ/ have not been studied yet. The /ɦ/ does not have its own fricative formants, and its formants are affected by neighbouring vowels. Hence, from a purely acoustic point of view, the /ɦ/ might be considered as a vowel produced with a breathy voice (Macháč & Skarnitzl, 2009). Czech /x/ has its main noise formant between 1 and 1.5 kHz (Macháč & Skarnitzl, 2009). The spectral moments of this consonant were studied in detail by Sedláčková (2010) on recordings of read news (Czech Radio 1 - 'Radiožurnál') by 21 Czech moderators. The spectral moments were measured in the middle part of the fricative duration shortened by 6 milliseconds on both sides so that the measured part of the fricative did not contain a periodic component. The mean value of the /x/ *COG* pronounced by these 21 Czech moderators was 1191 Hz (SD=623 Hz), the mean value of the /x/ *standard deviation* was 1373 Hz (SD=496 Hz), the mean value of the /x/ *skewness* was 3 (SD=1.9), and the mean value of the /x/ *kurtosis* was 18.1 (SD=25.9).

6.5.2 Predictions

Taking into account available spectral characteristics of the Czech /ɦ/ and /x/, and listeners' comments in the perceptual test concerning these two consonants (see subsection 6.5.1 for both), our predictions for these consonants in CF's L1 speech are:

1. Phonetic CLI will occur in the spectral moments of the /ɦ/ in CF's L1 speech as listeners in the perceptual test perceived /ɦ/ as being substituted by the Czech /x/.
2. Phonetic CLI will occur in spectral moments of /x/ in CF's L1 speech as listeners in the perceptual test noted it as having an untypical pronunciation.
3. The values of the spectral moments of /ɦ/ produced by CF will be close to the values of the spectral moments of /x/ produced by C as the listeners in the perceptual test noted that /ɦ/ of CF was produced as Czech /x/.

6.5.3 Methodology

For the analyses of the spectral characteristics of CF /ɦ/ and /x/, four spectral moments of /ɦ/ and /x/ were measured automatically using Praat script. Similarly to Sedláčková (2010), we extracted their values from the middle third of duration of these two consonants. The power was set as in the analysis of the spectral moments of rhotics (see subsection 6.4.3). The statistical analyses of spectral moments of /ɦ/ and /x/ were done in R using the same packages as in the perceptual test. Unfortunately, there were not enough occurrences of /ɦ/ to be studied in C's and CF's L1 production in the reading aloud task. Thus, our analyses of /ɦ/ concerned only its production in semi-spontaneous speech. In total, the analyses involved 367 /ɦ/ and 551 /x/.

After the visual inspection of the data, we analysed the relationship between *group* and spectral moments of /ɦ/ in semi-spontaneous speech and between the *group* and the spectral moments of /x/ in both tasks using linear mixed-effect models. For the analysis of the /ɦ/ in semi-spontaneous speech, we computed the model with *speakers* and *words* of /ɦ/ occurrences as random effects, and *group* as fixed effect for each spectral moment. Thus, the model was:

$$lmer(\text{Spectral moment of /ɦ/} \sim group + (1|word) + (1|speaker),\ \text{datahSS})$$

The model of each spectral moment converged without issues.

For the analysis of /x/ in both tasks, we computed the model with interaction between *group* and *task*. We had intercepts for *speakers* and *words* of /x/ occurrences as random effects, *group* and *task* as fixed effects in interaction, and *task* as random slope for random effects *words* and *speakers*. Thus, the model was:

$$lmer(\text{/x/ s. moment} \sim (group{*}task)+(1+task|word)+(1+task|speaker),\ \text{datax})$$

where the 's. moment' is a given spectral moment. The models for the analysis of the first three spectral moments of /x/ (*COG*, *standard deviation*, *skewness*) encountered convergence issues. We resolved them by deleting the random slope *task* in the random effect *words*. Finally, we computed the mean values of /x/ spectral moments in both tasks separately with the confidence level set at 95% in order to compare them to the values in the Sedláčková's study.

The CF's [ɦ] and C's [x] values of spectral moments were visualised in a plot to determine their proximity. Then, in order to test whether the /ɦ/ produced by CF and the /x/ produced by C differ in their spectral moments, we computed the model for each spectral moment, similar to the model used for the analyses of C's and CF's [ɦ]. We had *speakers* and *words* of /ɦ/ or /x/ occurrence as random effects, and *group* as fixed effect. The model of each spectral moment converged without issues.

For all the models used, visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality of the data. Comparison of estimated means across effect levels was carried out as in the analysis of the Czech /r/ (see subsection 6.4.3).

6.5.4 Results and discussion

The analyses of the /ɦ/ in semi-spontaneous speech showed a significant difference between the *group* of speakers in all four spectral moments. Thus, concerning /ɦ/ in semi-spontaneous speech, the *group* affected its *COG* ($t - ratio = -2.511, p = 0173$) increasing the CF's value by 174 Hz ± 69.4 Hz (standard errors), its *standard deviation* ($t - ratio = -3.047, p = 0046$) increasing the CF's value by 209 Hz ± 68.7 Hz (standard errors), its *skewness* ($t - ratio = 5.428, p < .0001$) increasing the C's value by 9.22 ± 1.7 (standard errors), and its *kurtosis* ($t - ratio = 5.567, p < .0001$) increasing the C's value by 540 ± 97 (standard errors). Given these results, the first prediction of differences in the C's and CF's spectral moments of /ɦ/ was

Table 6.7: Mean values of spectral moments of C's and CF's /x/ in each *task*.

Reading aloud task								
	COG		*standard deviation*		*skewness*		*kurtosis*	
	mean	95% c.i.	mean	95% c.i.	mean	95% c.i.	mean	95% c.i.
C	1127	1005–1248	1622	1511–1733	7	6–7	86	69–103
CF	2633	2417–2849	2265	2126–2404	4	4–4	31	24–38
Semi-spontaneous speech								
	COG		*standard deviation*		*skewness*		*kurtosis*	
	mean	95% c.i.	mean	95% c.i.	mean	95% c.i.	mean	95% c.i.
C	1199	1070–1329	1654	1533–1774	6	5–7	83	58–107
CF	2801	2548–3054	2302	2155–2448	3	3–4	25	18–33

Note: Rounded to whole number. 95% c.i. signifies confidence interval set at 95%.

fully confirmed for semi-spontaneous speech, meaning that there was a significant difference in the manner and place of articulation in the /ɦ/ produced by C and CF, but remains unconfirmed for the reading aloud task as there were an insufficient number of occurrences of /ɦ/.

The analyses of /x/ showed a significant difference between groups in all four spectral moments in both tasks. The *group* affected the /x/ *COG* in the reading aloud task($t{-}ratio = -7.911, p < .0001$) increasing the CF's value by 1488 Hz ± 188 Hz (standard errors), and in semi-spontaneous speech ($t{-}ratio = -6.724, p < .0001$) increasing CF's value by 1668 Hz ± 248 Hz (standard errors). The *group* affected /x/ *standard deviation* in the reading aloud task ($t - ratio = -4.403, p = 0.0001$) increasing CF's value by 648 Hz ± 147 Hz (standard errors), and in semi-spontaneous speech ($t - ratio = -4.244, p = 0.0002$) increasing CF's value by 653 Hz ± 154 Hz (standard errors). The *group* affected the /x/ *skewness* in the reading aloud task ($t - ratio = 4.993, p < .0001$) increasing the CF's value by 2.49 ± 0.498 (standard errors), and in semi-spontaneous speech ($t - ratio = 3.941, p = 0.0004$) increasing the CF's value by 2.49 ± 0.632 (standard errors). The *group* affected /x/ *kurtosis* in reading aloud task ($t - ratio = 4.612, p = 0.0001$) increasing the CF's value by 53.6 ± 11.6 (standard errors), and in semi-spontaneous speech ($t - ratio = 3.270, p = 0.0025$) increasing the CF's value by 47.1 ± 14.4 (standard errors). Given these results, the second prediction concerning phonetic CLI in CF's spectral characteristics of Czech velar fricative /x/ was fully confirmed in both tasks meaning that there was a significant difference in the manner and place of articulation in /x/ produced by C and CF. Table 6.7 gives mean values of the spectral moments of /x/ in C's and CF's L1 speech. We may observe that the C's mean *COG* value in both tasks is very similar to mean *COG* value of the Czech /x/ in Sedláčková (2010) (see subsection 6.5.1) while the means of the other three spectral moments of C /x/ slightly differ from the means of these moments of the Czech /x/ found in

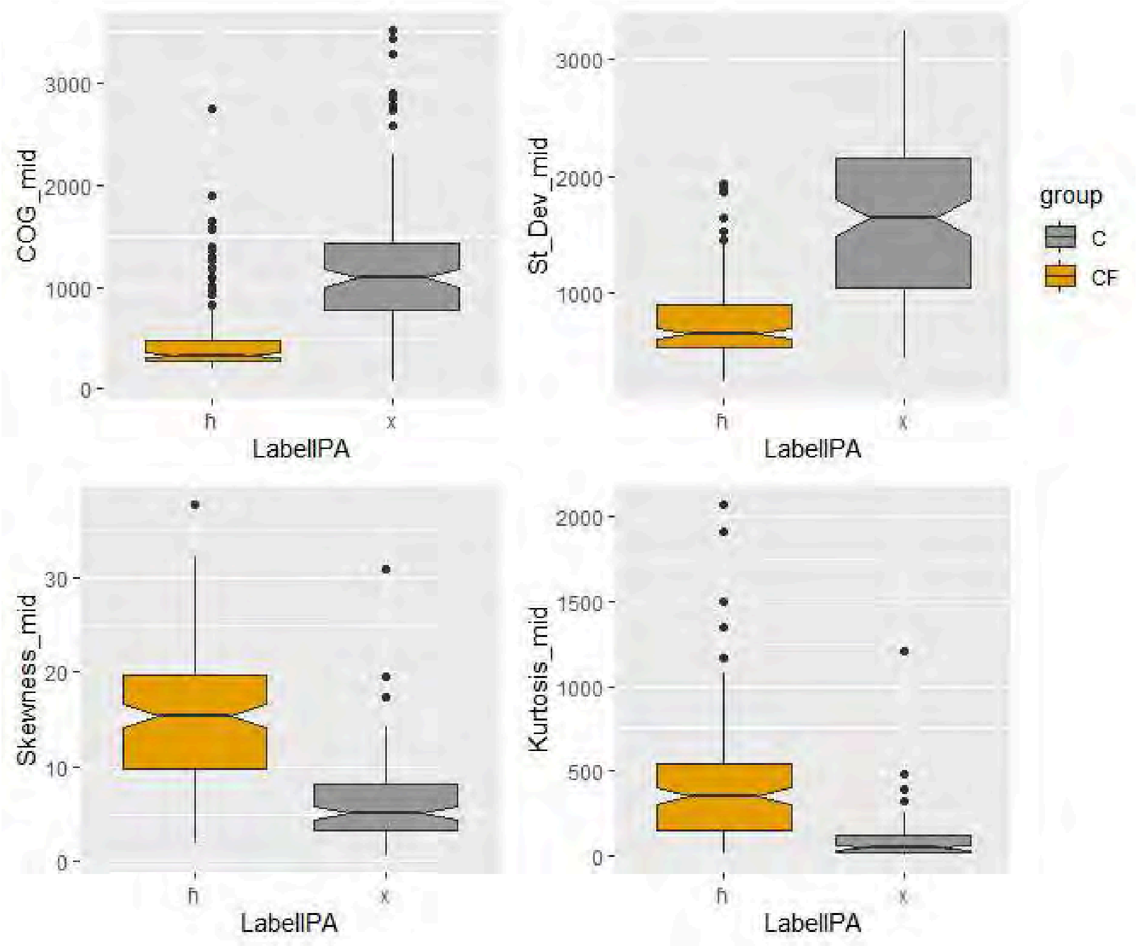


Figure 6.8: Spectral moments of CF's [ɦ] and C's [x] in semi-spontaneous speech.

Sedláčková (2010).

Figure 6.8 shows spectral moments of /ɦ/ produced by CF and /x/ produced by C in semi-spontaneous speech. We may see that the values of the CF's [ɦ] and C's [x] are close in all four spectral moments. In this sense, the third prediction was confirmed in semi-spontaneous speech but remained unconfirmed in the reading aloud task due to a insufficient number of /ɦ/ occurrences in that task. Nevertheless, the statistical analyses of the CF's [ɦ] and C's [x] showed that there is still a significant difference between their values in all four spectral moments. That suggests that even if the CF's pronunciation of /ɦ/ in semi-spontaneous speech was close to the pronunciation of the Czech /x/, CF's [ɦ] and C's [x] remained two different sounds.

Figure 6.9 shows *COG* values of /ɦ/ and /x/ produced by C and CF in semi-spontaneous speech and illustrates the usual distribution of the values of spectral moments of C's and CF's /ɦ/ and /x/; the highest values of *COG* and *standard deviation* were in CF's [x], then in C's [x], then in CF's [ɦ], and then in C's [ɦ]. By constrast, the lowest values of *skewness* and *kurtosis* were in CF's [x], then in C's [x], then in CF's [ɦ], and then in C's [ɦ].

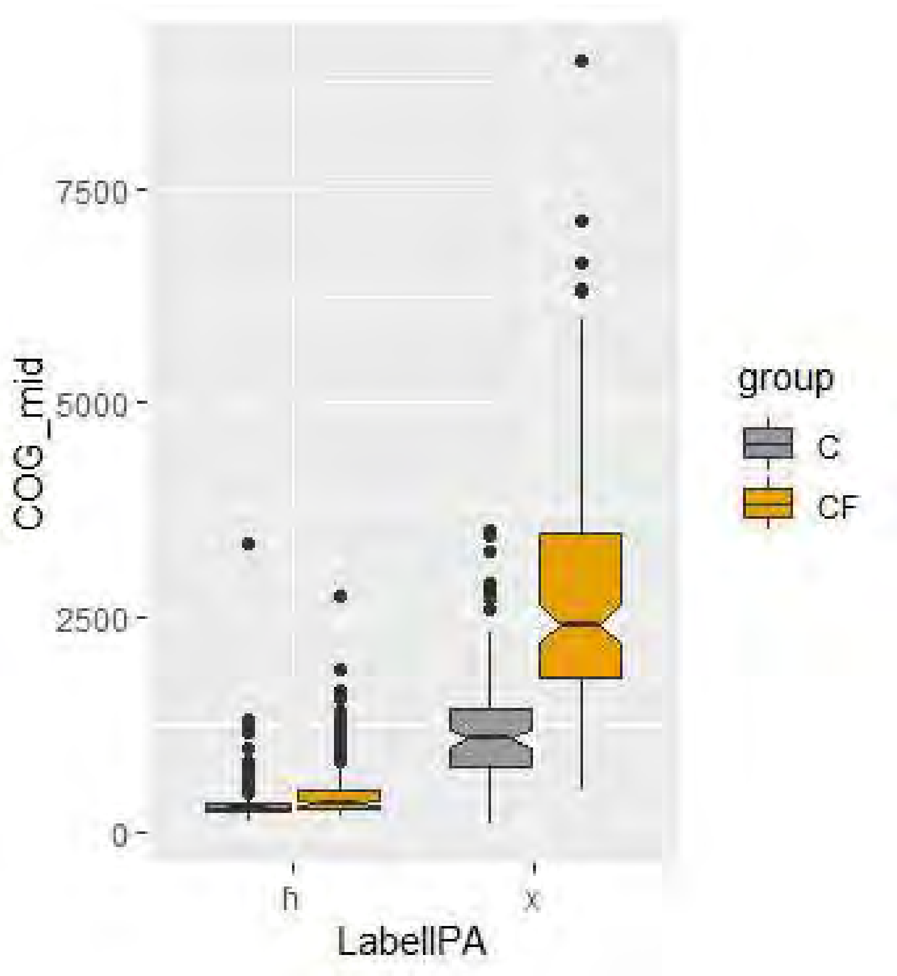


Figure 6.9: *COG* of /ɦ/ and /x/ per *group* in semi-spontaneous speech.

Note: in Hz.

6.6 $f0$ in non-conclusive intonation patterns

This section focuses on the cadences used by CF in their L1 speech in non-conclusive intonation patterns.

6.6.1 Non-conclusive intonation patterns in Czech and French

Non-conclusive intonation patterns in Czech, French as in many other languages have a function of signalling the syntactic or semantic boundary in the speech and, at the same time, the intention of the speaker to continue the speech by providing other information after this boundary (Volín, 2008; Santiago, 2019). In this sense, the non-conclusive intonation patterns alert the listener that the utterance is not yet complete and that the listener should expect the continuation of the utterance (Di Cristo, 2016). Hence, the non-conclusive intonation patterns occur mainly in the end of non-final intonational phrase, i.e., the intonational phrase which is not the final phrase of the utterance. Thus, the non-conclusive intonation patterns may also be called continuing intonation patterns (cf. Di Cristo, 2016).

Delattre (1966a) used the name *continuation majeure* for French non-conclusive intonation patterns. This author states that the non-conclusive intonation patterns have an intonation contour rising from the 'medium register' (level 2) to the 'high register' (level 4) (cf. Derivery, 1997; M. Léon, 1997) and that their contour is convex (see fig. 6.10 for illustration) contrary to the concave intonation contour of the intonation pattern for yes/no questions, (i.e., questions requiring a yes/no answer without special pragmatic marking). Nevertheless, more recent studies showed the limitations of these contours proposed by Delattre (1966a) as well as the limitation of the contours which he proposed for another eight intonation patterns. For example, Di Cristo (2016) showed that the cadences used for the non-conclusive and yes/no questions intonation patterns are generally similar, and the form of the contour (convex or concave) does not allow the non-conclusive intonation patterns to be distinguished from yes/no questions.

The French non-conclusive intonation patterns were most recently studied by Di Cristo (2016); Jun and Fougeron (2000); Post (2000). As summarised in Delais-Roussarie et al. (2015), all these studies showed that the tonal movements associated with non-final intonational phrases are usually rising. Similarly, taking into consideration the findings of these studies, Santiago (2019) proposed a rising stylised contour as a model of production for non-conclusive intonation patterns, yes-no questions and enumerations. According to this study, $f0$ rises from the beginning of the last syllable of the non-final intonational phrase. Delais-Roussarie et al. (2015) add that the most common final boundary tone of non-final intonation phrase is high (H-) as well as it is at the end of non-final elements in enumerations.

Even if the non-conclusive intonation patterns in French most often have a ris-

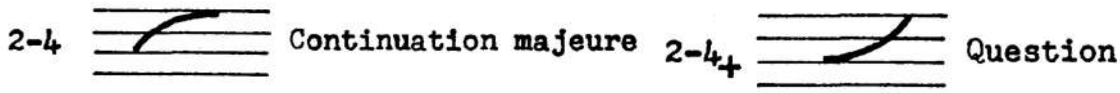


Figure 6.10: Stylization of the non-conclusive intonation pattern and the intonation pattern of yes/no questions in French

Note: Taken from Delattre (1966a, p. 4).

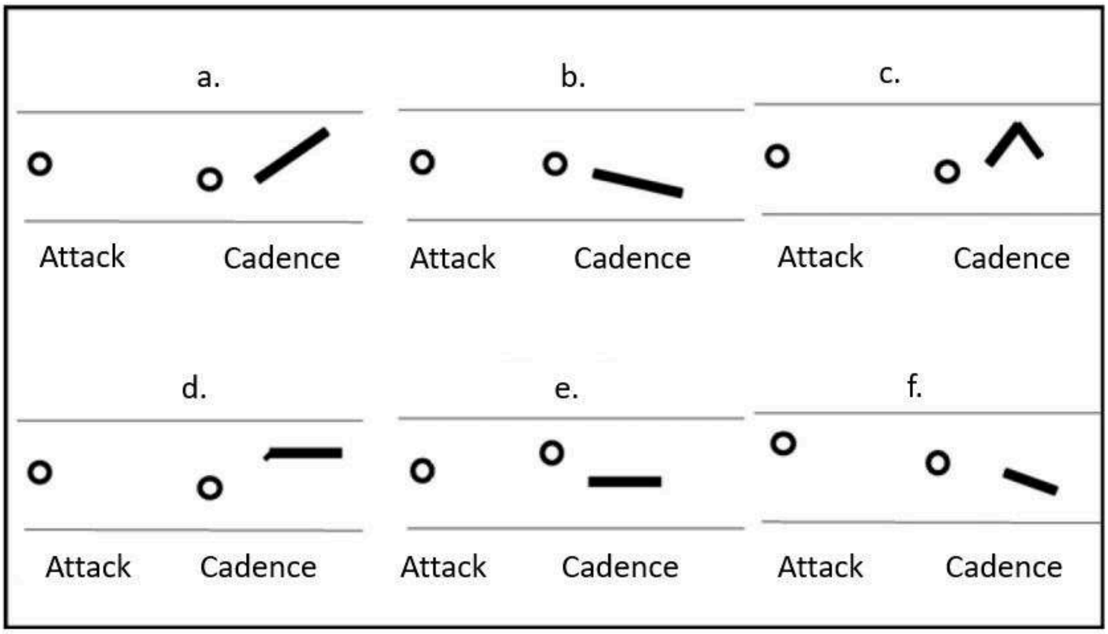


Figure 6.11: Schematic representation of six cadences of non-conclusive intonation patterns in French.

Note: Taken from Di Cristo (2016, p 218)

ing contour (as illustrated in fig. 6.11, picture a.), Di Cristo (2016) listed another five possible cadences (see, fig. 6.11). The first cadence is with falling intonation contours (fig. 6.11, picture b.) which, according to his study, are used in frequent interpersonal speeches such as interviews or conversation. The second are cadences with rising-falling intonation contours (fig. 6.11, picture c.) which were found mainly in the non-conclusive intonation patterns ending with the stuck schwa (i.e., the last word of the pattern contains a final schwa as it may be for example in the French word 'galette', see subsection 3.3.2). There, the intonation is rising and falls on the final schwa. According to this author, the specific category of Paris French speakers produce non-conclusive intonation patterns in this manner. Thirdly, the authors propose three other possible cadences for non-conclusive intonation patterns containing enumerations that are not produced with the classic rising intonation contour (fig. 6.11, pictures d., e., and f.).

Concerning southern French, two essential findings were provided by Adda-

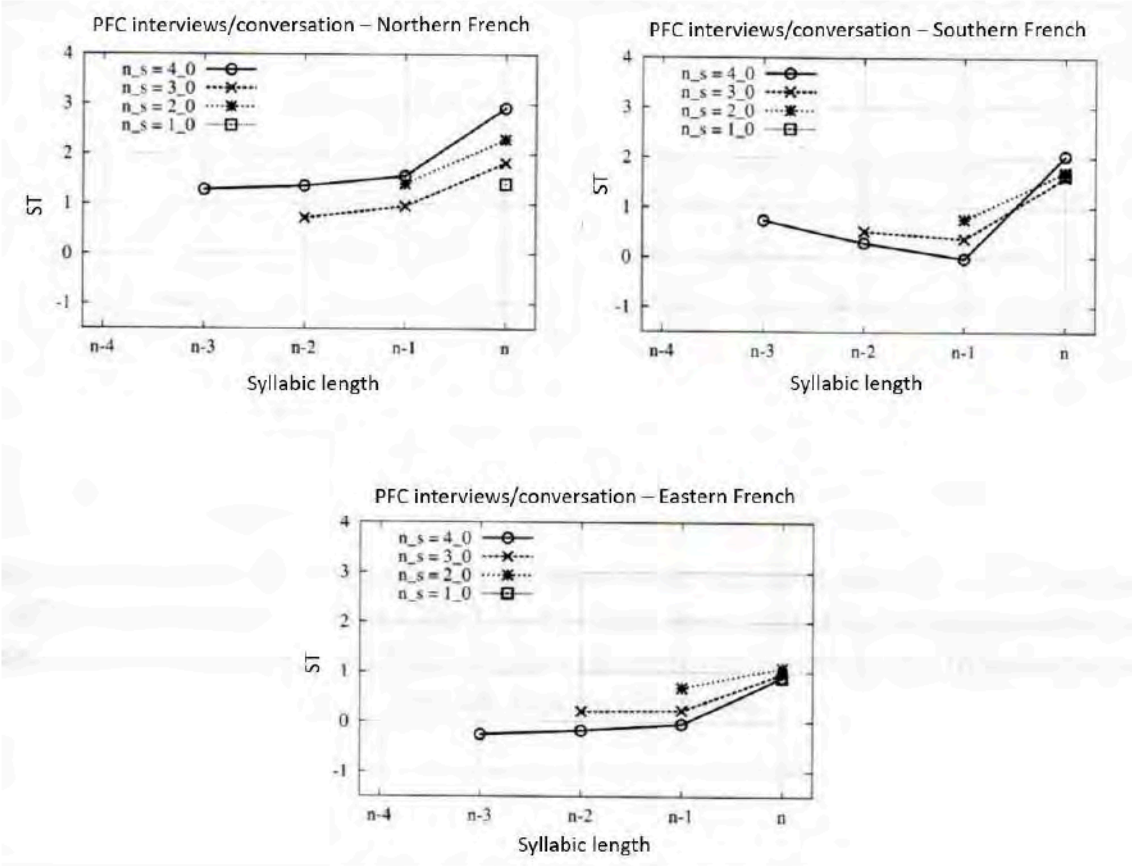


Figure 6.12: Intonation contours of the n syllabic words without stuck schwa

Note: s=0 means not ending by stuck schwa. Obtained from PFC corpus analysis of production of northern, eastern and southern French speakers. Taken from Adda-Decker et al. (2012, p. 57).

Decker, Nemoto, and de Mareüil (2012). The authors analysed $f0$ movements in n-syllables words taken from PFC corpus (Durand, Laks, & Lyche, 2005, 2009) produced in interviews or conversations by speakers from the east, south and north of France. Firstly, they found that in words without a stuck schwa, there was a fall of intonation on the penultimate syllable in southern French production, but this fall does not occur in northern French or east pronunciation (see fig. 6.12). This finding seems to go in the direction of Coquillon's (2005) observation that a phenomenon of iterations of gradual increase in $f0$ or gradual decrease seems frequent in the southern French, especially compared to Standard French. Secondly, Adda-Decker et al. (2012) found that concerning the words with stuck schwa, the height of intonation in schwa and the previous syllable is very closed in southern French production, while the intonation is falling in the schwa compared to the previous syllable in northern and eastern French production (see, fig. 6.13). This finding brings new information compared to an old affirmation of Carton et al. (1983) that in the intonation of continuation, the sentences ending with a schwa have either a 'circumflex' $f0$ contour, i.e., the rise of $f0$ before the schwa and the fall of $f0$ in schwa, or rising $f0$ contour with its peak on the schwa.

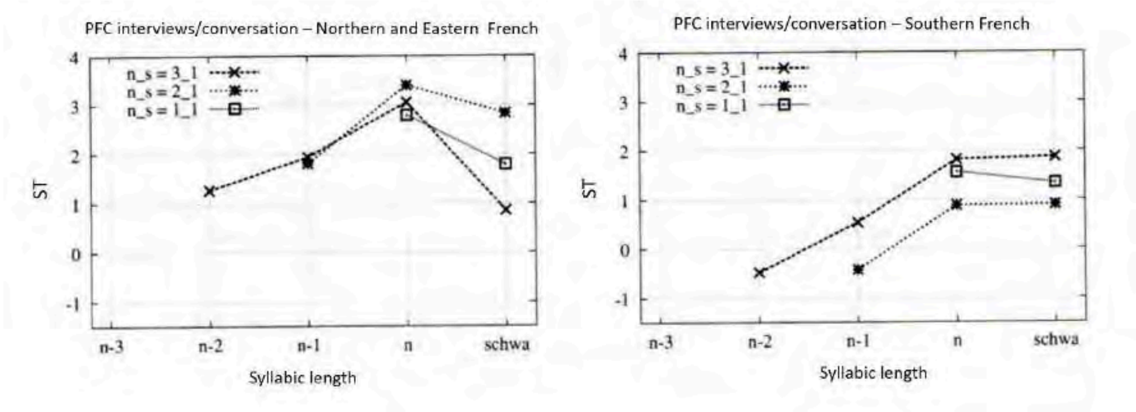


Figure 6.13: Intonation contours of the *n* syllabic words with stuck schwa.

Note: Obtained PFC corpus analysis of production of speakers of northern, eastern and southern French. 's' in 'n_s' refers to the presence of the schwa. Taken from Adda-Decker et al. (2012, p. 58).

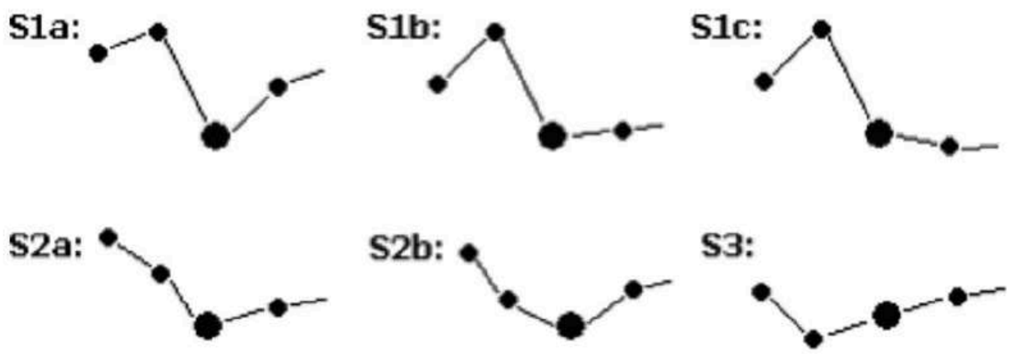


Figure 6.14: Six cadences of non-conclusive intonation patterns in Standard Czech.

Note: Taken from Volín (2008, p. 177). Dots represent individual syllables, larger dots a stressed syllable.

The non-conclusive intonation patterns in Standard Czech were studied most recently with a large speech corpus by Volín (2008) using k-means cluster analysis. The author analysed 252 non-conclusive intonation patterns produced by 252 speakers in a reading of continuous text. The author investigated the intonation in the last accentual phrase of the non-final intonation phrase and two previous syllables in order to show $f0$ movement in the non-conclusive intonation patterns and that closely before it. The author found that the non-conclusive intonation patterns were produced by six cadences, among which the cadence with a slightly rising intonation in the last syllable of the pattern was the most frequently produced (see fig. 6.14).

Given the examinations of Czech and French non-conclusive intonation patterns in the previous paragraph, we may conclude that the intonation rises in the final syllable of the non-conclusive intonation patterns occur more in French than in Czech. We may also suppose that it may fall on the penultimate syllable before the rise on the last syllable in the pattern produced by southern French speaker. Finally, we may suppose that in southern French, the intonation is high in the stuck schwa at the end of the non-conclusive intonation pattern as well as in its penultimate syllable.

6.6.2 Predictions

A detailed description of non-conclusive intonation patterns in Standard Czech, Standard French and Toulouse French in subsection 6.6.1 leads us to two following predictions concerning non-conclusive intonation patterns in CF's L1 speech:

1. C will produce non-conclusive intonation patterns with rising intonation as often as CF. This is as slightly rising intonation is typical for non-conclusive intonation patterns in Standard Czech, and rising intonation is typical for non-conclusive intonation patterns in Standard and Toulouse French.

2. Among non-conclusive intonation patterns with rising intonation, C will produce intonation patterns with a very high intonation but not as often as CF. This will be as the intonation in non-conclusive intonation patterns rises higher in French than in Czech.

These predictions are related to the primary hypothesis put in section 6.1 based on the theoretical background of the present thesis. The first prediction is linked to the sameness of the systemic and semantic dimension of intonation in the non-conclusive intonation patterns in Standard Czech, Standard French and Toulouse French: in all three languages' varieties, the non-conclusive intonation patterns are generally used for the expression of the same meaning with rising intonation (see above and subsection 1.2.7 for the remainder of the dimensions of intonation). Hence, sameness in these dimensions does not suggest important phonetic CLI in these dimensions of intonation in non-conclusive intonation patterns produced by CF (cf. the first prediction). However, non-conclusive intonation patterns differ in the realisational dimension of their intonation in Standard Czech, Standard French and Toulouse French: the intonation rises more in Standard and Toulouse French than in Standard Czech. Therefore, that may affect the intonation in non-conclusive patterns produced by CF (cf. the second prediction).

6.6.3 Methodology

For the analyses the non-conclusive intonation patterns, the last accentual phrases in the non-final intonation phrases were manually annotated into the TextGrids of the recordings of the reading aloud task and semi-spontaneous speech. Before $f0$ extraction, it was necessary to define the approximate $f0$ range of each speaker. One may suppose that the CF $f0$ range in semi-spontaneous speech would be larger than their range in the reading aloud task. Indeed, the CF intonation may rise significantly in semi-spontaneous speech because they might undergo more phonetic CLI in semi-spontaneous speech and because $f0$ range seems to be larger in French than in Czech mainly for female speakers (cf. Major, 1992, and subsection 4.3.1). Thus, it was essential to define $f0$ range for each *task* and each speaker separately.

The process to define the approximate $f0$ range of the speaker in each *task* is explained below. Firstly, using the Praat script, ye automatically extracted the minimal, maximal and mean $f0$ value from the entire duration of each phone in all recordings, and formed a table. Then, the table was imported in R and all the phones with undefined minimal and maximal $f0$ values were removed from the table. We selected from the table vowels (i.e., full pronounced vowels as well as semi-pronounced vowels annotated in brackets) and the stuck schwa because we planned to extract $f0$ contour from the nuclei in the vowels. Following this, we made a table with the selected vowels and the stuck schwa for each speaker and each *task*, and observed the lowest value among the minimal $f0$ and mean $f0$ values. These were verified by inspecting the recording $f0$ in Praat ensuring that the value corresponds to the lowest value of the speaker $f0$ range and is not caused by some parasite sound in the recording. The same was done for the highest $f0$ value of the speaker in the *task*, but the highest value among the maximal $f0$ and mean $f0$ values was observed. For determining the speaker's $f0$ range in the *task*, the highest $f0$ value was rounded to the closest higher multiple of five and the lowest $f0$ value to the closest lower multiple of five. The approximate speakers' $f0$ ranges in the reading aloud task and semi-spontaneous speech can be found in Appendix D.

For each speaker and each *task* $f0$ contours were extracted separately and stylised in Prosogram v3.0 (Mertens, 2020) for Praat with the following settings: Task – Calculate intermediate files, Segmentation method – Nuclei in vowels in tier phone, and $f0$ detection range was set to the approximate $f0$ range of the speaker in the given *task*. Then, the stylised contours were processed using the package *rPraat* in R where $f0$ values were converted to semitones. We cut from each TextGrid $f0$ contour in the last accentual phrase of the non-final intonation phrase and the approximate two previous syllables following Volín (2008). The approximate duration of two syllables before the beginning of the last accentual phrase of the non-final intonation phrase was calculated as two divided by the mean articulatory rate of the given sound file. For simplicity, the cut last accentual phrases of non-final intonation phrases with the approximate two previous syllables will be hereafter referred to as 'speech pieces'. If $f0$ was not detected at the end of a speech piece, the piece was excluded from the analyses. The speech pieces ending with the word with stuck schwa were not analysed because of the low occurrence. In total, the analysis involved 1566 speech pieces (323 produced in the reading aloud task, 1243 in semi-spontaneous speech). Their intonation contours were analysed by their approximation using the

Legendre polynomials implemented in the package *rPraat* and k-mean clustering of the Legendre coefficients. The intonation contours of the speech pieces were visually inspected by dividing them into different clusters. It was found that they may be most precisely described using five clusters representing five cadences of $f0$ contours, a number near to number of cadences in Di Cristo (2016); Volín (2008). The five cadences were numbered from 1 to 5 (see fig. 6.15).

For the statistical analysis for each *task*, each speaker and each cadence the percentage of the realisation of speech pieces by the given cadence was computed. This was called $P\_cadence$, and computed as follows:

$$P\_cadence\ [\%] = \left(\frac{nb \text{ of speech pieces realised by the given cadence}}{sum \text{ of all speech pieces}} \right) 100$$

where the $P\_cadence$ indicates the per cent of speech pieces the speaker produced in the given *task* using the given cadence. Thus, it was known the per cent of speech pieces produced, using the given cadence (number 1, 2, 3, 4 or 5 on fig. 6.15) by the given speaker in the given *task*.

The cadences with rising intonation were cadences number 1, 3 and 5 (see fig. 6.15). The sum of $P\_cadence$ in these three cadences of *group* of speakers in each *task* was compared in order to test the first prediction of the rising intonation in C's and CF's non-conclusive intonation patterns. The normal distribution of this sum in each *task* was verified by a visual inspection of a histogram, Quantile-Quantile plots and using Shapiro-Wilks test. The unpaired Two-Samples T-test was used for the comparison of the groups of speakers in semi-spontaneous speech as the sum followed the normal distribution there. The Two-samples unpaired Mann-Whitney U-test was used for the comparison of groups of speakers in the reading aloud task as the sum did not follow the normal distribution in the reading aloud task. In both tests, the confidence level set at 95%.

The cadences with intonation rising very high were the cadences number 1 and 5 (see fig. 6.15). Therefore, in order to test the second prediction of higher rising intonation in CF's non-conclusive intonation patterns, the sum of $P\_cadence$ of these two cadences was divided by the sum of $P\_cadence$ in all rising cadences (i.e., cadences number 1, 3 and 5) in order to obtain a *ratio* for each *group* in each *task* separately, that is:

$$ratio\_of\_very\_high\_rising = \frac{P\_cadence1 + P\_cadence5}{P\_cadence1 + P\_cadence3 + P\_cadence5}$$

The normal distribution of the *ratio* in each *task* was verified as with the sum. The Unpaired Two-Samples T-test was used for the comparison of the groups of speakers in semi-spontaneous speech as the *ratio* followed the normal distribution there, and the Two-samples unpaired Mann-Whitney U-test was used for the comparison of

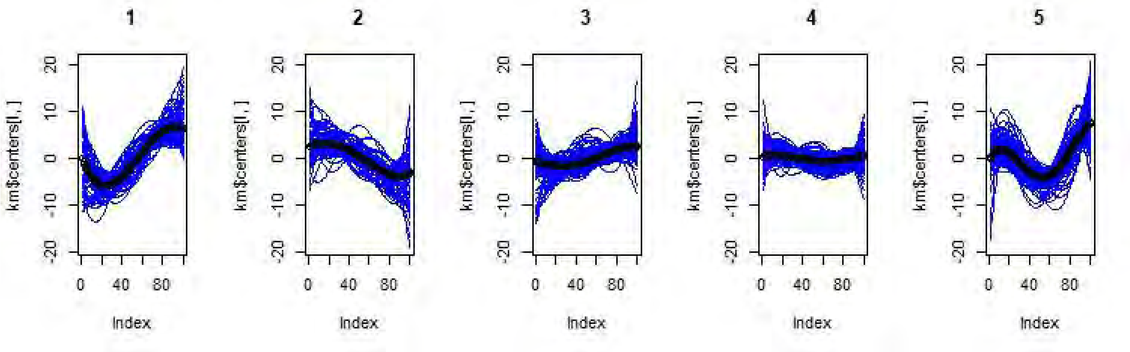


Figure 6.15: Cadences of non-conclusive pattern in C's and CF's L1 speech in each *task*

Note: Obtained by k-means cluster analysis, y-axis indicates intonation in semitones [ST].

groups of speakers in the reading aloud task because the *ratio* did not follow the normal distribution in the reading aloud task. In both tests, the confidence level was set as that used for the sum.

