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Vienna“

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1 Introduction

The present study deals with phonetic cross-language mappings in the speech of late bilinguals, who migrated as adults from Bosnia to Austria (Vienna) during the war in Bosnia. They acquired their native language (L1) in a monolingual way, and started to acquire their second language (L2) post adolescence. The speakers of the present study are defined as bilinguals, because they used both of their languages on a daily basis, since their arrival in Austria (see also Grosjean 1998). Moreover, they use exactly two and not more languages on a regular basis.

The speakers of the present study are part of a growing number of people who have to learn a second language later in life in the context of migration. Learning a second language later in life is a challenge, because of the manifold pressures (amongst others, social and professional pressures) exerted on L2 learners in an L2 environment on the one hand, and because of reduced opportunities, especially for late learners, to receive quantitatively and qualitatively high-level input in the L2 on the other hand. Moreover, in a migration setting, maintaining the L1 might be an additional challenge. While the L2 is often objectively the more important language in case of migration, the L1 is, at least subjectively, often at least as important as the L2. This is because language use is one of the most important identification markers (see, e.g., Edwards 1999, Krzyzanowski & Wodak-Leodolter 2007), often involving emotional aspects. Many people feel more comfortable in their L1 and can express themselves more efficiently, especially in more emotional or ambiguous situations (for an overview on studies about the role of emotions for the choice of the L1 instead of the L2, see Kim & Starks 2008, e.g., Dewaele 2006, Harris et al. 2006). These challenges in L2 learning and L1 maintenance are at least partly due to a monolingual bias, which is common in our western culture (Cook 1997, Auer 2007). This bias refers to the widespread assumption that monolingualism rather than multilingualism is the norm. Furthermore, this bias leads to the ignorance of the fact that languages mutually influence each other and that multilingual speakers may differ in their language use from monolinguals in both of their languages. Earlier work used to view multilingual language use as an approximation to monolingual language use. According to the “Chomskian notion of monolingual native speaker competence”, linguistic variation, and, thus, also multilingualism, should not exist (criticised in Cook 1991, Sridhar 1994: 801, Pavlenko 2000). As a consequence, multilinguals tended to be characterized as failed monolinguals in each of their languages (see, e.g., Sridhar 1994, Grosjean 1989, Grosjean 1998, Major 1992). More state-of-the-art language models build on the assumption that “the bilingual is not two monolinguals in one person” (Grosjean 1989) and assume bilingual speech to inherently feature specific characteristics that differ from monolingual speech (see for example the idea of “multi competence” of Cook, e.g., in Cook 1991, Cook 2003, Cook & Wei 2016), resulting from inevitable bidirectional cross-language influences at divers linguistic levels. Aside from more recent linguistic theories, multilingual speakers still may be perceived, and may perceive themselves as poor speakers

of the respective languages, compared to monolingual speakers. Because language use is a matter of belonging, the speech proficiency¹ of a speaker, and more specifically, the degree of foreign accent in L2 or in L1, has an impact on how the speaker is perceived and to which community she/he is allocated to by listeners. It seems therefore necessary to test whether cross-language influences at the more unconsciously produced phonetic level are indeed perceived by others, and how these influences might result from subjective language attitudes, and feelings of belonging. Even though speakers are able to consciously control their speech productions to some degree (for example in order to reveal certain aspects of their personality, or because they want to be recognized as being part of a certain community, see Edwards 1999), speech productions, especially those of bilingual speakers, are always unconsciously influenced by several uncontrollable factors. Language internal as well as language external factors influence the language proficiency in a speakers' L1 and L2 productions, and lead to a considerable amount of inter- and intraspeaker variation. Even in apparently comparable speaker groups, in terms of biographic factors, considerable variability between the speakers' proficiencies is observed. Therefore, it seems inevitable to consider, in addition to group results, differences between individual speakers.

The present study investigates the phonetic proficiency of late and experienced bilingual speakers in their L1 Bosnian and L2 German speech, focusing on the acoustic production of laterals, that is <l> sounds. Phonetic characteristics are particularly relevant for the examination of cross-language mappings in bilingual speech, as the phonetic level is rather unconscious to the speaker and therefore less controllable by the speaker in situations of examination. Laterals in Bosnian and German are specifically interesting in an investigation of cross language influences. Bosnian and German feature different sets of laterals, that is, Bosnian has two lateral phonemes, and German only one lateral phoneme. Most importantly, one of the two Bosnian lateral phonemes, the velarized lateral, is more similar to the German lateral phoneme, which is a plain alveolar lateral, than the second Bosnian lateral phoneme, the palatal lateral. Moreover, the production of laterals in bilingual settings has hardly been investigated so far, in contrast to other phonetic characteristics, such as Voice Onset Time in plosives, for example. At the general level, the present study focuses on cross-language influences in the speech of late bilingual speakers and, more specifically, addresses the question of how the phonetic-

¹ Within the framework of the current work, the term „proficiency“, if related to language use, is always referring to the language use of typical monolingual speakers. The higher the language proficiency of a bilingual speaker in one of her/his languages, the closer her/his language use is to the typical monolingual reference speakers of the respective language. This is because for a uniform analysis, reference values are needed. Monolingual norms are often used as a reference for proficiency in speech productions, by monolingual listeners and also in the literature. Another example is the language evaluation of bilingual children in diagnostic procedures, who are often evaluated with reference to monolingual norms (although this might be problematic).

phonological system is restructured in bilingual speakers due to the contact with a second language, as compared to monolingual speakers of the respective languages. At a more specific level, the study has two aims: First, to characterize overall cross-language influences at the phonetic level for a relatively homogeneous *group of bilingual speakers*. This involves both acoustic analyses of L1 and L2 production data (with reference to monolingual control groups) as well as analyses of accent ratings experimentally collected with monolingual listeners presented with production data. Second, to examine *speaker specific variation* within the group of bilingual speakers, further supported by information about individual speakers gathered in qualitative interviews.