6.6.4 Results and discussion

Figure 6.15 shows the 5 cadences found in speech pieces, i.e., 5 clusters of non-conclusive intonation patterns in C's and CF's production in reading aloud task and in semi-spontaneous speech found by k-means analysis. The first and fifth pictures show cadences number 1 and 5 with very rising intonation in both, and downstep of intonation at the beginnings of the contour in cadence number 1, and in the middle of the contour in the cadence number 5. The second picture shows cadence number 2 with falling intonation. The third picture, i.e., cadence number 3, is with slightly rising intonation, while flat intonation characterises the cadence number 4 (fourth picture). Table 6.8 gives the computed mean *P_cadence* values in per cent for each *group* of speakers and cadence in each *task* separately.

The statistical analysis of the sum of rising cadences showed no significant difference between the groups of speakers in the reading aloud task or in semi-spontaneous speech, meaning that the frequency of use of rising intonation in the production of the non-conclusive did not differ significantly for C and CF. In this sense, the first prediction concerning rising intonation in general was fully confirmed. On the other hand, the statistical analysis of the very high rising *ratio* showed a significant difference between groups of speakers in semi-spontaneous speech (t=-2.1941, df=28.59, p=0.03651, *mean* CF=0.35, *mean* C=0.21) but not in the reading aloud task. In this sense, our second prediction concerning very rising intonation in particular was confirmed only for semi-spontaneous speech. In the situation where C and CF used cadences with rising intonation (cadences number 1, 3 and 5) for production of non-conclusive intonation patterns, the frequency of use of very high rising intonation in non-conclusive intonation patterns was significantly higher for CF than for C

Table 6.8: Mean *P_cadence* per *task* and *group* of each cadence.

Reading aloud task					
	mean P_cadence				
group	cadence1	cadence2	cadence3	cadence4	cadence5
C	0	19.97	7.36	71.6	1.07
CF	1.39	24.51	18.72	50.64	4.74
Semi-spontaneous speech					
	mean P_cadence				
group	cadence1	cadence2	cadence3	cadence4	cadence5
C	4.9	2.97	40.31	46.42	5.41
CF	8.85	4.61	36.18	38.75	11.61

Note: The values are in per cent. *mean P_cadence* indicates in average, how many per cent of non-conclusive intonation patterns were produced by using the given cadence by the given *group* of speakers in the given *task*

in their semi-spontaneous speech but not in their production in the reading aloud task. This result may be interpreted as an assimilation effect as high rising intonation is typical for non-conclusive intonation patterns in French but not in Czech (see subsection 6.6.1).

6.7 Stuck schwa and its acoustic properties

This section concerns the use of stuck schwa by CF in their L1 speech.

6.7.1 Acoustic properties of stuck schwa in Czech and French

In subsection 3.3.2, we described the stuck schwa, abundantly used in Toulouse French. We saw in section 3.4 that the stuck schwa may also be used as an expression of hesitation, or more precisely of work of formulation as claimed by Candea (2000). To distinguish a stuck schwa of support from stuck schwa of hesitation (i.e., *euh* of support and *euh* of work of formulation in Candea, 2002) in the speech of Standard French speakers, Candea (2000) primarily used the difference in duration. She considered stuck schwa of support to be when it did not exceed the threshold of a long syllable located at the end of rhythmic group (in general, about 200 ms), and in her study, the stuck schwa of hesitation varied approximately between 150 ms and 500 ms, though some reached almost one second (see section 3.4 for reminder). From this research it can be seen that there are two types of stuck schwa, one of hesitation and one of support, which may occur in Toulouse French, and thus also in CF's L1 speech. The question remains how we may distinguish them as Candea's (2000) criteria were made for Standard French speakers and not for Toulouse French speakers. In agreement with Candea (2000) we consider duration to be the key distinguishing factor. Hence, we examine duration and other acoustic properties of the stuck schwa in Toulouse French, as found in the studies in the following paragraphs, before discussing which criterion might be used for distinction of stuck schwa of hesitation from stuck schwa of support in CF's L1 speech.

Coquillon (2005) measured duration of stuck schwa in the production of three Toulouse French speakers. The mean duration of the stuck schwa of these three speakers was 93.17 ms, which was on average 46.30% of the duration of the vowel in the syllable preceding the stuck schwa. Duration of stuck schwa was also measured in the production of one speaker living near Figeac, a southern French city by Eychenne (2015). His stuck schwa was on average 77 ms long, which made 34.7% of the duration of the vowel in the syllable preceding the stuck schwa. Nemoto and Adda-Decker (2013) examined duration of the stuck schwa in spontaneous speech and production in reading of a text by 32 speakers from north, and 18 speakers from south of France (see subsection 3.3.2 for further detail on this study). All words ending in a phonemic consonant in the recordings were considered as having a potential ending by stuck schwa and the study focused on the analysis of only lexical words. In both spontaneous speech and reading, speakers from the south produced a longer stuck schwa than those from the north. The mean duration ratio of speakers from the south, i.e., ratio between duration of stuck schwa and duration of vowel in the syllable preceding the stuck schwa, was around 1, meaning that they produced the stuck schwa at a similar length to the vowel in the syllable preceding the stuck schwa. A comparison of the speakers duration ratio in reading and in spontaneous speech showed that its difference between the two groups of speakers was slightly higher in spontaneous speech than in reading. The duration of stuck schwa of south speaker was between 60–80 ms in the reading and 80–90 ms in spontaneous speech.

Concerning the other acoustic properties of the stuck schwa in southern French, Eychenne (2015) compared the first three formants of this stuck schwa to the formants of the vowels in the syllable preceding the stuck schwa in his speaker's production. Eychenne (2015) found that the stuck schwa formant values were close to the values of /ø/ (the mean $F1$ of /ə/ was 420 Hz, its mean $F2$ was 1507 Hz, and its mean $F3$ was 2634 Hz). Concerning $f0$ of the stuck schwa in southern French, Nemoto and Adda-Decker (2013) observed that relatively high $f0$ values were typical for the stuck schwa produced in spontaneous speech by speakers from the south compared to those of speakers from the north. The speakers from the north "tended to feature systematic $f0$ drops" (Nemoto & Adda-Decker, 2013, p. 308) on stuck schwa while the speakers from the south produced the stuck schwa similarly high to the vowel of the preceding syllable thus forming a flat $f0$ at the end of the words (see also subsection 6.6.1).

In Standard Czech, the stuck schwa rarely occurs (Průchová, 2016). Contrastingly, the schwa which is separated from the words by the silences is often used for a hesitation in Standard Czech (cf. Šulecová, 2015, and section 4.4). Cvrček (2010) uses symbols [əː] and [əːː] for this separated schwa. Concerning the schwa, we might also observe that in Standard Czech there is a parasite sound called epenthetic schwa. It occurs among consonants as a strong vocal element [ə] in contexts where it may not be justified (Machač & Skarnitzl, 2012). It is found primarily during more careful articulations of successive sounding explosives (Machač & Skarnitzl, 2012). From the sound examples of epenthetic schwa available on the website of the Institute of Phonetics of Prague, we consider that the epenthetic schwa is significantly shorter than the stuck schwa in Toulouse French and does not necessarily make an additional syllable even though it may occur (Machač & Skarnitzl, 2012).

From all these considerations, we may conclude that the longer duration of the stuck schwa is in CF's L1 production and in Toulouse French, the more likely the stuck schwa is one of hesitation. However, it is extremely difficult to determine a precise value of duration which might be considered as a boundary between stuck schwa of hesitation and stuck schwa of support in Toulouse French and CF's L1 speech, as duration of stuck schwa in southern French varies with the speech production task, and the geographical area where the speaker is living. Moreover, the articulatory rate may vary with the speaker and the speech production task, thus an non-normalised duration value considered as a boundary is not feasible. Nevertheless, from the cited studies, we might consider that stuck schwa longer than 110–120 ms may be the one of hesitation.

6.7.2 Predictions

The presented acoustic properties of the stuck schwa in Czech and French in subsection 6.7.1 allow us to make the three following predictions concerning stuck schwa in CF's L1 speech:

1. There will be a difference in the number of occurrences of stuck schwa in CF's L1 speech and C's L1 speech because the stuck schwa is rare in Standard Czech while it is abundant in Toulouse French, and also occurs in Standard French.

2. There will be a difference in the number of occurrences of the stuck schwa of support in CF's L1 speech and C's L1 speech because the stuck schwa of support does not exist in Standard Czech while it is abundantly pronounced in Toulouse French, and it also occurs in Standard French (cf. Candea, 2000, subsection 4.3.2 and section 4.4).

3. There will be a difference in the number of occurrences of the stuck schwa of hesitation in CF's L1 speech and C's L1 speech because the stuck schwa of

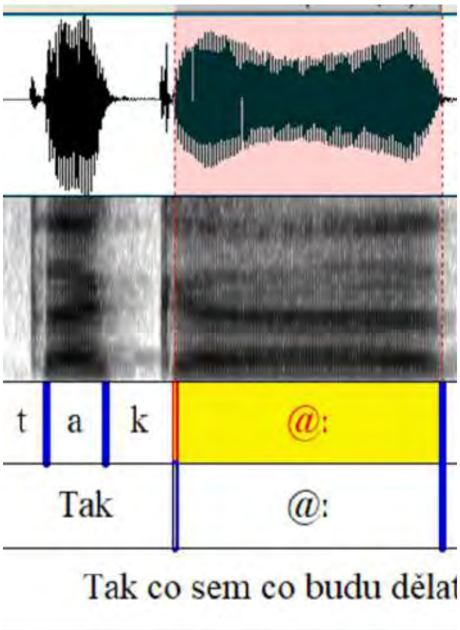


Figure 6.16: Example of stuck schwa produced by a CF speaker in semi-spontaneous speech.

hesitation is rare in Standard Czech while it is abundantly used in French (cf. Candea, 2000, section 4.4).

6.7.3 Methodology

Analysis of the stuck schwa was performed for semi-spontaneous speech of the 17 C and 17 CF. There was no occurrence of stuck schwa in the reading aloud task. The stuck schwa were manually annotated to the tier 'phone' into the TextGrids by the symbol [@:]. The schwa was considered as a stuck schwa when it respected to the three following conditions:

- It was directly stuck to the end of the word, i.e., the formants structure of the stuck schwa was not separated by silence, glottal stops or another parasite sound from the last phone of the word (see fig. 6.16 for an example of stuck schwa).
- It perceptually created an additional syllable of the word
- It was not perceived as a Czech epenthetic schwa.

Moreover, the annotation of the stuck schwa was also guided by its duration and formant structure inspected visually in the spectrogram with respect to the acoustic properties of the stuck schwa in southern French described above.

Using Praat scripts, all labels were automatically extracted from the tier 'phone' and all words from the tier 'word' in the TextGrids. The data were analysed in R using the same packages as in the perceptual test. At first, we verified the similarity of spectral and temporal characteristics of extracted stuck schwa from semi-spontaneous speech with its spectral and temporal characteristics described in subsection 6.7.1 by computing stuck schwa maximal, minimum and mean duration, and its mean $F1$, $F2$ and $F3$ values per *group*. This ensured the manual annotation of stuck schwa was correct.

Secondly, in order to test our first prediction concerning the number of occurrences of the stuck schwa, we computed the number of [@:] and the number of words produced by each speaker in semi-spontaneous speech. The non-silent markers of hesitation were not considered to be a word. Considering that the more words the speaker produces, the more schwa may stick, we computed the percentage of stuck schwa in the speaker production in semi-spontaneous speech. This was termed *Percent_schwa*. Thus, it was the number of speaker's [@:] divided by the number of his words and multiplied by 100. Consequently, the *Percent_schwa* tells us the per cent of the speaker's words ending by the stuck schwa. A histogram, Quantile-Quantile plots and a Shapiro-Wilks test did not reveal the normal distribution in *Percent_schwa*. A Two-samples unpaired Mann-Whitney U-test with confidence level set at 95% was performed on *Percent_schwa* of the C and CF in semi-spontaneous speech in order to determine whether there is a significant difference between groups of speakers. In order to test the second and third prediction concerning the number of occurrences of stuck schwa of support and stuck schwa of hesitation, for each *group*, we displayed duration of stuck schwa in semi-spontaneous speech per speaker and *group* in a plot.

6.7.4 Results and discussion

Table 6.9 gives temporal and spectral characteristics of stuck schwa per *group*. We may observe that non-normalised minimal duration of CF's stuck schwa corresponds to the mean stuck schwa duration in the Eychenne's (2015) study while non-normalised minimal duration of C's stuck schwa is higher than that of CF's. Taking into account mean, minimum and maximum duration of the stuck schwa of C's and CF's, it may be concluded that regarding duration of stuck schwa of hesitation in Candea (2000) and duration of stuck schwa in Coquillon (2005); Eychenne (2015); Nemoto and Adda-Decker (2013) (see subsection 6.7.1) all manually annotated stuck schwa were sufficiently long enough to be considered as a stuck schwa. We may also observe that the mean formant values of stuck schwa in C's semi-spontaneous speech are close to the mean formant values of stuck schwa in CF's semi-spontaneous speech. Mean $F2$ and $F3$ of both groups are close to $F2$ and $F3$ given in Eychenne (2015) study while their $F1$ is slightly higher than in Eychenne (2015). This small difference in $F1$ in stuck schwa produced by our speakers and Eychenne (2015) speaker may be related to many factors. There are two main factors, which merit mentioning. Firstly, $F1$ values of our speakers are

Table 6.9: Mean formant values and duration of C's and CF's stuck schwa in semi-spontaneous speech.

group	n	Mean formants			Duration		
		$F1$	$F2$	$F3$	*mean*	*min*	*max*
C	20	564	1501	2679	274	134	472
CF	101	546	1493	2731	309	77	833

Note: In Hz (non-normalised values), maximal, minimal and mean of non-normalised duration is in ms. Values rounded to whole number. n indicates numbers of stuck schwa occurrences per *group*.

not normalised. Consequently, its mean values might change after normalisation. Secondly, the Eychenne's (2015) speaker did not live in Toulouse but near to Figeac. Therefore, one may suppose that schwa produced near Figeac may differ slightly in its spectral characteristics from schwa produced in Toulouse as both cities are about 160 km far, one from another. The most important factor for our study is that the C's and CF's spectral characteristics of stuck schwa seem not to differ as the non-normalised values of their formants are similar. Thus, the same sounds were annotated as stuck schwa in C's and CF's recordings.

The analysis of values of *Percent_schwa* of speakers by the Mann-Whitney U-test showed a significant difference across groups of speakers (W=42.5, p=0.0004). C produced very rarely the stuck schwa in their semi-spontaneous speech (*mean Percent_schwa*=0.515, SD=0.751) while the stuck schwa were produced much more frequently in semi-spontaneous speech of CF (*mean Percent_schwa*=2.923, SD=2.847). In total, there were 20 occurrences of stuck schwa in C's semi-spontaneous speech, while there were 101 occurrences of stuck schwa in CF's semi-spontaneous speech (cf. table 6.10). Thus, the first prediction of the difference in number of occurrences of stuck schwa in CF's L1 speech and C's L1 speech was confirmed for their production in semi-spontaneous speech but not for the reading aloud task as no speaker produced stuck schwa in the reading aloud task.

On fig. 6.17 detailing duration of the stuck schwa produced by the speakers in semi-spontaneous speech, we may see that none of the C's stuck schwa was shorter than 120 ms whereas eight stuck schwa produced by CF were shorter than 120 ms. From that, given our considerations in subsection 6.7.1, it can be found that C produced no stuck schwa of support whereas eight stuck schwa produced by CF might be considered as stuck schwa of support. Moreover, fig. 6.17 shows that CF produced in semi-spontaneous speech more stuck schwa with duration above 120 ms than C. Thus, it can be concluded that CF very probably produced more stuck schwa of hesitation than C. Therefore, the second prediction about the number of occurrences of stuck schwa of support and the third prediction about the number of occurrences of the stuck schwa of hesitation in CF's L1 speech and C's L1 speech were both confirmed for the semi-spontaneous speech but not for the speakers' production

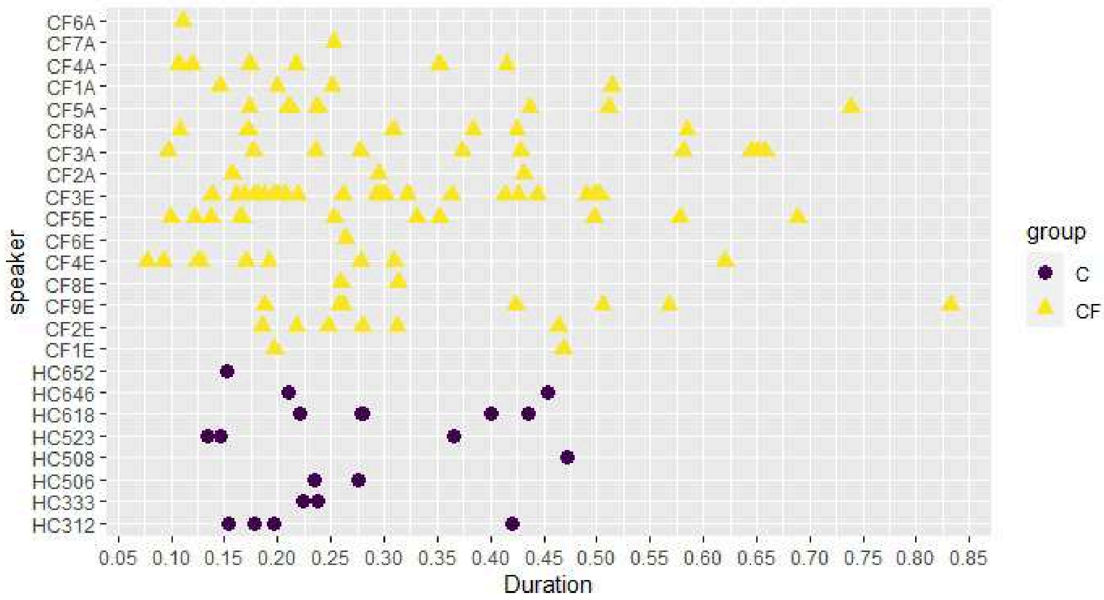


Figure 6.17: Duration of stuck schwa of C's and CF's speakers in semi-spontaneous.

Note: Duration in seconds. Colour and shape indicate the *group* of the speaker.

in the reading aloud task. We may suppose that the CF often produced a stuck schwa of hesitation and of support because as it is produced often in their French for hesitation and for support and/or they are used to hearing the stuck schwa of support mainly in southern French and stuck schwa of hesitation in Toulouse and Standard French. Note that the longest stuck schwa in CF's semi-spontaneous speech approaches one second which is a result similar to the one in Candea's (2000) speech corpus where some stuck schwa of hesitation reached almost a second (see subsection 6.7.1).

6.8 Discussion of acoustic study

For the present acoustic study, two hypotheses were made in section 6.1. The primary hypothesis predicted that phonetic CLI will occur in some phonetic features of CF's vowels, /r/, /ɦ/ and /x/, non-conclusive intonation patterns and stuck schwa if these features are not identical in Czech and French. Tables 6.10 and 6.11 give an overview of the phonetic features that are not identical in Czech and in French and were examined in the present chapter. It can be seen that the phonetic CLI occurred in some phonetic features of some speech segments and/or suprasegments of CF, thus the primary hypothesis was fully confirmed. More precisely, the phonetic CLI occurred in CF's L1 production in the reading aloud task as well as in semi-spontaneous speech, in $F1$ of /aː/, $F1$ of /ɛː/, $F2$ and $F3$ of /ɪ/, $F3$ of /iˑ/, normalised duration and spectral moments of /r/, and spectral moments of /x/ (cf. tables 6.10 and 6.11). It occurred only in CF's L1 production in the reading aloud task in $F2$ of /ɛ/, $F1$ of /u/ and the first three formants of /r/ (see table 6.10). It occurred only in the CF's L1 semi-spontaneous speech in $F1$ of /ɛ/, $F2$ of /ɛː/, $F2$ of /iː/, *ratio* of very high rising in non-conclusive pattern, *Percent_schwa* of stuck schwa, and number of occurrences of the stuck schwa of support and the stuck schwa of hesitation. The spectral moment of /ɦ/ and distance between values of the spectral moments of /ɦ/ and /x/ were examined only in CF's L1 semi-spontaneous speech and they also underwent phonetic CLI. When counting spectral moments as one element (i.e., *COG*, *standard deviation*, *kurtosis*, *skewness* together) and including all phonetic CLI found by at least one type of analysis of formants (i.e., when formant values non-normalised or normalised), in total, phonetic CLI occurred in 20 phonetic features in CF's L1 speech, some of them occurring in their L1 production in the reading aloud task as well as in their L1 semi-spontaneous speech while the others occurred only in one *task*.

The secondary hypothesis presented in the beginning of the present chapter (see section 6.1) was that the acoustic study would reveal more phonetic CLI in the CF's L1 semi-spontaneous speech than in their L1 production in the reading aloud task. This hypothesis was based on the result of the Major's (1992) study and related to the result of our perceptual test (see section 5.3) revealing that CF's speech items extracted from their semi-spontaneous speech were rated as less Czech sounding than those of C but it was not a case for their speech items extracted from their production in the reading aloud task. When counting spectral moments as one element (i.e., *COG*, *standard deviation*, *kurtosis*, *skewness* together) and including all phonetic CLI found by at least one type of analysis of formants (i.e., when formant values non-normalised or normalised), in the reading aloud task, phonetic CLI occurred in 13 CF's phonetic features of all 30 phonetic features of speech segments and suprasegments examined, that is 43% of all 30 examined phonetic features. In semi-spontaneous speech, the phonetic CLI occurred slightly more often: when counting spectral moments as one element (i.e., *COG*, *standard deviation*, *kurtosis*, *skewness* together) and including all phonetic CLI found by at least one type of analysis of formants (i.e., when formant values non-normalised or normalised), phonetic CLI occurred in 17 CF's phonetic features of all 32 phonetic features of speech segments and suprasegments examined, that is 53% of all 32 examined phonetic features in semi-spontaneous speech (cf. tables 6.10 and 6.11). From tables 6.10 and 6.11, we may see that more phonetic CLI occurred in CF's semi-spontaneous speech than in their production in the reading aloud task mainly in phonetic features of suprasegments. Concerning the speech segments, their phonetic features underwent similar phonetic CLI in each *task* (see, e.g., spectral moments of /r/ and /x/ and normalised duration of /r/) or phonetic CLI in them varied with the *task* but this variation might be linked to the type of analysis discussed in the following paragraph.

Table 6.10: 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 6.11: 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.

Indeed, concerning the normalisation of formants, we may see in tables 6.10 and 6.11 that without normalisation, one shift in CF's vowels in their production in the reading aloud task was found and three shifts in semi-spontaneous speech were found. In the case of normalisation by the Bark Difference Metric method, one shift in the reading aloud task was found and three shifts in semi-spontaneous speech in CF's vowels were found. In the case of normalisation by the Lobanov method, five shifts in the reading aloud task and two shifts in semi-spontaneous speech were found. With the shifts in $F3$ of CF's i-sounds there were in total in the CF's vowels, two shifts in the reading aloud task and four shifts in semi-spontaneous speech in the case of non-normalised vowels. In the case of vowels normalised by the Lobanov method, six shifts were found for the reading aloud task and three shifts in semi-spontaneous speech. Finally, in the case of vowels normalised by the Bark Difference Metric method, one shift was counted in the reading aloud task and four shifts were counted in semi-spontaneous speech. Thus, the analysis of non-normalised vowels as well as of normalised vowels using the Bark Difference Metric method showed more shifts occurred in CF's vowels in semi-spontaneous speech than in the reading aloud task while the analyses of normalised vowels by the Lobanov method showed the contrary. Moreover, for the analysis of formants of /r/, when normalised by the Lobanov method, the significant results were for the first three formants of /r/ in the reading aloud task while, in the case of non-normalised values, there was only one significant result in $F1$. From that, we may observe that analyses of non-normalised values of formants in vowels and their normalised values by the Bark Difference Metric method seems to report similar results, while when the formant values are normalised by the Lobanov method, the results became different in the analysis of vowels as well as in the analysis of /r/. Therefore, one might question the use of Lobanov method for normalisation in cross-linguistic studies, even if this method was reported as the best for these studies by the authors as mentioned in subsection 6.3.1.

Hence, in general, we may consider that the secondary hypothesis was confirmed in the present chapter. From a general point of view, more phonetic CLI occurred in the CF's L1 semi-spontaneous speech than in their L1 production in the reading aloud task in the present acoustic study. That was fully valid for the phonetic CLI in suprasegments examined in the present chapter: all examined suprasegments underwent phonetic CLI in CF's semi-spontaneous speech but not in their L1 production in the reading aloud task. Nevertheless, the validity of the secondary hypothesis for phonetic CLI in speech segments examined acoustically remains debatable due to the possible variation of the result with the method used or not for normalisation of formant values (see above).

Tables 6.10 and 6.11 also indicate whether the found phonetic CLI may be considered as a general dissimilation or assimilation effect in L1 speech of CF. With respect to the SLM-r, we are conscious that one CF speaker might reveal assimilation effect in a given phonetic feature while another CF speaker might show dissimilation effect in the same phonetic feature (see subsection 1.2.6 and section 2.3). Tables 6.10 and 6.11 thus indicate the general significant trend of the effect in the *group* of CF without taking into consideration the inter-speaker variations. We may observe that more dissimilation effect occurred in CF's L1 production in the reading aloud task (6 at total) than in their semi-spontaneous speech (3 at total). There was more assimilation effects than dissimilation effects in semi-spontaneous speech, whereas, in the reading aloud task, the number of dissimilation effects and assimilation effects was equal. Nonetheless, many dissimilation effects in the reading aloud task occurred in normalised formant values by the Lobanov method with respect to the possible unsuitably of this method for cross-linguistic studies, as expressed in the previous paragraphs.

Moreover, concerning the dissimilation and assimilation effect, an interesting observation can be seen: according to the results displayed in tables 6.10 and 6.11, an assimilation and dissimilation effect of the *group* of speakers might occur simultaneously in the same phoneme. Three occurrences were found in the present acoustic study. The first concerns CF's /r/ produced in the reading aloud task. There was a dissimilation effect in its $F3$ and assimilation effect in its $F2$. Both where revealed when the values were normalised by the Lobanov method which might bring some doubt to this result due to the use of this normalisation method. Nevertheless, the similar case occurred in the /r/ in CF's semi-spontaneous speech: there was an assimilation effect in its spectral moments and simultaneously, a dissimilation effect in its normalised duration. Of course, one may argue that, since there is no reference value of /r/ duration in spontaneous speech and as Vernerová (2006) focused only on /r/ in a read production, we can ignore whether duration of nonsyllabic /r/ of C in semi-spontaneous speech corresponds to the usual duration of Czech nonsyllabic /r/. Moreover, contrary to our reading aloud task, in semi-spontaneous speech, the number of positions of the /r/ may vary with the speaker. More precisely, in the reading aloud task, all speakers read the same text, meaning they produced the same number of /r/ in the same position. In semi-spontaneous speech, one speaker may produce, for example, much more /r/ in the final position than another. These difference may also be seen at the level of the *group*. For the reading, Vernerová (2006) showed no important difference in duration of nonsyllabic /r/ with respect to its position in the word. Nevertheless, it is unknown if this finding is valid for the semi-spontaneous speech. Thus, the found significant difference in duration of /r/ in semi-spontaneous speech between groups of speaker should not be viewed as a definitive result or a dissimilation effect without consideration, but should be viewed with the possibility that there are many external and uncontrolled factors may be related to this result. Nonetheless, there is another case of coexistence of a dissimilation and assimilation effect in the same phoneme: in the /ɪ/ of CF in semi-spontaneous speech, its $F2$ shows assimilation effect while its $F3$ demonstrates dissimilation effect both when normalised using the Bark Difference Metric method.

Even if two of the three cases described in the previous paragraph may be considered as uncertain, they all suggest that, in the same phoneme produced by the same *group* of late bilingual speakers the assimilation and dissimilation effect may coexist. This finding is particularly interesting with respect to the claim of De Leeuw (2019a) based on SLM, and PAM-L2, and followed by the studies of phonetic CLI, that assimilation occurs when the L2 sound is classified into the category of L1 sounds which are perceived as similar to the L2 sound and the dissimilation occur when the L2 sound is classified into a new phonetic category which was established, because it is perceived as too different to the L1 sounds. The assimilation means approaching phonetic features of L1 and L2 sounds existing in the same phonetic category in the speaker's phonetic space, while dissimilation means deepening the distance between phonetic features of L1 and L2 sounds classified in the different phonetic categories (see subsection 2.1.4 and De Leeuw (2019a)). As noted in subsection 1.2.6, also SLM-r shares fully this conception of assimilation and dissimilation effect. Flege and Bohn (2021, p. 42) wrote that:

> *"Meanwhile, interactions between L1 and L2 phonetic categories provide a reflex that is diagnostic of L2 category formation or its absence. According to the SLM-r, new L2 categories may shift away from (i.e., dissimilate from) neighboring L1 categories to maintain phonetic contrast between certain pairs of L1 and L2 sounds. This is so because, by hypothesis, the L1 and L2 phonetic categories of a bilingual exist in a common phonetic space. In the absence of category formation for an L2 sound, on the other hand, the SLM-r predicts a merger of the phonetic properties of an L1 sound and the L2 sound to which it remains perceptually linked. This may cause the L1 sound to shift toward (assimilate to) the L2 sound in phonetic space."*

The issue which arise from this is how the assimilation and dissimilation effect may occur in the same CF's L1 sound, because as explained above, for assimilation, the L1 sound must exist in the category with an L2 sound, for the dissimilation effect, they must exist in separated categories. One might argue that according to SLM-r, an important differences may exist among speakers (see subsection 1.2.6), and therefore, suppose that the dissimilation and assimilation coexist in CF's /r/ and /ɪ/ because analysis was done only between the different groups of speakers and not among individual CF. It might be supposed that an analysis of the /r/ and /ɪ/ of individual CF will show that in the /r/ or /ɪ/ of an individual CF there is no coexistence of dissimilation and assimilation effect. However, if, for example, we display $F2$ and $F3$ of /ɪ/ normalised by the Bark Difference Metric method of individual CF with comparison with that of C, as on fig. 6.18, we may observe that dissimilation and assimilation coexist also in the /ɪ/ of an individual CF: the $Z3 - Z2$ is lower for an individual CF than that of an individual C (assimilation effect) and, at the same time, its $Z2 - Z1$ is higher than that of an individual C (dissimilation effect). That is the case for example, of the speaker CF1A, CF1E, CF6E and others (see fig. 6.18). Therefore, we cannot explain the coexistence of dissimilation and assimilation effect through the individual differences, both effects may coexist in the same phoneme of the individual speaker according to this study's results.

This observation might lead one to cast doubt on the conception of phonetic space where dissimilation and assimilation effect occur according to the category in which L1 and L2 sounds exist, i.e., either they are in one common phonetic category or in two separated categories. One might ask where in the phonetic space is an L1 sound which simultaneously underwent the assimilation and dissimilation effect in its phonetic features: this sound cannot coexist in the same phonetic category as an L2 sound because it underwent dissimilation effect but, it cannot be in an L1 category and its pair in L2 alone in the new phonetic category because it underwent assimilation effect. This result seems to show the limitation of linking assimilation and dissimilation effects directly to whether a new phonetic category was established for L2 sound or not (cf. De Leeuw, 2019a). From our results, in addition to the presumption of SLM-r which claims that the changes may occur in the phonetic categories and a new category may be established at all times in the speaker's life (see subsection 1.2.6), it might be envisaged, that these changes are not a subtle integration of one sound from one category to another category but they might be a longer process. Consequently, we might imagine that during this long process, an L2 phoneme existing in the same category as an L1 phoneme is moving to the new L2 phonetic category which will be established. There is a situation during which the part of the L2 phoneme is still in the common category with the L1 phoneme. Thus, the assimilation effect may occur in one phonetic feature of L1 phoneme. However, also during that situation, another part of the L2 phoneme is already in a free phonetic space where all L2 phoneme might move later and create the new phonetic category. Because of this, the part of the L2 phoneme which is already in the free phonetic space may undergo the dissimilation effect with another feature of the L1 phoneme (see fig. 6.19 for illustration). Even if such interpretation is to the best of our knowledge completely new in the research field of phonetic CLI and particularly interesting, it needs to be examined further in future research.

The proposed interpretation of the coexistence of the dissimilation and assimilation effects in the same CF's phoneme is pertinent for the interpretation of the coexistence of dissimilation and assimilation effects in CF's $F2$ and $F3$ of /ɪ/ when

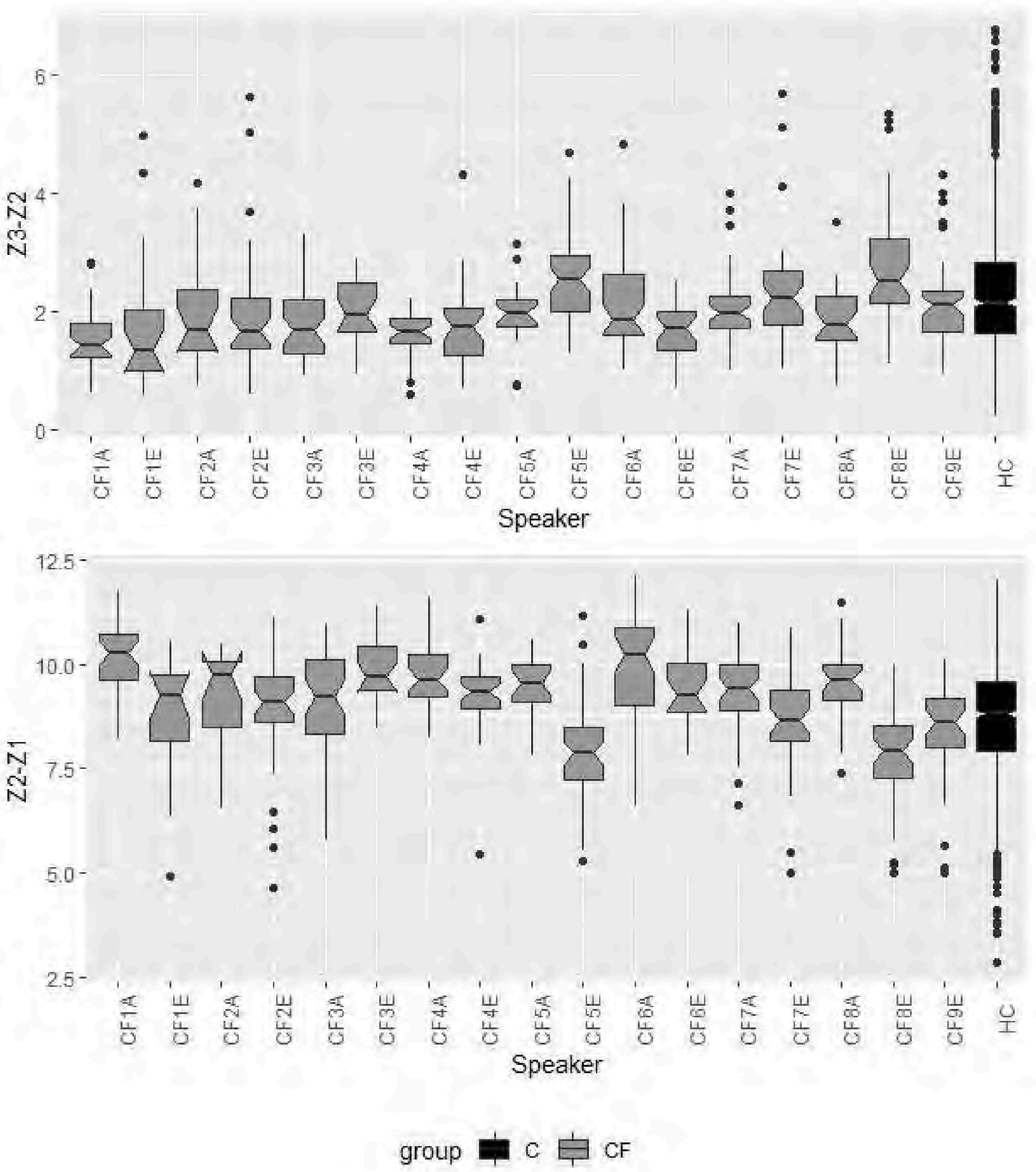
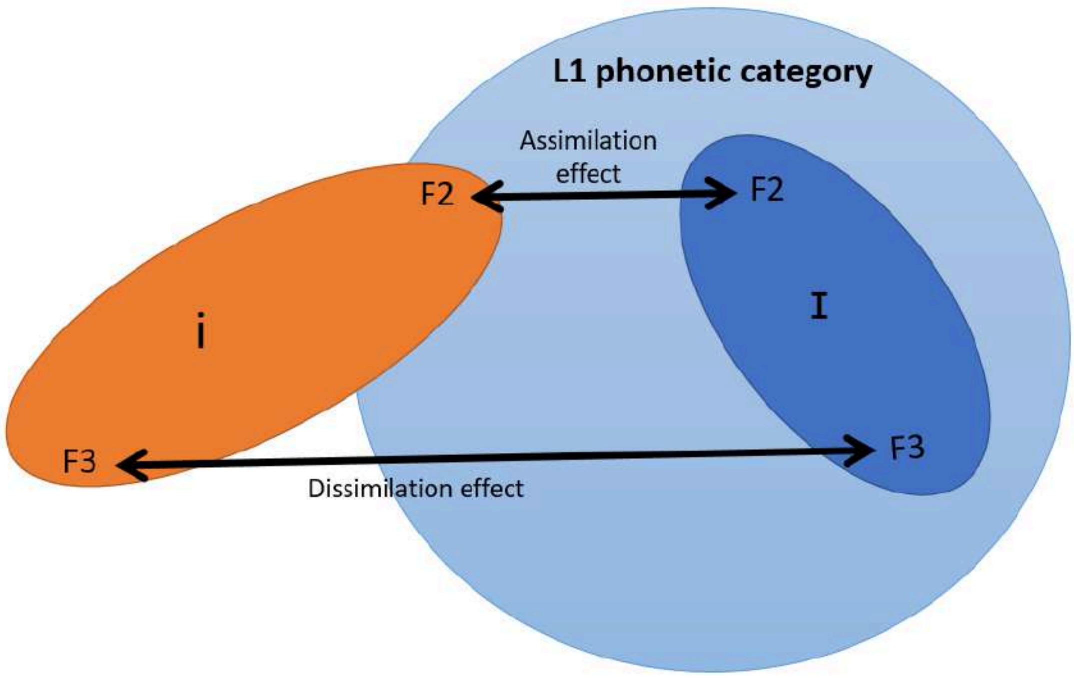


Figure 6.18: Normalised $F2$ and $F3$ of /ɪ/ of individual CF and C in semi-spontaneous speech

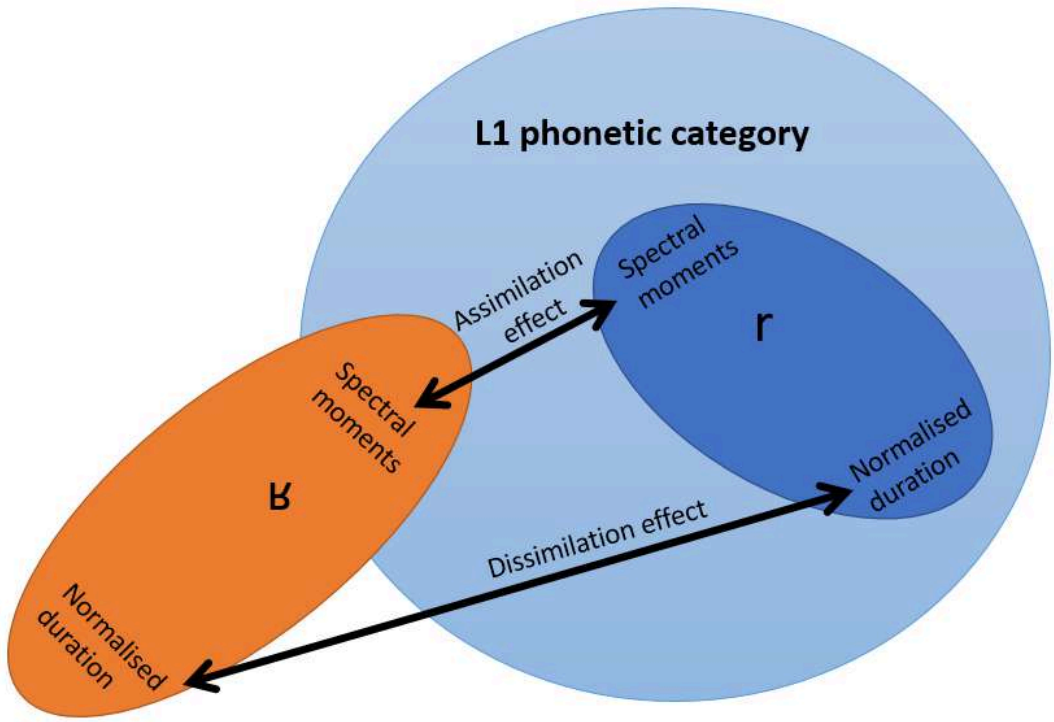
Note: Normalised by Bark Difference Metric method. $Z3 - Z2$=normalised $F2$, $Z2 - Z1$=normalised $F3$. HC=all C's speakers together.

normalised by the Bark Difference Metric Method and the /r/ when normalised by the Lobanov Method, both in semi-spontaneous speech. For the existence of assimilation in normalised duration of the CF's /r/ and at the same time the dissimilation effect in its spectral moments in semi-spontaneous speech, we might imagine that the CF's L1 /r/ exist in the same phonetic category as their L2 /ʁ/ and thus it undergoes the assimilation in its spectral moments, while the Toulouse French /r/ was placed in a new category by CF and thus a dissimilation effect occurs between its normalised duration and the CF's /r/. Nevertheless, such a hypothesis cannot be verified as duration of the Toulouse French /r/ has not been investigated. Moreover, note that there is an assimilation effect in normalised duration of the CF's L1 /r/ in their production in the reading aloud task, whereas there is a dissimilation effect in their semi-spontaneous speech (see subsection 6.4.4 and tables 6.10 and 6.11). That means that the assimilation effect may occur in a phonetic feature of the phoneme in one speech production task, whereas the dissimilation effect occurs in the same phonetic feature of the same phoneme in another speech production task. This result also goes against the conception of the assimilation and dissimilation effect as a consequence of the establishment, or not, of a new phonetic category for a new L2 sound if we suppose that the phonetic categories of the speaker remain the same independently of the speech task production.

In section 2.3, we saw that Chang (2011) found a systemic shift in $F1$ in whole vocalic space of English learners of Korean as well as Mayr et al. (2012) who founded this shift in the entire vocalic space of a late Dutch-English bilingual and Lang and Davidson (2019) who found this effect in the whole vocalic space of late English-French bilinguals. Mayr et al. (2012) also considered that the systemic shift occurs more in $F1$ than in $F2$ as the human auditory system is more sensitive to differences between lower frequencies than higher frequencies (cf. Goldstein & Brockmole, 2016). On the other hand, such a shift was not found by Bergmann et al. (2016). From fig. 6.3, we may observe that in the examination of the spectral characteristics of CF revealed a more significant shift in $F2$ than in $F1$ in CF's semi-spontaneous speech when the formant values were not normalised or when normalised by the Bark Difference Metric method. On the other hand, there were more significant shifts in $F1$ than in $F2$ in both CF's reading aloud task and semi-spontaneous speech when the formant values are normalised by the Lobanov method. Concerning the systemic shift, there were no systemic shift in $F1$ when formant values normalised or not (see Appendix D for normalised and non-normalised mean formant values of C's and CF's vowels and fig. 6.3). On the other hand, as seen on fig. 6.20a visualising mean $F1$ and $F2$ of the C's and CF's vowels in the reading aloud task and semi-spontaneous speech (see Appendix D for mean $F1$ and $F2$), systemic drift may be observed in $F2$ in CF's non-normalised formant values of vowels: $F2$ in all CF's vowels is generally higher than that in C's vowels and that it mainly occurs in speakers' production



(a) Assimilation and dissimilation effect in /ɪ/ of CF in semi-spontaneous speech.



(b) Assimilation and dissimilation effect in /r/ of CF in semi-spontaneous speech.

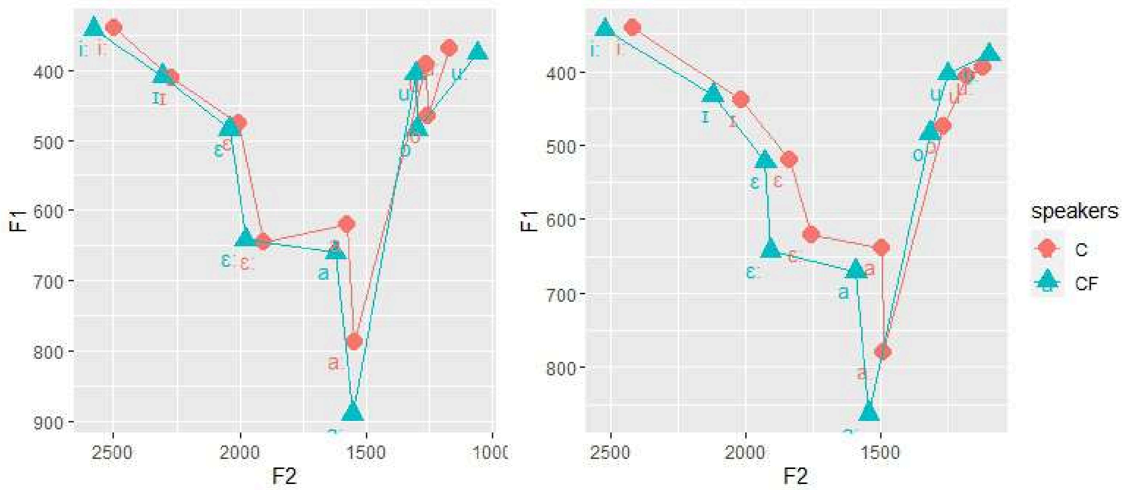
Figure 6.19: Envisaged schematic representations of coexistence of assimilation and dissimilation in an CF's phoneme.

Note: L2 French sounds in orange, L1 Czech sounds in blue, both of CF. The biggest circle represents L1 phonetic category in which the L2 and the L1 phonemes had coexisted together before the L2 phoneme started to move away the category.

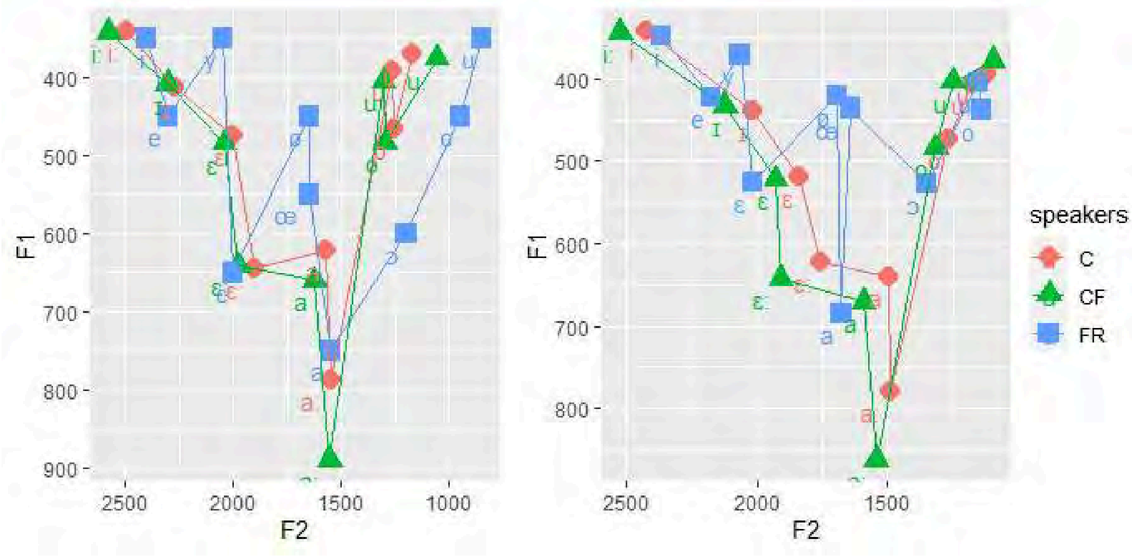
in semi-spontaneous speech. The same drift may be observed in the C's and CF's vowels when normalised by the Bark Difference Metric method while there is not such drift when vowels are normalised by the Lobanov method (cf. fig. 6.3). Nevertheless this systemic drift in $F2$ may not be considered as a general assimilation or dissimilation effect because some CF's vowels approach French vowels in their $F2$, while other CF's vowels move away from $F2$ of French vowels (see fig. 6.20b) when using studies presented in subsection 6.3.1 as a reference value of French vowels. Hence, the analysis of CF's vowels did not confirm the possible generalisation of $F1$ systemic drift occurrence found by Chang (2011); Lang and Davidson (2019); Mayr et al. (2012), and also reveals that a systemic drift in vocalic space of late bilinguals may vary with the method used for vowels' normalisation.

We saw that CF incorporated from the French language, their L2, both stuck schwa of hesitation and stuck schwa of support into their L1. We saw that the stuck schwa is not typical for Czech (see subsection 3.3.2, section 3.4, subsection 6.7.1). Due to this, one may classify the results concerning stuck schwa as a *borrowing transfer* with respect to the five types of CLI proposed by (Pavlenko, 2000) (see subsection 2.1.2). Concerning the non-conclusive intonation patterns, we saw that CF used them for high rising intonation subsection 6.6.4. We saw in subsection 2.1.2, that *restructuring transfer*, one of the five types of CLI noted by Pavlenko (2000), may be from changes in the function of L1 elements within the language system (Ulbrich & Ordin, 2014). Thus, we may suppose that high rising intonation is not usually used for the indication of continuation of speech in non-conclusive patterns in Czech (cf. Volín, 2008) but it has the function of indicating the continuation of speech in CF's L1 speech. We may consider it as a change in function of CF's L1 element and thus, speak about *restructuring transfer* in CF's L1 non-conclusive intonation patterns. Concerning our findings of assimilation effects in CF's vowels and /r/, they may be considered as a *shift* in the sense of one type of CLI according to Pavlenko (2000). However, the dissimilation effects found in the segments produced by CF may not be classified in any of five types of CLI listed by Pavlenko (2000) as Pavlenko (2000) five types of CLI do not include the possibility of dissimilation effect (see subsection 2.1.2).

On the other hand, the classification of found CLI in CF's /ɦ/ and /x/ seems particularly less evident. We saw in subsection 3.2.2 that these two phonemes do not exist in French, but phonetic CLI occurred in their spectral characteristics in CF's production: their spectral characteristic when produced by CF were different from when produced by C (see subsection 6.5.4). One might suppose that among French phonemes, those which have the most influence on the CF's /ɦ/ and /x/ is the French rhotic because of the sameness of its manner of articulation with the Czech /ɦ/ and /x/ (all three sounds are fricatives, see fig. 3.6 in subsection 3.2.2) and similarity in its place of articulation with the Czech /ɦ/ and /x/ (the French



(a) Mean $F1$ and $F2$ values of C's and CF's vowels.



(b) Mean $F1$ and $F2$ values of C's and CF's vowels and French vowels.

Figure 6.20: Mean $F1$ and $F2$ values of C's and CF's vowels.

Note: C's and CF's L1 production in reading aloud task in left and in semi-spontaneous speech in right. Values in Hz. Values of $F1$ and $F2$ of French vowels are taken from Tubach (1989) for the reading aloud task and from Gendrot and Adda-Decker (2005) for the semi-spontaneous speech (for more detail about this study, see subsection 6.3.1).

rhotic is the most uvular, the Czech /ɦ/ is glottal and the Czech /x/ is velar, see subsection 3.2.2). Nevertheless, when comparing the values of *COG* of the French rhotic found by Wu et al. (2015) (i.e., between 250 and 750 Hz, see subsection 6.4.1), with the values of *COG* of the C's and CF's /ɦ/ and /x/ (see figures 6.7 and 6.9), we observe that the lowest value of *COG* is in the French rhotic, followed by that of the C' /ɦ/, the CF's /ɦ, the C's /x/ and the CF's /x/. Due to this, we cannot consider the CF's /ɦ/ and /x/ underwent an assimilation effect with respect to the French rhotic. The only possible interpretation is that CF's /ɦ/ and /x/ might undergo a dissimilation effect with respect to the French rhotic. This interpretation seems particularly believable as one might consider that the French rhotic and the Czech /ɦ/ and /x/ exist in two different phonetic categories in the CF's phonetic space. Consequently, the two categories might move from one to another and thus, increase the dissimilation effect as might be supposed in agreement with SLM (see chapter 1 and subsection 2.1.4). However, this interpretation remains questionable as it is not certain that the difference in spectral characteristics of the C's and CF's /ɦ/ and /x/ is directly caused by the influence of the French rhotic, and doubts arise over the conception of phonetic space in phonetic categories as described above.

To relate the results of analysis of intonation in non-conclusive intonation patterns with LILt, we may consider the difference between C's and CF's realisation of non-conclusive intonation patterns as a difference at the realisational (i.e., phonetic) dimension of intonation (see subsection 1.2.7). With respect to developmental L2 intonation hypothesis, we might suppose that high rising intonation in non-conclusive patterns were acquired early by CF, because according to Pešková (2020), patterns with a heavy semantic weight, among which non-conclusive patterns might be considered, are acquired earlier than patterns with no changes in meaning (see subsection 1.2.7). Moreover, Pešková (2020) also claims that new but frequent and perceptually prominent patterns [of an L2] tend to be subject to overgeneralization by L2 learners. We might also suppose that high rising intonation in non-conclusive patterns in French was perceived as particularly prominent by CF because of its high rise, and that CF were usually exposed to non-conclusive patterns in French speech during university lectures and other types of speech, as these might constitute an important part of everyday conversation. Consequently, their frequency and prominence might help CF to quickly acquire and to transfer them to their L1. Moreover, if we observe the mean *P_cadence* values in table 6.8 giving the per cent of non-conclusive intonation patterns produced using a given cadence by the *group* of speakers in the given *task* (see subsection 6.6.4), we see that in the reading aloud task, on average, 71.6% of C's non-conclusive intonation patterns were produced by using the cadence 4 (i.e., flat intonation) while 50.64% of CF's non-conclusive patterns were produced by using this cadence. Thus leading us to suppose that flat intonation is more characteristic for non-conclusive intonation patterns in reading aloud tasks produced by C than those produced by CF.

6.9 Summary of the chapter

This chapter has focused on the acoustic study of L1 production in the reading aloud task and in semi-spontaneous speech of 17 CF and 17 C female speakers. The 17 CF speakers were all living in the Toulouse area. Phonetic CLI were examined by comparing the spectral properties of vowels, rhotics, velar and glottal fricatives, temporal characteristics of rhotics, $f0$ in non-conclusive intonation patterns and occurrence of stuck schwa in CF's L1 speech with that in C's L1 speech. Several acoustic properties were studied: three first formants, spectral moments, duration, harmonicity and $f0$ course. The phonetic CLI were found to occur mainly in CF's spectral characteristics of /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, and /x/ in both the reading aloud task and semi-spontaneous speech. It occurred also in CF's normalised duration of /r/ and its spectral moments in both the reading aloud task and semi-spontaneous speech, while the first three formants of CF's /r/ were affected by phonetic CLI only in reading aloud task. Due to insufficient data, the spectral moments of /ɦ/ were only examined in semi-spontaneous speech and they were affected by phonetic CLI when the /ɦ/ was produced by CF. The distance in the values of spectral moments of the /ɦ/ and /x/ were lower in CF's semi-spontaneous speech than in C. Among all rising cadences, the frequency of use of the cadence with very high rising intonation in non-conclusive patterns was significantly higher for CF than C in semi-spontaneous speech. The frequency of use of the stuck schwa was significantly higher for CF than C in semi-spontaneous speech.

I have demonstrated, by reviewing the result in the light of the phonetic differences between Czech and French, that all the phonetic CLI found in CF's L1 speech is related to the influence of French on CF's Czech, with the exception of the phonetic CLI in /ɦ/ and /x/ whose direct link to French might be considered uncertain. The CLI usually occurred as an assimilation or dissimilation effect. Our result concerning the stuck schwa may be considered as the *borrowing transfer* and the phonetic CLI in non-conclusive intonation patterns as the *restructuring transfer*. We saw that phonetic CLI occurred in several phonetic features which are not identical in Czech and French, and that they occur more often in CF's production in semi-spontaneous speech than in the reading aloud task. Of great interest, our results showed that assimilation and dissimilation effect may coexist in the same phoneme. This finding was in contradiction with what was predicted according to SLM, PAM and SLM-r, and this is why I proposed a slight modification to the conception of the assimilation and dissimilation effect and their link to the phonetic categories in the phonetic space of a speaker. Finally, our analysis of vowels showed more systemic drift in $F2$ than in $F1$, a result different from that seen in the studies of Chang (2011); Lang and Davidson (2019); Mayr et al. (2012) presented in section 2.3.

Chapter 7

Extralinguistic factors

Extralinguistic factors were defined in subsection 2.4.1 as factors external to the language as a system but related primarily to the bilingual as a person, potentially contributing to first language attrition and CLI. In section 2.3, we saw that few extralinguistic factors were studied in the research field of phonetic CLI and that authors focused primarily on the LOR, followed by L1 use. The L2 proficiency impact on phonetic CLI was analysed only by Major (1992); Sůčková (2020), and none authors focused on the attitudinal exralinguistic factors in the studies of phonetic CLI. In the same subsection, I also highlighted the methodological difficulties of studying extralinguistic factors and the chosen methodology for extralinguistic factor examination is far from homogeneous in studies of phonetic CLI. That makes studying extralinguistic factors in the research field of phonetic CLI incredibly challenging.

This chapter aims to address this challenge. The majority of this chapter is dedicated to an examination of the relationships between four so-called predictor variables (the term 'predictor variables' is used, e.g., by Sůčková, 2020) and twenty so-called indicator variables. Nineteen of the twenty indicator variables refers to phonetic CLI in the nineteen acoustic features of CF's L1 speech segments and suprasegments taken from chapter 6. These will be termed acoustic indicator variables. The twentieth indicator variable was constituted with respect to the result of the perceptual test (see chapter 5), and therefore, will be called the perceptual indicator variable. The four predictor variables examined are CF's *LOR*, *Use of Czech*, *Proficiency in French* and *Preferred identity* which refers to CF's preference for Czech or French country, culture and language. As announced in Part I, the term extralinguistic factors is here used with its general meaning as used previously, whereas the term predictor variable will refer only to the four predictor variables I examine. These four variables were chosen in particular because their examination did not present any huge methodological issues, contrary to the other extralinguistic factors.

Thus, in this chapter, I will state the hypotheses based on the results of the studies on relationship between phonetic CLI and extralinguistic factors (for more detail about these studies, see subsection 2.4.2). The methodology used will the be explained. In addition to examining the relationships between predictor and indicator variables, the chapter provides an examination of correlations between indicator variables and a general portrait of CF. The results discussed at the end of the chapter are compared to the results of studies presented in subsection 2.4.2 and allow us to see the methodological difficulties linked to studying extralinguistic factors in general and predictor variables in particular.

7.1 Hypotheses

A general presentation of the extralinguistic factors in subsection 2.4.1 and results of studies examining the relationship between phonetic CLI and extralinguistic factors (see subsection 2.4.2) allows us to make the following hypotheses concerning the relationship between phonetic CLI in CF's L1 speech and the four predictor variables:

1. 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. We saw in subsection 2.4.2 that, in several studies examining the speech of late bilinguals with various LOR, i.e., both low and high LOR values included, higher LOR was related to more phonetic CLI when examined by acoustic measurements or perception experiments (Bergmann et al., 2016; Dmitrieva et al., 2010; Kupske & Alves, 2016; Lang & Davidson, 2019). By contrast, no significant impact of LOR on phonetic CLI seems to occur when the study includes only high values of LOR, e.g., 10 years and more (cf. subsection 3.4.2 and Schmid, 2011).

2. Lower amount of *Use of Czech* of CF will not be related to more phonetic CLI in the acoustic indicator variables. It was shown in subsection 2.4.2, that several studies found no impact of L1 use on phonetic CLI in an acoustic feature of a speech segment or suprasegment (Bergmann et al., 2016; De Leeuw, 2008; Sůčková, 2020). Contrarily, a lower amount of *Use of Czech* of CF will be related to more phonetic CLI in the perceptual indicator variable as found by Bergmann et al. (2016); De Leeuw (2008).

3. Higher *Proficiency in French* will be related to more phonetic CLI in indicator variables. We saw in subsection 2.4.2 this was a result of Major's (1992) work, whereas there was no significant impact of L2 proficiency on phonetic CLI in *VOT* of /t/ in Sůčková (2020).

4. Higher value in *Preferred identity*, meaning more preference for French culture, language and country will be related to more phonetic CLI in indicator variables. Even if no study about phonetic CLI focused on variables similar to *Preferred identity*, an interesting relationship between bilingualism and biculturalism might exist (cf. Yılmaz, 2019).

7.2 Methodology

This section presents the methodology used for the analysis of the four predictor variables.

7.2.1 Participants

For the present study, we used extralinguistic and speech data collected from all 19 CF, i.e., 18 female CF and 1 male CF (see Appendix A). Their speech data was used either for the perceptual test (see chapter 5) or for acoustic study (see chapter 7) or for both. 18 CF were living in Toulouse area, whereas one CF was living in Paris (cf. chapter 5 and chapter 6).

7.2.2 Extralinguistic data collection

The extralinguistic data was collected from the CF immediately after recording their L1 speech production by using an extralinguistic questionnaire. The questionnaire was constructed according to the questionnaire proposed by M. S. Schmid on the language attrition website,[1] and was adapted for this research. Thus, it consisted of 7 parts entitled as follows:

1. "About you", a part comprising the questions for collecting the information about the personal background of the CF.

2. "Your French", a part with questions concerning CF's use and acquisition of French.

3. "Your Czech", a part with questions concerning CF's use of Czech, dialectal background, and passive contact with Czech by media, listening to music and reading.

4. "Language self-evaluation", a part in which the CF self-evaluated their proficiency in speaking and comprehension in French and Czech.

[1] See https://languageattrition.org/.

5. "Other languages", a part aiming to obtain the information about the CF's use of other languages than Czech and French and their proficiency in that languages according to themselves.

6. "Language preferences", a part about the CF's culture, language and country preferences.

7. "Concluding questions", a part with two questions: the first asking whether the CF had the experience to come back to the Czech Republic after a long stay in France and be noticed as speaking with a strange accent in Czech by Czech people, the second giving the CF space to adding information or comments to all questionnaire and our research.

In total, the questionnaire involved 41 questions, language self-evaluation excluded. The CF filled a paper version of the questionnaire (see Appendix F). They were able to ask if they did not understand the requirements of a question. The collected data from the questionnaires was encoded and assembled in an Excel sheet. In the following paragraphs, I will describe only the encoding of CF's answers to the language self-evaluation and the selected questions necessary for constituting our four predictor variables. For rules of encoding of all collected data with the extralinguistic questionnaire, see Appendix F.

7.2.3 Predictor variables

Using data collected by the extralinguistic questionnaire, we constituted our four predictor variables as follows:

1. *LOR* was constituted from question number 5 in the questionnaire. In that question, CF were asked to indicate how long they had lived in France in months or years and provide the information about the breaks in their time in France, if these were longer than 6 months. (Following Sůčková (2020), we considered that the period of interruption of stay in France by longer than 6 months should be excluded from total LOR.)

2. *Use of Czech* was constituted from 7 items in question number 29 in the questionnaire, in which CF indicated how often they use the French with a partner, children, other family members, friends, at work, during the studies and in church, clubs or other organisations. To each item, they could reply 'always' encoded as 5, 'often' encoded as 4, 'sometimes' encoded as 3, 'rarely' encoded as 2, 'never' encoded as 1 or leave the box empty if the item was not applicable for them, e.g., they did not have a partner, encoded as NA. (See fig. 7.1 for illustration, note that the item 'To pet(s)' was not used for constituting the predictor variable *Use of Czech* as it had much more function of a distractor in the questionnaire than the significant information.)

3. *Preferred identity* was constituted from questions number 37, 38, and 40. In question 37, "Do you feel more at home in Czech or French culture?", the speakers could reply between 'in French culture' (a reply encoded as 4), 'in both, but more with French culture' (encoded as 3), 'in both cultures equally' (encoded as 2), 'with both, but more with Czech culture' (encoded as 1), and 'in Czech culture' (encoded as 0). To question 38, "Do you feel more comfortable while speaking Czech or French?", the reply 'French' was encoded as 4, the reply 'without preference' was encoded as 2, and the reply 'Czech' was encoded as 0. For question 40, "If you could choose between the Czech Republic and France the country where you will live, which country would you choose?", the possible four replies were encoded as follows: 'France'=4, 'I don't know' or 'without preference'=2, 'Czech Republic'=0.

4. *Proficiency in French* was constituted from the CF's replies in self-evaluation in the questionnaire (see fig. 7.2). In this self-evaluation, CF had to indicate if they were able to accomplish a given ability in French without difficulties (number 5) or not at all (number 1). Five abilities of comprehension and four speaking abilities were given.

For the further statistical analysis of the relationship between predictor variables and indicator variables, *LOR* was calculated in years, and as the entire length of residence of the CF speaker in France, i.e., the full stay of the CF speaker in France added together. For example, if a CF spent one year in France for the Erasmus exchange, returned to the Czech Republic for one year, and later, he moved again to France and stayed there 4 years, his LOR was 5 years. *Use of Czech*, *Preferred identity* and *Proficiency in French* were conceived as factors with two levels by using k-mean clustering in R. In order to use k-mean clustering, NA values in data collected for constitution of predictor variable *Use of Czech* were replaced by the median of CF's replies in the given item, as use of median is one of the possible strategies of dealing with missing values (Kaiser, 2014). In this way, we divided CF into two subgroups in each predictor variable, i.e., a subgroup of CF with lower *Use of Czech* and the one with higher *Use of Czech*, a subgroup of CF with lower *Proficiency in French* and the one with higher *Proficiency in French*, and a subgroup of CF with lower *Preferred identity* and the one with higher *Preferred identity.* Thus, in total, we obtained six subgroups of CF, all of which were balanced in number (see Appendix F).

7.2.4 Indicator variables

As mentioned at the beginning of the present chapter, the twenty indicator variables, i.e., one perceptual indicator variable and nineteen acoustic variables, were

29) Could you, in the following table, please indicate to which extent you use Czech in the provided domains? You may simply tick the box. If a certain domain is not applicable to you (for example, you don't have any pet), leave the box empty.

I speak Czech					
	always	often	sometimes	rarely	never
With partner	❑	❑	❑	❑	❑
With children or grandchildren	❑	❑	❑	❑	❑
With other family members	❑	❑	❑	❑	❑
To pets	❑	❑	❑	❑	❑
With friends	❑	❑	❑	❑	❑
At work	❑	❑	❑	❑	❑
During my studies	❑	❑	❑	❑	❑
In church, at clubs or organisations	❑	❑	❑	❑	❑

Figure 7.1: Question 29 of the extralinguistic questionnaire.

Note: Used for constitution of predictor variable *Use of Czech*.

constituted from the results of the perceptual test and acoustic studies (see chapter 5 and chapter 6). RT in the indicator variables refers to reading aloud task and SS to semi-spontaneous speech. The indicator variables were:

- *mean response in SS*. It was computed by taking *meanResponse* of all CF speaker's speech items produced in semi-spontaneous speech and rated in the perceptual test, and calculation an arithmetical mean of them. A higher value of *mean response in SS* was, more the CF speaker's L1 speech items were perceived as typically French sounding (see section 5.2 for reminder) which may be considered as more phonetic CLI.

- Normalised formant values of vowels by the Lobanov method which significantly differed between C and CF in the reading aloud task or in semi-spontaneous speech. As there were many normalised formants of vowels by Lobanov method, which significantly differed with *group*, we decided to focus only on the most significant vowels, i.e., those with a difference between C and CF was p lower than 0.02. We computed their mean for each CF speaker and named them by giving the vowel, formant and *task* in question. Thus, they were:

  – */aː/ F1 in RT*. A higher value was, more phonetic CLI occurred.

  – */ɛː/ F1 in RT*. Lower value meant more phonetic CLI.

  – */ɛ/ F1 in SS*. A lower value indicated more phonetic CLI.

  – */ɪ/ F2 in RT*. A lower value meant more phonetic CLI.

  – */iː/ F3 in SS*. A higher value indicated more phonetic CLI. (See subsection 6.3.4 for reminder.)

IV. Language self-evaluation

The following table lists several language skills. These are formulated as individual statements. Please read each statement carefully and evaluate how you handle the matter. For evaluation, please circle one of the numbers from 1 to 5 in the right column, where:

1 means that you cannot do that at all
2 means that you can do that, but with many difficulties
3 means that you can do that, although with some difficulty
4 means that you can do that fairly easily
5 means that you can do that without any difficulty

	Listening comprehension	**Czech**	**French**
a.	I understand TV news and current affairs programmes.	1 2 3 4 5	1 2 3 4 5
b.	I understand any kind of spoken language, even though it is in a fast rate, assuming I have some time to get used to the accent of the speaker.	1 2 3 4 5	1 2 3 4 5
c.	I understand extended speech.	1 2 3 4 5	1 2 3 4 5
d.	I understand extended speech (lectures, at work, at school, concerning hobbies) and follow even complex lines of argumentation provided the topic is reasonably familiar to me.	1 2 3 4 5	1 2 3 4 5
e.	I understand films in standard dialect.	1 2 3 4 5	1 2 3 4 5

	Speaking ability	**Czech**	**French**
f.	I speak with a fluency and spontaneity that allows me to have regular interactions with native speakers.	1 2 3 4 5	1 2 3 4 5
g.	I can take part in any conversation or discussion and use idiomatic expressions and colloquialisms. (Idiomatic expression is language-settled expression, e.g. "to stretch slippers" means to die in Czech)	1 2 3 4 5	1 2 3 4 5
h.	I can tell a story, narrate the plot of a book or film and describe my reactions.	1 2 3 4 5	1 2 3 4 5
i.	When I have a language problem (for example, I do not know some vocabulary or I am not sure about grammar), I can make the situation so smooth that other people will not notice it.	1 2 3 4 5	1 2 3 4 5

Figure 7.2: Language self-evaluation in the extralinguistic questionnaire used for the constitution of variables *Comprehension in French* and *Speaking in French*.

- Selected spectral and temporal characteristics of /r/ which significantly differed with *group* of speakers (C or CF):
  - *duration of /r/ in RT* referring to mean normalised duration by a CF's articulatory rate of nonsyllabic /r/ in reading aloud task. A longer the /r/ was, more phonetic attrition and CLI in the /r/ occurred.
  - *COG of /r/ in RT*, *COG of /r/ in SS*, *Kurtosis of /r/ in RT* and *Kurtosis of /r/ in SS* referring to mean first and fourth spectral moments of /r/ in reading aloud task and in semi-spontaneous speech. We focused on these two spectral moments as they are related to the different articulatory features; *COG* is related to the place and manner of articulation, while *kurtosis* is related to the manner of articulation (see subsection 6.4.1 for reminder). For *COG*, higher values meant more phonetic CLI, while for *kurtosis*, the lower value meant more phonetic CLI.
  - *F1 of /r/ in RT* referred to mean normalised $F1$ of /r/ by the Lobanov method for the reading aloud task. Its higher value indicates more phonetic CLI. (I did not add the significant difference in normalised $F2$ and $F3$ of /r/ in the reading aloud task among our indicator variables as they were significant only when normalised by the Lobanov method while $F1$ was also significant without normalisation, see subsection 6.4.4 for reminder.)
- */ɦ/ COG in SS* which was the mean of *COG* of /ɦ/ in semi-spontaneous speech and its higher value indicated more phonetic CLI, and */ɦ/ kurtosis in SS* which was the mean of /ɦ/ *kurtosis* in the same *task* and its lower value indicated more phonetic CLI.
- */x/ COG in RT* and */x/ COG in SS* which were the mean of *COG* of /x/ in the reading aloud task and semi-spontaneous speech. Their higher value meant more phonetic attrition CLI. */x/ kurtosis in RT* and */x/ kurtosis in SS* (mean of *kurtosis* of /x/ in reading aloud task and semi-spontaneous speech) that lower value meant more phonetic CLI.
- *ratio of very high rising in SS* referring to ratio of non-conclusive intonation patterns produced with very high rising intonation by the CF speaker and all non-conclusive intonation patterns with intonation rising in semi-spontaneous speech of the speaker (see subsection 6.6.3 for reminder). The higher the ratio value was, the more often the CF speaker's production was closer to French in rising cadences of non-conclusive intonation patterns, i.e., there was more phonetic CLI.
- *Percent_schwa in SS* which higher value meant that more produced stuck

schwa in semi-spontaneous speech by a CF speaker as it is typical for Toulouse French, i.e., more phonetic CLI (see subsection 6.7.1 for reminder).

7.2.5 Analyses

All data was analysed in R. Before the statistical analysis, by first observations of the collected extralinguistic data, we tried to establish a general portrait of CF speakers. It was noted that the CF speakers may be divided into two categories according to their extralinguistic data. I draw the portrait of each category below.

Following this, we examined the correlations inside indicator variables in order to conclude if there were correlations between variables. For that, we computed the correlation matrix which we converted into long format and stretched by using package *reshape2* (Wickham, 2007), and visualised the results in tiles with the package *ggplot2*. We created the tile as heatmap and added the correlation coefficients (ρ) inside the tile. Correlations were considered to be very strong if the coefficient was higher or equal to ± 0.8. They were considered strong if the coefficient was higher or equal to ± 0.6 and lower than ± 0.8. If the correlation coefficient was higher or equal to ± 0.4 and lower than ± 0.6 it was considered a moderate correlation.

Following this, the relationships between the indicator and predictor variables was studied. We computed twenty multiple linear regression models with the predictor variables as independent variables and each of twenty indicator variables as dependent variables. Thus, the basic model was:

$$lm(\text{DV} \sim LOR + Use\ of\ Czech + Preferred\ identity + Proficiency\ in\ French, \text{data})$$

where DV means a given dependent (indicator) variable.

7.3 Results

After providing a general overview of the speakers, this sections brings the results of the analyses of the relationships between perdictor and indicator variables and of indicator variables themselves.

7.3.1 General portrait of the speakers

The first observations of the extralinguistic data showed that the 19 CF speakers could be divided into two categories according to their job, their reason for living in France, their degree of education, the nationality of a partner whom they live with and any children. Table 7.1 shows that the first category comprising 7 CF speakers is in the majority composed of university students, who were in France for the studies, who did not live with a partner in France and who did not have children.

Table 7.1: Two general categories of CF speakers.

	LOR < 4 year	**LOR ≥ 4 years**
Education	All university students, 1 graduated	1 student, all the others graduated
Reason of living in France	Studies	Partner/ex-partner, 1 studies
Job	Students, 1 social assistent	1 student, 1 architect, 1 coach, 1 homemaker 2 on maternity leave, 1 After-school staff 3 translators, 1 religious, 1 teacher
L1 of partner (if living with partner)	NA, 1 Czech	3 NA, 8 French
Nb of children	NA	3 without children, 3 with 1 child, 3 with 2 children and 1 with 3 children

Note: Classification according to the items given in the first column of the table after first observations of the collected extralingustic data. Nb=number. Education refers to whether CF had graduated or not. The numbers refer to the number of concerned CF.

By contrast, the majority of the other 12 CF speakers (i.e., the second category) had already finished the university studies, lived in France because of a partner or ex-partner and had a job (3 among them were translators) or were on maternity leave (2 among them). One CF was a homemaker. In general, the CF speakers of the second category live with a French partner and had at least one child.

7.3.2 Correlations between indicator variables

The correlations between indicator variables are detailed in fig. 7.3 visualising the matrix of correlation of them. We observe that few indicator variables have a strong positive or negative correlation, and there is no very strong correlation between indicator variables (i.e., ρ higher than or equal to 0.8). We found the strong and positive correlation between */aː/ F1 in RT* and */ɪ/ F2 in RT* (ρ=0.7), *Kurtosis of /r/ in RT* and the one *in SS* (ρ=0.7), */ɦ/ COG in RT* and */x/ in SS* (ρ=0.6), and *COG of /r/ in RT* and the one *in SS*.

Concerning the negative strong correlations, they were more numerous than the positive ones. We found them logically between *COG* and *kurtosis* values as it was the case of:

- *Kurtosis of /r/ in SS*. It correlated with *COG of /r/ in RT* (ρ=0.6) and *COG of /r/ in SS* (ρ=0.7).