The following section of the introduction chapter (1.1) introduces the basic theoretical concepts underlying the current research relevant for the understanding of the development of L1 and L2 speech in late bilingual speakers. Section 1.2 then presents the most important factors influencing the overall speech productions of late bilingual speakers and section 1.3 addresses the phonetic-phonological level in more detail with regard to processes operating in bilingual speakers. Speech learning models focusing on late L2 learners will be presented in subsection 1.3.1, specifically the Speech Learning Model (SLM, e.g., Flege 1995, and the revised version SLM-r in Flege & Bohn 2021) and its predictions about the phonetic restructuring of the L1-L2 phonetic-phonological space (i. e., concerning effects on both L2 acquisition and L1 attrition). A larger subsection (1.3.2) presents literature on the restructuring of the phonetic-phonological system in either L1, L2, or both, which represented the basis of the present study. The last section (1.4) of this introduction chapter deals with the particular settings that are analyzed in the present study. The L1 (Bosnian) and the L2 (German) of the bilingual speakers of the present study are described, including possibly relevant contact varieties which might have influenced the L1 or L2 development of these bilingual speakers. A focus will be on the articulatory and acoustic production of the lateral sounds occurring in these language varieties. Relevant implications for the present study are highlighted in section 1.5. Finally, research questions and hypotheses are presented at the end of the introduction chapter (1.6).

1.1 Development of L1 and L2 proficiency in late bilingual speakers

The current investigation assumes that the linguistic system of all individual speakers, including both mono- and bilingual speakers, is complete and unique, and varies over time (Ulbrich & Ordin 2014). This implies that the idea of an exclusive existence of either complete and successful (monolingual, native) competences, or incomplete (multilingual, non-native) competences is inadequate. Instead, language competences of all speakers emerge and develop over time, as a result of language use and experience (following usage-based approaches, as described, e.g., in Bybee & Hopper 2001, Pierrehumbert 2003, Flege & Bohn 2021). Thus, language competences, especially in bilingual speakers, are not stable when observed over a longer period, neither in L1 nor in L2.

The L2 acquisition process goes along with a continuous increase of L2 competences, especially in the initial phase. While speakers are assumed to be able to learn further languages later in life following the same principles as in L1 acquisition (e.g., Flege & Bohn 2021, Best & Tyler 2007), the acquisition of an L2 in case of late bilingual speakers nevertheless differs from the acquisition of an L1. As a speaker's language proficiency is seen as a construct of one's own experiences and accompanying biological processes, late L2 learners already carry a functional, highly specialized linguistic system in their L1 (regarding neuronal processing and fine-motor skills for articulation) when they start to learn the L2 (see, e.g., Kuhl 1991, Kuhl et al. 2008).

Therefore, the L2 is initially shaped by the L1 at all linguistic levels. In the course of time, the activation of the L1 and, thus, the influence of the L1 on the L2 becomes weaker, especially when living in an L2 environment. At the same time, the L2 can shape the L1, that is, L2 acquisition can cause a decrease in proficiency in the linguistic system of the L1, especially as a result of a long-term stay in an L2 speaking environment. In the present study, this change is referred to as L1 attrition². The concept of L1 attrition as used in the present study has to be distinguished from an incomplete acquisition of a first language due to the early contact to an additional language and an early abandonment of this first language. Furthermore, it also has to be distinguished from a change in L1 competences for pathological reasons. The present study, thus, follows the definition given by Köpcke & M. Schmid³ (2004: 5), who describe L1 attrition as "the non-pathological decrease in proficiency in a previously acquired language". However, the notion of "decrease", or "loss", with reference to L1 attrition would

² The term attrition within the framework of the present study always refers to L1-attrition, although in bilingual/ multilingual speakers each of the languages can show attrition effects, if the proficiency in the respective language decrease in the course of time (see for example the review of research into L2 attrition in Mehotcheva & Köpcke 2019).

³ In order to prevent mistakes in name due to the widespread name of the author of the present study, the initials of the respective author's first name are given additionally to the last name "Schmid".

be problematic, if it implied a notion of deficit, since all (and also bilingual) speakers have a complete, albeit varying, linguistic system, as described above.

Therefore, the definition of L1 attrition in the framework of the present study is further specified, following the description given by M. Schmid & Köpke ((2017: 638), to comprise “phenomena that arise in the native language of a sequential bilingual as the consequence of the co-activation of languages, crosslinguistic transfer or disuse, at any stage of L2 development and use.

This continuing bidirectional influence in cross-language mappings is also reflected in the dynamic model of multilingualism, as proposed by Herdina & Jessner (2002), who claim that there is no linear development of the language systems spoken by one individual speaker over longer time periods, and that all acquired languages are rather developing dynamically. The model accounts for linguistic, sociolinguistic and psycholinguistic variables and predicts that different variables, such as motivation, attitude, language use and choice interact with language proficiency in the respective languages of multilingual speakers. According to the model, acquiring a new language additionally to the previously acquired language(s) leads to a decrease of competences in these previously acquired language systems. Herdina & Jessner (2013: 753) highlight the importance of the “dynamic and systemic significance of attrition, which is more specifically addressed in the more elaborate interpretation of attrition as the reduction or simplification of language systems and/or the impairment of access to them, which is furthermore assumed to be a normal and inevitable aspect of language development and change over the life-span of a multilingual speaker.” Most importantly, L1 attrition is linked to the decreased use of the L1 (passive and active use) caused by the use of an additional language and, hence, characteristic of bilingualism as such (see also Paradis 2007). Referring to this decreased use of the L1 by bilingual speakers who are immersed in an L2 environment for a long term, L1 attrition studies might be interpreted within the scope of “theories of forgetting” (as done by Ecke 2004). “Forgetting” in the framework of L1 attrition concerns the function of the long term memory, because only information which has been acquired and retained previously can be forgotten. Thus, either the representation of information in memory or the retrieval of this information is disturbed when it comes to L1 attrition. Some studies suggest that it is especially the retrieval of information, in other words the accessibility of the linguistic knowledge, which is disturbed in L1 attrition, not the knowledge itself. This is based on the findings, that a revitalization of the L1 linguistic system (approaching monolingual norms), even after a longer contact to an L2, is possible, and, thus, a “loss” of L1 proficiency seems to be temporary (see, e.g., Bot & Clyne 1994, Fishman 1991, Hinton & Hale 2001, M. Schmid 2002b, Stolberg & Münch 2010, Chamorro & Sorace 2019, Köpke & Genevskaja-Hanke 2018). Moreover it has been shown, that these changes in the L1 proficiency can occur and also be reversed within relatively short intervals (Köpke & Genevskaja-Hanke 2018, Chang 2012, Evans & Iverson 2007, Pavlenko & Jarvis

2002). Köpke & Genevskaja-Hanke (2018: 1) claim that “[...] attrition of a highly entrenched L1 is a phenomenon affecting language processing only temporarily and that it is likely to regress quickly after reexposure or return to balanced L1-use.”