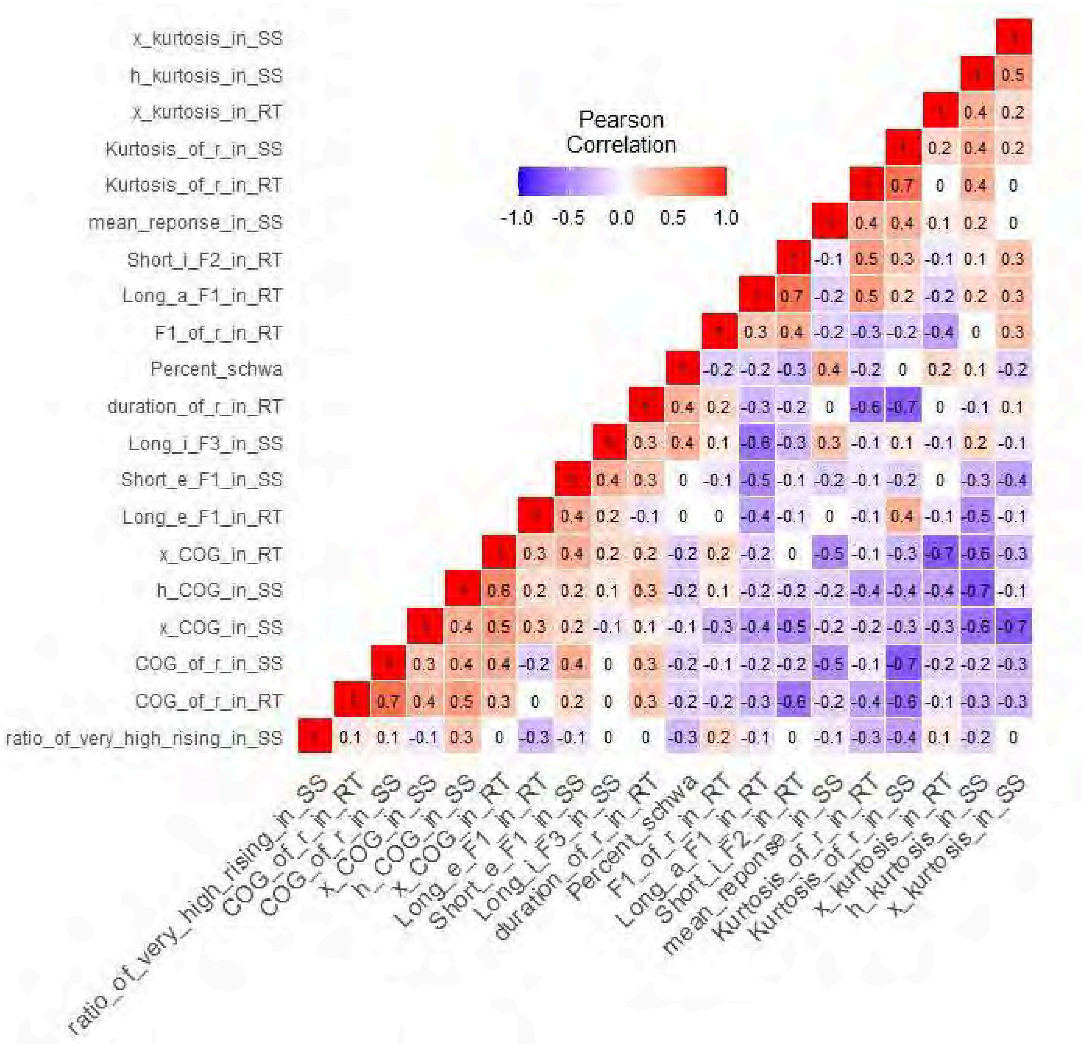


Figure 7.3: Tile plot of correlations inside indicator variables.

Note: The correlation coefficients between variables are given inside the tiles, the colors indicates the strength of correlations. Tiles are ordered according to the correlation coefficients.

- */ɦ/ kurtosis in SS*. It correlated with */ɦ/ COG in SS* (ρ=0.6), */x/ COG of in SS* (ρ=0.6), and */x/ COG in RT* (ρ=0.6).
- */x/ kurtosis in RT*. It correlated with */x/ COG in RT* (ρ=0.7).
- */x/ kurtosis in SS*. It correlated with */x/ COG in SS* (ρ=0.7).

Moreover, *duration of /r/ in RT* correlated with *Kurtosis of /r/ in RT* (ρ=0.6) and *Kurtosis of /r/ in SS* (ρ=0.7). *COG of /r/ in RT* also correlated with */ɪ/ F2 in RT* (ρ=0.6). Finally, */aː/ F1 in RT* correlated with */iː/ F3 in SS* (ρ=0.6).

7.3.3 Relationships between predictor and indicator variables

The analysis of relationships between predictor and indicator variables by using multiple linear regression models revealed two significant results: *Proficiency in French* affected */ɦ/ kurtosis in SS* (t=2.896, p=0.0134) by increasing its values by 406.82 ± 140.50 (standard errors), and it affected */x/ COG in RT* (t=-2.470, p=0.0295) by decreasing its values by 740.47 Hz ± 299.83 Hz (standard errors). There were no other significant results.

7.4 Discussion of extralinguistic factors

With respect to the results, the first hypothesis predicting an association of higher CF's *LOR* to more phonetic CLI in the indicator variables (see section 7.1) was not confirmed. No relationship between *LOR* and indicator variables was found. This result is in contradiction with the studies of Bergmann et al. (2016); Dmitrieva et al. (2010); Kupske and Alves (2016); Lang and Davidson (2019) who found the significant impact of LOR on phonetic CLI. It was assumed that due to the similarity between this and the aforementioned studies in the values of LOR the impact would be found. Schmid (2011) highlighted the probability of a significant impact of LOR's on phonetic CLI was likely to be higher if bilinguals' with an LOR lower than 10 years were included. Even if our CF represented a large range of LOR values including low values, the impact was not found. Thus, our result is similar to Sůčková's (2020) who did not find a significant impact on phonetic CLI, even including in her work bilinguals with LOR lower then 10 years (see subsection 2.4.2). The difference between our results and Bergmann et al. (2016); Dmitrieva et al. (2010); Kupske and Alves (2016); Lang and Davidson (2019) may be explained the use of a different methodology. As mentioned in subsection 2.4.2, Kupske and Alves (2016); Lang and Davidson (2019) studied the impact of LOR by dividing the bilinguals into two groups according to their LOR or cumulative experience with the L2 and compared the groups without taking other extralinguistic factors into account. Bergmann et al. (2016) used a linear mixed-effects model including, in addition to the LOR, bilinguals' L1 as a factor. Dmitrieva et al. (2010) conducted Pearson correlation in order to investigate the relationship between the phonetic CLI and L2 experience score (see subsection 2.4.2). Thus, we may see that these authors examined in general one extralinguistic factor or at most two extralinguistic factors at the same time. I suppose that the methodological approach might have an impact on the statistical results. Using models of multiple linear regression containing four predictor variables (i.e., four extralinguistic factors) rather than one or two, that might be linked to phonetic CLI, a more realistic result is created. Nevertheless, by *Preferred identity*, *Proficiency in French* and *Use of Czech*, I divided CF into subgroups which were similar in their number but might be considered as insufficiently numerous for statistical comparisons (see the subgroups in Appendix F). Thus, having an important impact on our results.

The second hypothesis, predicting that lower amount of *Use of Czech* of CF will be related to more phonetic CLI in the perceptual indicator variable but not in acoustic indicator variables was confirmed only partially. Indeed, we found no significant relationship between phonetic CLI in acoustic indicator variables and *Use of Czech*, a result similar to that in Bergmann et al. (2016); De Leeuw (2008); Sůčková (2020), see subsection 2.4.2. Nevertheless, there was also no significant relationship between phonetic CLI in the perceptual indicator variable and *Use of Czech*, a result that differs to Bergmann et al. (2016); De Leeuw (2008), but similar to the one of Sůčková (2020). Here again, one might suppose that no significant impact of phonetic CLI in the perceptual indicator variable on *Use of Czech* may be due to the methodology used, consisting in putting the four predictor variables in the same multiple linear regression model.

Interestingly, the third hypothesis, concerning the impact of *Proficiency in French* on phonetic CLI was not confirmed as it was predicted that more phonetic CLI with higher *Proficiency in French*, would be found. However, contrary to what was expected, */ɦ/ kurtosis in SS* was higher in CF subgroup with higher *Proficiency in French* than that with lower *Proficiency in French* meaning that CF with higher *Proficiency in French* showed less phonetic CLI in */ɦ/ kurtosis in SS* than those with lower *Proficiency in French* (see subsection 7.2.4). In addition, */x/ COG in RT* was lower in CF subgroup with higher *Proficiency in French* than in that with lower *Proficiency in French* meaning that CF with higher *Proficiency in French* showed less phonetic attrition in /x/ *COG in RT* than those with lower *Proficiency in French* (see subsection 7.2.4). This could be explained as the phonetic CLI in Czech /ɦ/ and /x/ being linked to the dissimilation effect between these two sounds and French rhotic consonant (see section 6.8), CF with lower *Proficiency in French* needed to deepen the distance between Czech /ɦ/ and /x/ and French rhotic consonant in their phonetic space and thus show bigger dissimilation effect. By contrast, the CF who had a higher *Proficiency in French* and had already mastered the French rhotic consonant well, were unlikely to perceive it as a potential concurrent of Czech /ɦ/ and /x/. This result might be also related to Chang's (2010) supposition that phonetic drift may occur rapidly, in the beginnings of L2 learning when a near to native-like L2 proficiency is not achieve yet. Thus, we found a significant impact of L2 proficiency on phonetic attrition as found by Major (1992) (see subsection 2.4.2), even if this author's results were opposite to the present study: in his study, higher proficiency in L2 was associated with more phonetic CLI. We suppose that this contradiction between our result and Major's (1992) may be as we did not focus on the same phonetic features of the same speech segments as the author.

Our fourth hypothesis concerning the variable *Preferred identity* was not confirmed as this variable showed no significant impact on phonetic CLI. From this result, it seems that preference for Czech of French country, culture and language of CF did not impact the degree of phonetic CLI that the speakers underwent. One might be tempted to generalise such a result by claiming that this variable does not have an impact on the degree of phonetic CLI that the bilingual undergoes. However, as the number of our CF is limited for statistical comparison when divided into subgroups it is important to avoid overgeneralising.

Finally, concerning the results of correlations inside indicator variables examined (see section 7.3), we may observe that strong positive correlations were rare between indicator variables, and they the most often occurred between the same feature in the reading aloud task and semi-spontaneous speech or between similar or identical features of two phonemes (e.g., *COG* of two variables, $F1$ of first variable, $F2$ of the second). Concerning strong negative correlations, we may observe that they occurred mainly between *COG* and *kurtosis* values (which is a logical correlation because of the link between *COG* and *kurtosis*, see subsection 6.4.1 for a further explanation), and in a few cases, between phonetic features of the same phoneme or two vowels. The correlation between *COG of /r/ in RT* and */ɪ/ F2 in RT* seems to be coincidental rather than an explicable finding. Therefore, the indicator variables can be seen as operating individually, without being related each other, if they correlate, the correlation seems to be comprehensive and predictable, as seen in the correlation between *COG* and *kurtosis* or between the same feature in the reading aloud task and in semi-spontaneous speech. Interestingly, any acoustic indicator variable correlated with *mean response in SS*, i.e., our perceptual indicator variable. From that, we may suppose that none of our acoustic indicator variables is sufficient to predict on its own how CF's L1 speech will be perceived by a monolingual Czech listener.

7.5 Summary of the chapter

The present chapter focused primarily on the relationships between CF's phonetic CLI in twenty indicator variables (obtained from the results presented in chapter 5 and chapter 6) and four predictor variables which were *LOR*, *Preferred identity*, *Proficiency in French* and *Use of Czech*. *Preferred identity* referred to the CF's preference for Czech country, culture, and language. The predictor variables were constituted from the data collected after the recordings of CF by the extralinguistic questionnaire. The chapter also provided a general portrait of CF obtained from first observations of the data collected by the extralinguistic questionnaire. An examination of correlation between indicator variables was conducted.

The portrait of CF was drawn by dividing them into two categories taking into consideration their reason of living in France, job, L1 of the partner they live with, number of children and whether they are already graduates. We saw that the first category is primarily composed of university students who did not live with a French partner and did not have children, whereas the CF from the second category were primarily living with a French partner, had children and a profession. The analysis of correlations between indicator variables showed that few of them are strongly correlated. If they strongly correlate, the correlation is comprehensive and predictable, for example the correlation between *COG* and *kurtosis* or between the same feature in the reading aloud task and in semi-spontaneous speech. Finally, the analysis of relationships between indicator and predictor variables brought only two significant results: CF with higher *Proficiency in French* showed less phonetic attrition in *kurtosis* of /ɦ/ in semi-spontaneous speech and in *COG* of /x/ in reading aloud task than CF with lower *Proficiency in French*.

Discussing the results, we highlighted that even if the results of significant or not significant relationships between predictor and indicator variables may be of interest, they should not be overgeneralised because of the methodological issues that an analysis of extralinguistic data represents. I underlined that these results might be linked to the choice to analyse the relationships by using multiple linear regression models with all four predictor variables inside the model and the number of our CF which is limited for statistical comparison when CF separated into subgroups according to their *Preferred identity*, *Proficiency in French* and *Use of Czech*.

Chapter 8

General discussion

The three previous chapters (chapter 5, chapter 6 and chapter 7) presented the investigation of phonetic CLI in CF's L1 speech and its results. The present chapter consists of a general discussion of these results and commences with a brief overview of the results and their further examination. The chapter also highlights the contributions of the present thesis and discusses the future directions of possible research and the thesis's limitations.

8.1 An overview of results and their comparison

In this section, I provide an overview of all results of this thesis and present possible explanations. I also compare the results of the acoustic study with that of the perceptual test in order to discuss, when taking these both into consideration, whether Major's (1992) finding, that more phonetic CLI occur in informal styles of the speech than in formal ones, might be overgeneralised. Following this, I shall examine the link between the perceived occurrence of phonetic CLI and the acoustically revealed occurrence, i.e., whether the results of our acoustic study confirmed the phonetic CLI in CF's L1 speech perceived by the listeners in the perceptual test.

8.1.1 Rapid overview of all results and further explanations

The results of the perceptual test (chapter 5) and the acoustic study (chapter 6) revealed the occurrence of phonetic CLI in CF's L1 speech and therefore confirmed the general hypothesis of the present thesis predicting phonetic CLI in CF's L1 speech (see chapter 4). We saw that the speech items of CF's L1 semi-spontaneous speech were perceived as less typically Czech sounding by Czech monolingual listeners, which I interpreted to be linked to the occurrence of phonetic CLI in these items (see chapter 5). From this result, I addressed the first research question given in section 4.1: CF's L1 semi-spontaneous speech may be perceived by Czech monolinguals as less native-like because of the presence of the phonetic CLI, but their

L1 production in reading aloud task cannot. From the acoustic study, we saw that phonetic CLI occurred in CF's spectral characteristics of mainly /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, and /x/ and in CF's normalised duration of /r/ and its spectral moments in both, reading aloud task and semi-spontaneous speech, while the first three formants of CF's /r/ were affected by phonetic CLI only in the reading aloud task. It also occurred in CF's spectral moments of /ɦ/, in cadences used for non-conclusive intonation patterns by CF and in their use of stuck schwa in semi-spontaneous speech (see chapter 6). By these results, we answered our second research question (see section 4.1) querying in which phonetic features of the CF's L1 speech CLI occur and can be revealed by acoustic measurements. We saw that some CLI revealed by acoustic measurements may be present in CF's L1 semi-spontaneous speech, but not in their L1 production in reading aloud task or vice versa. Finally, to answer the third research question, how are extralinguistic factors related to phonetic CLI in the CF's L1 speech (see section 4.1, the results of the examination of extralinguistic factors (see chapter 7) showed only that CF with higher *Proficiency in French* showed less phonetic attrition in *kurtosis* of /ɦ/ in semi-spontaneous speech and in *COG* of /x/ in reading aloud task than CF with lower *Proficiency in French.* (For more detailed results of the perceptual test, acoustic study and the examination of extralinguistic factors, see chapter 5, chapter 6, and chapter 7.)

I have already discussed these results in the individual discussions at the end of chapter 5, chapter 6 and chapter 7, related them to the results of the studies presented in section 2.3 and linked them to the models presented in chapter 1. I also highlighted the fascinating finding of the coexistence of dissimilation and assimilation effect in the same L1 phoneme. In the following paragraphs, I query whether the explanation of the results of the studies of phonetic CLI (see section 2.3) proposed by the author may provide further possible explanations for the results of this thesis.

In the studies of Bergmann et al. (2016); De Leeuw (2008); Mayr et al. (2020); Sancier and Fowler (1997), the L1 speech of late bilinguals was perceived as less native compared to the L1 speech of monolinguals (see section 2.3). A similar result was found in the perceptual test concerning CF's L1 semi-spontaneous speech. To explain this result, authors often relate it to the presumption of SLM that L1 and L2 sounds exist in a common phonetic space, and thus, influence each other (see, e.g., Bergmann et al., 2016). Similarly I related the results of the perceptual tests to the presumption shared by SLM, PAM-L2 and SLM-r about a common phonetic space in which L1 and L2 sounds interact, and highlighted that the result concerning CF's L1 speech obtained in the perceptual test, in this sense, supports the claim of SLM-r that L1 and L2 of a bilingual may never by as native because of these interactions (see subsection 1.2.6). Sancier and Fowler (1997) proposed another less typical explanation concerning the perception of L1 speech of the bilingual speakers by L1 monolingual listeners. The author suggests that speakers are disposed to imitate the sound of the ambient language. The author mention that it is evident that individuals are disposed to imitate what they perceive which was shown by unintentional imitation of facial expression by adults (McHugo, Lanzetta, Sullivan, Masters, & Englis, 1985). Sancier and Fowler (1997) relate the imitation to the Direct Realist Theory (see subsection 2.1.5) and suggests that the speakers unintentionally imitate the ambient language by the same mechanism as they use for imitation of facial expression explained in McHugo et al. (1985). I believe this interesting explanation of phonetic CLI might also be employed to understand the perceptual test results. Indeed, many comments of the listeners suggested 'French pronunciation' in Czech of CF (see section 5.3). In this sense, it might be supposed that CF imitated unintentionally the French language they were exposed to. It might also be supposed that they are in their everyday lives more exposed to spontaneous French speech than to the texts read aloud in French. Consequently, they might be more disposed to imitate the speech style to which they are exposed more often. This fact might explain why their L1 semi-spontaneous speech was perceived as less typically Czech sounding by the listeners in comparison to their L1 production in the reading aloud task.

In several studies of phonetic CLI (e.g., Bergmann et al., 2016; Flege, 1987; De Leeuw, 2008; Major, 1992, see section 3.3), phonetic CLI in a given phonetic feature of a phoneme in the L1 speech of late bilinguals occurred as assimilation effect. The results of the acoustic study showed the same, i.e., many found phonetic CLI were explained as assimilation effect. Authors have primarily explained the found assimilation effects by the claim of SLM that similar L1 and L2 sounds exist in the same phonetic category (see, e.g., Bergmann et al., 2016; De Leeuw, 2008). SLM-r reaffirmed this consideration by the term of 'composite L1–L2 phonetic category' in which similar L1 and L2 sound interact with each other. Similarly, the found assimilation effects in the acoustic study may be understood by this claim of SLM and SLM-r.

Nevertheless, note that in the studies reviewed in section 2.3, only Sůčková (2020) found a dissimilation effect in the production of word-final voiced stops by the group of late bilinguals. By contrast, the results of the acoustic study showed that phonetic CLI in CF's L1 speech occurred more than one time as dissimilation effect (see table 6.10 and table 6.11 for the reminder). I have already mentioned that many of these dissimilation effects, especially in the reading aloud task occurred in normalised formant values of vowels by the Lobanov method, I have expressed doubts over its use in chapter 6. Beside the dissimilation effects in vowels, the phonetic CLI found in Czech /ɦ/ and /x/ in the acoustic study might also be interpreted as a dissimilation effect in the sense of deepening the distance between the two Czech fricatives (/ɦ/ and /x/) and the French rhotic consonant (see section 6.8). However, this interpretation might have an important consequence when related to Chang's (2010) proposal based on his results. Indeed, Chang (2012) states that L1 and L2 phonetic categories that are already very far from each other probably do not need to dissimilate. Chang (2012) reminds that also Flege et al. (2003) considered the possibility of an L2 sound which is distant from an L1 category in the phonetic space that a new category established for it will not influence any Ll category. Therefore, Chang (2012) supposes that if L1 and L2 sounds are very different, they will exist in different phonetic categories, which will be sufficiently distant from each other meaning that the dissimilation effect will not occur. To relate this consideration to the results concerning the found phonetic CLI in /ɦ/ and /x/ means that if this phonetic CLI is the dissimilation effect (i.e., a deepening of the distance between these two Czech fricatives and French rhotic consonant), the CF did not perceive the Czech /ɦ/ and /x/ and French rhotic as very different sounds which I consider to be interesting.

Moreover, the examination of predictor variables shown that dissimilation effect between the two Czech fricatives (/ɦ/ and /x/) and French rhotic consonant was bigger for CF with lower *Proficiency in French* than for CF who had a higher *Proficiency in French* (see chapter 7). This result, in the light of Chang's (2010) proposal mentioned in the previous paragraph, might mean that CF with a lower *Proficiency in French* perceive the Czech /ɦ/ and /x/ and the French rhotic as not dissimilar sounds because a large dissimilation occurs between these sounds in their phonetic space. By contrast, this result might mean for CF with a higher *Proficiency in French* that they perceive the Czech /ɦ/ and /x/ and the French rhotic as very dissimilar because a small or no dissimilation is likely to occur between these sounds in their phonetic space. This interpretation of the result is particularly interesting. However, the study of our predictor variables have several limitations (see chapter 7 and below) which may question the veracity of the found relationship between CF's *Proficiency in French* and the degree of dissimilation effect between the two Czech fricatives (/ɦ/ and /x/) and the French rhotic.

8.1.2 Phonetic CLI in formal and informal styles of speech

When comparing the results of the perceptual test with those of the acoustic study, both revealed more phonetic CLI in CF's L1 semi-spontaneous speech than in their production in the reading aloud task. While one could argue that, in the acoustic study, more phonetic features were studied in CF's L1 semi-spontaneous speech than in their production in the reading aloud task, when comparing the percentage of phonetic features in which phonetic CLI occurred for each *task* separately, the percent is slightly higher for semi-spontaneous speech than for the reading aloud task (see section 6.8). Therefore, these results seem to suggest those of Major (1992) that more phonetic CLI are likely to occur in informal styles of speech than in formal styles of speech. In section 2.3, we mentioned that Flege and Hillenbrand (1984); Flege and Eefting (1987b) also compared the amount of phonetic CLI in different speech production tasks involving more and less formal styles of speech. Flege and Hillenbrand (1984); Flege and Eefting (1987b) did not find any significant effect of speech production tasks on VOT values of the bilinguals' L1 /t/ they examined (see section 2.3). We stated that this result of Flege and Hillenbrand (1984); Flege and Eefting (1987b) may be due to the format of the experiment, i.e., telling an invented story containing phrases read directly before, and the production of a created sentence containing the phrase read directly before may not, in my opinion, lead to the production of speech sufficiently spontaneous enough for more CLI to appear, than in the speech elicited by reading phrases (see section 2.3). Therefore, I discuss in the following paragraphs my results mainly with those of Major (1992).[1]

Major (1992) examined in his study only VOT of voiceless stops (see section 2.3) and found more phonetic CLI in informal conversation than in the reading of the word-list, and production of sentences containing the read word directly before. Our acoustic study showed a slightly contrasting result. Indeed, the results of our acoustic study suggest that occurrence of more phonetic CLI in informal styles of speech than in formal styles of speech, might be probable when the speech is examined more globally, i.e., in more than one of the phonetic features of a few segments or suprasegments. In our acoustic study, we focused on several speech segments and two suprasegments, and examined several of their acoustic characteristics. In our perceptual test, listeners rated speech segments composed of at least one clause meaning that they perceived more than one phonetic feature of a small number of segments. Therefore, I suggested that the acoustic study, as well as the perceptual test, gave a more global representation of CF's L1 speech than if it had focused solely on one phonetic feature of a few speech segments. I also suggested that, due to that fact, it was found, on the whole, that more phonetic CLI was found to be in CF's L1 semi-spontaneous speech than in their production during the reading aloud task.

In contrast, if we compare the number of CLI in each examined segment or suprasegment separately from each *task* in our acoustic study, in some of the segments, phonetic CLI were more numerous in CF's L1 production in the reading aloud task, than in their semi-spontaneous speech. It was the phonetic CLI in CF's

[1]Note that the exact question discussed here is whether phonetic CLI occurs more in informal styles of speech than in formal ones, meaning that I do not compare acoustic properties of speech produced in different speech production tasks, but I compare the phonetic CLI occurring in different speech production tasks. It is generally known that acoustic properties of speech produced in reading aloud tasks, and those of spontaneous speech differ. (See, for example, subsection 6.3.1 in which I presented the formant values of Czech and French vowels when produced in reading aloud tasks and in semi-spontaneous speech.) Nevertheless, in this thesis, I did not compared acoustic properties of CF's production in the reading aloud task with their semi-spontaneous speech, but I compared their production in the reading aloud task with C's production in that task. I also compared CF's semi-spontaneous speech with that of C.

/r/ and /u/ (see Table 6.10 and Table 6.11). This result means that one should not overgeneralise the findings of Major (1992). Should it be assumed that an examination of one phonetic feature, in a few segments, is sufficient to show that phonetic CLI is more likely to occur in late bilinguals' semi-spontaneous speech, than in their production in the reading aloud task? Should it be suggested that Flege and Hillenbrand (1984); Flege and Eefting (1987b) did not find the differences in the amount of phonetic CLI, in the different speech production tasks, because they examined solely one phonetic feature of one speech segment (VOT of /t/), and not the bilinguals' speech on the whole? Indeed, except for the previously mentioned /r/ and /u/, in our acoustic study, phonetic CLI in semi-spontaneous speech and in the reading aloud task, occurred either similarly or more frequently in the former than in the latter (see Table 6.10 and Table 6.11). If we look in detail at the found phonetic CLI in /r/ and /u/, we may see that these concern their formant values (see *idem*), mainly when normalised by the Lobanov method. In subsection 6.3.4, we also saw that less phonetic CLI occurred in the formants of vowels in CF's semi-spontaneous speech than in their production from the reading aloud task, when the formants were normalised using the Lobanov method. From these observations, it might be discussed whether the higher level of phonetic CLI found in these segments, in the CF's L1 production in the reading aloud task, than in their semi-spontaneous speech is not simply linked to the use of the Lobanov method for their formant normalisation. However, without normalisation, $F1$ of /r/ also showed phonetic CLI in the reading aloud task but not in semi-spontaneous speech. Therefore, $F1$ of /r/ remains the only phonetic feature that does not allow overgeneralising Major's (1992) finding, and allows us to state that, when studying a late bilingual's speech by focusing only on one phonetic feature of a few segments, phonetic CLI occurs more in informal styles of speech than in the formal ones.

8.1.3 Correspondence between perceived and acoustic CLI

Taking both the results of our acoustic study and perceptual test one can ask: Did the acoustic study reveal the same phonetic CLI in CF's L1 speech as the one perceived by Czech monolingual listeners? Concerning the vowels, we found phonetic CLI in /aː/, /ɛː/ and /iː/ in the acoustic study however, these vowels were not commented on by the listeners meaning that it is unlikely they perceived the phonetic CLI in these vowels. Conversely, the listeners commented on /o/, /a/ and /uː/ in which we found no significant phonetic CLI. Concerning the /ɛ/, the listeners frequently commented as "French" which might let us suppose its assimilation in its spectral characteristics. Nevertheless, we found assimilation only in its $F1$ when produced in semi-spontaneous speech and normalised by Lobanov method. The listeners on commented this phoneme as differing in quality which is understandable as its spectral characteristics differ: indeed, the acoustic study revealed a phonetic

CLI in its $F1$ in semi-spontaneous speech and in $F2$ in reading aloud task when formants normalised by Lobanov method. Nonetheless, there was no significant phonetic CLI in its $F1$ in reading aloud task and in its $F2$ in semi-spontaneous speech, meaning that, obviously, CF's /ɛ/ differed from the one of C in its quality but not in all components of the vowels' quality. The listeners also commented the /ɛ/ as closer, which was its case in CF's semi-spontaneous speech when normalised as Lobanov method as its value was lower than the one of C. Concerning the /ɪ/, it was commented by the listeners as "French" which suggests the assimilation effect in its spectral characteristics. We found the assimilation effect by the acoustic study only in its $F2$ when produced in semi-spontaneous speech and normalised by Bark Difference Metric or not-normalised. The listeners also commented it as different in quality. The acoustic study revealed that CF's /ɪ/ differed from that of C in the reading aloud task in its $F2$ and $F3$ when normalised by Lobanov method, and in semi-spontaneous speech in its $F2$ and $F3$ when both were normalised by the Bark Difference Matric method or $F2$ not-normalised. There was no significant phonetic CLI in /ɪ/ meaning that, evidently, CF's /ɪ/ differed in quality from the one of C as noted by the listeners but not in all components of vowels' quality. Moreover, the absence of phonetic CLI in $F1$ of /ɪ/ is contrary to another comment by the listeners, i.e., that the /ɪ/ is closer than usual. The listeners also commented /u/ as more rounded, which might be linked to its $F2$. However, the only phonetic CLI that we found in /u/ when produced in the reading aloud task concerned its $F1$ and not $F2$. Finally, the listeners commented the CF's vowels as generally closer. From Figure 8.1, we may see that it can be a case for certain CF's vowels after Lobanov normalisation when produced in reading aloud task. (For the listeners' comments about vowels, see Appendix E, and for the results of our acoustic study, see chapter 6, mainly table 6.10 and table 6.11.) From this comparison of the listeners' comments concerning vowels and the results of their acoustic study, we may see that a small number of listeners' comments were confirmed acoustically. Nevertheless, this fact might be explained by the essential difference between the acoustic study and the perceptual test: in the perceptual test, the listeners commented on the selected speech items which did not represent the totality of the recorded speech, whereas, in the acoustic study, the totality of the recorded speech was examined. Thus, it might be possible that the listeners commented on the speech items in agreement with their acoustic properties. However, as one given acoustic property was investigated in all recorded speech, the statistical significance of the commented property could not have to reach. Note also that when the listeners' comments on vowels did not specify the vowel length, I considered that the comment concerns the short vowel. For example, the comment "strange e" was interpreted as strange /ɛ/. Though, it might be possible that by "strange e" the listener meant both Czech e-sounds, the short /ɛ/ and /ɛː/. Thus, that listeners also might perceive some phonetic CLI in

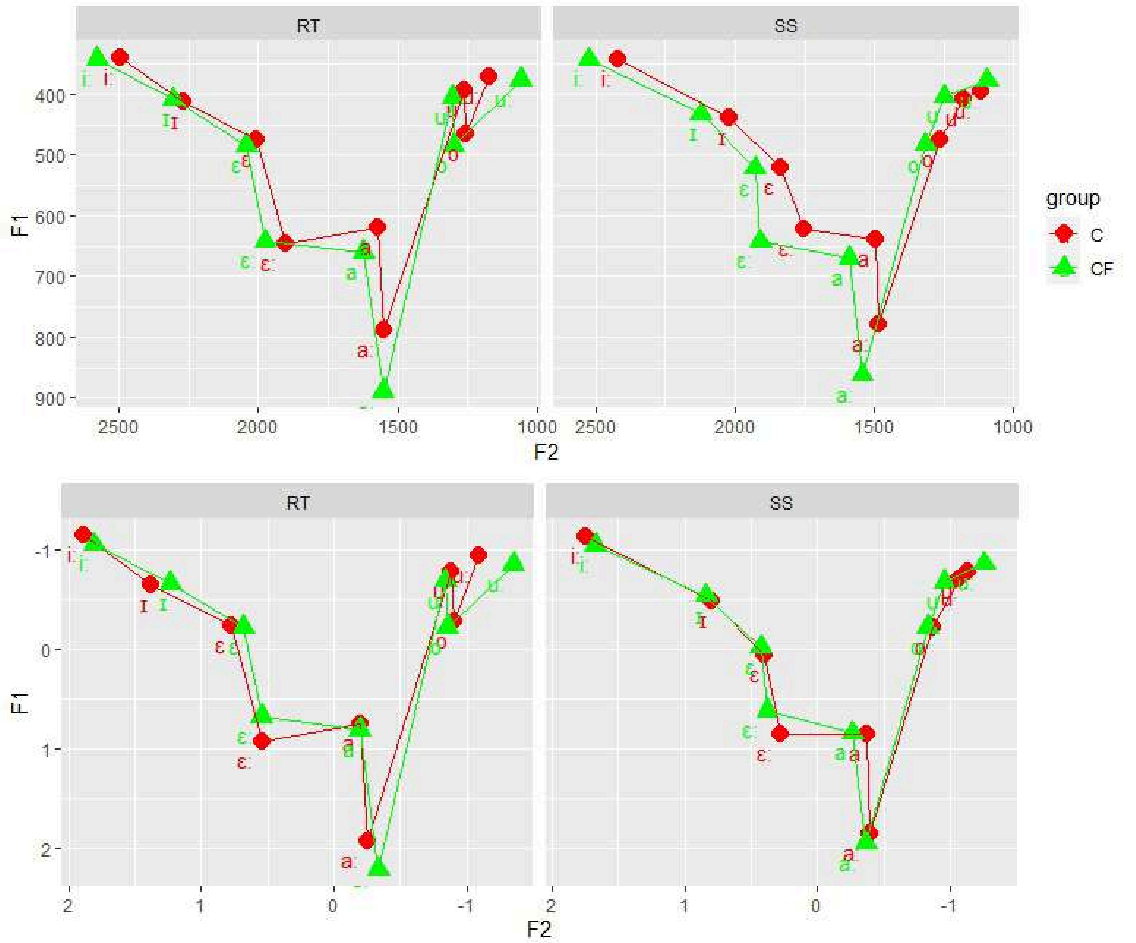


Figure 8.1: Mean formant values of C's and CF's vowels plotted in $F1/F2$ plane.

Note: The upper half of figure was obtained from not-normalised formant values in Hz, the lower half of figure obtained from normalised formant values by Lobanov method. RT=reading aloud task, SS=semi-spontaneous speech.

long vowels, perhaps those found in the acoustic studies. Indeed, in a small number of comments, the listeners specified that they concerned long vowels.

Concerning the /r/, listeners commented that it was not Czech but French. The acoustic study showed that CF's /r/ in each *task* differed from the one of C in its spectral moments and was approached according to that the French rhotic uvular consonant in its manner and place of articulation. The listeners commented the /r/ as multi-cycle, which might be revealed by its longer normalised duration. However, this was only the case in CF's production in the reading aloud task. In their semi-spontaneous speech the contrary occurred. Finally, the /r/ was commented by the listeners as uvular which the results of spectral moments of /r/ seem to confirm for its production in each *task*. Nevertheless, the found phonetic CLI in CF's /r/ formants allows considering CF's /r/ to be uvular only partially: indeed, it had higher $F1$ and lower $F2$, which characterised uvular rhotic, but it also had lower $F3$, which cannot be interpreted without doubts as assimilation of CF's /r/ to uvular rhotic.

Moreover, the phonetic CLI in formants of /r/ occurred only in CF's production, in the reading aloud task and mainly when normalised by Lobanov method. (For the listeners' comments about /r/, see Appendix E, and for the results of our acoustic study about /r/, see subsection 6.4.4, mainly table 6.10 and table 6.11.) Thus, generally, the listeners' comments about /r/ were confirmed by the results of the acoustic study. Nevertheless, whether CF's /r/ is uvular remains uncertain because of its $F3$. Similarly, CF's /r/ seems to be multi-cycle more often in CF's semi-spontaneous speech than in their production in reading aloud task.

Concerning the phonemes /x/ and /ɦ/, the predictions for their acoustic analysis were based on the comments of the listeners (see subsection 6.5.1 and subsection 6.5.2). Firstly, the listeners commented the /ɦ/ as being replaced by /x/. The acoustic study revealed that CF's /ɦ/ in semi-spontaneous speech is nearer in its spectral moments to C's /x/ than /ɦ/ of C. Nevertheless, there was still a significant difference between spectral moments of CF's /ɦ/ and C's /x/ in semi-spontaneous speech meaning that CF's /ɦ/ was not completely replaced by /x/ in semi-spontaneous speech. The listeners commented the /x/ as untypical, not Czech or with a wrong pronunciation. The acoustic study showed the differences between spectral moments of /x/ produced by C and the one produced by CF in reading aloud task as well as in semi-spontaneous speech which confirmed the listeners' comments. Another listeners' comments indicated absence of pronunciation of /ɦ/ and /x/ and that /x/ pronounced like unvoiced /h/. However, as the acoustic study did not examine these comments, they were not verified. Nevertheless, the acoustic study revealed the difference between spectral moments of /ɦ/ in semi-spontaneous speech produced by C and CF, the CF /ɦ/ in semi-spontaneous speech is probably less typically Czech than that of C which was not commented on in this way by the listeners. (For the listeners' comments about /x/ and /ɦ/, see Appendix E, and for the results of our acoustic study, see tables 6.10 and 6.11) Thus, to summarise about /ɦ/ and /x/, on the one hand, the listeners perceived more phonetic CLI than we verified in the acoustic study, on the other hand, we found one phonetic CLI which was not clearly noted by the listeners. Moreover, the listeners perceived one phonetic CLI that was confirmed by the acoustic study and one which was not confirmed. To explain the last, we suppose that it might be due to the reason already mentioned for the vowels: in some speech items, /ɦ/ was probably replaced by /x/ in CF's production but, when examining the totality of the speech, it was not significant.

At suprasegmental level, the results of the acoustic study of non-conclusive intonation patterns in CF's semi-spontaneous speech confirmed listeners' comments of intonation as very rising, with more important rising pattern, rising at the ends, and untypical for Czech as CF showed significantly higher *ratio_of_very_high_rising* than C. As we saw, the cadences used by them for non-conclusive intonation patterns in semi-spontaneous speech were probably near to these normally used in French. Therefore, another listeners' comment on intonation, considering it as French, seems to be confirmed. The listeners commented the intonation was also variable. However, this was not examined in the acoustic study. Concerning the stuck schwa, the listeners commented on it as a hesitation schwa stuck to the last consonant of the word and not Czech hesitation. The analysis of *Percent_schwa* and the presentation of stuck schwa in Czech and in Standard and southern French in chapter 6 and chapter 3 showed that CF's stuck the schwa to the end of the words in their semi-spontaneous speech significantly more often than C, and that some of these stuck schwa might be considered as a mark of hesitation. Therefore, we may consider that listeners' comments about stuck schwa were confirmed in chapter 6. (For the listeners' comments about stuck schwa and intonation, see Appendix E, for the results about their analysis, see table 6.11.)

Thus, the acoustic study confirmed the listeners' perception of certain phonetic characteristics during the perceptual test which they communicated in their comments. We saw that the study of stuck schwa and non-conclusive intonation pattern in chapter 6 seems to fully confirm the comments made by the listeners in the perceptual test, i.e., their perception by the listeners. In contrast, at a segmental level, listeners' comments about some phonetic features of segments examined in chapter 6 were in agreement with the results of their acoustic analysis, whereas others were not. To explain the latter, I argued that even if a given phonetic CLI is perceived in a speech segment by the listener, it may not reach statistical significance when examining all recorded speech as the speech items in the perceptual test did not represent all recorded speech. We also argue that even if an effect (dissimilation or assimilation) may be perceived in a speech item by the listener, the acoustic study may show the opposite effect as when studying all recorded speech, a given perceived effect in one speech item may become insignificant in comparison to the general opposite effect in all recorded speech.

8.2 Contributions of the thesis

In this section, the theoretical and methodological contributions of the thesis are discussed.

8.2.1 Theoretical contributions

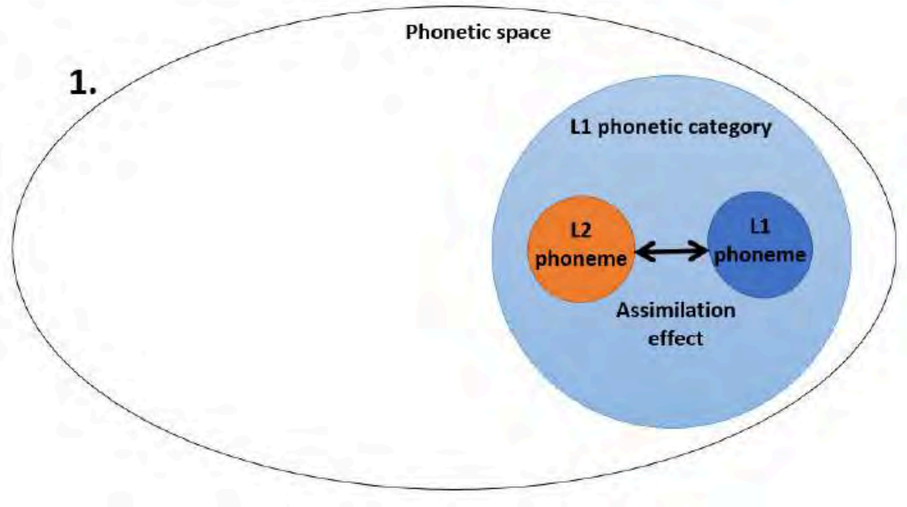
Among the theoretical contributions of the present thesis, we may distinguish the one which is linked to the models of L2 speech production and perception (section 1.2) and the other which are related to phonetic CLI (section 2.3). Concerning the former, we have already evoked in section 6.8 that, according to the result of our acoustic study, dissimilation and assimilation effect may coexist in the same L1 phoneme produced in the same *task* by the same speaker: the dissimilation effect occurred in one acoustic characteristic of the phoneme while the assimilation effect occurred in another acoustic characteristic of the same phoneme. To explain that, I proposed the conception of the formation of a new L2 category as a long process. In this process, the L2 phoneme is moving away from the L1 phonetic category where it coexisted with the L1 phonemes together (see section 6.8). This leads us to imagine a phonetic space of the speaker as a dynamic place in which an L2 phoneme, when a new phonetic category for it was not established from the beginning of L2 acquisition, may undergo the following three stages in the development of its classification:

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 effect (see fig. 8.2a).

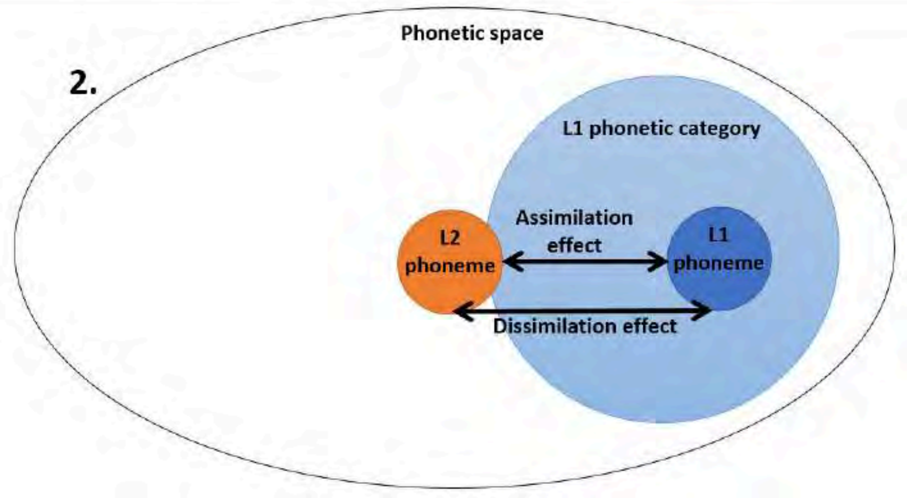
2. With growing L2 input, L2 experience and dependently on other factors mentioned by SLM-r (see subsection 1.2.6), the L2 phoneme starts to be perceived as sufficiently different for being classified in a separated phonetic category. The L2 phoneme starts to move away from the L1 phoneme, thus removed 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 (see fig. 8.2b).

3. With growing L2 input, L2 experience and depending on other factors mentioned by SLM-r (see subsection 1.2.6), 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 (see fig. 8.2c).

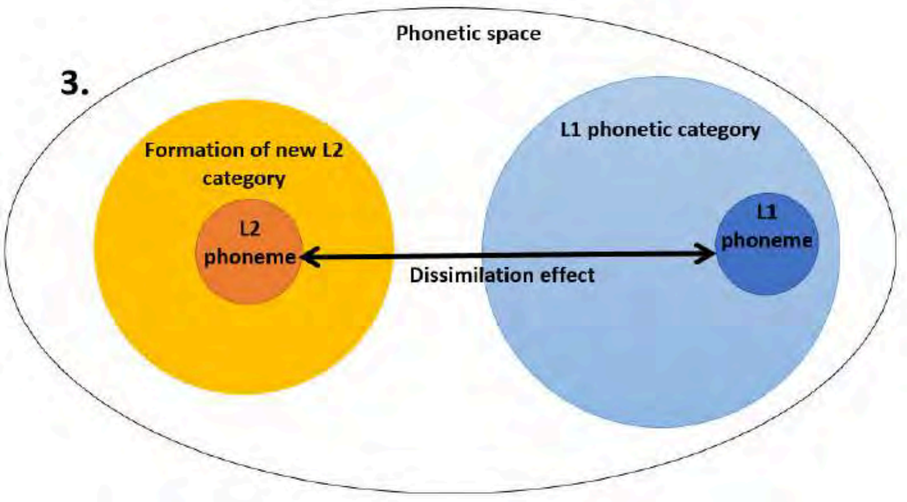
This proposal of the three stages of development of L2 phoneme classified in the L1 category seems reasonable. However, no model of L2 speech production and perception has yet made this proposal. Thus, several studies will be needed in the future in order to verify its accuracy. Nevertheless, this proposal of the 3-stages development of L2 phoneme classified in the L1 category has potential to be



(a) Stage 1.



(b) Stage 2.



(c) Stage 3.

Figure 8.2: 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.

an essential contribution from the present thesis to the phonetic studies of second language acquisition. Finally, it is important to note that according to our results, the 3-stages development of L2 phoneme classified in the L1 category may occur primarily in an L2 phoneme which differs in its IPA symbol from a given L1 phoneme but at the same time is acoustically and perceptually similar to the L1 phoneme, probably the main reasons for which it is classified in an L1 category in the beginning of L2 learning. Moreover, the proposal of the 3-stages development of L2 phoneme classified in the L1 category may be important for the interpretation of the results of future studies on the phonetic influence of L2 on L1. As demonstrated in section 2.3, authors examining phonetic CLI has yet to find the coexistence of dissimilation and assimilation effect in the same phoneme. We may consider that it is because the number of studies of phonetic CLI is still limited, and thus, not all possible cases of its occurrence were revealed. Moreover, many of these studies, when focusing on a speech segment or suprasegment, examined only one phonetic feature of this segment meaning that there was no large possibility to find the dissimilation and assimilation effects in different phonetic features of the given segment or suprasegment.

Another important theoretical contribution of the present thesis concerns a generally missing correlation among acoustic features where the CLI was found. We saw in chapter 6 that phonetic CLI occurred in several acoustic features of several CF's speech segments and suprasegments, and in chapter 7, that these CLI, in general, do not correlate one another (there were some strong correlations which are logical, for example, between *COG* and kurtosis, or a given phonetic feature in the reading aloud task and semi-spontaneous speech). To illustrate, fig. 8.3 displays a scatter plot of the *ratio* indicating very high rising intonation in non-conclusive intonation patterns in semi-spontaneous speech and normalised $F1$ of /aː/ by the Lobanov method in the reading aloud task. On the example of fig. 8.3, we see that missing correlation means that in a situation when we have two phonetic features in which CLI can potentially occur, phonetic CLI may occur in the first feature but not in the second for one CF's speaker, it may occur in both features for a next CF's speaker, and it may occur in the second feature but not in first for another CF's speaker. Consequently, the missing correlation among phonetic features in which we found phonetic CLI means that the phonetic feature in which CLI occurs varies with the CF's speaker. In this sense, the findings of the present thesis confirm that organisation inside phonetic space of the speaker vary with the speaker as claimed by the new SLM-r specifying which factors related to the individual speakers may be a cause of this variation (see subsection 1.2.6).

This thesis has also shown that Czech and French is a particularly interesting pair of languages that differ at phonetic level (see chapter 3) sufficiently for allowing the phonetic CLI's occurrence (see chapter 5 and chapter 6). This way, the thesis brought an important contribution to the research area of phonetic L2 influence on

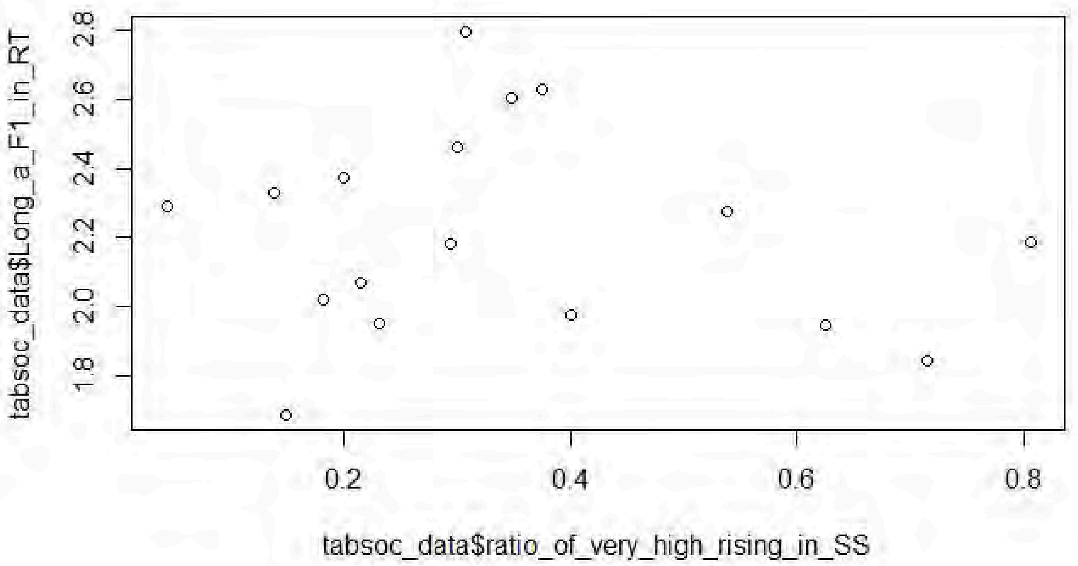


Figure 8.3: Scatter plot of *ratio_ of_ very_ high_ rising* in semi-spontaneous speech and normalised $F1$ of /aː/ in reading aloud task.

Note: $F1$ normalised by the Lobanov method. in both *ratio* and $F1$, higher value means more phonetic CLI.

L1 by indicating that the Czech French language pair merits further examination in this area.

8.2.2 Methodological contributions

At a methodological level, the present thesis showed that HNR and spectral moments may be pertinent indicators of phonetic CLI when the given phoneme differ in these in L1 and L2. We saw in section 2.3 that authors studying phonetic CLI did not examine these. From our study, it also seems to appear that analysing intonation contours by using the approximation of them by Legendre polynomials implemented in the package *rPraat* is an appropriate method allowing phonetic CLI in intonation to be revealed. Those authors who examined phonetic CLI in intonation did not use this methodological approach yet (cf. section 2.3). Moreover, we did not use FAR as many authors studying phonetic CLI have done. The perceptual test used in this present study consisted in one judgement contrary to the FAR consisting of two judgements (see section 2.3 and subsection 5.2.5), and allowed us to examine the perception of phonetic CLI well. Thus, the present thesis offers a new type of perceptual test that may be used to study phonetic CLI. Another significant methodological contribution of the present thesis is how we chose to deal with the statistical analysis of extralinguistic data. We saw in subsection 2.4.2 that though the majority of authors studying phonetic CLI used the same extralinguistic questionnaire (used in this study too), their methodology of analysing extralinguistic data varies. We chose to use k-mean clustering, which allowed the division of CF speakers into a subgroup according to the collected ordinal data, and linear multiple regression, which allowed me to consider that more than one extralinguistic factor may have an impact on phonetic CLI. Indeed, in subsection 2.4.2, we saw that many authors studying phonetic CLI examined only one extralinguistic factor, which might lead to the misinterpretation of their results: one might consider that because the given extralinguistic factor in the studies was found to have an impact on phonetic CLI it is the most important factor. However, this factor may have been impacted by other factors that the authors did not investigate and may have a more important impact on phonetic CLI. In subsection 2.4.2, we also saw that the methodology of computing the extralinguistic factor indicating L1 use may be not sufficiently detailled and explained in studies of phonetic CLI. Bergmann et al. (2016) computed the average from the questions about bilinguals' L1 use in different contexts (work, home and other) but did not give an example of these questions and how the replies were coded. De Leeuw (2008) also computed the average from the "subvariables" contact with L1 at work, the amount of L1 spoken with the present partner, the frequency of visits to L1 country and an overall estimate of amount of contact with L1, which were obtained from questions with five-point Likert scale, later converted to an interval variable between 0 and 1. It is important to highlight that if these studies used the same scales as those in fig. 7.1, which seems to be (see section 2.3), the computing of the mean of L1 use from the collected data by mixing the data collected from the different questions of the questionnaire together is, according to us, inaccurate, as ordinal data is converted to numeric when making the average value. Therefore, to deal with these issues, we used the k-mean clustering for dividing the CF into subgroups without making an average of ordinal data. In this sense, the present thesis brings a new methodological approach for dealing with extralingusitc data collected by the questionnaire, which seems statistically accurate.

In subsection 1.2.3, we saw that phonetic CLI studies are heterogeneous with respect to normalisation of vowels. Some authors did not normalise the vowels without justification (see Chang, 2012; Flege, 1987), another normalised them by Nearey1 formula or Lobanov method because these were found to be the best for cross-linguistic study by Adank et al. (2004). Our study of spectral characteristics of vowels by using two different normalisation methods and analysing non-normalised vowels demonstrates that the results differ with the choice to normalise or not normalise the vowels and a used normalisation method. This result should be considered in future studies of phonetic CLI in vowels and when reading the results of the studies of phonetic CLI in vowels already published.

8.3 Limitations of the thesis and future directions

The present thesis investigated the L1 speech of CF. The phonetic CLI found were interpreted as either assimilation or dissimilation effect or as a *borrowing transfer*. These interpretations were based on the comparison of the acoustic characteristics of CF's L1 speech to these of C's speech, and the comparison of the acoustic characteristics of CF's L1 speech to these of French language as described in the literature (see chapter 6). One might argue that, because for the models of L2 speech production and perception presented in section 1.2 the assimilation occurs when the L2 sound is integrated into the L1 category whereas the dissimilation occurs when it is not, it is also necessary to examine CF's L2 phonemes in order to determine whether the dissimilation or assimilation occurs. In other words, we suppose that acoustic examination of CF's L2 speech would help us to determine whether a given pair of L1 and L2 speech segment or suprasegment coexist in a shared phonetic category or separated phonetic categories. From this, to determine whether the found phonetic CLI is assimilation or dissimilation effect is more accurate than when comparing acoustic properties of CF's L1 speech with these of French as described in the literature.

Another limitation of the present thesis concerns the statistical analyses of vowels' formants (section 6.3) and of extralinguistic factors (chapter 7). Due to analysing the non-normalised vowels and vowels normalised by the Lobanov method and vowels normalised by the Bark Difference Metric method, we computed in total around 15 linear mixed effect models, the risk of type 1 error was relatively high, meaning that some of the significant results found in the analysis of vowels' spectral characteristic are not in reality significant. However, it seemed important to analyse the non-normalised vowels and vowels normalised by the two normalisation methods as the previous studies of phonetic CLI in vowels focused either on non-normalised vowels or normalised vowels by one method. Moreover, this choice allowed us to show that the results vary with the chosen normalisation method and when studying non-normalised vowels. As fig. 6.3 displays the formants of C's and CF', the reader may observe the phonetic CLI on this figure and compare them to the statistical results.

Concerning the statistical analysis of the extralinguistic factors, I consider that the first limit is the questionnaire itself. The questionnaire is based on subjective auto-evaluation and auto-declaration of the speakers, which may be far from the objective reality. Nevertheless, we chose to use this questionnaire in order to follow its traditional use in the research field of phonetic CLI (see subsection 7.2.2). As the found phonetic CLI in the phonetic features of CF's L1 speech did not generally correlate with one another, we examined the relationship of the twenty indicator variables (the found phonetic CLI) with all four predictor variables separately. Therefore, we computed 20 multiple linear regression models. Due to this number of the linear regression models, one might suppose that the type 1 error might also occur in that analysis. In addition, to statistically compare groups or subgroups of speakers, each group or subgroup should be composed of at least 15 speakers. Having four predictor variables, three of them with two levels, we should have at least 120 participants (i.e., 2*2*2*15). However, in the Toulouse area there is not this number of CF. To deal with that issue, it might be possible not to use multiple linear regression for studying extralinguistic factors but student tests. Nonetheless, in that case, it would be necessary to compute 80 student tests, each containing one indicator variable and one predictor variable (4*20). In that case, the risk of type 1 error will be notably higher than when using the multiple linear regression models. Another option might be to reduce the number of predictor variables and focus on a smaller number in the linear regression model. However, in that case, the risk of Simpson's paradox is higher than when including all four predictor variables. Thus, even if the present thesis brought a possibility of a new methodological approach for studying extralinguistic data, this approach may be used only when the number of participants in the study is sufficiently high.

From the first mentioned limitation above emerges one important future direction for studying phonetic CLI in L1 speech of CF. As mentioned in subsection 5.2.2, we also recorded the CF's L2 semi-spontaneous speech. Thus, for the reasons mentioned above, it will be particularly interesting to analyse the CF's L2 semi-spontaneous speech in relation to the phonetic CLI in CF's L1 speech found here.

As mentioned above, the research in phonetic CLI and acquisition of L2 at phonetic level could verify in the future the accuracy of the proposed 3-stages development of L2 sound classified into L1 category. In the research field of phonetic CLI, this could be verified by longitudinal studies, whether the second stage, i.e., whether the coexistence of dissimilation and assimilation effect in the same phoneme occurs in a given temporal moment. In autumn 2019 and winter 2020, I recorded five Czech students in Erasmus program in Toulouse. The data of each were collected at least three times: firstly when they first arrived in Toulouse, secondly, when they stayed in Toulouse for five weeks and thirdly, after three months in Toulouse. In addition, one student was recorded after a year of staying in Toulouse. I hope that studying these recordings will allow us to learn more about the possibility of coexistence of the dissimilation and assimilation effect in the same speech segment or suprasegment when produced by the speaker in a given task. Note also that our conception of 3-stages development of L2 sound classified into L1 category at the beginning of L2 learning is not the only one possible development of L2 sound classified into L1 category. We are conscious that an L2 sound classified into L1 category might also show increasing assimilation effect with the time as some results of Kornder and Mennen's (2021) seem to affirm. Nevertheless, the supposition of the possible change from the assimilation to dissimilation effect (stage 1 and stage 3) in the 3-stage development of L2 sound classified into the L1 category at the beginning of L2 learning is linked to SLM-r. Specifically, to the notion that with increasing L2 input and L2 experience, a new phonetic category for L2 phonemes may be established.

Future research in phonetic CLI might also verify the conjecture that phonetic CLI occurrence is higher in informal styles of speech than in formal ones, mainly when the global speech is examined rather than one phonetic feature. Developing from this thesis, it might also be investigated which is the best and the most accurate normalisation method for studying phonetic CLI in vowels and what new methodological ways for analysing the extralinguistic data might be found.

Part IV

Conclusion

This thesis aimed to investigate phonetic CLI in CF's L1 speech. Therefore, chapter 1 focused on hypotheses and models of L2 speech production and perception in order to discuss which of these might be used for predicting phonetic influence of L2 on L1. In chapter 2, the notions related to phonetic CLI were defined and the studies of phonetic CLI were presented. We saw that given the findings of these studies SLM-r seems to be the most convenient model as it gives us the possibility to explain the differences among speakers, such that found by De Leeuw (2008). De Leeuw (2008) demonstrated that in the same phonetic feature, some speakers may show an assimilation effect, whereas other speakers may show a dissimilation effect. As phonetic differences between L1 and L2 are important according to SLM-r and other models for predicting phonetic CLI, chapter 3 consisted of the comparison of Czech and French phonetic systems. From these theoretical considerations, the general hypothesis and three research questions were determined in chapter 4 and assessed in the three experimental chapters, chapter 5 – chapter 7.

In chapter 5, the first experiment, i.e., the perceptual test, examined phonetic CLI in the L1 speech of 14 CF speakers. The results of the perceptual test showed that Czech monolingual listeners perceived CF's L1 semi-spontaneous speech as less typically Czech sounding, i.e., more French sounding, whereas this was not the case for the perception of CF's L1 production in the reading aloud task. The listeners' comments made during the perceptual test most often concerned the quality of vowels, glottal and velar fricatives, /r/ and intonation. Due to this and given the differences between the phonetic system of Czech and French, we chose to investigate CF's L1 vowels, /r/, global and velar fricatives and intonation in non-conclusive patterns by acoustic measurements in the acoustic study (chapter 6). We also focused on a phenomenon, referred to as stuck schwa in this thesis, as the stuck schwa is typical for Toulouse French, the geographical area where almost all of the CF lived.

The acoustic study focused on the L1 speech of 17 CF speakers and revealed the significant occurrence of phonetic CLI in spectral characteristics mainly of /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, and /x/. This occurrence was also found in the temporal characteristics of /r/ produced by CF in the reading aloud task as well as in semi-spontaneous speech. Concerning the spectral characteristics of CF's L1 /r/, phonetic CLI occurred in its spectral moments in the reading aloud task as well as in semi-spontaneous speech. It also occurred in its first three formants in the reading aloud task. In addition, phonetic CLI occurred in spectral moments of /ɦ/, in cadences used for non-conclusive intonation patterns and in use of stuck schwa in CF's L1 semi-spontaneous speech.

In chapter 7, the results of the perceptual test and acoustic study were used for examination of the relationship between four extralinguistic factors (i.e., predictor variables) and the observed phonetic CLI. The analysis of the four predictor variables which were *LOR*, *Use of Czech*, *Proficiency in French* and *Preferred identity* (i.e., speaker's preference for L1 or L2 country, culture and L1 or L2 themselves) showed that (1) given the number of CF speakers, the extralinguistic factors could not be examined with perfect exactitude, (2) *kurtosis* of /ɦ/ in semi-spontaneous speech and *COG* of /x/ in the reading aloud task were less affected by phonetic CLI when produced by CF with higher proficiency in French than when produced by those with a lower proficiency in French.

Interestingly, this thesis showed that the dissimilation and assimilation effects could coexist in the same phoneme. I discussed this finding primarily in relation to SLM and SLM-r, which both consider that the assimilation effect occurs when L1 and L2 phoneme coexist in the same phonetic category, whereas the dissimilation effect occurs when they exist in separated phonetic categories. We saw that according to this definition, both effects could not coexist in the same phoneme. Thus, given the results of the present study which seem to reveal the contrary, I propose to adjust this conception of the assimilation and dissimilation effects by adding an additional stage. In this stage, the L2 phoneme would be on the margin of the L1 phonetic category, partially inside an L1 category while the other part of it would be situated already outside the L1 category. Therefore, I considered that the assimilation of the L1 phoneme would occur with a part of the L2 phoneme inside the L1 category and the dissimilation with its part outside the category. Nevertheless, I highlighted that due to the limitations of this study, further research is needed to verify my findings.

Concerning this proposal of this stage, I also mentioned that, using a longitudinal study, it might be examined whether the coexistence of the dissimilation and assimilation effects in a given phoneme of a speaker due to CLI, exists in a given temporal moment. It was noted that for such a study, the data collected in autumn 2019 and winter 2020 consisting of speech recordings of five Czech Erasmus students in Toulouse might be considered. If this and other studies find that the assimilation and dissimilation effects can coexist in the same phoneme, the SLM-r assumption that the new phonetic category for L2 phonemes can be established with increasing L2 input and L2 experience might be understood more as a dynamic process including the stage mentioned above than an immediate placement of the L2 sound into that new category.

This thesis has also challenged the question if phonetic CLI is more prone to occur in informal speech styles than in formal ones. Results have been inconsistent with respect to this issue so far (Flege & Hillenbrand, 1984; Major, 1992). According to the results of the present study, phonetic CLI seemed to occur more often in informal speech styles, i.e., in semi-spontaneous speech than in formal speech style (the reading aloud task). This seems to be particularly the case when the speech is studied as a whole, rather than when focusing only on one selected acoustic feature of a phoneme. This assumption would deserve to be re-examined in future studies in order to test its validity.

The limits of studying extralinguistic factors in the area of phonetic influence of L2 on L1 was also discussed in this thesis. I examined common methodologies used by the authors in this field. Indeed, studying extralinguistic factors when using the extralinguistic questionnaire proposed by Monika Schmid on Language attrition website[2] requires dealing with ordinal data. In this thesis, cluster analysis was proposed for dividing the speakers into groups, according to the collected data, and examining the extralinguistic factors using multiple linear regression models. From the statistical point of view, I suggested that this approach seems the most appropriate and might be used in future in the studies of phonetic CLI. Nevertheless, this methodological approach requires many participants in a given study. Therefore, future studies on phonetic CLI may continue to improve the methodological approach proposed for studying the extralinguistic factors.

This thesis also highlighted the issues linked to the normalisation of formants when studying phonetic CLI in vowels. Indeed, on this point, there is no shared methodology used by researchers in the field of phonetic influence of L2 on L1. This thesis showed that normalisation of vowels seems to be a crucial point when studying phonetic CLI in vowels as the results change with the chosen methodological approach. Therefore, it is hoped that, in the future, researchers will find an optimal methodological approach allowing formant values of L1 vowels, produced by both monolinguals and late-bilinguals who underwent phonetic CLI, to be normalised.

In sum, the thesis showed that the phonetic CLI in CF's L1 speech may be perceived by Czech monolinguals and revealed through acoustic measurements. Through its originality in the research field of phonetic CLI, consisting of investigating a pair of languages never studied before, focusing on late bilinguals who lived in the same geographical area without knowledge of each other, and measuring acoustic features never analysed before (HNR, spectral moments), the thesis has opened new possibilities for the research field of phonetic CLI. Indeed, we consider that, in this research field, the language pair of Czech and French might be continued to be analysed. Late bilinguals, similar to CF in the sense of living in foreign country without making an expat bubble, might be studied further in the future, and the findings about their L1 speech might be compared to the findings of this thesis. Finally, I consider that measuring acoustic properties such as HNR and spectral moments which are not usually measured by the authors in the research field of phonetic CLI might be used, as modelled on this thesis, for studying phonetic CLI in the case of language combinations in which their measurements is relevant.

[2]See https://languageattrition.org/.

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Appendices

Appendix A

C and CF speakers

Speaker	Sex	Age	LOR	Perceptual test	Acoustic study
HC109	F	49	NA	yes	no
HC308	F	31	NA	no	yes
HC312	F	36	NA	no	yes
HC314	F	38	NA	yes	no
HC316	F	23	NA	yes	no
HC333	F	37	NA	yes	yes
HC340	M	35	NA	yes	no
HC364	F	23	NA	no	yes
HC505	F	22	NA	yes	yes
HC506	F	25	NA	no	yes
HC508	F	21	NA	no	yes
HC510	F	21	NA	no	yes
HC523	F	43	NA	no	yes
HC561	M	37	NA	yes	no
HC595	F	36	NA	yes	yes
HC615	F	35	NA	no	yes
HC618	F	28	NA	no	yes
HC626	F	29	NA	yes	yes
HC628	F	30	NA	no	yes
HC646	F	49	NA	no	yes
HC650	F	32	NA	yes	yes
HC652	F	45	NA	yes	yes
CF1E	F	23	0.17	yes	yes
CF2E	F	22	0.17	yes	yes
CF3E	F	25	4.25	yes	yes
CF4E	F	36	3	yes	yes
CF5E	F	37	4	yes	yes
CF6E	F	23	3.25	no	yes
CF7E	F	26	1.42	no	yes
CF8E	F	21	0.25	no	yes
CF9E	F	20	0.23	no	yes
CF1A	F	42	15.3	no	yes
CF2A	F	37	7	yes	yes
CF3A	F	22	7	yes	yes
CF4A	F	37	15.33	yes	yes
CF5A	F	38	9	yes	yes
CF6A	F	49	28.25	yes	yes
CF7A	F	42	22.42	yes	yes
CF8A	F	31	8.33	yes	yes
CF9A	F	49	23.33	yes	no
CF10A	M	34	10.33	yes	no

Appendix B

Material for recording

B.1 Material for recording semi-spontaneous speech

Druhý úkol je popovídání v češtině. Nyní Vás požádám, abyste mi souvisle minutu a půl o něčem vyprávěl/a v češtině. Můžete si vybrat jedno z následujících témat:

1. Vyprávějte, co budete dělat během prázdnin
2. Popište, jak vypadá váš typický den
3. Hovořte o vaší práci, o vašem studium
4. Hovořte o vaší rodině
5. Hovořte o vašich koníčcích
6. Vyprávějte, co budete dělat o víkendu
7. Vyprávějte, co jste dělal/a o víkendu

Během Vašeho vyprávění se pokuste nezmiňovat, že bydlíte v Toulouse či žijete ve Francii. Rozuměl/a jste zadání? Máte nějaké otázky

Translation: The second task is talking in Czech. Now I will ask you to talk me during one minute and half about something in Czech. You can choose one of the following topics:

1. Tell what you will do during the holidays
2. Describe your typical day
3. Talk about your job, about your studies
4. Talk about your family
5. Talk about your hobbies
6. Tell what you will do during the weekend
7. Tell what did you last weekend

During your narration, try not to mention that you live in Toulouse or live in France. Did you understand the instruction? Do you have any questions?

B.2 Material for recording reading aloud task

Třetí úkol je přečtení odstavce v češtině. Nyní Vás poprosím o přečtení krátkého úryvku textu. Pokud používáte brýle, tak si je vezměte. Rozuměl/a jste zadání? Máte nějaké otázky?
Když člověk poprvé vsadí do země sazeničku, chodí se na ni dívat třikrát denně: tak co, povyrostla už nebo ne? I tají dech, naklání se nad ní, přitlačí trochu půdu u jejích kořínků, načechrává jí lístky a vůbec ji obtěžuje různým konáním, které považuje za užitečnou péči. A když se sazenička přesto ujme a roste jako z vody, tu člověk žasne nad tímto divem přírody, má pocit čehosi jako zázraku a považuje to za jeden ze svých největších osobních úspěchů.

Translation: The third task is to read the paragraph in Czech. Now I will ask you to read the short text. If you use glasses, take them. Did you understand the instruction? Do you have any questions?
When an human plants for the first time a seedling in a ground, he goes to see it three times a day: so what, has it grown or not? He is also holding her breath, leaning over her, pushing the ground a little at her roots, fluffing her petals and harassing her at all the different things she considers useful. And yet, when the seedling takes over and grows fast, here he marvels at this wonder of nature, it feels like a miracle and considers it one of his greatest personal succes. [Our translation]

B.3 Material for obtaining the distractors

Gdije tchloviék poprvé fsadi do zémegné sazégnitchkou, hodi sé nagni divate třikráte dégné: tak tso, povirostla ouje nébo né? I tayi déh, naklagni sé nadni, přitlatchi trohou poudou ou yéiih kořénkou, natchéhrává yi listki a voubétz yi obtiéjuié rouznim konanim, ktéré povajuié za oužitétchneauou pétchi. A gdije ssé sazégnitchka přésto ouimé a rosté yako svodi, tou tchloviék jas sné nat tim tos divéme pří rodi, má potsit tchéhossi yako zázrakou a povajouié tos za yédén zé svifs néiviéttchifs o sobegnif ouspiéfou.

- Yague vipada mouille tipitski déne? Rano fstanou fsédoum hodyine a dou sé hnéde nasgnidate.
- Ténto vikénde sém bila nakauoupide vémegnéstié.
- Potomessi hraillou smime sinattchkéme, ktérémou ié iédéne rok.
- Aktoualgné stoudouyi filozofiyi.
- Rada spivam a outoho hrayou naklavire.
- Biéhém prazdegnine pauillédou natidéne kmori do chpagnélska, doufam, jéssé vidari potchassi anéboudé voubéts prechéte.
- Fpolédené obiédevam skolégui, ktéri pratsouyi na steynéme prauilléktou iako ia.
- Iabif tié ftéla poviédiéte gnétso omoyi pratsi. Iséme outtchitelka nazakladegni chkolé anédavno isémesé mouséla viporadat zvélmi zlobivimi jaki.
- Na ténto tabore yézdyime kajdi rok.
- Mouille pritéle si kauoupile dvie nové kochilé.
- Mouille sine sé menouye honza.
- To ié hrozegné krasni.
- Pague zatchnou pratsovate a neyprevé otepovime na moyé meyli.

Appendix C

Speech items in the perceptual test

C.1 Detailed duration of speech items

Note: Values rounded to 2 digits. F=the French speaker, I=the speech synthesis.

Item	Duration	Item	Duration
1M_C_HC505_1.wav	4.58	31M_CF_A6_15.wav	1.2
2M_C_HC626_2.wav	7.28	32M_CF_A7_6.wav	3.06
3M_C_HC561_3.wav	9.3	33M_CF_A7_4.wav	8.45
4M_C_HC595_4.wav	12.33	34M_CF_A8_7.wav	4.36
5M_C_HC650_5.wav	8.7	35M_CF_A8_8.wav	9.75
6M_C_HC595_2.wav	6.55	36M_CF_A9_8.wav	3.28
7M_C_HC650_7.wav	3.89	37M_CF_A9_10.wav	3.72
8M_C_HC652_5.wav	4.77	38M_D_I2_1.wav	7.91
9M_C_HC652_9.wav	2.22	39M_D_I2_2.wav	5.32
10M_CF_A1_1.wav	13.28	40M_D_I3_4.wav	4.04
11M_CF_A1_18.wav	1.89	41M_D_F-E8_5.wav	4.18
12M_CF_E1_2.wav	8.62	42M_D_F-E7_6.wav	8.65
13M_CF_E1_4.wav	11.29	43G_CF_A1_6.wav	4.28
14M_CF_A2_5.wav	5.19	44G_CF_E1_4.wav	4.05
15M_CF_A2_8.wav	8.47	45G_CF_A2_7.wav	2.52
16M_CF_E2_6.wav	5.62	46G_CF_E2_8.wav	2.02
17M_CF_E2_8.wav	13.15	47G_CF_A3_1.wav	4.75
18M_CF_A3_1.wav	8.36	48G_CF_E3_3.wav	5.17
19M_CF_A3_2.wav	9.42	49G_CF_A4_1.wav	4.65
20M_CF_E3_2.wav	7.18	50G_CF_E4_9.wav	3.42
21M_CF_E3_11.wav	2.75	51G_CF_A5_5.wav	1.96
22M_CF_A4_11.wav	6.58	52G_CF_E5_1.wav	4.36
23M_CF_A4_7.wav	4.56	53G_CF_A6_6.wav	2.97
24M_CF_E4_1.wav	1.92	54G_CF_A7_2.wav	2.02
25M_CF_E4_5.wav	4.73	55G_CF_A8_8.wav	2.32
26M_CF_A5_8.wav	6.11	56G_CF_A9_4.wav	3.63
27M_CF_A5_3.wav	3.52	57G_D_F-E4_3.wav	5.99
28M_CF_E5_4.wav	5.2	58G_D_I2_6.wav	4
29M_CF_E5_2.wav	4.8	59G_C_HC340_6.wav	3.31
30M_CF_A6_5.wav	1.33	60G_C_HC316_8.wav	2.1
61G_C_HC333_3.wav	5.58	62G_C_HC109_4.wav	4.48
63G_C_HC314_1.wav	4.62	64M_CF_A4_1.wav	3.08
65M_CF_A4_2.wav	3.43	66M_CF_A4_3.wav	3.15
67M_CF_A4_6.wav	2.44	68M_CF_A5_12.wav	3.98
69M_CF_A5_5.wav	7.66	70M_CF_A6_2.wav	4.67
71M_CF_A8_5.wav	9.67	72M_CF_E3_1.wav	5.13
73M_CF_E3_3.wav	5.35	74G_CF_A6_1.wav	5.52
75G_CF_A6_3.wav	5.06	76G_CF_A8_7.wav	3.26
77G_CF_A9_1.wav	4.43		

C.2 Number of speech items per speaker and per task

Reading task		Semi-spontaneous speech	
speaker	**number**	**speaker**	**number**
CF10A	1	CF10A	2
CF2A	1	CF2A	2
CF3A	1	CF3A	2
CF4A	1	CF4A	6
CF5A	1	CF5A	4
CF6A	3	CF6A	3
CF7A	1	CF7A	2
CF8A	2	CF8A	3
CF9A	2	CF9A	2
CF1E	1	CF1E	2
CF1E	1	CF2E	2
CF3E	1	CF3E	4
CF4E	1	CF4E	2
CF5E	1	CF5E	2
F-E4	1	F-E7	1
HC109	1	F-E8	1
HC314	1	HC505	1
HC316	1	HC561	1
HC333	1	HC595	2
HC340	1	HC626	1
I2	1	HC650	2
		HC652	2
		I2	2
		I3	1

Appendix D

Vocalic $F1$, $F2$ and $f0$ range of C and CF

Note: in Hz.