In summary, language competences highly depend on nurture effects, that is, on the actual use of the respective languages, which is also connected to language dominance (Köpke & Genevskaja-Hanke 2018). Language coactivation and competition between languages lead to disfluencies in the lesser activated language, either L1 or L2 (Bergmann et al. 2015). Therefore, statistics and probability factors related to language use do have an impact on language proficiency (Ulbrich & Ordin 2014, Pierrehumbert 2003), which implies that they can change over time. Most importantly, this concerns not only proficiency in the use of linguistic information, but also proficiency in the use of additional non-linguistic information in L1 and L2, including the fine phonetic details which are rather unconsciously applied in speech production and which might be superfluous information at first sight, but carry important information about the individual speaker, such as self-chosen and actual belonging (Bybee 2001). Therefore, any investigation of cross-language influences must account for factors that might lead to individual differences. In the following subsections, the diverse factors possibly influencing the dynamic development of language competences in L1 and L2 are reviewed in more detail.

1.2 Factors influencing L1 and L2 proficiency

As described in the previous section, compared to monolingual speakers of the L2, there is important inter- and intraspeaker variation in the course of L2 acquisition, specifically in the initial stage, but also in the following stages. Therefore, any investigation of bilingual language proficiency must take into account the factors that might influence this variation in order to draw valid conclusions. The present section deals with the factors that are described in the literature as having the most important influence on variation in L2 acquisition, but also on L1 proficiency. This allows to give a motivation for the selection of the speaker group to be studied in the framework of the present investigation and more generally for the method applied in the present study.

Reasons for a change in the L1 or L2 system of a bilingual speaker can be rooted in a multitude of factors. First, a change in L1 or L2 proficiency is caused by language internal factors, occurring due to language specific interferences. Such interferences can occur at diverse linguistic levels, such as at the phonetic-phonological level, which is the main interest of the present study. Different sets of phonemes, and specifically the fine phonetic differences in the production of these phonemes might interfere between languages. This would be expected for all speakers with a given language combination in a similar way. Second, L1 and L2 competences are influenced by language external factors, and these factors are decisive for the strength of language specific interferences. Language external factors are highly individual. They can be cognitive in nature, and thus, be related to the individual memory capacities and language aptitude, which is related to the general intelligence, and consists of various language skills (see Paradis 2011). They can also be sociolinguistic in nature. Sociolinguistic factors are, on the one hand, personal background factors such as age, or onset of L2 acquisition, and on the other hand more subjective factors, such as attitude. Cognitive factors will not be investigated within the framework of the present study and will thus not be presented in detail. In the following, sociolinguistic factors, which contribute to the manner in which the L1 and L2 systems of late bilingual speakers develop, will be described first, before internal factors will be described second.

1.2.1 Language external factors

Personal background factors

A change in L1 or L2 competences and the strength of this change strongly correlates with personal background factors, which are rooted in the biography of the speaker, such as age at onset of L2 acquisition, age at emigration, length of residence, amount and settings of use of the respective languages, and the speakers' level of education (see, e.g., Birdsong 2006, Köpke & M. Schmid 2004). With the exception of the factor education, these factors are all related to age (and, in some respect, even the factor education might be related to age). Furthermore, they are all important for the quantity and quality of language input.

One prominent hypothesis regarding the factor age, and more specifically, the specific age at the onset of L2 acquisition, is the Critical Period Hypothesis formulated by Lenneberg (1967). He suggested that the onset of puberty is the threshold for a successful acquisition of an L2 (or further languages), that is, after this point in time, no further language can be acquired anymore in a native-like manner. Other authors suggested a sensitive period for the optimal development of the first language system, after which the linguistic system of the L1 would be stable enough to resist interferences from further languages (see, e.g., Bylund 2009, maturational constraint hypothesis).

These hypotheses suggest that the decreasing plasticity of the brain, that is, the decreasing ability of the brain to reorganize neural structures, disables the development of target-like L2 proficiency, and stabilizes L1 proficiency. However, there is evidence for neural plasticity in even progressing adulthood. Neuroplasticity has been shown to be retained and exploited in adult language learning (Gurunandan et al. 2019; Zhang & WANG 2007). For example, due to neural plasticity, older people are able to improve their cognitive performance, which is reduced to some extent due to the age-related volume loss of the brain (Erickson et al., 2011; Stern, 2012). Furthermore, the functional reorganization of brain regions after stroke in patients with aphasia is an example for neural plasticity (see, e.g., Wilson et al. 2019, Heiss & Thiel 2006, Saur et al. 2006). Concerning L1 competences in late bilingual speakers, it has been shown that they are not equally stable in all speakers, even though this would be assumed by the hypothesis of maturational constraints. Specifically, the phonetic-phonological systems also continue to develop throughout the lifespan, even after the L1 sounds⁴ have been acquired (Flege 1987, Flege & Liu 2001, see also de Leeuw 2019, and see section 1.3 of the present study). Changes in the phonetic-phonological system of late bilingual speakers are possible in L1 as well as in L2 system. Although it is commonly accepted that it is way more difficult to learn to use an

⁴ The term „sound“ in the present study refers to the productions at the level of position-sensitive allophones, rather than to the more abstract phonological categories (see Flege and Bohn 2021).

L2 in a native-like manner later in life (compared to earlier in life), it has been shown that native-like L2 productions are possible. Birdsong 2007), for example, reports a rate of nearly 10% of speakers who reach native-like performance in both production and in obtained accent ratings for these productions by native listeners (see also Birdsong 2014).

Therefore, by now, it is widely accepted that there must be other factors than the brain structure having a more important effect on language competences in bilingual speakers than decreasing plasticity of the brain/ maturational constraints (see, e.g., Flege & Bohn (2021), and de Leeuw et al. (2018), amongst others). Overall, it can be presumed that the earlier, the longer, and the more intensive the contact of a bilingual speaker is to her/his L2, the better it is for her/his L2 competences, and the worse it is for her/his L1 competences. However, as is suggested in the previous paragraph, a direct causality of the factor age per se does not exist. Instead, the factor age typically determines the amount and quality of input a speaker obtains in a language. Therefore, it is suggested that it is the quantity and quality of input in a language that might more accurately explain a bilingual speakers' competences in the respective languages (see, e.g., Flege & Liu 2001, Flege & Bohn 2021). Late L2 learners usually have less opportunities and less time to learn a second language than younger learners, so that quantity and quality of input in late L2 learners is often impoverished (Moyer 2009). The quality of input is connected to the possibility of language use with native speakers of the respective language. Earlier L2 learners have more easily access to qualitatively high input in their L2 as compared to late L2 learners. At the same time, in their L1, earlier L2 learners have less access to high qualitative input than late bilingual speakers. This is why earlier bilingual speakers are often more competent in their L2 than late bilingual speakers, and why earlier bilingual speakers more often neglect their L1 in favour of their L2, and, thus, lose their L1 competences more quickly as compared to late bilingual speakers. This leads to the faster and more complete deprivation of the L1 by young migrant children compared to older children and adults, which is more pronounced the more dominant the L2 language is in their daily lives and the higher the status of the L2 is compared to the L1 (see review in Ecke 2004).

Furthermore, the speakers' education, as defined by the socio-economic status (SES), might contribute to the acquisition of L2 competence. SES has been shown to have an impact on L1 acquisition, specifically on children's vocabulary acquisition, (see, e.g., Hoff 2002 for monolingual acquisition, and Bohman et al. 2010, Scheele et al. 2010 for bilingual acquisition). The advantage in language acquisition for children with higher SES is also often related to the higher quality and quantity of input in the language a speaker receives (see, e.g., Barbu et al. 2015). In L2 acquisition, however, SES is rarely investigated. According to Archila-Suerte et al. (2015), SES plays a less important role than age of acquisition for L2 speech processing. Nevertheless, it might be assumed that also in late L2

learners, SES is strongly correlated to possibilities for more quantity and quality in L2 input, so that one might also assume a link between SES and L2 proficiency in late L2 bilinguals.

The finding that early bilingual speakers tend to have less L1 competences than late bilingual speakers has also been explained by their incomplete acquisition of the L1, together with a still “incomplete identification” with the L1 culture (Kaufman 2001). Thus, the decisive factors of age and time (and therefore quality and quantity of input) for competences in L1 and L2 seem to be further dependent on the degree of identification with the involved languages and cultures connected to them. This illustrates the link between purely biographical and more subjective factors and suggests that language competences are a complex interplay of a diversity of factors.

Subjective factors

Additionally to the biographic factors, the more subjective language external factors such as attitude, identification, motivation, and emotion, are also described to play an important role in L2 acquisition as well as in L1 attrition. Specifically, attitudinal factors provide strong explanations for variation in L1 and L2 proficiency, when other personal background factors are kept constant (Cherciov 2013). However, these subjective factors, as well as the previously described biographical factors age and time, are not independent of each other. It has been shown, for example, that attitudinal factors are strongly linked to language use. Cherciov (2013) found that a positive attitude towards the L1 only has positive effects on the L1 proficiency, if this positive attitude goes along with an active effort to maintain the L1.

In the context of migration, speakers always experience a change in their identity (M. Schmid et al. 2014b). In the first time after their arrival, migrants are often seen as outsiders by residents in the L2 environment. This is primarily due to their poor L2 proficiency at the early stage after arrival and because language is one of the most important markers of belonging (as already outlined above). Therefore, the strength of the increase of L2 proficiency also depends on the desire to be integrated in the new language environment. At the same time, the strength of desire to be integrated in the new language environment is related to the so-called ethnolinguistic vitality of the specific ethnic community of the speaker. The ethnolinguistic vitality is defined by factors such as geographic concentration, economic status, and political representation, as well as appearance and cultural properties (see Ehala 2015). Especially in the context of migration, identity is, thus, a complex phenomenon. The individual feeling of belonging (e.g., to a certain social group) is a source of identity on the one hand, and on the other hand, the attributed status of the ethnolinguistic background of the migrant group as a whole, as perceived by people from outside the group, also contributes to the identity construction of a (migrant) speaker (see Ben-Rafael & M. Schmid 2007). Moreover, individual attitudes or emotions connected to a language can change over time, depending on various

experiences in life (with regard to, e.g., friends, family constellation, personal interests, professional occupation etc). Therefore, language competences in each of the languages a bilingual (multilingual) speaker uses might develop dynamically over the course of time a speaker uses these languages (according to the dynamic model of multilingualism as described above, see section 1.1).

Traumatic experiences

Speakers might have particularly strong emotional associations with a language, which can lead to strong and persistent effects on the language competences compared to other, less emotional subjective factors. Specifically, the degree of attrition seems to be highly linked to the degree of traumatic experiences a speaker made in the L1 environment, and to her/his attitude towards the L1 community at the time of migration. The worse the attitude of the speaker toward the L1 community and the higher the feeling of belonging to the L2 community, the higher is the degree of L1 attrition. This is illustrated by M. Schmid (2002a, 2011), with the example of German Jewish migrants, who escaped as adults from the Nazi regime in Germany during the war and emigrated to either England or the USA. The importance of the experiences a speaker made with a language and the respective language community before migration has also been shown for migrants who already arrived as orphans in their new L2 environment. The suppression of their L1 was explained by the traumatic experiences they had in their past life as orphans (see review in Ecke 2004, e.g., Isurin 2000, Nicoladis & Grabois 2002), and was, thus, interpreted as the result of an intentional suppression led by a so-called essential human defense mechanism (Ecke 2004, with reference to Golding, Jonathan M. MacLeod, Colin M. 1998, and Jones 1993).

1.2.2 Language internal factors

In addition to the aforementioned language external factors, purely language internal factors are also relevant for the development of L1 and L2 language systems of bilingual speakers.

From a psycholinguistic viewpoint, linguistic information acquired earlier in life can generally be inhibited or blocked by linguistic information acquired later in life, as well as the other way round, that is, linguistic information acquired in the past can influence the linguistic information more recently gained (according to the interference theory, see, e.g., Anderson et al. 1994, Postman & Underwood 1973). Linguistic information refers to information at all linguistic levels. The respective linguistic levels of the languages used by bilingual speakers mutually influence each other, a process which has been called cross-language interference (see, e.g., Flege and Prot 1981, Flege and Bohn 2021, but compare also to other related concepts such as “cross-linguistic influence”, see Kellerman & Sharwood-Smith 1986, Müller & Hulk 2001, “interference”, see Weinreich 1953, or “transfer”, see Odlin 2012, or

“crosslinguistic interaction”, see Herdina & Jessner 2002). Cross-language mapping has initially been studied mainly with respect to the influence of the L1 on the acquisition of the L2 (as stated for example by Ecke 2004 and Pavlenko & Jarvis 2002, see, e.g., Gass & Selinker 1992; Ringbom 1987). But also the influence of the L2 on the L1 of a speaker is receiving increasing attention (e.g., Major 1992, Waas 1996, Seliger & Vago 1991, M. Schmid 2002a, and a recent overview in M. Schmid et al. 2019). Furthermore, an increasing number of studies is dealing with cross-language mapping in a larger framework of multilingualism, comprising more than two languages (Herdina & Jessner 2002, Jessner et al. 2016).