D.1 Mean $F1$ and $F2$ of C' and CF' vowels in reading aloud task and semi-spontaneous speech

Not-normalized formants									
Reading aloud task					Semi-spontaneous speech				
vowel	group	n	F1	F2	vowel	group	n	F1	F2
iː	C	186	339.86	2497.75	iː	C	265	341.35	2420.97
iː	CF	184	342.01	2576.81	iː	CF	302	343.69	2522.29
ɪ	C	254	411.80	2271.96	ɪ	C	837	438.41	2018.65
ɪ	CF	259	408.69	2304.81	ɪ	CF	625	432.57	2122.52
ɛ	C	339	475.09	2006.28	ɛ	C	1087	519.84	1837.73
ɛ	CF	340	484.14	2041.41	ɛ	CF	988	522.28	1927.31
ɛː	C	51	645.05	1903.32	ɛː	C	91	621.71	1755.03
ɛː	CF	49	641.60	1976.33	ɛː	CF	36	642.44	1908.74
aː	C	68	788.46	1548.57	aː	C	262	779.37	1487.10
aː	CF	69	889.72	1553.12	aː	CF	236	862.27	1542.44
a	C	357	620.46	1572.92	a	C	1067	639.43	1495.39
a	CF	356	660.28	1622.21	a	CF	851	670.25	1589.68
o	C	424	465.50	1254.45	o	C	904	473.87	1263.84
o	CF	422	484.06	1298.79	o	CF	815	483.59	1315.19
u	C	203	392.05	1263.00	u	C	295	406.43	1180.10
u	CF	206	405.30	1304.71	u	CF	284	403.80	1248.96
uː	C	100	370.22	1170.58	uː	C	59	394.37	1118.82
uː	CF	97	376.01	1058.31	uː	CF	43	377.67	1094.92
Normalized formants by Lobanov method									
Reading aloud task					**Semi-spontaneous speech**				
vowel	group	n	F1	F2	vowel	group	n	F1	F2
ɛ	C	339	-0.23	0.77	ɛ	C	1087	0.06	0.40
ɛ	CF	340	-0.23	0.68	ɛ	CF	988	-0.02	0.43
ɛː	C	51	0.92	0.54	ɛː	C	91	0.85	0.28
ɛː	CF	49	0.68	0.54	ɛː	CF	36	0.61	0.38
ɪ	C	254	-0.66	1.38	ɪ	C	837	-0.49	0.80
ɪ	CF	259	-0.67	1.23	ɪ	CF	625	-0.54	0.84
a	C	357	0.76	-0.20	a	C	1067	0.86	-0.37
a	CF	356	0.81	-0.19	a	CF	851	0.85	-0.26
aː	C	68	1.92	-0.26	aː	C	262	1.85	-0.39
aː	CF	69	2.22	-0.34	aː	CF	236	1.95	-0.36
iː	C	186	-1.14	1.89	iː	C	265	-1.14	1.74
iː	CF	184	-1.06	1.80	iː	CF	302	-1.05	1.67
o	C	424	-0.29	-0.91	o	C	904	-0.22	-0.86
o	CF	422	-0.22	-0.86	o	CF	815	-0.23	-0.83
u	C	203	-0.79	-0.88	u	C	295	-0.70	-1.06
u	CF	206	-0.69	-0.84	u	CF	284	-0.68	-0.95
uː	C	100	-0.94	-1.10	uː	C	59	-0.79	-1.13
uː	CF	97	-0.86	-1.35	uː	CF	43	-0.86	-1.25

Normalized formants by Bark Difference Method									
Reading aloud task					Semi-spontaneous speech				
vowel	group	n	Z3-Z1	Z3-Z2	vowel	group	n	Z3-Z1	Z3-Z2
iː	C	186	12.74	1.74	iː	C	265	12.46	1.67
iː	CF	184	12.97	1.76	iː	CF	302	12.86	1.79
ɪ	C	254	11.43	1.73	ɪ	C	837	10.97	2.33
ɪ	CF	259	11.49	1.65	ɪ	CF	625	11.08	2.04
ɛ	C	339	10.63	2.34	ɛ	C	1087	10.21	2.89
ɛ	CF	340	10.54	2.20	ɛ	CF	988	10.25	2.62
ɛː	C	51	9.07	2.51	ɛː	C	91	9.14	2.96
ɛː	CF	49	9.15	2.31	ɛː	CF	36	9.09	2.49
aː	C	68	7.68	3.55	aː	C	262	7.77	3.84
aː	CF	69	7.09	3.62	aː	CF	236	7.36	3.74
a	C	357	9.13	3.66	a	C	1067	9.08	4.12
a	CF	356	8.78	3.41	a	CF	851	8.85	3.69
o	C	424	10.48	5.23	o	C	904	10.36	5.15
o	CF	422	10.40	5.08	o	CF	815	10.32	4.92
u	C	203	10.89	5.09	u	C	295	10.83	5.48
u	CF	206	10.90	5.03	u	CF	284	10.96	5.23
uː	C	100	11.40	5.97	uː	C	59	11.11	6.06
uː	CF	97	11.33	6.42	uː	CF	43	11.18	6.01

D.2 Approximate $f0$ range of C and CF in reading aloud task and semi-spontaneous speech

CF speakers					
speaker	task	approximate $f0$ range	speaker	task	approximate $f0$ range
CF1E	RT	75-400	CF1A	RT	110-460
CF1E	SS	75-360	CF1A	SS	100-460
CF2E	RT	150-360	CF2A	RT	120-240
CF2E	SS	120-390	CF2A	SS	125-310
CF3E	RT	75-300	CF3A	RT	100-350
CF3E	SS	120-390	CF3A	SS	90-400
CF4E	RT	140-300	CF4A	RT	75-330
CF4E	SS	130-330	CF4A	SS	75-365
CF5E	RT	80-300	CF5A	RT	100-310
CF5E	SS	75-310	CF5A	SS	75-320
CF6E	RT	125-380	CF6A	RT	130-380
CF6E	SS	90-310	CF6A	SS	85-320
CF7E	RT	80-340	CF7A	RT	100-380
CF7E	SS	85-325	CF7A	SS	75-420
CF8E	RT	150-400	CF8A	RT	175-330
CF8E	SS	150-350	CF8A	SS	95-355
CF9E	RT	105-350			
CF9E	SS	100-390			
C speakers					
speaker	task	approximate $f0$ range	speaker	task	approximate $f0$ range
HC308	RT	75-295	HC595	RT	125-335
HC308	SS	80-345	HC595	SS	75-285
HC312	RT	125-320	HC615	RT	125-305
HC312	SS	75-270	HC615	SS	85-330
HC333	RT	155-350	HC618	RT	145-330
HC333	SS	100-365	HC618	SS	75-290
HC364	RT	80-335	HC626	RT	135-300
HC364	SS	75-435	HC626	SS	75-275
HC505	RT	145-290	HC628	RT	140-375
HC505	SS	155-275	HC628	SS	100-330
HC506	RT	120-295	HC646	RT	75-320
HC506	SS	105-245	HC646	SS	75-315
HC508	RT	125-330	HC650	RT	75-395
HC508	SS	95-320	HC650	SS	75-370
HC510	RT	165-390	HC652	RT	125-315
HC510	SS	100-380	HC652	SS	130-285
HC523	RT	75-290			
HC523	SS	115-275			

Appendix E

Listeners' observations in the perceptual test

E.1 Observation concerning speech segments

vowels	degree of aperture, anteriority, lip shape	french e and i, difference in quality of i and e, softer i, closer e and i, strange e, o approaching u, closer o, closer vowels, something wrong with e pronunciation, closer a, more rounded u, u:, o
	nasalisation	more frequent
	length	unnaturally significant adherence to length, missing difference between short and long vowels, lengthening of short vowels, longer diphthongs
fricatives	/h/ and /x/	h replaced by ch, ch pronounced like unvoiced h, unpronouced h, ch, untypical ch, non Czech ch, wrong pronunciation of ch
	sibilants	different sibilants and semi-sibilants, more back ž, untypical ž, ž is near to š, ž approaches z, soft s, hyperarticulation of š
	/v/	missing, replaced by "b", protetic
lateral approximant	/l/	soft, missing
trills	/r/	uvular, rhotacism, different, multi-cycle, untypical, not Czech, french
	/r̝̊/ and /r̝̊/	disonorized, untypical, wrong pronunciation, missing, rhotacisme, replaced by r or š, strange
stops	/d/	alveolar, dentalisation, palatisation before "i", aspiration
	/k/	untypical pronunciation, aspiration, something wrong with its pronunciation
	/t/	untypical pronunciation, aspirated, something wrong with its pronunciation
	/ɟ/	untypical pronunciation
	/ʔ/	missing, liaison, linking of words, no separation of words, linking words by vowels
	/ɟ/	untypical pronunciation
nasals	/n/	alveolar, replaced by ň
	/m/	pronounced more higher, more nasal
	/ɲ/	untypical pronunciation, pronounced as n
affricates	/t͡ʃ/	in word *největší* - pronunciation of detached t and š instead of č, more heavy č, hyperarticulated

E.2 Observation concerning speech suprasegments

intonation	intonation in general	very rising, more important rising pattern, strange, French, not Czech, intonation rises in the ends, untypical for Czech, singing, fine, rising ends of the phrases, variable
	questions	untypical intonation pattern for questions
	pitch range	larger pitch range
stress	place	in the end of accentual phrase, is not on the first syllable, on an untypical syllable, on another syllable than first syllable, on the last syllable
	properties	final vowel/syllable lengthening
stuck schwa/ hesitation	stuck schwa	hesitation shwa stuck to the last consonant of the word, not Czech hesitation

Appendix F

Extralinguistic questionnaire

F.1 Extralinguistic questionnaire in Czech

Extralingvistický dotazník

Číslo mluvčího:

Datum:

Tímto dotazníkem bych chtěla získat informace o používání jazyků, tedy zvláště českého a francouzského jazyka občany ČR, kteří krátkodobě či dlouhodobě bydlí ve Francii. Dotazník obsahuje následujících 7 kapitol:

I. O Vás
II. Vaše francouzština
III. Vaše čeština
IV. Jazykové sebehodnocení
V. Jiné jazyky
VI. Jazykové preference
VII. Závěrečné otázky

Každá kapitola představuje několik otázek. Pokud se Vás některá/některé z otázek netýká/netýkají, (například otázka vztahující se k jazyku, kterým mluvíte s Vašimi dětmi a Vy žádné děti nemáte), škrtněte číslo před otázkou a přejděte na další. Je důležité, abyste odpověděli na všechny otázky, které se Vás týkají a to sám/sama za sebe, protože, co mě zajímá je Vaše užívání jazyků. Pokud nějaké otázce nerozumíte, neváhejte se zeptat. Zde nejsou ani správné ani špatné odpovědi! Dotazník je zcela anonymní.

1

I. O Vás

1) Pohlaví: ❑ muž ❑ žena

2) Věk: …………………….

3) Národnost: ❑ česká a francouzská ❑ česká ❑ Jiná, uveďte: …………………………

4) Jaké je vaše nejvyšší dosažené vzdělání? …………………………………………………

5) Jak dlouho už jste ve Francii? Uveďte přesný počet roků či měsíců. Pokud žijete ve Francii s dlouhodobými přestávkami, to znamená, že jste strávil(a) více jak šest souvislých měsíců mimo Francii, rozepište:………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………
………………………………………………………………………………………………

6) Jaký je hlavní důvod vašeho pobytu ve Francii?
   - ❑ studium
   - ❑ nabídka práce
   - ❑ práce partnera
   - ❑ partner žijící ve Francii
   - ❑ jiný, upřesněte: ………………………………… …………………………………

7) Jakým(i) jazyk(y) jste mluvil(a) (tj. úroveň B2 či rodný jazyk) před tím, než vám bylo 6 let?
   - ❑ Čeština
   - ❑ Čeština a jiným upřesněte:………………….……………….…………………
   - ❑ Jiný/é:…………………..…………………..………………...……………………

8) Jaké je vaše současné povolání? ……..……………………………………..……………….

9) Měl(a) jste nějaké předchozí povolání, ve kterém jste byl(a) nucen(a) hojně používat francouzštinu?
   - ❑ Ano, upřesněte jaké a jak dlouho:……………………………………………………
   - ❑ Ne

10) Pokud žijete s partnerem, jaký je mateřský jazyk vašeho partnera?
   - ❑ čeština
   - ❑ francouzština
   - ❑ Jiný, upřesněte: ……………………………………………….. …………………

11) Pokud váš partner nežije ve Francii od narození, kdy přišel do Francie (přibližné datum)?………………………………

12) Máte děti nebo vnoučata?
   - ❑ ne
   - ❑ ano, počet: …………………………………………………
     jejich věk:…………………………………………………

2

II. Vaše francouzština

13) Učil(a) jste se francouzsky před vaším příjezdem do Francie?

❑ Ne ❑ Ano, popište, jak jste se začal učit francouzsky

(Příklad: Začal jsem se učit, když mi bylo 7 let s mým dědečkem, který miloval francouzštinu. V 10i letech jsem začal chodit do jazykové školy, kde jsme měli dvouhodinovku francouzštiny dvakrát týdně. A když mi bylo 13 let, tak jsem začal studovat na bilingvním gymnáziu, kde jsme měli 10 hodin francouzštiny týdně. Potom jsem odjel do Francie.)

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

14) Chodil(a) jste v ČR do nějaké školy s rozšířenou výukou francouzštiny?

❑ ano, upřesněte (jméno a typ školy): ………………………………………… ……

❑ ne

15) Chodil(a) jste na nějaké intenzivní kurzy francouzštiny po příjezdu do Francie?

❑ ano, upřesněte (počet hodin týdně, úroveň): …………………………………………

❑ ne

16) Mohl(a) byste v následující tabulce uvést, do jaké míry používáte francouzštinu v následujících oblastech? Jednoduše zaškrtněte políčko. Pokud se vás některá z položek netýká (např. Pokud nemáte žádné domácí mazlíčky), nechte pole prázdná.

Mluvím francouzsky					
	vždy	často	někdy	zřídka	nikdy
S partnerem	❑	❑	❑	❑	❑
S dětmi nebo vnoučaty	❑	❑	❑	❑	❑
S ostatními členy rodiny	❑	❑	❑	❑	❑
S domácím/i mazlíčky/em	❑	❑	❑	❑	❑
S přáteli	❑	❑	❑	❑	❑
V práci	❑	❑	❑	❑	❑
Při studiu	❑	❑	❑	❑	❑
V kostele, organizacích, klubech	❑	❑	❑	❑	❑

17) Město/vesnice, kde nyní bydlíte ve Francii: ………………………………………………

18) Jiná francouzská města/vesnice, kde jste žil(a): ……………………………………………
…………………………………………………………………………………………

3

III. Vaše čeština

19) Mluvil(a) jste dlouhodobě nějakým nářečím (např. moravským), když jste žil(a) v ČR?
- ❑ Ne
- ❑ Ano, upřesněte, jaké nářečí a kolik let: ……………………………………………

20) Myslíte si, že nyní mluvíte česky s nějakým specifickým přízvukem, např. moravským?
- ❑ Ne
- ❑ Ano, upřesněte jaký přízvuk: ……………………………………………………
……………………………………………………………………………………………

21) Města/vesnice, ve kterých jste v ČR žil(a) alespoň jeden rok:

Město/vesnice/kraj: ………………………………délka pobytu: ………………
Město/vesnice/kraj: ………………………………délka pobytu: ………………
Město/vesnice/kraj: ………………………………délka pobytu: ………………
Město/vesnice/kraj: ………………………………délka pobytu: ………………

22) Chodil(a) jste/chodíte na hodiny češtiny během vašeho pobytu ve Francii?
- ❑ ano, upřesněte kdy: ……………………………………………………………
  - po jak dlouhou dobu: ……………………………………………………
  - co je/byl obsah hodin: ……………………………………………………
  - kdo jsou/byli vaši spolužáci (rodilí Češi/cizinci): ……………………………
- ❑ ne

23) Účastníte se/účastnil(a) jste se aktivně života českých škol/asociací/komunit či jiných českých organizací ve Francii?
- ❑ ano, upřesněte (typ organizace a doba vašeho hlavního podílení se na životě organizace): ……………………………………………………………………
- ❑ ne

24) Jak často jezdíte do ČR?
- ❑ nikdy nebo velmi zřídka
- ❑ pravidelně, jednou až dvakrát ročně
- ❑ pravidelně, třikrát až pětkrát ročně
- ❑ pravidelně, více jak pětkrát ročně

25) Spočítejte přibližně kolik dnů/týdnů či měsíců ročně strávíte v ČR: ……………………
……………………………………………………………………………………………

26) Když se vracíte do ČR, ve kterém městě/vesnici/kraji trávíte obvykle nejvíce času?
……………………………………………………………………………………………

27) Jak nejčastěji udržujete kontakt s vašimi přáteli nebo rodinou v ČR?
- ❑ zavoláním si přes telefon, skype, facebook, whatsApp a jiné aplikace
- ❑ zasíláním si zpráv či chatováním (osobní i skupinové konverzace: Telefon, skype, facebook, whatsApp, e-mail a jiné aplikace)
- ❑ jiné, popište: ……………………………………………………………………..

4

28) Obecně vzato, jak často mluvíte česky?
❑ nikdy nebo zřídka
❑ přibližně pětkrát ročně
❑ alespoň jedenkrát měsíčně
❑ alespoň jedenkrát týdně
❑ každodenně

29) Mohl(a) byste v následujících tabulce uvést, do jaké míry používáte češtinu v následujících oblastech? Jednoduše zaškrtněte políčko. Pokud se vás některá z oblastí netýká (např. Pokud nemáte žádné domácí mazlíčky), nechte pole prázdná.

Mluvím česky					
	vždy	často	někdy	zřídka	nikdy
S partnerem	❑	❑	❑	❑	❑
S dětmi nebo vnoučaty	❑	❑	❑	❑	❑
S ostatními členy rodiny	❑	❑	❑	❑	❑
S domácím/i mazlíčky/em	❑	❑	❑	❑	❑
S přáteli	❑	❑	❑	❑	❑
V práci	❑	❑	❑	❑	❑
Při studiu	❑	❑	❑	❑	❑
V kostele, organizacích, klubech	❑	❑	❑	❑	❑

30) Jak často posloucháte hudbu v češtině?
❑ velmi zřídka nebo nikdy ❑ zřídka ❑ občas ❑ často ❑ velmi často

31) Jak často se koukáte na televizní programy v češtině?
❑ velmi zřídka nebo nikdy ❑ zřídka ❑ občas ❑ často ❑ velmi často

32) Jak často posloucháte české rádio?
❑ velmi zřídka nebo nikdy ❑ zřídka ❑ občas ❑ často ❑ velmi často

33) Jak často čtete v češtině?
❑ velmi zřídka nebo nikdy ❑ zřídka ❑ občas ❑ často ❑ velmi často

Komunikace s code-switchingem

Jde o komunikaci s jednou nebo více osob, které stejně tak jako vy mluví francouzsky a česky, což dovoluje míchat francouzštinu s češtinou. Například, když spolu mluvíte a nenapadá vás nějaké slůvko v češtině, tak ho prostě řeknete ve francouzštině, protože víte, že vám osoba/y rozumí. Vytvoříte tak mezi sebou zvláštní styl komunikace, kdy ve vaší řeči střídáte a mícháte věty/slova v češtině a ve francouzštině.

34) Stává se vám, že používáte code-switching?
❑ ano, upřesněte jak často: ……………………………………………………………
❑ ne

5

IV. Jazykové sebehodnocení

V následující tabulce je uvedeno několik jazykových dovedností. Ty jsou formulovány jako jednotlivé věty. Přečtěte si prosím pečlivě každou větu a ohodnoťte, jak danou věc zvládáte. Pro ohodnocení zakroužkujte, prosím, jedno z čísel od 1 do 5 v pravém sloupci, kde

1 znamená, že danou věc vůbec nezvládáte
2 znamená, že danou věc zvládáte, ale s velkými potížemi
3 znamená, že danou věc zvládáte, i přesto, že vám dělá nějaké potíže
4 znamená, že danou věc zvládáte docela snadno
5 znamená, že danou věc zvládáte bez potíží

	Poslechové porozumění	**Čeština**	**Francouzština**
a.	Rozumím televizním zprávám a pořadům o aktuálním dění.	1 2 3 4 5	1 2 3 4 5
b.	Rozumím jakémukoli druhu mluveného jazyka, i když je v rychlém tempu, za předpokladu, že mám nějaký čas k tomu, abych si zvykl na přízvuk daného mluvčího.	1 2 3 4 5	1 2 3 4 5
c.	Rozumím rozsáhlé řeči.	1 2 3 4 5	1 2 3 4 5
d.	Rozumím rozsáhlým projevům (přednášky, práce, škola, volný čas…) a dokážu pochopit i složitá argumentovaní za předpokladu, že téma projevu dostatečně znám.	1 2 3 4 5	1 2 3 4 5
e.	Rozumím filmům ve standardním dialektu.	1 2 3 4 5	1 2 3 4 5

	Schopnosti v mluvení	**Čeština**	**Francouzština**
f.	Komunikuji plynule a spontánně, což mi umožňuje pravidelné interakce s rodilým mluvčím.	1 2 3 4 5	1 2 3 4 5
g.	Umím se zapojit do jakéhokoli rozhovoru nebo diskuse, používat idiomy a hovorové výrazy. (Idiom je jazykově ustálený výraz např. „Natáhnout bačkory" znamená v češtině „zemřít")	1 2 3 4 5	1 2 3 4 5
h.	Dokážu vyprávět příběh, podat děj knihy nebo filmu a popsat svoji reakci.	1 2 3 4 5	1 2 3 4 5
i.	Když mám nějaký jazykový problém (např. neznám dané slovíčko, co chci říct nebo si nejsem jistá gramatikou), umím situaci popsat jinak tak hladce, že ostatní lidé si toho téměř nevšimnou.	1 2 3 4 5	1 2 3 4 5

6

V. Jiné jazyky

35) Kromě Francie a ČR, žil(a) jste v nějakém dalším státě déle jak 6 měsíců?

❑ ne

❑ ano, upřesněte do tabulky:

Stát	Město/vesnice	Jazyk/y, kterým jste se zde dorozumíval(a)	Délka pobytu

36) Kromě češtiny a francouzštiny, jakými dašími jazyky mluvíte? Odpovězte do tabulky. Označení A1, A2, B1, B2, C1, C2 představují následující stupně jazykové úrovně:

A1 = Začátečník　A2 = Mírně pokročilí

B1 = Středně pokročilí　B2 = Vyšší pokročilí

C1 = Vysoce pokročilí　C2 = Nejvíce pokročilí

Jazyk	Odhadovaná úroveň	Jak často tímto jazykem mluvíte?	Kde tímto jazykem mluvíte? (např. v práci, během jazykových kurzů...)
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ Vůbec nevím	❑ pětkrát ročně a méně ❑ alespoň jedenkrát měsíčně ❑ alespoň jedenkrát týdně ❑ každodenně	
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ Vůbec nevím	❑ pětkrát ročně a méně ❑ alespoň jedenkrát měsíčně ❑ alespoň jedenkrát týdně ❑ každodenně	
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ Vůbec nevím	❑ pětkrát ročně a méně ❑ alespoň jedenkrát měsíčně ❑ alespoň jedenkrát týdně ❑ každodenně	
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ Vůbec nevím	❑ pětkrát ročně a méně ❑ alespoň jedenkrát měsíčně ❑ alespoň jedenkrát týdně ❑ každodenně	

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VI. Jazykové preference

37) Cítíte se více doma v české nebo francouzské kultuře?
- ❑ ve francouzské kultuře
- ❑ v obou, ale více ve francouzské kultuře
- ❑ v obou kulturách rovnoměrně
- ❑ v obou, ale více v české kultuře
- ❑ v české kultuře

38) Cítíte se více pohodlně, když mluvíte česky nebo francouzsky?
- ❑ francouzsky
- ❑ česky
- ❑ bez preference

39) Jak se cítíte v přítomnosti Čechů (např. českých turistů), kteří mluví francouzsky s těžkým českým přízvukem?
- ❑ rozčiluje mě to/vadí mi to
- ❑ necítím se příliš příjemně ale je mi to nějak jedno
- ❑ vůbec mi to nevadí

40) Kdybyste si mohl(a) vybrat mezi ČR a Francií, kde budete žít, vybral(a) byste si?
- ❑ ČR
- ❑ Francie
- ❑ nevím
- ❑ je mi to jedno

VII. Závěrečné otázky

41) Už se vám někdy stalo, že jste se vrátil(a) do ČR po delším pobytu ve Francii a vaši bližní vám poznamenali, že když mluvíte česky, tak máte neobvyklý přízvuk?
- ❑ ano, popište situaci/e:
  ……………………………………………………………………………………………
  ……………………………………………………………………………………………
  ……………………………………………………………………………………………
- ❑ ne. nikdy

42) Došel/a jste nakonec tohoto dotazníku. Je něco, co byste chtěl(a) přidat? Může to být cokoli od komentářů souvisejících s jazykem, s poznámkami k dotazníku nebo k samotnému výzkumu: ……………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

8

F.2 Extralinguistic questionnaire – English translation

Sociolinguistic questionnaire

Speaker's number:

Date:

This questionnaire aims to gather an impression of the personal background and language use of Czech and French languages by the Czech people staying in France, in the short or long term. It consists of 7 sections:

I. About you
II. Your French
III. Your Czech
IV. Language self-evaluation
V. Other languages
VI. Language preferences
VII. Concluding questions

It is important to note that not all items may apply to you personally. Should you think that a certain item does not apply to you (for example when you are asked about the language use of your children and you do not have any children), you may cross out the number in front of that particular question and move on to the next. It is important that you answer these questions on your own, as I am interested in *your* language use. If you do not understand a certain question, please do not hesitate to ask me. There are no right or wrong answers!

I. About you

1) Are you: ❑ male ❑ female

2) Age: …………………

3) Nationality: ❑ French & Czech ❑ Czech ❑ Other, namely: ………………………………

4) What is the highest level of education you have completed? ………………………………

5) How long do you stay in France? Get the number of months or years. If you stay in France with breaks longer than 6 moths, please get more details about your breaks:
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

6) What is the main reason of your staying in France?
   ❑ studies
   ❑ job
   ❑ partner's job
   ❑ partner living in France
   ❑ other, namely: ……………………………………

7) What language(s) did you acquire (level B2 at least or native language) before you were 6 years old?
   ❑ Czech
   ❑ Czech & other, namely: …………………..………………..………………
   ❑ Other: ……………………..………………..…………………………………..

8) What is your current profession? ……………………………………………………..……

9) Did you have some previous profession(s), where you were forced to use French language a lot?
   ❑ Yes, specify the profession and how long:…………………..………………………
   ❑ No

10) If you live with your partner, what is his/her mother tongue?
   ❑ Czech
   ❑ French
   ❑ Other, namely: ……………………………………………………….………………

11) If your partner has not been living in France since birth, when did he come to France (approximate date)? ………………………………

12) Do you have children or grandchildren?
   ❑ no
   ❑ Yes, number: ……………………………………………………
   Age: …………………………………………………………

2

II. Your French

13) Did you learn French before coming to France?

❑ No ❑ yes, write a short story of your learning of French language

(Example: I started learning the first phrases when I was 7 years old with my grandfather who loved French, and at the age of 10 I started going to a language school where we had two hours of French twice a week, and when I was 13, I started studying at a bilingual middle school where we had 10 hours of French each week, then I went to France.)

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

14) Have you attended any school in Czech Republic (CR) with extended learning of French?

❑ Yes, specify (name and type of school):……………………………… ……………

❑ no

15) Did you take some intensive French courses after arriving in France?

❑ Yes, specify (number of hours per week, level): ……………………………………

❑ no

16) Could you, in the following table, please, indicate to which extent you use French in the provided domains? You may simply tick the box. If a certain domain is not applicable to you (for example, if you don't have any pet), leave the box empty.

I speak French					
	always	often	sometimes	rarely	never
With partner	❑	❑	❑	❑	❑
With children or grandchildren	❑	❑	❑	❑	❑
With other family members	❑	❑	❑	❑	❑
To pet(s)	❑	❑	❑	❑	❑
With friends	❑	❑	❑	❑	❑
At work	❑	❑	❑	❑	❑
During my studies	❑	❑	❑	❑	❑
In church, at clubs or organisations	❑	❑	❑	❑	❑

17) City / Village in France where you live now: ………………………………………………

18) Other French cities/villages where you lived: ………………………………………………
……………………………………………………………………………………………………

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III. Your Czech

19) Did you speak a variety of Czech while you lived in the CR or a dialect?
- ❑ No
- ❑ Yes, specify the dialect and how long: ……………...……………..…………………..……

20) Do you think that you speak Czech with some specific accent such as a Moravian accent?
- ❑ No
- ❑ Yes, specify the accent: ……………..…………..……………..……….……….…..
……………………………………………...……………………………………………

21) Towns/villages in CR where you lived at least a one year:
Town/village/region:………………………………length of residence: ..……………
Town/village/region:………………………………length of residence: ..……………
Town/village/region:………………………………length of residence: ..……………
Town/village/region:………………………………length of residence: ..……………

22) Have you ever attended Czech classes while living in France?
- ❑ Yes, specify when:……………..……………………………………………..
  - how long:……………..………………………..…………………..…
  - the content of classes:………………………………………..…………………
  - type of classmates (Native Czech speakers/foreigners):……………..………
- ❑ No

23) Do/did you participate actively on the life of Czech schools / associative / communities or other Czech organizations in France?
- ❑ Yes, specify (type of organization and time of your main share of life organization):
…………………………………………………………………………
- ❑ No

24) How often do you return to the CR?
- ❑ Never or very rarely
- ❑ Regularly, once or twice a year
- ❑ Regularly, from three to five times per year
- ❑ Regularly, more than five times per year

25) Give approximately how many days/weeks or months per year you spend in the CR:
……………………………………………………………………………………………

26) When you return in the CR, in which town/village/region do you spend the majority of your time?………………………………………………………………………………

27) How do you keep in touch the most often with your family or friends in the CR?
- ❑ by calling by phone, skype, facebook, whatsApp and other applications
- ❑ by sending messages or chatting (personal and group conversations on phone, skype, facebook, whatsApp, e-mail and other applications)
- ❑ another way, namely:………...……………………………………………………

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28) Taken together, how often do you speak Czech?
- ❑ never or rarely
- ❑ Approximately five times per year
- ❑ At least once per month
- ❑ At least once per week
- ❑ Every day

29) Could you, in the following table, please indicate to what extent you use Czech in the domains provided? You may simply tick the box. If a certain domain is not applicable to you (for example, if you don't have any pets), you may leave the box empty.

I speak Czech					
	always	often	sometimes	rarely	never
With partner	❑	❑	❑	❑	❑
With children or grandchildren	❑	❑	❑	❑	❑
With other family members	❑	❑	❑	❑	❑
To pets	❑	❑	❑	❑	❑
With friends	❑	❑	❑	❑	❑
At work	❑	❑	❑	❑	❑
During my studies	❑	❑	❑	❑	❑
In church, at clubs or organisations	❑	❑	❑	❑	❑

30) How often do you listen to Czech songs?
❑ very rarely or never ❑ rarely ❑ sometimes ❑ often ❑ very often

31) How often do you watch Czech television programmes?
❑ very rarely or never ❑ rarely ❑ sometimes ❑ often ❑ very often

32) How often do you listen to Czech radio programmes?
❑ very rarely or never ❑ rarely ❑ sometimes ❑ often ❑ very often

33) How often do you read in Czech?
❑ very rarely or never ❑ rarely ❑ sometimes ❑ often ❑ very often

Communication by code-switching

It is a communication with one or more people who like you, speak French and Czech, so, it allows you to mix French with Czech. For example, if you speak and you have forgotten some word in Czech, you will say it in French because you know that the others will understand you. By this way, you create a special spoken style when, in your speech, you mix sentences or words in Czech and French.

34) Do you use code-switching?
- ❑ Yes, specify how often: ……………………………………………………………
- ❑ No

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IV. Language self-evaluation

The following table lists several language skills. These are formulated as individual statements. Please read each statement carefully and evaluate how you handle the matter. For evaluation, please circle one of the numbers from 1 to 5 in the right column, where:

1 means that you cannot do that at all
2 means that you can do that, but with many difficulties
3 means that you can do that, although with some difficulty
4 means that you can do that fairly easily
5 means that you can do that without any difficulty

	Listening comprehension	**Czech**	**French**
a.	I understand TV news and current affairs programmes.	1 2 3 4 5	1 2 3 4 5
b.	I understand any kind of spoken language, even though it is in a fast rate, assuming I have some time to get used to the accent of the speaker.	1 2 3 4 5	1 2 3 4 5
c.	I understand extended speech.	1 2 3 4 5	1 2 3 4 5
d.	I understand extended speech (lectures, at work, at school, concerning hobbies) and follow even complex lines of argumentation provided the topic is reasonably familiar to me.	1 2 3 4 5	1 2 3 4 5
e.	I understand films in standard dialect.	1 2 3 4 5	1 2 3 4 5

	Speaking ability	**Czech**	**French**
f.	I speak with a fluency and spontaneity that allows me to have regular interactions with native speakers.	1 2 3 4 5	1 2 3 4 5
g.	I can take part in any conversation or discussion and use idiomatic expressions and colloquialisms. (Idiomatic expression is language-settled expression, e.g. "to stretch slippers" means to die in Czech)	1 2 3 4 5	1 2 3 4 5
h.	I can tell a story, narrate the plot of a book or film and describe my reactions.	1 2 3 4 5	1 2 3 4 5
i.	When I have a language problem (for example, I do not know some vocabulary or I am not sure about grammar), I can make the situation so smooth that other people will not notice it.	1 2 3 4 5	1 2 3 4 5

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V. Other languages

35) Apart from France and CR, have you ever lived in another country for more than 6 months?

❑ No

❑ Yes, specify into the table:

Country	Town/village	Language(s) which you spoke there	Length of residence

36) Apart from French and Czech, what other languages do you speak? Answer in the table.

A1 = Beginner A2 = Elementary
B1 = Intermediate B2 = Upper Intermediate
C1 = Advanced C2 = Proficient

Language	Estimated level	How often do you speak this language?	Where do you speak this language? (e .g. : At work, during language lessons etc.)
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ I don't know at all	❑ Five times per year and less ❑ At least once per month ❑ At least one per week ❑ Every day	
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ I don't know at all	❑ Five times per year and less ❑ At least once per month ❑ At least one per week ❑ Every day	
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ I don't know at all	❑ Five times per year and less ❑ At least once per month ❑ At least one per week ❑ Every day	
	❑ A1 ❑ A2 ❑ B1 ❑ B2 ❑ C1 ❑ C2 ❑ I don't know at all	❑ Five times per year and less ❑ At least once per month ❑ At least one per week ❑ Every day	

VI. Language preferences

37) Do you feel more at home in Czech or French culture?
- ❑ in French culture
- ❑ in both, but more in French culture
- ❑ in both cultures, equally
- ❑ in both, but more in Czech culture
- ❑ in Czech culture

38) Do you feel more comfortable while speaking Czech or French?
- ❑ French
- ❑ Czech
- ❑ without preference

39) How do you feel in the presence of Czech people (for example, tourists) who speak French with a heavy Czech accent?
- ❑ that annoys me
- ❑ I do not feel very comfortable but I do not care
- ❑ I don't have any problems with that

40) If you could choose between the CR and France the country where you will live, which country would you choose?
- ❑ CR
- ❑ France
- ❑ I don't know
- ❑ Without preference

VII. Concluding questions

41) Have you ever come back to the CR after a long stay in France, and your neighbours or family members have remarked that when you speak Czech, you have a strange accent?
- ❑ yes. Describe the situation(s):
  ....
  ....
  ....
- ❑ no. never

42) You have come to the end of this questionnaire. Is there anything you would like to add? This can be anything from language-related comments to remarks about the questionnaire or research itself. ....
....
....
....

8

F.3 Rules of encoding of collected data

Note: CR=Czech Republic, Q.=number of the question in the extralinguistique questionnaire

Variable label	Q.	Variable name	Coding
Sex	1	Sex	M=Male, F=Female
Age	2	Age	number
Nationality	3	Nationality	C=Czech, CF=Czech and French, O=other
HighestEduc	4	Highest school level attained	1=grammar school, 2=university degree
LOR	5	Length of residence in France	number of years
ReasonFrance	6	Reason of staying in France	1=study, 2=job, 3=partner's work, 4=partner in France, 5=other, if more than one reason, e.g., 3-5
NativLang	7	Native Language	C=Czech, CO=Czech and other, O=other
Job	8	Actual job	S=student, ...=other
JobFrench	9	Previous job with an important use of French	F=no, T=yes
PartnerL1	10	L1 of Partner	F=French, C=Czech, O=other, NA=without partner
FrancePartner	11	Partner's stay in France	number of years
NbChildren	12a	Number of (grand)children	number, G=grandchildren
AgeChildren	12b	Age of (grand)children	number, Gnumber=age of grand-children
FrenchBeforeFrance	13	Learning French before moving to France	F=no, Y=yes with start before or at 12 years, O=yes after age of 12
FrenchIntenseBefore	14	Learning French intensively at school before moving to France	F=no, T=yes
FrenchIntenseAfter	15	Attending French intense lessons in France	F=no, T=yes
FrUsePartner	16a	Speaking French with partner	5=always, 4=often, 3=sometime, 2=rarely, 1=never

Variable label	Q.	Variable name	Coding
FrUseChildren	16b	Speaking French with children	as in 16a
FrUseFamily	16c	Speaking French with family	as in 16a
FrUsePet	16d	Speaking French with a pet	as in 16a
FrUseFriends	16e	Speaking French with friends	as in 16a
FrUseWork	16f	Speaking French in work	as in 16a
FrUseStudy	16g	Speaking French in school	as in 16a
FrUseOrga	16h	Speaking French in organisations	as in 16a
ActFrTown	17	Actual town of residence in France	T=Toulouse, R=Occitan region, O=other
PrevFrTown	18	Previous town(s) of residence in France	NA=Toulouse, R=Occitan region, P=Paris region, O=other
CzDialect	19	Speaking a dialect during living in CR	F=no, ...=yes
ActCzAccent	20	Actual speaking Czech with some specific accent	F=no, ...=yes
CzTown	21	Czech town(s) of stay of at least one year	name-years
CzLessonsFrance	22	Attending Czech lessons in France	F=no, T=yes
CzLifeFrance	23	Participation on Czech organisation in France	F=no, T=yes
FrequenceCz	24	Frequency of visiting CR	1=never or rarely, 2=ones to two times per year, 3=three times to five times per year, 4=more that five times
TimeInCR	25	Number of weeks spent in CR per year	number of weeks, E=Erasmus student
TownVisitCR	26	Town(s) of stay when visiting CR	name(s)
MaintainContact	27	Main manner of maintaining contact with Czechs	3=calling, 2=messages, ...=other, 3-2=two and more options

Variable label	Q.	Variable name	Coding
CzFrequency	28	General frequency of speaking Czech	1=never or rarely, 2=five per year, 3=at least ones time per month, 4=at least ones time per week, 5=every day
CzUsePartner	29a	Speaking Czech with partner	5=always, 4=often, 3=sometime, 2=rarely, 1=never
CzUseChildren	29b	Speaking Czech with children	as in 29a
CzUseFamily	29c	Speaking Czech with family	as in 29a
CzUsePet	29d	Speaking Czech with a pet	as in 29a
CzUseFriends	29e	Speaking Czech with friends	as in 29a
CzUseWork	29f	Speaking Czech in work	as in 29a
CzUseStudy	29g	Speaking Czech in school	as in 29a
CzUseOrga	29h	Speaking Czech in organisations	as in 29a
CzMusic	30	Frequency of listening Czech music	5=very often, 4=often, 3=sometimes, 2=rarely, 1=very rarely or never
CzTV	31	Frequency of watching Czech TV programs	as in 30
CzRadio	32	Frequency of listening Czech radio	as in 30
CzReading	33	Frequency of reading in Czech	as in 30
CodeSwitch	34	Use of Code-switching	...=yes, F=no
OtherCountry	35	Staying in another country longer than 6 months	...=yes-year, F=no
OtherLanguage	36	Speaking another languages	F=no, ...=yes (e.g.: English-B2-1-family, 4=everyday, 3=min. once a week, 2=min. once a month, 1= <five a year

Variable label	Q.	Variable name	Coding
CulturePref	37	Culture where you feel like at home	4=French, 3=French and Czech but more French, 2=French and Czech equaly, 1=French and Czech but more Czech, 0=Czech
LanguagePref	38	Language where you feel more confortable when you speak in	4=French, 0=Czech, 2=without preference
HeavyAccent	39	Feeling about people speaking French with heavy foreign accent	4=angry, 2=uncomfortable, 0=fine
CountryPref	40	Country where you would like to live	4=France, 0=CR, 2=without preference or I don't know
FrAccentInCz	41	French accent in Czech speech noted by Czechs	T=yes, F=no
FrAccentCom	41	Comments about French accent in Czech speech	...