The cross-language mapping of the L1 on the L2 has been shown at all linguistic levels, from the beginning of the L2 acquisition process on. Over the course of L2 acquisition, these influences become weaker, due to increasing exposure to and increasing familiarity with the L2 (see, e.g., Flege & Bohn 2021: 31–32). Cross-language mapping of the L2 on the L1 has also been shown at all linguistic levels, but is most evident at the lexical level (M. Schmid 2011). At the phonetic level, cross-language influence of the L2 on the L1 is less evident, at least at the initial stage of language contact, and might occur only at a later stage (M. Schmid 2011; Thomason & Kaufman 1988, but see Chang 2012, e.g., and the next section 1.3). As the phonetic level of cross-language mapping in late bilingual speakers is the topic of the present study, it will be described in more detail in the following chapter.

1.3 Cross-language influences at the phonetic level

1.3.1 Theoretical considerations

Language specific characteristics at the phonetic-phonological level are often less conscious to the speaker and thus more automatized than at other linguistic levels, that is, they are less intentionally controllable by the speaker. Therefore, it is more difficult to apply avoidance strategies at the phonetic-phonological level, compared to other linguistic levels that can be better consciously controlled, and where, thus, the simple absence of „errors“ alone would not be sufficient evidence for native-like proficiency (see M. Schmid 2004). This implies that the analysis of the phonetic-phonological system might be useful in order to make predictions about the bilingual speakers' overall linguistic proficiency in L1 and L2. Because of this automatism it is suggested, on the one hand, that the phonetic-phonological level is the most difficult to acquire in an L2 in a native-like manner, as indicated by the mostly long-lasting or even permanent retention of a foreign accent (see, e.g., M. Schmid et al. 2014a, Singleton 2005). On the other hand, the phonetic-phonological level is assumed to be the last level at which the first language is restructured (see also M. Schmid 2011). According to de Leeuw (2019: 204) “native language phones are the building blocks from which all other language representations are built [...]”. Phonetic attrition therefore is indicative for an unbalancing of the whole native language system at a given point in time, and not only of the phonetic-phonological system.

In addition to linguistic information (as carried by phonemes), fine phonetic detail carries subtle “non-linguistic information”, that is, information that does not change the meaning of the word or the utterance, and which might be less obvious for speakers and listeners than the purely linguistic information. This subtle non-linguistic information can be characteristic for a language (variety), or for an even more restricted social group (e.g., a sociolect, or idiolect, or L2 speech).

In an L2, this fine phonetic detail is specifically difficult to perceive and to acquire by an L2 learner, especially in the initial stage of acquisition, but probably also thereafter (see the section on the Speech Learning Model, about the difficulty in the acquisition of L2 sounds that are “similar” to L1 sounds). As it is not necessary for the pure communication need of a speaker to fully govern the fine phonetic detail in the L2, learners might unconsciously content themselves with less native-like speech productions.

In L1 production, these fine phonetic details are strongly automatized, so that individual speakers would not succeed in longer speech sequences pretending having another language background, and analyses of such fine phonetic details are hence also used, for example, for forensic speaker identification. However, not all phonemes or position-dependent allophones reveal the same degree

of automatism. More salient segments are perceived and produced more consciously, and, thus, are probably more easy to control (see, e.g., Ulbrich & Ordin 2014).

The consequences of a restructuring of the phonetic-phonological system of a language on either the phonetic or the phonological representations depend on whether a change in sound production has implications on linguistic information or only on non-linguistic information. Thus, the consequences of a change in sound production depend on the languages and phoneme systems involved. In one language a given change in the production of an L1 phoneme might only be subtle, that is, having only an effect on non-linguistic information, and therefore be referred to as purely phonetic attrition. In another language, however, the same change in the production of an L1 phoneme might have an effect on linguistic information, if the differentiation of meanings is no longer provided. Such a consequence for the phonemic organization of the L1 would then be referred to as phonological attrition (see Celata & Cancila 2010, de Leeuw 2019, de Leeuw & Celata 2019).

Given the automated nature of the phonetic level, it might be assumed that long-term influences of the L2 phonetic-phonological system on the L1 phonetic-phonological system occur only after a longer exposure time compared to influences at other linguistic levels. However, available data showed evidence for an early influence of the L2 on the phonetic-phonological system on the L1. For example, L1 English speakers learning Korean in a beginners course in Korea were shown to reveal changes in their L1 Voice Onset Time (VOT) in plosives and changes in vowel production after only 6 weeks (Chang 2012). Chang (2013) further showed that the changes in the L1 speech were more pronounced in less experienced L2 learners than in more experienced learners. Rapid effects of the L2 on L1 vowel production have been confirmed by Kartushina et al. (2016), who showed that after only one hour training, monolingual L1 speakers of French showed assimilation effects of L1 vowels towards the two vowels which were trained: Danish [ɔ] and Russian [ɪ]. However, a change in L1 vowel production was not found in L1 English L2 French speakers upon a six-week study abroad program in Paris, France, see Lang & Davidson 2019). Evans & Iverson (2007) showed that the L1 phonetic-phonological system is influenced by an L2 (in this case a new variety of their L1) after an immersion period of only 2 years. This indicates that the phonetic level can be influenced by a further language as early as other linguistic levels, such as the domains of morphosyntax, lexis, and semantics. These levels were shown to evidence L1 attrition after 3 to 8 years of contact to the L2 (see Pavlenko & Jarvis (2002). Studies revealing a specifically early influence of the L2 on the L1 phonetic system upon intensive phonetic training support the theory of accessibility problems related to the coactivation and competition between the L1 and L2 phonetic system (see section 1.1), but would not automatically be indicative for an imbalancing of other linguistic levels. However, a purely phonetic training would represent a rather unnatural learning situation for an immersion setting. In immersion settings, and/or in

(intensive) language courses, all linguistic levels of an L2 are trained. This implies that phonetic changes in the L1 phonetic-phonological system might indeed be indicative for the whole language system, as already stated above.

The Speech Learning Model

Among the most discussed models of L2 sound learning and cross-language influence at the phonetic level are the Speech Learning Model (SLM, Flege 1995, and SLM-r, Flege & Bohn 2021 for the revised version of SLM), the L2-Perceptual Assimilation Model (PAM-L2, Best & Tyler 2007), the revised Second Language Linguistic Perception (L2LP) Model (van Leussen & Escudero 2015), and the Native Language Magnet theory expanded (NLM-e, Kuhl et al. 2008).