Language self-evaluation		
Part	**Q.**	**Rating**
Comprehension	Cza	from 1 (not at all) to 5 (without difficulties)
Comprehension	Czb	from 1 (not at all) to 5 (without difficulties)
Comprehension	Czc	from 1 (not at all) to 5 (without difficulties)
Comprehension	Czd	from 1 (not at all) to 5 (without difficulties)
Comprehension	Cze	from 1 (not at all) to 5 (without difficulties)
Comprehension	Fra	from 1 (not at all) to 5 (without difficulties)
Comprehension	Frb	from 1 (not at all) to 5 (without difficulties)
Comprehension	Frc	from 1 (not at all) to 5 (without difficulties)
Comprehension	Frd	from 1 (not at all) to 5 (without difficulties)
Comprehension	Fre	from 1 (not at all) to 5 (without difficulties)
Speaking	Czf	from 1 (not at all) to 5 (without difficulties)
Speaking	Czg	from 1 (not at all) to 5 (without difficulties)
Speaking	Czh	from 1 (not at all) to 5 (without difficulties)
Speaking	Czi	from 1 (not at all) to 5 (without difficulties)
Speaking	Frf	from 1 (not at all) to 5 (without difficulties)
Speaking	Frg	from 1 (not at all) to 5 (without difficulties)
Speaking	Frh	from 1 (not at all) to 5 (without difficulties)
Speaking	Fri	from 1 (not at all) to 5 (without difficulties)

F.4 Collected data about CF by the questionnaire

Note: J=Jizerou, Pr=Prague, ČB=České Budějovice, Uh.=Uherské, Ml.=Mladá, Austr=Australia, Eng=England, w=work, tr=travelling, Ven=Venezuela

speaker	**CF1E**	**CF2E**	**CF3E**	**CF4E**	**CF5E**	**CF6E**	**CF7E**	**CF8E**	**CF9E**	**CF1A**	**CF2A**	**CF3A**	**CF4A**	**CF5A**	**CF6A**	**CF7A**	**CF8A**	**CF9A**	**CF10A**
FrUseFriends	3	4	4	4	5	4	4	2	2	4	3	4	5	5	5	5	5	5	4
FrUsePet	1	1	4	2	NA	NA	NA	1	1	1	NA	NA	NA	NA	NA	3	NA	NA	NA
FrUseFamily	1	1	1	1	1	1	1	1	1	1	2	2	5	NA	1	1	1	NA	1
FrUseChildren	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	1	NA	5	4	4	4	1	NA	NA
FrUsePartner	1	1	5	NA	5	2	5	1	1	5	5	5	5	NA	5	5	5	5	NA
FrenchIntenseAfter	F	T	T	T	F	F	T	F	T	T	F	F	F	F	F	F	F	F	F
FrenchIntenseBefore	F	F	F	F	F	F	F	F	T	F	F	F	F	F	F	F	T	F	F
FrenchBeforeFrance	O	O	Y	O	Y	O	Y	Y	O	O	O	Y	O	F	O	O	O	O	O
AgeChildren	NA	NA	NA	NA	NA	NA	NA	NA	NA	12-9-5	0.13	NA	75	94	12	14-11	0.5	NA	NA
NbChildren	0	0	0	0	0	0	0	0	0	3	1	0	2	2	1	2	1	0	0
FrancePartner	NA	NA	NA	NA	NA	3,25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PartnerL1	NA	NA	F	NA	F	C	NA	NA	NA	F	F	F	F	NA	F	NA	F	O	NA
JobFrench	F	F	F	T	F	F	F	F	F	T	F	F	T	F	F	T	F	F	F
Job	S	S	Afterschool staff	Social assistent	Architect	S	S	S	S	Translator	Maternity leave	S	Translator	Homemaker	Coach	Translator	Maternity leave	Teacher	Religious
NativLang	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
ReasonFrance	1	1	4	1	4	1	1	1	1	4	4	3-5	4	5	1	4	4	2	1
LOR	0.17	0.17	4.25	3.00	4.00	3.25	1.42	0.25	0.23	15.3	7.00	7.00	15.33	9.00	28.25	22.42	8.33	23.33	10.33
HighestEduc	1	1	2	2	2	2	2	1	1	2	2	1	2	2	2	2	2	2	2
Nationality	C	C	C	C	C	C	C	C	C	C	C	C	C	C	CF	CF	C	C	C
Age	23	22	25	36	37	23	26	21	20	42	37	22	37	38	49	42	31	49	34
Sex	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	M

speaker	**FrUseWork**	**FrUseStudy**	**FrUseOrga**	**ActFrTown**	**PrevFrTown**	**CzDialect**	**ActCzAccent**	**CzTown**	**CzLessonsFrance**	**CzLifeFrance**	**FrequenceCz**	**TimeInCR**
CF1E	3	4	2	T	NA	F	F	Pr-23	F	F	3	E
CF2E	3	5	3	T	NA	F	F	Víchová nad J.-6, Rokytnice nad J.-14, Pr-2	F	F	2	E
CF3E	5	NA	5	T	O	F	F	ČB-2, Pardubice-18	F	F	3	15.75
CF4E	5	4	2	T	NA	F	F	Pr-33	F	F	2	4.5
CF5E	NA	NA	4	T	O, P	F	F	Pr-33	F	F	3	4
CF6E	NA	4	5	T	O	F	F	Mstišov/Teplice-19, Pr-1	F	F	3	7
CF7E	3	5	NA	T	NA	F	F	Pr-23	F	F	2	11
CF8E	NA	4	NA	T	NA	F	F	Bast-11, Pr-10	F	F	1	E
CF9E	NA	4	NA	T	NA	F	F	JK-20	F	F	2	E
CF1A	NA	NA	NA	T	R	F	F	HK-22, Stracov-4	F	F	2	2.5
CF2A	NA	NA	5	T	P	Pilsen	F	Domažlice-13, Pilsen-8, ČB-2, Pr-1	F	T	2	2
CF3A	5	5	5	T	R	F	F	Ústí nad Labem-15	T	F	2	6
CF4A	5	5	5	T	NA	F	F	Ml. Boleslav-10, Pr-2	F	F	1	0
CF5A	NA	NA	5	T	P	F	F	Rumburk-29	F	F	2	2
CF6A	5	5	5	R	P	F	F	Liberec-18, Pr-3	F	F	2	2.5
CF7A	5	NA	5	R	NA	F	F	Pr-19	F	F	2	2
CF8A	5	5	5	T	P	F	F	Milevsko-20, Pilsen-3, Pr-2	T	T	2	3.5
CF9A	5	NA	5	O	NA	F	F	Pr-26	F	T	3	1.75
CF10A	3	5	4	T	O	F	F	Uh. Hradiště-5, Choceň-10, Pr-7, Olomouc-1	F	F	3	10

speaker	TownVisitCR	MaintainContact	CzFrequency	CzUsePartner	CzUseChildren	CzUseFamily	CzUsePet	CzUseFriends	CzUseWork	CzUseStudy	CzUseOrga	CzMusic	CzTV	CzRadio	CzReading	CodeSwitch
CF1E	Pr	3-2-1-postcard	5	2	NA	5	1	4	2	1	3	1	1	1	4	F
CF2E	Region of Liberec	2	5	1	NA	5	5	4	1	1	3	1	1	1	3	F
CF3E	Pardubice	2	5	2	NA	5	4	2	1	NA	1	4	3	1	2	T
CF4E	Pr, Kraslice	3-2	4	NA	NA	5	2	4	4	2	2	3	3	2	4	T
CF5E	Pr	3-2	4	1	NA	5	NA	2	4	NA	2	3	1	1	4	T
CF6E	Mstišov, Pr	3-2	5	5	NA	5	NA	3	NA	1	1	1	3	4	1	T
CF7E	Pr	3	4	1	NA	5	NA	4	1	1	NA	1	2	1	3	T
CF8E	Pr	3	5	NA	NA	5	NA	3	NA	1	1	4	3	3	4	T
CF9E	Jihocesky kraj	2	4	5	NA	5	NA	2	NA	1	NA	1	1	1	3	T
CF1A	Jičín	3	5	1	5	5	1	2	NA	NA	NA	5	1	2	2	T
CF2A	Domažlice	2	5	1	5	4	NA	3	NA	NA	1	4	3	3	4	T
CF3A	Pr, Ústí nad Labem	1	2	1	NA	4	NA	2	1	1	1	1	1	1	1	T
CF4A	Pr	2	5	2	3	1	NA	2	2	2	1	2	4	2	5	T
CF5A	Rumburk, Pr	3-2	5	NA	4	NA	NA	4	NA	NA	NA	3	1	1	1	T
CF6A	Liberec	3	5	1	4	5	NA	1	1	1	1	2	2	1	2	T
CF7A	Pr	3-2	5	2	3	5	3	1	1	NA	1	3	2	2	4	T
CF8A	Milevsko	3-2	5	1	5	5	5	5	1	NA	1	2	1	2	2	T
CF9A	Pr	3	2	1	NA	5	NA	5	NA	NA	NA	1	3	1	1	T
CF10A	Pr	2	3	NA	NA	5	NA	4	3	1	4	4	4	3	4	T

speaker	OtherCountry	OtherLanguage	CulturePref	LanguagePref	HeavyAccent	CountryPref	FrAccentInCz	FrAccentCom
CF1E	F	English-B2-4-study, partner, tr	0	0	2	2	F	NA
CF2E	F	English-C1-4-friends, language classes, Italian-A1-2-language classes	0	0	0	2	F	NA
CF3E	F	English-C1-1-friends, w, Spanish-A2-1-no use	1	4	2	2	T	NA
CF4E	Ireland-1	English-C2-2-friends	2	0	0	4	F	NA
CF5E	F	English-B2-2-friends, w, Spanish-B1-1-friends	2	0	2	4	F	NA
CF6E	Engl.-0,75	English-C1-4-study, friends	1	2	0	2	T	NA
CF7E	F	English-C2-4-ex-partners, w, Latvian-A2-1, German-A1-3-language classes	1	0	2	4	F	NA
CF8E	F	English-B1-3-tr, friends, Italian-A1-3-language classes	0	0	0	0	F	NA
CF9E	F	English-C1-3-study, friends	1	0	2	0	F	NA
CF1A	F	Italian-B2-2-holidays, reading, English-1, Spanish-A1, Russian-A2	2	2	0	4	T	by family
CF2A	F	German-A2-1-tr, mother, partner, English-B2-1	1	0	2	4	F	NA
CF3A	F	Chinese-B1-1-friends, Spanish-A2-2-friends, English-C1-3-friends	2	0	2	2	T	NA
CF4A	F	English-B2-3-w, Spanish-A1-1-w,tr	2	2	0	4	T	NA
CF5A	Is-1, Eng-2, Austr-7	English-C2-3-friends, German-A1-2-sister's partner	3	2	0	2	T	by family
CF6A	F	English-C1-4-work, German-A2-1-occasionally, Russian-B1-1-occasionally	2	2	2	4	T	when speaking about w
CF7A	Ven-0.75	Spanish-B1-1-friends, tr, German-B1-1, English-B2-1-tr,friends	3	4	0	4	T	by friends
CF8A	F	English-B2-4-w	1	2	2	2	F	NA
CF9A	F	English-C2-1-conferences, Italian-B2-1	3	0	2	4	F	NA
CF10A	F	English-B2-1, Italian-B1-1	4	2	2	4	F	in Italian

speaker	Cza	Czb	Czc	Czd	Cze	Fra	Frb	Frc	Frd	Fre	Czf	Czg	Czh	Czi	Frf	Frg	Frh	Fri
CF1E	5	5	5	5	5	3	1	2	2	1	5	5	5	5	2	1	2	3
CF2E	5	5	5	5	5	3	3	3	3	2	5	5	5	5	2	2	2	2
CF3E	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	4	5	4
CF4E	5	5	5	5	5	4	3	4	5	3	5	5	5	5	4	3	3	3
CF5E	5	5	5	5	5	4	4	5	5	4	5	5	5	5	5	4	5	4
CF6E	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	4
CF7E	5	5	5	5	5	3	3	4	4	3	5	5	5	5	5	3	3	3
CF8E	5	5	5	5	5	4	4	4	4	3	5	5	5	5	4	3	4	3
CF9E	5	5	5	5	5	4	4	4	4	4	5	5	5	5	4	3	4	3
CF1A	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	3	5
CF2A	5	5	5	5	5	4	4	3	4	3	5	5	5	5	4	3	4	3
CF3A	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4
CF4A	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
CF5A	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5	4	5	5
CF6A	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
CF7A	5	5	5	5	5	5	5	5	5	5	5	4	5	3	5	5	5	4
CF8A	5	5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	5	4
CF9A	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
CF10A	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

F.5 Subgroups of CF for analysis of extralinguistic factors

Impr. analysis - group1	Use of Czech - group1	Proficiency in Fr. - group1	Preferred identity - group1	Impr. analysis - group2	Use of Czech - group2	Proficiency in Fr. - group2	Preferred identity - group2
CF1E	CF1E	CF1E	CF2A	CF2A	CF3A	CF3A	CF1E
CF2E	CF2A	CF2A	CF4A	CF3A	CF3E	CF3E	CF2E
CF4E	CF2E	CF2E	CF4E	CF3E	CF4A	CF4A	CF3A
CF6E	CF4E	CF4E	CF5A	CF4A	CF6A	CF5A	CF3E
CF7E	CF5A	CF7E	CF5E	CF5A	CF7A	CF5E	CF8A
CF8E	CF5E	CF8E	CF6A	CF5E	CF1A	CF6A	CF6E
CF9E	CF8A	CF9E	CF7A	CF6A	CF6E	CF7A	CF8E
	CF7E		CF1A	CF7A	CF9E	CF8A	CF9E
	CF8E		CF7E	CF8A		CF1A	
	CF10A		CF10A	CF1A		CF6E	
	CF9A		CF9A	CF10A		CF10A	
				CF9A		CF9A	

A French summary

Le projet de cette thèse est né d'une expérience personnelle avec l'influence translinguistique (ci-après CLI). Ayant la langue tchèque pour langue maternelle (ci-après L1), j'ai commencé à apprendre le français, ma deuxième langue (ci-après L2), à 16 ans. Après le baccalauréat, j'ai quitté la République Tchèque pour aller étudier en France. Quand je suis retournée en République Tchèque dans ma famille après avoir passé une année en France, mon père s'est étonné de mon accent avec lequel je parlais en tchèque. Au cours de mes études universitaires, j'ai découvert que ce phénomène, que mon père percevait dans mon discours natif, s'appelle la CLI phonétique ou, dans les cas extrêmes, l'attrition phonétique de la L1 et qu'il peut concerner les bilingues tardifs, qui, comme moi, ont commencé à apprendre une L2 après l'âge de six ans et l'utilisent dans leur vie quotidienne.

L'étude de la CLI et de l'attrition de la L1 a d'abord une importance sociale car le nombre de personnes vivant à l'étranger augmente. Même si les termes CLI et attrition sont peu connus, de nombreuses personnes peuvent ainsi prendre conscience de la CLI et de l'attrition dans le discours natif de membres de leur famille ou de personnalités publiques vivant dans un pays étranger où leur L1 est peu ou pas parlée (cf. Sůčková, 2020). En outre, étudier la CLI et l'attrition de la L1 peut nous aider à mieux comprendre les stratégies de maintien de la L1 (voir, e.g., Schmid & Yılmaz, 2018), ainsi que les anxiétés et les inquiétudes qui pourraient survenir comme conséquence de la CLI et de l'attrition (voir, e.g., Serra et al., 2015).

L'étude de la CLI et de l'attrition permet également de repenser des termes tels que la langue maternelle, le locuteur natif, la norme linguistique et la perte de la langue. Si nous distinguons « le statut de locuteur natif », c'est-à-dire le fait que le locuteur soit perçu comme natif par les monolingues, de « la performance réelle du locuteur », c'est-à-dire la correspondance acoustique et articulatoire de son discours par rapport à la « norme » d'une langue donnée (voir Hyltenstam & Abrahamsson, 2008), alors nous pouvons, par exemple, parler de la « perte du statut de locuteur natif » pour les 14 bilingues tardifs dont le discours dans leur L1 n'était pas perçu comme produit par un natif par les auditeurs monolingues, accompagnée ou pas de « la perte de la performance de locuteur natif » dans l'étude de De Leeuw (2008).

Des études croissantes ont déjà examiné l'influence phonétique de la L2 sur la L1 dans le discours natif des bilingues tardifs. Elles se fondaient sur les mesures acoustiques (cf., par exemple, Major, 1992; Mayr et al., 2012; Mennen, 2004) et/ou sur les expériences de perception (cf., par exemple, De Leeuw, 2008; Sancier & Fowler, 1997) qui sont toutes les deux pertinentes pour étudier la CLI phonétique. Les mesures acoustiques permettent de saisir de très légers changements phonétiques dans la L1 des bilingues tardifs, et les expériences de perception peuvent, par les résultats, nous aider à déterminer l'analyse acoustique à mener (voir, par exemple, De Leeuw, 2008). En outre, certaines études sur l'influence phonétique de la L2 sur la L1 ont analysé le lien entre la CLI trouvée et des facteurs tels que l'usage de la L1 et de la L2 par les bilingues, la compétence en L2, et la durée de résidence dans le pays de la L2 (ci-après LOR).

Les études sur l'influence phonétique de la L2 sur la L1 ont principalement porté sur les bilingues dont la L1 ou la L2 était l'anglais. Le cas du tchèque comme L1 et du français comme L2 n'a pas encore été étudié même si ces deux langues présentent des différences phonétiques intéressantes tant au niveau segmental que suprasegmental. Ainsi, plusieurs questions se posent : Quelle est l'influence phonétique de la L2 sur la L1 lorsque le tchèque est la L1 et le français la L2 des bilingues tardifs ? Cette influence phonétique peut-elle être perçue par les monolingues tchèques ? Quels segments et éléments suprasegmentaux du discours tchèque peuvent subir cette influence phonétique ? Comment cette influence phonétique est-elle liée à l'usage des langues par les locuteurs, à la maîtrise de ces langues et à d'autres facteurs ? Cette thèse examine ces questions en étudiant le discours tchèque de bilingues tardifs tchèque-français (ci-après – CF) qui sont locuteurs natifs du tchèque ayant appris le français et déménagé en France à l'adolescence ou à l'âge adulte ; ils utilisent le français (leur L2) dans la vie quotidienne.

Dans cette thèse, l'expression CLI phonétique désigne avant tout l'influence phonétique de la L2 sur la L1, y compris l'attrition phonétique de la L1. Lorsque nous parlons de l'influence phonétique de la L1 sur la L2, nous le précisons. Les facteurs tels que l'usage des langues, la maîtrise des langues et d'autres facteurs similaires sont désignés par le terme « facteurs extralinguistiques » lorsque nous en parlons en général et par le terme « variables prédictives » lorsque nous parlons de ceux qui sont examinés dans cette thèse. Dans cette thèse, nous fondons nos hypothèses sur les modèles de la perception et production de la parole en L2, les résultats des études sur la CLI phonétique et les différences entre le système phonétique du tchèque et du français. Nous étudions l'influence du français sur le tchèque dans la parole des CF par une expérience de perception et par des mesures acoustiques dont les résultats sont, par la suite, analysés en relation avec les variables prédictives.

Chapitre 1 : Production et perception de la parole

en L2

Le chapitre 1 concerne la production et la perception de la parole en L2, et plus précisément la manière dont les locuteurs apprennent une L2 au niveau phonétique. La section 1.1 porte sur les hypothèses sur la production et la perception de la parole en L2 : comme mentionné dans Eckman (2012), celles-ci peuvent être divisées en deux, à savoir celles qui précèdent la formulation de l'hypothèse de l'interlangue (c'est-à-dire avant 1972) et celles qui la suivent (c'est-à-dire après 1972). Les premières expliquent les erreurs des apprenants de la L2 par les différences qui existent entre la L1 et la L2, avec la supposition que la L1 influence l'acquisition de la L2, et cherchent à déterminer quels sont les sons de la L2 les plus difficiles à acquérir par l'apprenant. Nous pouvons classer parmi elles l'hypothèse de l'analyse contrastive (voir Lado, 1957) et l'hypothèse de marquage différentiel (voir Eckman, 1977). Les deuxièmes commencent avec l'hypothèse de l'interlangue (Selinker, 1972). Selon l'hypothèse de l'interlangue, pendant l'acquisition de la L2, les apprenants créent un système linguistique intermédiaire, c'est-à-dire une langue intermédiaire qui évolue avec l'apprentissage et permet aux apprenants de produire et de comprendre les énoncés de la L2 (Selinker, 1972). La théorie d'optimalité (Prince & Smolensky, 1993), l'hypothèse de conformité structurelle (Eckman, 1991) et l'hypothèse du taux différentiel de similitude (Major & Kim, 1996) ont suivi l'hypothèse d'interlangue.

Dans la section 1.2, les modèles de production et de perception de la parole en L2 sont présentés. Il s'agit de la théorie de l'aimant perceptif (Native Language Magnet Theory : NLM), des modèles de l'assimilation perceptive (Perceptual Assimilation Model : PAM et PAM-L2), des modèles de l'apprentissage de la parole (Speech Learning Model : SLM et SLM-r), du modèle de perception linguistique (Second Language Linguistic Perception : L2LP) et de la théorie de l'apprentissage de l'intonation de la L2 (L2 intonation learning theory : LILt). L'hypothèse développementale de l'intonation de la L2 (Developmental L2 Intonation hypothesis) est aussi brièvement mentionnée. Les prédictions du PAM, du PAM-L2 et du L2LP concernent la perception du contraste des sons de la L2 (Best, 1994, 1995; Best & Tyler, 2007; Escudero, 2005, 2009; Van Leussen & Escudero, 2015), tandis que les modèles NLM, SLM et SLM-r concernent la perception et/ou la production d'un seul son de la L2 (voir, par exemple, Flege, 1988, 1995; Flege & Bohn, 2021; Kuhl, 1993). Dans le NLM et le SLM, la production ou la perception du/des son(s) de la L2 est prédite sur la base des similarités perceptives entre les sons de la L1 et de la L2. Le SLM prend également en compte la similitude des symboles utilisés par l'alphabet phonétique pour ces sons et leur similitude acoustique, qui est aussi prise en compte par L2LP. Le PAM prend aussi en considération la similarité des gestes articulatoires de ces sons et le PAM-L2 tient davantage compte de leurs dimensions phonétique et phonologique. Quant au SLM-r, il prédit que l'acquisition de la L2 dépend de nombreux facteurs phonétiques et endogènes qui varient avec l'individu et au cours de sa vie. Enfin, le SLM, le PAM, le PAM-L2, le L2LP et le SLM-r partagent l'hypothèse que les auditeurs-apprenants de la L2 catégorisent les sons de la L2 en fonction des catégories existantes dans leur propre L1. Concernant l'intonation de la L2, la LILt propose de comparer l'intonation de la L1 et de la L2 dans ses quatre dimensions : systémique, réalisationnelle, sémantique et fréquentielle (Mennen, 2015). Cependant, les hypothèses de la LILt se fondent sur les prédictions du SLM, qui a été récemment mis à jour et a pris le nom SLM-r. Une seule hypothèse de LILt est compatible avec le SLM-r. Elle prédit que les différences dans la dimension réalisationnelle de l'intonation de la L1 et la L2 peuvent avoir un impact sur la capacité de l'apprenant à discriminer, catégoriser et produire avec précision les éléments phonologiques de l'intonation de la L2 (Mennen, 2015). Tous les modèles mentionnés abordent la CLI principalement comme l'influence de la L1 sur la L2, mais pas nécessairement comme l'influence de la L2 sur la L1, à l'exception du SLM et du SLM-r. Selon ces deux derniers, l'influence phonétique de la L2 sur la L1 peut advenir puisque les catégories phonétiques de la L1 et de la L2 existent dans le même espace phonétique du locuteur. En revanche, le L2LP considère l'apprentissage de la L2 comme un développement de deux grammaires de perception entièrement séparées qui ne s'influencent pas mutuellement. Selon le L2LP donc, l'influence phonétique de la L2 sur la L1 n'advient pas, sauf en cas d'exposition insuffisante à une entrée riche de la L1 par le locuteur (cf. Escudero, 2005; Yazawa, 2020).

Dans la section 1.3 nous discutons l'intérêt de ces considérations théoriques pour la partie expérimentale de la thèse : L'usage du SLM pour étudier la CLI phonétique semble pertinente. En effet, selon le SLM, lors de l'acquisition de la L2, soit (1) la nouvelle catégorie phonétique n'est pas créée pour un son de la L2 qui est, par conséquent, classé dans une catégorie de la L1 soit (2) la nouvelle catégorie phonétique est créée pour un nouveau son de la L2 qui y est classée. Dans (1), les sons de la L1 et de la L2 s'influencent mutuellement en rapprochant leurs propriétés (effet d'assimilation), et dans (2), les interférences entre les sons de la L1 et de la L2 existent sous forme de l'effort de maintien du contraste entre la catégorie de la L1 et de la L2 (effet de dissimilation) (voir, par exemple, De Leeuw, 2019a). De plus, le SLM propose quelques critères pour prédire quel type d'effet va advenir. Cependant, ces critères restent insuffisants et seul le SLM-r apporte une approche plus complète concernant les prédictions de type d'effet à advenir. Ainsi, selon le SLM-r, le type d'effet à advenir dépend de très nombreux facteurs phonétiques et endogènes qui peuvent varier avec le locuteur. Par conséquent, nous considérons que le SLM-r est probablement le modèle le plus propice pour étudier la CLI phonétique. Néanmoins, nous n'avons pas pu examiner tous ces très nombreux facteurs phonétiques et endogènes déterminant l'acquisition de la L2 de chaque CF, puisque cela semble être presque une tâche impossible à accomplir. Par conséquent, nous avons décidé de considérer que tous les phonèmes tchèques et français qui diffèrent dans au moins un de ces éléments suivants : symbole selon l'alphabet phonétique, propriétés acoustiques, propriétés articulatoires, propriétés perceptives, propriétés phonologiques, pourraient être affectés par la CLI phonétique dans le parole tchèque des CF. De plus, en raison des prédictions du L2LP, nous considérons que la CLI phonétique pourrait également se produire dans les phonèmes tchèques qui n'existent pas en français, car les CF y seraient moins souvent exposés.

Chapitre 2 : Influence translinguistique et attrition de la L1

Le chapitre 2 concerne l'influence translinguistique et l'attrition de la L1. Dans la section 2.1, nous apportons les définitions des concepts liés à la notion de la CLI phonétique. Il est précisé que selon l'âge du début de l'acquisition d'une L2 par le locuteur, on peut distinguer le bilinguisme précoce simultané, le bilinguisme précoce successif et le bilinguisme tardif. Le dernier concerne l'apprentissage de la L2 après l'âge de six ans et est l'un des cadres dans lequel la CLI peut advenir. La CLI est ainsi définie comme tout type d'effet qu'une langue du locuteur peut avoir sur une autre de ses langues (Jarvis & Pavlenko, 2008; Pavlenko, 2000). Pavlenko (2000) liste cinq types de CLI dont le dernier est l'attrition de la L1. Celle-ci, l'attrition de la L1, est définie comme le déclin non pathologique des compétences en L1 que le locuteur possédait auparavant, lié à un usage moins fréquent ou nul de la L1 (Köpke & Schmid, 2004; Köpke, 2019). Au niveau phonétique, l'attrition référerait aux changements phonétiques dans la parole de la L1 (cf. De Leeuw, 2019b) qui, vu les prédictions faites par le SLM et le SLM -r, se produisent sous forme d'assimilation ou de dissimilation. Cela signifie que, dans la parole en L1 produite par un bilingue tardif, les segments et/ou les éléments suprasegmentaux soit se rapprochent dans leurs propriétés phonétiques de celles des segments et/ou des éléments suprasegmentaux de la L2 produite par un locuteur natif de la L2 (i.e., assimilation) soit ils s'en éloignent tout en s'éloignant aussi des propriétés phonétiques des segments et/ou des éléments suprasegmentaux de la L1 produite par un locuteur natif de la L1 (i.e., dissimilation) (cf. De Leeuw, 2019b).

La section 2.2 propose une revue rapide des études sur l'influence phonétique de la L1 sur la L2. Nous soulignons que ces études examinent très souvent le VOT dans les occlusives, les voyelles et l'accent. À partir des résultats des études présentées, nous suggérons que (1) certains apprenants tchèques du français pourraient avoir des difficultés à percevoir et à produire correctement certaines voyelles françaises, notamment les contrastes entre /y/ et /u/, /e/ et /ɛ/, /ø/ et /œ/, /o/ et /ɔ/ (Hradecká, 2020; Paillereau, 2015), et (2) ils pourraient parler le français en utilisant les règles d'accentuation tchèques, du moins au début de l'acquisition du français

(Duběda, 2009).

La section 2.3 apporte une large revue des études de l'influence phonétique de la L2 sur la L1. Nous proposons de résumer ces études dans les cinq points suivants :

- Très peu d'études ont comparé la quantité de la CLI phonétique dans différents styles de parole (tâches de production). Seule Major (1992) a trouvé une CLI phonétique significativement plus évidente dans la conversation informelle que dans les styles de parole formels.

- De nombreuses études se sont concentrées sur l'anglais en tant que L1 ou L2 des bilingues tardifs (voir, par exemple, Flege & Hillenbrand, 1984; Chang, 2010; Mayr et al., 2012; Sancier & Fowler, 1997; Sůčková, 2020) alors que les paires de langues qui n'incluent pas l'anglais étaient peu étudiées. Les études ont utilisé notamment la lecture d'une liste de mots ou de phrases comme tâche de production de la parole (voir, par exemple, Dmitrieva et al., 2010; Chang, 2012; Lang & Davidson, 2019; De Leeuw, 2008). Elles se sont concentrées surtout sur les VOT des occlusives (Flege & Eefting, 1987b; Chang, 2010; Kupske & Alves, 2016; Stoehr et al., 2017; Sůčková, 2020, entre autres) alors que les propriétés acoustiques d'autres segments ou éléments suprasegmentaux ont été moins fréquemment étudiées.

- Les expériences de perception ont été utilisées généralement afin de déterminer les directions que devaient prendre les analyses acoustiques (voir, par exemple, De Leeuw, 2008; Sancier & Fowler, 1997).

- L'effet de dissimilation a été trouvé dans peu d'études. Dans une étude, la CLI qui a été trouvée dans la parole en L1 des bilingues pourrait être interprétée comme un emprunt d'une caractéristique phonétique de la L2 et son incorporation dans la L1, dans laquelle cette caractéristique phonétique n'existait pas auparavant (voir Dmitrieva et al., 2010).

- L'influence phonétique de la L2 sur les éléments suprasegmentaux de la L1 a été peu examinée sur le plan acoustique (De Leeuw, 2008; Leeuw et al., 2011). Au niveau segmental, les caractéristiques acoustiques examinées dans les études concernent principalement le VOT, $F1$, $F2$, et le $F3$ (voir, par exemple, Bergmann et al., 2016; De Leeuw, 2008; Chang, 2010; Stoehr et al., 2017).

Dans la section 2.4, les facteurs extralinguistiques sont définis comme des facteurs externes à la langue en tant que système, mais davantage liés au bilingue en tant que personne, qui peuvent contribuer à la CLI phonétique. En ce qui concerne la LOR, Schmid (2011) constate que le lien entre la LOR et la CLI phonétique est rarement significatif lorsqu'une étude se concentre sur les bilingues dont la LOR est supérieure à dix ans, ce qui semble être confirmé par les résultats des études sur la CLI phonétique. Les résultats des études de Bergmann et al. (2016); Dmitrieva et al. (2010); Lang and Davidson (2019); Kupske and Alves (2016) nous laissent suggérer que le lien existerait quand des bilingues tardifs avec une LOR courte sont inclus dans l'étude. De plus, Bergmann et al. (2016); De Leeuw (2008) ont trouvé un impact significatif de l'usage de la L1 sur la CLI phonétique et Major (1992) a trouvé un impact de la compétence en L2. Néanmoins, étudier des facteurs extralinguistiques représente certaines difficultés méthodologiques auxquelles les auteurs dans le domaine de la CLI phonétique ne font pas tous face de la même façon. Le questionnaire proposé par Schmid (2002) pour la collecte des données extralinguistiques a été utilisé par certains auteurs (voir, par exemple, De Leeuw, 2008). Même s'il peut être considéré comme un outil méthodologique important, nous suggérons que plusieurs problèmes de traitement des données collectées par ce questionnaire peuvent mener aux choix statistiques difficiles. Nous mentionnons, par exemple, la conversion des variables ordinales en variables numériques et le calcul de la moyenne à partir de ces variables numériques qui, bien qu'il permette de traiter les donées, n'est pas un choix idéal d'un point de vue statistique (l'approche utilisée, par exemple, dans De Leeuw, 2008; Sůčková, 2020).

Chapitre 3 : Comparaison du système phonétique du tchèque et du français

Le chapitre 3 consiste en comparaison du système phonétique du tchèque avec celui du français. Dans la section 3.1, les notions telles que la variété linguistique et la norme sont définies. Comme les CF habitaient principalement à Toulouse ou ses environs, nous présentons les variétés du français qui sont très probablement parlées à Toulouse pour déterminer les variétés du français auxquelles les CF pourraient être exposés. Les CF ont tous habité dans la Bohème avant de venir en France. C'est pour cette raison que nous présentons dans cette section le tchèque standard qui est très parlé en Bohème. Ainsi, nous déterminons que les CF pourraient être en contact surtout avec trois variétés de langues : le tchèque standard, le français standard et le français toulousain.

Les systèmes phonétiques de ces trois variétés sont comparés dans les sections 3.2 et 3.3. Les similitudes et les différences entre ces systèmes peuvent être résumées de la manière suivante :

- Concernant les voyelles, le système vocalique du français standard est plus complexe dans les degrés d'ouverture et d'antériorité que le système vocalique du tchèque standard. Le système vocalique du français toulousain semble plus simple que celui du français standard car les différences entre /e/ et /ɛ/, /a/ et /ɑ/, /o/ et /ɔ/, et /œ/ et /ø/ peuvent être moins respectées en français toulousain. Par conséquent, le système vocalique du français toulousain semble être plus proche de celui du tchèque standard que celui du français standard. La longueur des voyelles est une caractéristique phonologique en tchèque standard mais pas en français. D'un point de vue phonologique, les voyelles nasales n'existent pas en tchèque mais elles existent en français standard. Le français toulousain ne semble pas contenir de voyelles entièrement nasalisées. Les voyelles diphtongues existent en tchèque mais pas en français. Le français standard a des voyelles plus arrondies que le tchèque, ce qui signifie que son système vocalique exige une articulation plus précise et plus tendue que le système vocalique tchèque (voir Durand, 2009; Dufková, 2012; Léon, 1992; Skarnitzl et al., 2016, entre autres).

- Concernant les consonnes, le système consonantique tchèque est plus riche que celui du français standard et du français toulousain, qui sont similaires. /ɱ/, /ʔ/, /χ/, /ɣ/, /ɦ/, /c/, /ɟ/, /t͡ʃ/, /d͡ʒ/, /t͡s/, /d͡z/, /r̝/ et /r̝̊/ existent en tchèque mais pas en français. En revanche, /ʁ/, /ɥ/ et /w/ existent en français mais pas en tchèque. Toute consonne en français ne peut pas être le noyau de la syllabe alors que /r/ et /l/ peuvent l'être en tchèque. Le tchèque peut utiliser l'occlusive glottale /ʔ/ pour séparer la consonne finale d'un mot de la voyelle initiale du mot suivant, alors que le français peut lier la consonne finale d'un mot à la voyelle initiale du mot suivant dans le cas de la liaison. Le dévoisement de la consonne finale ne caractérise pas le français standard alors qu'il est courant en tchèque standard (voir Durand, 2009; Dufková, 2012; Léon, 1992; Skarnitzl et al., 2016, entre autres).

- En ce qui concerne l'intonation, le français standard et le français toulousain sont des variétés linguistiques plus mélodiques que le tchèque standard qui est plus monotone. La cadence la plus utilisée pour le patron intonatif non-conclusif semble être plus montante en français qu'en tchèque. En ce qui concerne les registres vocaux, la moyenne de $f0$ s'avère être plus élevée en français standard qu'en tchèque standard, en particulier dans la production féminine. De plus, les locuteurs de Marseille ont eu tendance à utiliser des registres plus larges que les locuteurs du nord de la France. Les locuteurs français peuvent produire un « schwa final » à la fin des mots qui s'ajoute le plus souvent à la dernière consonne du mot et ils créent ainsi une syllabe supplémentaire au mot. Ce schwa caractérise le français toulousain et peut avoir un impact sur l'intonation (voir Duběda, 2012; Hruška, 2016; Gendrot & Gerdes, 2010; Pešková et al., 2018; Santiago, 2019; Skarnitzl et al., 2016; Volín et al., 2015, entre autres).

- Quant à l'accent, le français standard est une langue à dominance droite alors que le tchèque standard est une langue à dominance gauche. Les phrases accentuelles sont ascendantes ou bidirectionnelles en français, alors qu'elles sont descendantes en tchèque standard. L'accent primaire est sur la dernière syllabe de la phrase accentuelle ou intonative en français standard alors qu'en tchèque standard, il semble qu'il soit sur la deuxième syllabe en raison de ses valeurs acoustiques plus élevées (voir Skarnitzl et al., 2016; Duběda, 2002).

- À propos du rythme, le français standard est une langue syllabique alors que le tchèque standard se situe le plus probablement quelque part entre les langues accentuelles et les langues syllabique. Le français contient nettement plus de syllabes composées de consonne-voyelle (CV) que le tchèque. Le rythme du français toulousain peut être légèrement affecté par des schwas finaux (cf. Coquillon, 2005; Dačovicová & Dellwo, 2007; Dellwo et al., 2004; Skarnitzl et al., 2016).

Dans la section 3.4, nous comparons les marques d'hésitation en tchèque et en français. Les études sur les marques d'hésitation en tchèque sont rares, alors que l'hésitation en français a été étudiée en détail par, par exemple, Candea (2000). Dans les deux langues, les pauses sont très souvent remplies par un élément vocalique. En tchèque, l'élément vocalique est en général séparé des mots par des silences tandis qu'en français, l'élément vocalique est généralement ajouté à la fin du mot et est d'une durée et d'une intensité spécifique. On peut supposer que deux types de schwa final peuvent être produits notamment en français toulousain, le premier serait l'expression d'une variété linguistique, le second serait l'expression de l'hésitation du locuteur. La durée semble être un critère potentiel pour distinguer les deux types. L'allongement des voyelles est souvent utilisé en français comme marqueur d'hésitation (Candea, 2000).