One of the most applied and long standing models in research on cross-language influences is SLM-r, which has been continuously developed further since its first publication. SLM-r is specifically relevant for the present study, because it makes predictions about the restructuring of the L1-L2 phonetic-phonological system by assuming a reciprocal influence of the L1 and the L2, and therefore, unlike the other cited models, it has been applied in studies on L2 acquisition as well as on L1 attrition. Therefore, in the following, SLM-r is described in more detail than the other models. SLM-r focuses on the acquisition of individual L2 segments, rather than on the acquisition of L2 sound contrasts, which both PAM-L2 and L2LP are primarily concerned with. NLM also focuses on individual sounds, but focusing on phonological categories rather than on position-specific allophones. In the case of laterals, which are analyzed in the present study, a position-dependent approach is necessary, because of the large variation in lateral production triggered by vowel context and position within the word. Moreover, SLM-r refers to the acoustic properties of the sounds as basic units in the process of cross linguistic influence, rather than to their articulatory gestures (in contrast to PAM). It explicitly addresses both perception and production of sounds, and not only perception, unlike the other models cited (for a detailed review of SLM, PAM, and NLM, see also Chang 2019).

Most crucially, according to the SLM-r, language learners maintain access to basic learning mechanisms over the lifespan, thus using the same mechanisms for later language learning as already used for L1 learning. Furthermore, the SLM-r assumes that L1 and L2 sound categories exist in one common phonological space. This leads to what has been called "equivalence classification", that is, sounds are generally perceived in relation to already existing sound categories within the common phonological space (see also Holt & Lotto 2010). This is assumed to be inherent to speech perception in general, not only to L2 but also already to L1 speech, because it enables the listener to generalize and, thus, better deal with phonetic variability. Bilingual speakers, thus, perceive L2 sounds in relation to already existing L1 sounds. As the sound categories of both L1 and L2 are regarded as flexible and necessarily interacting, neither of the respective languages of a bilingual speaker is taken to perfectly

match the language of monolinguals. At any phase in life, input from any language or variety can exert influence on the overall representation of sounds in an individual's sound system. Phonological categories and their concrete phonetic realizations (carrying linguistic and non-linguistic information) are seen as the result of a probability distribution, which is consistently updated (see also Pierrehumbert 2003).

According to the SLM-r, two basic scenarios exist for the consequences of cross-language mapping between new L2 sounds and the closest L1 sounds. First, if the new L2 sound is not perceived to be different from the closest L1 sound by the L2 learner, the two sounds will most probably assimilate, insofar as either the L1 sound, or the L2 sound (or even both sounds) approximates the respective other sound. In this case, their productions would be within the range of one composite category. This scenario is most probable if L1 and L2 share the same phoneme category (see also Best et al. 2001), and if the two sounds differ only in fine phonetic detail, so that the difference is not directly evident for the L2 learner.

Second, if the L2 sound is perceived to be divergent from the L1 sound by the L2 learner, she/he will probably build a new sound category for this L2 sound. L2 category acquisition is supposed to be a slow process, just as L1 category acquisition (in L1, phonetic categories are adult-like only at the end of puberty, see Flege & Bohn 2021, with reference to Williams 1977). From the basic assumption that more and new input always influences the existing L1-L2 phonetic-phonological system, it follows that over the course of L2 learning there are different stages in the process of forming new categories. Whether a speaker perceives an L2 sound as similar or as different from the closest L1 sound is not directly determined already at the first contact with the L2. Specifically, a speaker might learn to distinguish similar sound pairs in L1 and L2 only, if at all, over the course of L2 acquisition, due to increasing input in the L2. Moreover, SLM states that it is the position-sensitive allophonic level rather than the abstract phonemic level where L1 and L2 sounds are perceptually related (see also, e.g., Ulbrich & Ordin 2014).

The ability of an L2 learner to perceive a sound as being different from the closest L1 sound further depends on the quantity and quality of input obtained for this sound in the L2 and also on the precision with which the closest L1 category is represented in the phonetic-phonological system of the L2 learner at the onset of L2 acquisition. L1 category precision usually increases towards adolescence, but individual variation exists. More precise L1 categories more likely allow for new category formation for the closest L2 sound. Whether this new L2 sound category is produced more or less close to the native speakers' productions by the L2 learner depends again on the input obtained in the L2. More formally, according to the SLM-r, L2 category formation is a three-stage process. In the first stage, the speaker must perceive a difference between a new L2 sound and its closest L1 sound. Then, in a second stage,

a link between these two sounds is established by forming a functional “equivalence class” for sounds in the L2. This L2 equivalence class is unstable, until, in a third stage, the new category emerges with stable and more precise distributions of input tokens. Thereby, in order to strengthen the perceived phonetic contrast between L1 and L2 sound categories, the new L2 categories produced by bilingual speakers might dissimilate from the closest L1 categories. That is, they might be produced even more distinct from each another and thus also more distinct from the production of the respective monolingual native speakers.

Most crucially, however, the SLM makes no explicit prediction which sounds are “similar” and therefore more prone for an assimilation process, and which sounds are “different” and thus more likely to be realized within a new category. Moreover, it remains unclear up to date how to define a new category and also, if and when a new category might undergo a dissimilation process. Concerning the judgment of similarity between L1 and L2 sounds, Chang (2019) states that “abstract knowledge of the target language” is the “crucial feature of L2 learners that distinguishes them from naïve listeners” (p.436). That is, L2 learners make use of several sources of information about L2 sounds, additionally to the purely phonetic information, such as knowledge about the phonemic inventory, phonotactic constraints, allophonic alternations, and/or the orthographic system. He concludes that the perceived similarity of an L1 and L2 sound is often influenced by abstract information about L1 and L2 sounds, and especially by phonemic cues, rather than by articulatory or acoustic cues alone, at least for advanced L2 learners. However, articulatory cues, especially, when they are easily visible (e.g., lip rounding) might also contribute to the attributed similarity of a sound (e.g., Bergmann et al. 2016). According to Ulbrich & Ordin (2014), the classification of an L2 sound as “similar” or, in contrast, “new”, mostly depends on individual linguistic experiences a speaker has made in her/his L1 and L2, that is, on input distributions of tokens of the two sounds.

The prediction that “similar” sounds in L1 and L2 undergo an assimilation process and that speakers thereupon unconsciously create a composite category for both sounds is challenged in Simonet (2010). He found that bilingual speakers indeed assimilated the “similar” sounds in their two languages, but that only a minority of the speakers had built a composite category for both sounds. Other speakers had built two separate phonetic categories, even though they showed assimilation. The same was described by Takahashi (2020), who did not find a relation between the direction of L1 restructuring (assimilation or dissimilation) and L2 category formation. The bilingual speakers in his study succeeded in building a separate L2 category even if the similar L1 sound was assimilated towards the L2 sound.

1.3.2 Literature review

In the following, studies that deal with the re-organization of both the L1 and the L2 phonetic-phonological system are reviewed. The review focuses on acoustic characteristics in the L1 and L2 speech productions of late and experienced bilingual speakers who learned the L2 in a migration setting.

The following literature review focuses particularly on the L2 category building and the question whether and to what extent bilingual speakers show assimilation or dissimilation effects of similar L1 and L2 phonetic-phonological categories, as predicted by the SLM. First, studies on cross-language acoustic mappings at the segmental phonetic level are presented. These studies are classified according to the type of speech sounds they investigated. Due to the scarcity of studies investigating cross-language mappings in the production of lateral phonemes, the review also includes studies on cross-language phonetic mapping of more commonly investigated sounds, that is, plosives and vowels. Second, studies are presented which investigated the perceived accentedness of bilingual speakers in their L1 and L2, either by pure accent ratings, or by combining production analysis and accent ratings.

1.3.2.1 Cross-language acoustic mappings at the segmental level

Laterals

A large number of L2 acquisition studies dealt with the acquisition of sonorants, often involving rhotics and laterals. Thereby, most prominently, the acquisition of the English phonemic /l-/ɭ/ contrast by speakers of East Asian Languages (as, e.g., L1 Japanese speakers) who do not have this phonemic contrast in their L1, has been investigated (see review in Colantoni et al. 2015). There are only a few studies dealing with cross-language influence in lateral production alone, specifically with regard to bidirectional cross-language influences. The existing studies all analyzed cross-language interferences between plain alveolar and velarized laterals and suggest a restructuring of the phonetic-phonological system of all or at least some of the speakers, even up to the neutralization of a phoneme contrast in the L1.

Plain alveolar and velarized laterals, as produced by ten late bilingual L1 German L2 Canadian English speakers, were analyzed in an acoustic study by de Leeuw et al. (2013). Their study focused on bilinguals' L1 German laterals that were elicited through a word repetition task, and were produced in word final position, following a front vowel. As (L2) Canadian English features a velarized lateral in coda position, whereas (L1) German only features a plain alveolar lateral in all positions, this context was supposed to reveal most L1 attrition effects in lateral production. The first two formant frequencies F1

and F2 were analyzed separately, as acoustic cues for lateral production. Results showed a general assimilation process of both L1 and L2 laterals of bilingual speakers, even though, at a group level, distinct categories were maintained for L1 and L2, insofar as significant differences between laterals in L1 and L2 were found. Interestingly, F1 was a significant acoustic cue for L1 attrition in the speech of all speakers, whereas F2 was observed to be significant only in productions of male speakers (but, note, that there were only three male bilingual speakers). Furthermore, important individual differences between speakers were observed. One female speaker, for example, produced L1 and L2 laterals within one composite category which lay within the range of monolingual English speakers, whereas other female speakers maintained distinct categories in L1 and L2, albeit at different degrees of assimilation in L1 and L2.

A further study of Barlow (2014) compared lateral productions of early and late bilingual L1 Spanish L2 English speakers (note, however, that the “late” bilingual speakers had a later age of onset of L2 acquisition compared to the “early” bilinguals, while their average age still was beneath 10 years). Results provided evidence for a general cross-language influence of L1 Spanish on L2 English in the productions of all speaker groups. This influence was stronger for the later bilinguals. Influences of L2 on L1 were exclusively found in the productions of later bilinguals. Thereby, the L2 English allophonic contrast was transferred into the L1, insofar as laterals were velarized in coda position but not in other positions within the word.

The influence of the L2 English allophonic lateral contrast in the speech of late bilingual speakers was also analyzed in another study, that time with bilingual speakers of Albanian as their L1 (de Leeuw et al. 2017). As Albanian distinguishes the two laterals (plain alveolar and velarized laterals) at a phonemic level, they asked whether L1 Albanian speakers would neutralize the phoneme contrast between plain alveolar and velarized laterals in their L1 due to the long-term contact to their L2 English (Standard Southern British English, SSBE) that features an allophonic lateral contrast rather than a phonemic lateral contrast. Impressionistic word accent ratings of five L1 monolingual Albanian speakers, as well as acoustic measurements of the laterals in these words, indicated a reduction of the L1 phonemic contrast due to the influence of the L2. Especially in coda position, where L2 SSBE exhibits a velarized lateral variant, this variant was found to often replace the plain alveolar variant. Again, important individual differences were observed. Two of the 10 speakers completely neutralized the contrast in coda position, and one speaker even completely neutralized the contrasts in all phonetic contexts that were analyzed.

A study by Bergmann et al. (2016) investigated a set of sounds, assumed to be similar in L1 German and L2 English (USA or Canada) and including L1 alveolar and L2 velarized laterals, with regard to L1 productions. Segmental acoustic analyses included four sounds that were assumed to be similar in L1

and L2, and therefore expected to be difficult to acquire and likely to undergo assimilation effects according to the SLM: the lateral /l/ and the three vowels /ɔ/, /ε/, /a:/. Assimilation of the L1 sound in the direction of the L2 was observed only for /l/ and /a/, but not for /ɔ/ and /ε/.

A further study which might be relevant for the present study, even though involving early learners rather than late learners, is Simonet (2010). That study analyzed bidirectional cross-language interferences and also explicitly considered category formation for L1 and L2 laterals. The early Catalan-Spanish and Spanish-Catalan bilingual speakers of this study were shown to assimilate Spanish plain alveolar and Catalan velarized laterals. However, there were individual differences with regard to whether speakers produced two separate lateral categories (though approaching each other), or one composite category, which was mostly produced in-between the respective monolingual ranges. Furthermore, some female L1 Spanish speakers also had developed a composite category for both laterals within the range of the Spanish alveolar laterals, which the author explained by a sociolinguistic factor of language contact, that is, the higher status of the Spanish language.

Altogether, the studies on bilinguals' lateral productions suggest assimilation effects between the L1 and L2 lateral sounds that are classified as "similar" sounds. Despite of this observed assimilation at the group level and at the level of the individual speakers, the use of separate categories for productions of L1 and L2 laterals was also reported for the productions of individual speakers. If lateral variants are involved in an allophonic contrast, the cross-language interferences are suggested to operate at the level of allophones rather than at a higher phonemic level. It was shown that some individual speakers might even neutralize their L1 phonemic contrast between alveolar and velarized laterals, when confronted with an L2 which features an allophonic contrast of these laterals. Some studies further point to large inter-speaker differences, and to gender-specific differences. Female speakers appeared to reveal less attrition than male speakers in the study of de Leeuw et al. (2013). Simonet (2010) found that female speakers more often produced the lateral variant of the more prestigious language.