Chapitre 4 : Questions, esquisse et intérêt de recherche

Le chapitre 4 présente les questions, l'esquisse et l'intérêt de recherche. L'hypothèse générale de la thèse et les questions de recherche sont données dans la section 4.1. L'hypothèse générale émerge des considérations théoriques présentées dans les chapitres précédents. En effet, les modèles de perception et de production de la parole en L2 (principalement le SLM et le SLM-r, voir chapter 1) et les résultats des études sur la CLI phonétique (chapter 2) suggèrent tous les deux que, lorsque les systèmes phonétiques de la L1 et de la L2 parlées par un bilingue tardif ne sont pas identiques, l'influence phonétique de la L2 sur la L1 peut advenir. Comme le tchèque et le français diffèrent de manière significative dans leurs systèmes phonétiques (cf. chapter 3), nous proposons l'hypothèse générale suivante : La CLI phonétique se produira dans la parole en L1 des CF. Par la CLI phonétique, nous entendons ici l'influence du français sur le tchèque des CF au niveau phonétique. De cette hypothèse générale découlent trois questions de recherche :

1. La parole en L1 des CF est-elle perçue par les monolingues tchèques comme étant moins proche de leur langue maternelle en raison de la présence de la CLI phonétique ?

2. Dans quelles propriétés phonétiques de la parole en L1 des CF se produit la CLI et peut-elle être révélée par des mesures acoustiques ?

3. Comment les facteurs extralinguistiques sont-ils liés à la CLI phonétique dans la parole en L1 des CF ?

Dans la section 4.2, nous esquissons la recherche à mener, en particulier les trois études qui nous permettront de répondre aux trois questions de recherche (voir fig. 8.1). La première (chapter 5) consiste en une expérience de perception, désignée ci-après comme le test perceptif et vise à répondre à la première question. La deuxième (chapter 6) est une étude acoustique visant à répondre à la deuxième question. La troisième (chapter 7) concerne les facteurs extralinguistiques, et vise à répondre à la troisième. Ces trois études sont liées entre elles. Les résultats obtenus dans le test perceptif nous ont aidés à déterminer les segments et les éléments suprasegmentaux, et leurs propriétés phonétiques à examiner dans l'étude acoustique. Les résultats du test perceptif et de l'étude acoustique ont été utilisés pour constituer les variables indiquant la CLI phonétique, dont la relation avec les variables prédictives a été examinée dans la dernière étude.

Dans la section 4.3, l'intérêt de cette recherche est souligné. En effet, la présente thèse implique l'étude d'un ensemble de nouveaux éléments qui n'ont pas été étudiés dans le domaine de la recherche sur la CLI phonétique auparavant. Se focaliser sur les langues tchèque et française, une paire de langues originale, permet d'étudier la CLI phonétique dans des segments et des éléments suprasegmentaux rarement examinés par les auteurs tels que le /r/, les fricatives et l'intonation, qui font partie des éléments examinés dans notre étude acoustique. De plus, dans l'étude acoustique, nous examinons le schwa final, le phénomène typique pour du français méridional, qui n'a pas encore été inclus dans les recherches sur la CLI phonétique. Cela nous permet d'analyser les propriétés de ces éléments originaux en comparaison avec ceux analysées dans les études sur la CLI phonétique, tels que HNR et les moments spectraux. De plus, nous analysons la CLI phonétique dans deux tâches de production différentes : la lecture à voix haute et la parole semi-spontanée, ce qui n'a pas été fait depuis l'étude de Major (1992). Enfin, contrairement aux groupes de bilingues tardifs fréquemment étudiés, les groupes de nos bilingues tardifs représentent des individus qui vivent tous dans la même zone géographique sans forcément se connaître. Ainsi, ils ne sont pas ou presque pas en contact avec la L1 parlée par les bilingues comme eux.

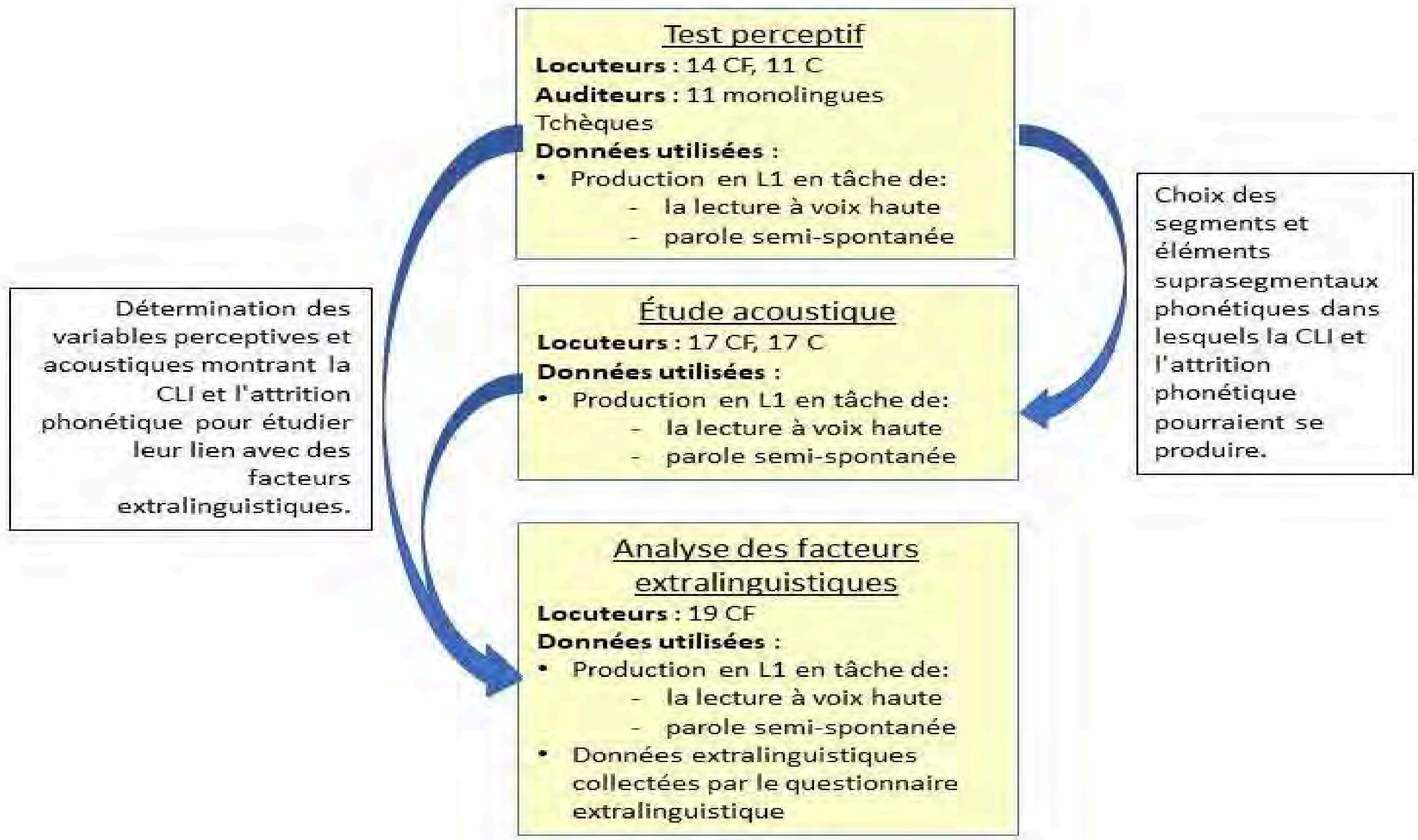


Figure 8.1: Schéma de la recherche

Note : Les cases jaunes indiquent les trois études de la thèse. Les flèches et les cases blanches indiquent les liens entre elles.

Chapitre 5 : Test perceptif

Ce chapitre présente le test perceptif par lequel nous avons examiné la perception de la parole en L1 des CF par des auditeurs monolingues tchèques. Dans la section 5.1, nous proposons trois hypothèses pour le test perceptif qui sont :

- La parole en L1 des CF sera perçue comme ayant une sonorité moins typiquement tchèque que la parole en L1 des tchèques monolingues par les auditeurs monolingues tchèques, en raison de l'occurrence possible d'une CLI phonétique dans la parole en L1 des CF. Cette hypothèse est en lien avec les résultats des études de Bergmann et al. (2016); De Leeuw (2008); Mayr et al. (2020); Sancier and Fowler (1997).
- La parole des CF dans la tâche de lecture à voix haute sera perçue par les auditeurs monolingues tchèques comme ayant une sonorité plus typiquement tchèque que leur parole semi-spontanée en L1 parce qu'il a été constaté que le discours informel était plus susceptible d'être affecté par la CLI phonétique que le discours formel par Major (1992).
- Certaines caractéristiques phonétiques des segments et éléments suprasegmentaux qui ne sont pas identiques en tchèque et en français seront mentionnées par les auditeurs tchèques comme ayant une sonorité moins typiquement tchèque dans la parole en L1 des CF. Cette hypothèse se fonde sur le SLM, le SLM -r et les résultats des études sur la CLI phonétique.

Dans la section 5.2, nous présentons la méthodologie. Pour constituer le test perceptif, les stimuli de la parole ont été choisis à partir des enregistrements de la parole semi-spontanée en L1 et de la lecture à voix haute en L1 de 11 monolingues tchèque et 14 CF. Les monolingues tchèques (ci-après C) étaient tous locuteurs natifs du tchèque standard et ont habité en Bohème. Pour les enregistrements de la parole semi-spontanée, les locuteurs ont été invités à parler pendant une minute et demie de leurs vacances, week-end, famille, profession ou autres sujets similaires. Pour les enregistrements de la lecture à voix haute, les locuteurs ont été invités à lire un texte court et simple, pris d'un livre de Čapek (1960), un auteur tchèque célèbre. Pour l'inclusion de distracteurs dans le test perceptif, nous avons enregistré la lecture d'un locuteur français natif et de la synthèse vocale. La synthèse vocale représentait deux voix de locuteurs français. Le locuteur natif ainsi que la synthèse ont lu un texte qui a été écrit de manière à ce qu'ils prononcent les segments comme un locuteur tchèque monolingue autant que possible mais qu'ils le lisent avec la prosodie du français. Le texte lu a été identique dans son contenu à la parole enregistrée des C et CF. Le test perceptif s'est composé de 77 stimuli de parole longs de 1,2 à 13,28 secondes.

Le test perceptif a été créé comme l'expérience à choix multiple dans Praat (Boersma & Weenink, 2019) et a été administré aux 17 auditeurs qui étaient des étudiants tchèques en phonétique à l'Institut phonétique de Prague. Les auditeurs devaient indiquer si le stimulus écouté semblait être prononcé par un locuteur « complétement tchèque » ou « complétement français » sur une échelle de 5 degrés (réponse 1= « complétement tchèque », réponse 5= « complétement français »). Ils pouvaient réécouter chaque stimulus cinq fois. Les stimuli étaient rendus aléatoires et séparés par un bip de désensibilisation. Tous les vingt stimuli, les auditeurs étaient invités à faire une courte pause, au cours de laquelle ils pouvaient écouter une courte chanson (environ 30 secondes). Le test perceptif était précédé d'une session d'entraînement comprenant sept stimuli afin de vérifier la compréhension de la consigne. Si les auditeurs remarquaient des phénomènes inhabituels pour le tchèque, ils étaient invités à les répertorier dans une feuille Excel (uniquement pour les réponses de 2 à 4). La durée totale du test perceptif était d'environ 25 min.

Les résultats sont présentés dans la section 5.3. Ils ont été obtenus par le calcul d'un modèle linéaire mixte et ont montré que les stimuli extraits de la parole semi-spontanée en L1 des CF ont été perçus par les auditeurs comme étant significativement moins typiquement tchèques que ceux extraits de la parole semi-spontanée des C. Les auditeurs ont principalement commenté la qualité des voyelles, de la fricative vélaire et glottale, du /r/ et de l'intonation dans les stimuli qu'ils ont évalués comme n'étant ni typiquement tchèques ni typiquement français, mais entre les deux.

Au vu de ces résultats, la première hypothèse a été confirmée uniquement pour la parole semi-spontanée des CF mais pas pour la lecture à voix haute. La deuxième hypothèse a été entièrement confirmée et ce résultat s'accorde donc avec le résultat de Major (1992). La troisième hypothèse a été aussi confirmée comme les commentaires faits par les auditeurs sur les stimuli portaient sur les propriétés phonétiques des segments et éléments suprasegmentaux qui ne sont pas identiques en tchèque et en français. Au vu des commentaires faits par les auditeurs lors du test perceptif, nous avons décidé d'analyser acoustiquement les caractéristiques spectrales des voyelles, de la fricative vélaire et glottale, et du /r/, les caractéristiques temporelles du /r/ et l'intonation dans les patrons intonatifs non-conclusifs dans l'étude suivante. Nous avons également décidé d'examiner de plus près le schwa final car il s'agit d'un élément phonétique spécifique pour le français méridional. Étant donné que la CLI phonétique peut être révélée lorsqu'elle est examinée acoustiquement même si elle ne l'était pas pendant une expérience de perception (cf. Sůčková, 2020), nous avons décidé d'examiner les caractéristiques phonétiques des segments et éléments suprasegmentaux mentionnés précédemment dans les deux tâches de production.

Chapitre 6 : Étude acoustique

Le chapitre 6 présente l'étude acoustique. Dans la section 6.1, nous proposons deux hypothèses pour cette étude. Ces hypothèses sont :

- La CLI phonétique se produira dans certaines propriétés acoustiques des voyelles, du /r/, du /ɦ/ et du /x/ quand ces propriétés ne sont pas identiques en tchèque et en français. La CLI phonétique se produira également dans les patrons intonatifs non-conclusifs et dans les schwas finaux dans la parole en L1 des CF. Cette hypothèse se base, entre autres, sur les résultats du test perceptif ainsi que sur les différences entre les systèmes phonétiques du tchèque et du français.

- L'étude acoustique révèlera plus de CLI phonétique dans la parole semi-spontanée des CF que dans leur production dans la tâche de lecture à voix haute. Cette hypothèse est faite en lien avec les résultats de Major (1992) et les résultats du test perceptif.

Dans la section 6.2, nous décrivons le corpus de parole utilisé pour l'étude acoustique. Nous utilisons pour l'étude acoustique le corpus composé de la production de 17 C et 17 CF en L1 dans les deux tâches, c'est-à-dire la lecture à voix haute et la parole semi-spontanée. Les 17 CF vivaient tous dans la région de Toulouse. Les 17 C vivaient tous dans la Bohème. Les locuteurs des deux groupes parlaient ainsi le tchèque standard et étaient d'âge proche. Les enregistrements de leur parole ont été transcrits, annotés et segmentés en phrases, mots et phonèmes sur Praat. Nous avons utilisé l'ensemble des enregistrements pour les analyses acoustiques mais nous avons exclu de l'analyse les mots étrangers dans les enregistrements et les phonèmes pas ou peu prononcés par le locuteur (comme cela peut par exemple être le cas de la voyelle /o/ dans le mot « protože » en tchèque).

Les sections de 6.3 à 6.7 présentent les analyses acoustiques des différents éléments. La CLI phonétique y est examinée en comparant les caractéristiques spectrales des voyelles, des rhotiques, et de la fricative vélaire et glottale dans la parole des CF avec celles dans la parole des C. Nous comparons également les caractéristiques temporelles des rhotiques, la $f0$ dans les patrons intonatifs non-conclusifs et l'occurrence des schwas finaux dans la parole des CF avec celles dans la parole des C. Plusieurs propriétés acoustiques ont été étudiées : les trois premiers formants, les moments spectraux, la durée, l'harmonicité et les contours de la $f0$. Chaque section commence de manière générale par une comparaison des propriétés acoustiques en tchèque et en français du segment ou de l'élément suprasegmental que nous étudions. À partir de cela, les prédictions spécifiques sont déterminées et la méthodologie expliquée. Pour les analyses statistiques, les modèles linéaires mixtes ont été abondamment utilisés. Notons que pour l'analyse des formants vocaliques, nous

Table 8.1: La CLI phonétique dans la production en L1 des CF dans la tâche de lecture à voix haute.

segment(s) du discours/ élément suprasegmental	valeur examinée	CLI phonétique	effet
a	$F1$		
	$F2$		
aː	$F1$	oui-nul, Lobanov, BDM	dissimilation
	$F2$		
ɛ	$F1$		
	$F2$	oui-Lobanov	dissimilation
ɛː	$F1$	oui-Lobanov	assimilation
	$F2$		
ɪ	$F1$		
	$F2$	oui-Lobanov	dissimilation
	$F3$	oui-Lobanov	dissimilation
iː	$F1$		
	$F2$		
	$F3$	oui-nul	assimilation
o	$F1$		
u	$F1$	oui-Lobanov	dissimilation
	$F2$		
uː	$F1$		
	$F2$		
r	HNR		
	durée normalisée	oui	assimilation
	moments spectraux	oui	assimilation
	$F1$	oui-nul, Lobanov	assimilation
	$F2$	oui-Lobanov	assimilation
	$F3$	oui-Lobanov	dissimilation
x	moments spectraux	oui	dissimilation ou autre
patrons intonatifs non-conclusifs	ratio de la montée haute		
tous les schwa finaux	pourcentage schwa		
schwa d'appui	nb d'occurrences		
schwa d'hésitation	nb d'occurrences		

Note : En gris = aucun résultat significatif, nul = résultat significatif lors de l'examen des valeurs non normalisées, Lobanov = résultat significatif lors de l'examen des valeurs normalisées par la méthode de Lobanov, BDM = résultat significatif lors de l'examen des valeurs normalisées par la méthode Différentielle Métrique de Bark, nb=nombre.

Table 8.2: La CLI phonétique dans la parole semi-spontanée en L1 des CF.

segment(s) du discours/ élément suprasegmental	valeur examinée	CLI phonétique	effet
a	$F1$		
	$F2$		
aː	$F1$	oui-nul	dissimilation
	$F2$		
ɛ	$F1$	oui-Lobanov	assimilation
	$F2$		
ɛː	$F1$	oui-Lobanov	assimilation
	$F2$	oui-BDM	assimilation
ɪ	$F1$		
	$F2$	oui-nul, BDM	assimilation
	$F3$	oui-BDM	dissimilation
iː	$F1$		
	$F2$	oui-nul	assimilation
	$F3$	oui-nul, Lobanov	assimilation
o	$F1$		
u	$F1$		
	$F2$		
uː	$F1$		
	$F2$		
r	HNR		
	durée normalisée	oui	dissimilation
	moments spectraux	oui	assimilation
	$F1$		
	$F2$		
	$F3$		
x	moments spectraux	oui	dissimilation ou autre
ɦ	moments spectraux	oui	dissimilation ou autre
ɦ–x	distance dans les moments spectraux	oui	dissimilation ou autre
patrons intonatifs non-conclusifs	ratio de la montée haute	oui	assimilation
tous les schwa finaux	pourcentage schwa	oui	autre
schwa d'appui	nb d'occurrences	oui	autre
schwa d'hésitation	nb d'occurrences	oui	autre

Note : En gris = aucun résultat significatif, nul = résultat significatif lors de l'examen des valeurs non normalisées, Lobanov = résultat significatif lors de l'examen des valeurs normalisées par la méthode de Lobanov, BDM = résultat significatif lors de l'examen des valeurs normalisées par la méthode Différentielle Métrique de Bark, nb=nombre.

avons choisi de faire trois types d'analyses : une analyse des valeurs des formants non-normalisés, une analyse des formants normalisés par la méthode de Lobanov et une analyse des formants normalisés par la méthode Différentielle Métrique de Bark. Pour l'étude des formants de /r/, seules les valeurs non-normalisées et les valeurs normalisées par la méthode de Lobanov ont été analysées. Les résultats significatifs concernant chaque propriété acoustique étudiée ont été interprétés soit comme l'effet de l'assimilation soit comme l'effet de la dissimilation. Les tableaux 8.1 et 8.2 les résument en indiquant l'effet trouvé.

La CLI phonétique s'est produite principalement dans les caractéristiques spectrales de /aː/, /ɛ/, /ɛː/, /ɪ/, /iː/, et /x/ des CF, dans leurs productions dans la tâche de lecture à voix haute et dans la parole semi-spontanée. Elle s'est également produite dans la durée normalisée de /r/ des CF et ses moments spectraux dans leur productions dans la tâche de lecture à voix haute et dans la parole semi-spontanée, tandis que les trois premiers formants de /r/ des CF ont été affectés par la CLI phonétique uniquement dans la lecture à voix haute. En raison de données insuffisantes, les moments spectraux de /ɦ/ n'ont été examinés que dans la parole semi-spontanée et ils ont été affectés par la CLI phonétique. La distance entre les valeurs des moments spectraux du /ɦ/ et du /x/ était plus petite dans la parole semi-spontanée des CF que dans celle des C. Parmi toutes les cadences ascendantes dans les patrons intonatifs non-conclusifs, les CF ont utilisé la cadence avec une intonation montante très haut plus souvent que les C dans la parole semi-spontanée. Ils ont également produit le schwa final plus souvent en parole semi-spontanée que les C.

Dans la section 6.8, nous discutons les résultats de notre étude acoustique. La CLI s'est produite, dans la parole des CF, dans quelques propriétés acoustiques qui ne sont pas identiques en français et tchèque. Ainsi, la première hypothèse a été confirmée. Concernant la deuxième hypothèse, elle a été confirmée si nous prenons en compte tous nos résultats et nous ne les regardons pas de manière séparée. Nous avons également démontré, en examinant les résultats à la lumière des différences phonétiques entre le tchèque et le français, que toutes les CLI phonétiques trouvées dans la parole en L1 des CF sont interprétables comme l'influence du français sur le tchèque, à l'exception de notre résultat concernant /ɦ/ et /x/. Les propriétés acoustiques de /ɦ/ et /x/ étaient significativement différentes dans la production des C et CF mais, il est moins certain que cela soit dû à l'influence du français sur /ɦ/ et /x/ tchèque. La CLI s'est généralement produite comme un effet d'assimilation ou de dissimilation. Le résultat concernant le schwa final peut être considéré comme un emprunt d'une caractéristique de la L2 incorporé en L1 des CF. Il est intéressant de noter que nos résultats ont montré que les effets d'assimilation et de dissimilation peuvent coexister dans le phonème. Cette découverte était en contradiction avec ce que peut prédire le SLM, le PAM et le SLM-r, et c'est pourquoi nous avons proposé une légère modification de la conception de l'effet de l'assimilation et de la dissimilation et de leur lien avec les catégories phonétiques dans l'espace phonétique d'un locuteur. Enfin, notre analyse a montré des modifications systémiques plus importantes dans les $F2$ que dans les $F1$ des voyelles, ce qui est un résultat différent de celui de Chang (2011); Lang and Davidson (2019); Mayr et al. (2012).

Chapitre 7 : Facteurs extralinguistiques

Le chapitre 7 se concentre principalement sur la relation entre la CLI phonétique trouvée dans la parole des CF et quatre variables prédictives qui sont LOR, *Compétence en français*, *Usage du tchèque*, et *Identité préférée* du locuteur à savoir sa préférence pour la culture, le pays et la langue tchèque ou française. La CLI est décrite par « les variables indicatrices acoustiques » qui sont obtenues des résultats de notre étude acoustique et par « la variable indicatrice perceptive » qui est obtenue des résultats de notre test perceptif. Dans la section 7.1, nous faisons les quatre hypothèses suivantes :

- Comme notre étude inclue les CF avec des LORs variées (de 0,17 à 28,25 ans) et que des valeurs basses de LOR sont incluses, les LOR plus élevées seront liées à une CLI phonétique plus importante dans les variables indicatrices. Cette hypothèse se base sur les résultats de Bergmann et al. (2016); Dmitrieva et al. (2010); Kupske and Alves (2016); Lang and Davidson (2019) et l'affirmation de Schmid (2011) à propos de la LOR.
- La fréquence plus basse de *Usage du tchèque* des CF ne sera pas liée à une CLI phonétique plus importante dans les variables indicatrices acoustiques. À l'inverse, une fréquence plus basse de *Usage du tchèque* des CF sera liée à une CLI phonétique plus importante dans la variable indicatrice perceptive. Cette hypothèse se base sur les résultats de Bergmann et al. (2016); De Leeuw (2008); Sůčková (2020).
- Une *Compétence en français* plus élevée sera liée à une CLI phonétique plus importante dans les variables indicatrices. Cette hypothèse se base sur les résultats de l'étude de Major (1992).
- Une valeur plus élevée dans *Identité préférée* sera liée à une plus grande CLI phonétique dans les variables indicatrices.

La section 7.2 est consacrée à la méthodologie. Les données extralinguistiques ont été collectées des 19 CF après l'enregistrement de leur parole par le questionnaire extralinguistique qui contenait 41 questions et une auto-évaluation linguistique. Les variables prédictives ont été constituées à partir des données recueillies. La variable *Usage du tchèque* a été constituée à partir de 7 questions visant à savoir à quelle fréquence les CF utilisent le tchèque avec le partenaire, des enfants, d'autres membres de la famille, des amis, au travail, pendant les études, à l'église, dans des clubs ou d'autres organisations. Les réponses possibles étaient « toujours », « souvent », « parfois », « rarement » et « jamais ». La variable *Identité préférée* a été constituée à partir des réponses aux trois questions dans lesquelles les CF ont indiqué leur préférence pour la culture, la langue et le pays tchèque ou français. Ils avaient aussi la possibilité de répondre ne pas avoir de préférence. La variable *Compétence en français* a été constituée à partir des réponses des CF en auto-évaluation pour laquelle ils indiquaient si leur savoir-faire en compréhension ou en expression orale en français était associé à aucune difficulté ou au contraire à de grandes difficultés. Puisque les données collectées pour constituer ces trois variables prédictives ont été ordinales à la différences de LOR, une variable numérique, nous avons décidé de diviser les CF en sous-groupes en utilisant k-means dans R pour éviter l'erreur méthodologique statistique mentionnée plus haut et observable, par exemple, dans les études de De Leeuw (2008); Sůčková (2020). Nous avons aussi cherché à établir un portrait général des CF à partir de l'observation des données extralinguistiques et nous avons également examiné les corrélations entre les variables indicatrices.

La section 7.3 rapporte les résultats. Le portrait général des CF a été dressé en les divisant en deux catégories selon la raison de leur séjour en France, leur profession, la L1 du partenaire, le nombre d'enfants et leur niveau d'éducation. La première catégorie était principalement composée d'étudiants universitaires qui étaient sans partenaire français et sans enfants, alors que les CF de la deuxième catégorie vivaient principalement avec un partenaire français, avaient des enfants et une profession. L'analyse des corrélations entre les variables indicatrices a montré que peu d'entre elles sont fortement corrélées. Enfin, l'analyse des relations entre les variables indicatrices et prédictives n'a apporté que deux résultats significatifs : les CF avec une *Compétence en français* plus élevée ont montré une CLI phonétique moins importante dans le *kurtosis* de /ɦ/ en parole semi-spontanée et dans le *COG* de /x/ dans la lecture à voix haute que les CF avec une *Compétence en français* plus basse.

Dans la section 7.4, nous discutons les résultats. La première hypothèse n'a pas été confirmée tout comme la quatrième puisqu'aucun lien significatif entre la LOR et la CLI phonétique ni aucun lien entre la LOR et *Identité préférée* n'ont été trouvés. La deuxième hypothèse a été confirmée seulement dans le sens où nous n'avons pas trouvé de lien significatif entre les variables acoustiques et *Usage du tchèque* et la troisième hypothèse a été confirmée par nos résultats concernant *kurtosis* de /ɦ/ en parole semi-spontanée et dans le *COG* de /x/ dans la lecture à voix haute. Cependant, nous soulignons que, même si les résultats des relations significatives ou non significatives entre les variables prédictives et les variables indicatrices peuvent être intéressants, ils ne doivent pas être généralisés en raison des problèmes méthodologiques que représente une analyse de données extralinguistiques. De plus, nos résultats pourraient être liés au choix d'analyser les relations en utilisant des modèles de régression linéaire multiple avec les quatre variables prédictives dans les modèles, ce qui n'est pas, d'un point de vue statistique, idéal vu le nombre de nos CF.

Chapitre 8 : Discussion générale

Le chapitre 8 consiste en la discussion générale de nos résultats. Dans la section 8.1, un bref résumé de tous nos résultats est proposé suivi par leur discussion. Nous nous demandons d'abord si les explications des résultats des études sur la CLI phonétique proposées par les auteurs ne pourraient pas fournir d'autres explications possibles des résultats de cette thèse. En effet, à côté de l'explication possible de nos résultats concernant le test perceptif par l'affirmation du SLM, du PAM-L2 et du SLM-r que les sons de la L1 et de la L2 interagissent dans un espace phonétique commun ce qui est une cause de la CLI phonétique, à la suite de Sancier and Fowler (1997), nous pouvons proposer une explication moins fréquente. Nous pouvons suggérer que les locuteurs sont disposés à imiter le son de la langue ambiante. Cela pourrait également expliquer pourquoi nous avons trouvé une CLI significative dans la parole semi-spontanée des CF dans le test perceptif mais pas dans leur lecture à voix haute. En effet, les CF auraient imité involontairement la langue française à laquelle ils ont été exposés et cela beaucoup plus en parole spontanée qu'en parole lue. Une autre considération intéressante est celle sur la dissimilation qui a été peu trouvée par les études sur la CLI phonétique mais pourtant trouvée dans notre thèse. Selon notre étude acoustique, elle semble avant tout se produire dans /ɦ/ et /x/ dans la production des CF et signifierait un approfondissement de la distance entre ces deux fricatives tchèques et la consonne rhotique française dans l'espace phonétique des CF. En reliant les considérations de Chang (2010) à propos de l'effet de la dissimilation avec nos résultats d'analyse des facteurs extralinguistiques, nous pourrions suggérer que les CF avec une *Compétence en français* plus basse perçoivent le /ɦ/ et le /x/ tchèques et le rhotique français comme des sons n'étant pas assez différents parce qu'une grande dissimilation se produit entre ces sons dans leur espace phonétique, alors que les CF ayant une *Compétence en français* plus élevée perçoivent le /ɦ/ et le /x/ tchèque et le rhotique français comme très dissemblables parce qu'une dissimilation faible ou nulle est susceptible de se produire entre ces sons dans leur espace phonétique. Nous discutons par la suite la correspondance entre les résultats de l'analyse acoustique et des commentaires faits par les auditeurs dans le test perceptif. L'étude acoustique a confirmée pour certaines caractéristiques phonétiques la perception que les auditeurs en ont eue lors du test perceptif et qu'ils ont communiquée dans leurs commentaires. Cela semble être particulièrement le cas du schwa final et des patrons intonatifs non-conclusifs. En revanche, au niveau segmental, les commentaires des auditeurs sur certaines caractéristiques phonétiques des segments étaient en accord avec les résultats de leur analyse acoustique, alors que d'autres ne l'étaient pas. Nous discutons également s'il est possible d'affirmer que la CLI phonétique se produit plus dans les styles du discours informel que dans les styles du discours formel de manière générale. Nos résultats de test perceptif le suggèrent. Nos résultats de l'étude acoustique le suggèrent aussi, sauf le $F1$ de /r/ dont une plus grande CLI phonétique a été trouvée dans la lecture à voix haute des CF que dans leur parole spontanée. Ainsi, nous suggérons que la CLI phonétique se produit plus dans les styles du discours informel que dans les styles du discours formel quand le discours est examiné dans sa globalité et non pas uniquement dans un petit nombre de ses segments.

Dans la section 8.2, nous discutons les contributions de la présente thèse. Nous suggérons que sa contribution théorique majeure est la proposition de l'évolution du phonème de la L2 classé en catégorie de la L1 en trois étapes suivantes :

1. Un phonème de la L2 est classé dans la catégorie phonétique de la L1 car une nouvelle catégorie de la L2 n'a pas été établie pour lui. Le seul effet qui peut se produire à ce moment-là est l'effet de l'assimilation (voir fig. 8.2a).

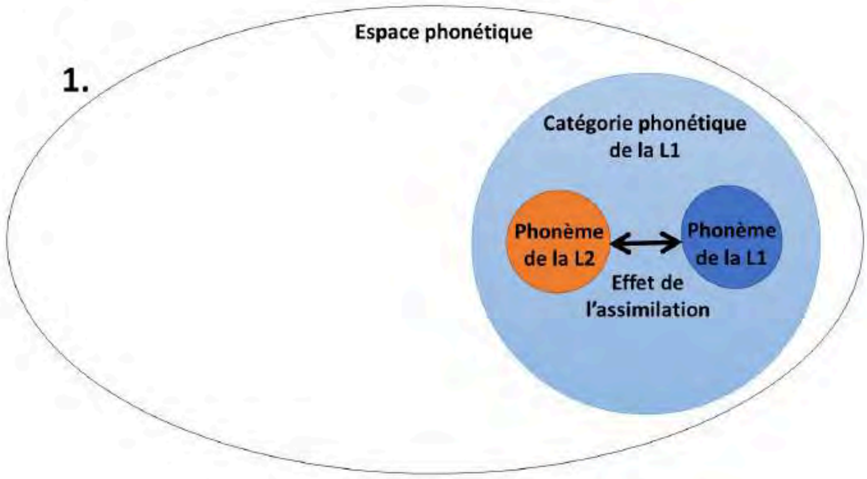
2. Avec l'augmentation de l'entrée en L2, l'expérience en L2 et en fonction d'autres facteurs mentionnés par le SLM-r, le phonème de la L2 commence à être perçu comme suffisamment différent pour être classé dans une catégorie phonétique séparée. Il commence à s'éloigner du phonème de la L1, donc à être retiré de la catégorie phonétique de la L1. Avant que le phonème de la L2 ne se soit complètement retiré, il y a une période pendant laquelle une partie du phonème L2 est encore à l'intérieur de la catégorie phonétique de la L1, alors qu'une autre partie est déjà en dehors de la catégorie. Les deux parties du phonème représentent ses différentes propriétés phonétiques. Dans la partie à l'intérieur de la catégorie phonétique de la L1, il y aura un effet de l'assimilation. Dans la partie située en dehors de la catégorie phonétique de la L1, l'effet de la dissimilation se produira (voir fig. 8.2b).

3. Avec l'entrée croissante de la L2, l'expérience croissante en L2 et selon d'autres facteurs mentionnés par le SLM-r, le phonème de la L2 quittera complètement la catégorie de la L1 et deviendra le commencement de la nouvelle catégorie de la L2. Seul l'effet de la dissimilation entre le phonème de la L2 et le phonème de la L1 qui se trouve dans la catégorie de la L1 peut se produire à ce moment-là (voir fig. 8.2c).

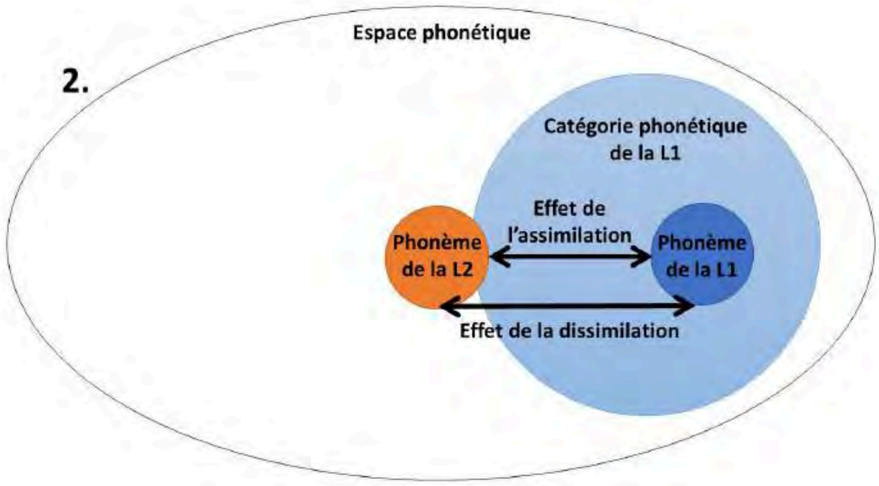
Comme contribution méthodologique de la thèse, nous mentionnons qu'elle a montré que l'analyse de la HNR et des moments spectraux peut être pertinente pour l'étude la CLI phonétique tout comme l'analyse de l'intonation à l'aide de k-means qui peut aussi être utilisé pour traiter les variables ordinales qu'on obtient suite à la collecte des données avec le questionnaire extralinguistique.

Dans la section 8.3, nous soulignons les limites de la présente thèse et les futures directions. La première limite consiste dans le fait d'interpréter nos résultats de l'étude acoustique comme la dissimilation ou l'assimilation sans avoir examiné acoustiquement les phonèmes de la L2 des CF. Par conséquence, une future direction qui émerge de cette thèse est d'examiner acoustiquement la L2 des CF puisque le discours des CF en leur L2 a été aussi enregistré. Ensuite, nous mentionnons que vu le nombre de modèles statistiques utilisés pour l'analyse des voyelles et l'analyse des facteurs extralinguistiques, une erreur de première espèce pouvait se produire. Nos résultats ne sont donc pas à prendre comme absolus. Nous mentionnons aussi que les enregistrements pour une étude longitudinale sur la CLI phonétique dans le discours en L1 des CF ont été collectés par l'auteur de cette thèse, et nous soulignons que cette étude tout comme toute étude longitudinale sur la CLI phonétique pourrait vérifier notre proposition de l'évolution du phonème de la L2 classé en catégorie de la L1 en trois étapes.

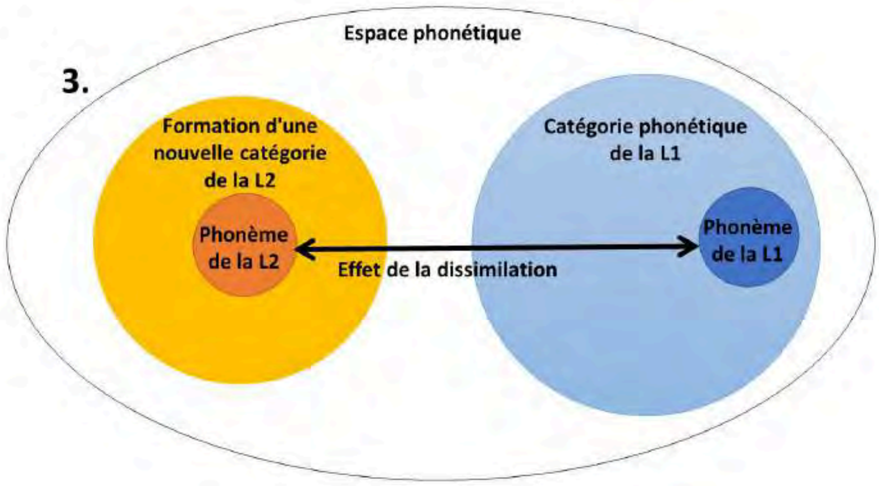
En conclusion, la présente thèse démontre que la CLI phonétique se produit dans la parole en L1 des CF et apporte une proposition de l'évolution du phonème de la L2 classé en catégorie de la L1 en trois étapes faite aux modèles de la production et de la perception de la parole en L2.



(a) Étape 1.



(b) Étape 2.



(c) Étape 3.

Figure 8.2: Développement envisagé en 3 étapes du son de la L2 classé dans la catégorie de la L1 au début de l'apprentissage de la L2.

Note: Proposé par rapport à nos résultats. Phonème de la L1 en bleu foncé, catégorie de la L1 en bleu clair. Phonème de la L2 en orange foncé, catégorie de la L2 établie en orange clair. L'espace phonétique est la grande ellipse blanche.