Plosives and Vowels

The Voice Onset Time of stop consonants (VOT, which is the duration between the release of the occlusion in a stop consonant and the onset of the voicing of the following vowel) is the by far best studied phonetic characteristic of cross-language influences, probably due to its language specific variation and straight-forward acoustic analysis. The acoustic realization of vowels is also commonly investigated, as languages commonly differ largely with respect to the size of their vowel inventories, thereby often featuring vowels that are clearly distinct in one language compared to another, as well

as highly similar vowels, that only differ in fine phonetic detail (concerning duration or formant frequencies).

In studies focusing exclusively on L2 acquisition, without simultaneously measuring effects in L1, it has been shown that the degree of native-likeness in productions in the L2 are primarily a matter of onset of acquisition of the learner (see, e.g., MacKay et al. 2001, for VOT productions), and therefore mainly a matter of the amount of L2 input. Even though the L2 productions of bilingual speakers as a group, including the productions of early L2 learners, often differ from monolingual speakers of the L2 (Flege & Eefting 1987b), and are often also rated as less native-like than productions of monolingual native speakers (Flege et al. 1995), target-like L2 productions have also been shown, even for late bilinguals and for speakers who do not live in an L2 speaking environment. Birdsong (2007), e.g., found that 9 out of the 21 (42,8%) L1 English L2 French bilingual speakers studied, who were immersed since at least 5 years in an French speaking environment in the Paris area, produced L2 stop consonants with native-like French VOT (see also, e.g., Major 1987 for results on L1 Portuguese L2 English speakers and M. Schmid et al. 2014a for results on L1 Dutch L2 English speakers). The percentage of bilingual speakers that reached target-like values in (similar) L2 vowel production (regarding formant stability and duration) in the study of Birdsong (2007) was smaller with only 13.6 percent compared to VOT production.

However, plosives as well as vowels in the productions of late bilinguals have early been described as being susceptible to cross-language assimilation effects in the literature, often bidirectional, when both L1 and L2 are considered. Moreover, these similar L1 and L2 sounds are often described as being produced within one composite phonetic category. As outlined above (section 1.3.1), already after a short contact to an L2 in an L2 environment, the VOT of L1 plosives and vowel formant frequencies have been shown to be influenced by the L2 in the speech of late L2 learners. For example, the acoustic characteristics of L1 sounds were assimilated towards the characteristics of the L2 in the productions of L1 English speaking learners of L2 Korean (Chang 2012; 2013).

For example, late bilingual L1 French L2 English speakers who were immersed in an English-speaking environment with a mean length of residence (LoR) of 12.2 years, were found to assimilate the VOT of the similar L1 and L2 /t/ sound categories, so that neither the L1 nor the L2 sound was produced in a native-like manner (Flege & Hillenbrand 1984). This finding was later confirmed by Flege (1987), who investigated the VOT of both L1 American English L2 French speakers living in Paris, France, and L1 French L2 American English speakers living in Chicago, USA (42 speakers in total, including monolingual control groups). The VOT of L1 and L2 voiceless stops was found to be produced in between the productions of monolingual speakers of the respective languages. Even though only group effects were analyzed within that study, results pointed to the presence of a certain degree of inter-individual

differences. VOT values of bilingual L1 French speakers were shown to overlap with VOT values of monolingual L1 French speakers, and also the VOT values of bilingual L1 English speakers overlapped with the VOT values of monolingual L1 English speakers. Although it was not explicitly described whether speakers used one composite or two separate categories for L1 and L2 productions, the results suggest that some of the (lesser experienced) L2 learners might have produced a composite L1-L2 category, whereas other (more experienced) L2 learners might have shown less assimilation, or even dissimilation and thus having built a new L2 category.

Within the same study, Flege (1987) also analyzed the bilinguals' vowel productions of /u/ and /y/. The productions of the vowel /u/, that is similar in L1 and L2, were produced within one composite category, which was assimilated towards the production of monolingual speakers of the respective L1. However, French /u/ produced by bilingual L1 French speakers indicated (albeit non-significantly) phonetic attrition, whereas English /u/, produced by bilingual L1 English speakers, was native-like. The new L2 French sound /y/, which has no similar counterpart in English, was acquired in a target-like way by L1 English speakers. L1 French speakers did not show attrition in the production of this sound.

The observation that learners are able to produce new L2 sounds in a more target-like manner compared to similar sounds, has also been made with regard to fricative production (see, e.g., the acquisition of the L2 German allophone /x/ by L1 English learners, as reported in (Young-Scholten 2004). An L2 sound which is obviously different from the closest L1 sounds might also be subjected to a transfer process from the L1 (this has often been observed with the interdental fricatives in L2 English, that are often replaced by either alveolar stop consonants, or by alveolar fricatives, see, e.g., Lombardi 2003).

Similarly, the acquisition of similar and new L2 vowels was investigated in a study with L1 German L2 English learners, who were compared to a control group of 10 monolingual native English speakers (Bohn & Flege 1992). Moreover, this study investigated the effect of L2 experience by analyzing the productions of 10 experienced and 10 unexperienced late bilinguals. Most of the L2 vowels that were acoustically similar to L1 sounds of the learners, that is, [i], and [ɪ], approximated the productions of monolingual English speakers, but were still assimilated towards their L1 counterparts. Interestingly, the third similar L2 vowel [ɛ] was produced target-like by both bilingual groups, whereas the new vowel [æ], in contrast, which was predicted to be acquired in a native-like manner by all speakers, was only acquired by the most experienced speakers. Note that no monolingual German control group was included; therefore no predictions can be made about the presence and the degree of L1 attrition. Nevertheless, a further interesting result of that study was that the difference in experience (of about 7 years of immersion in the L2 environment) between the two groups of L1 German bilinguals did not have an effect on L1 vowel production.

Assimilation processes between a sound in L1 and a similar sound in L2 have often been reported in the literature (see also, e.g., Birdsong 2007, Evans & Iverson 2007, Sancier & Fowler 1997). Sometimes the formation of two separate categories, despite of bidirectional assimilation effects, was explicitly reported (Stoehr et al. 2017). Some studies also reported a correlation between L2 and L1 proficiency (e.g., Major (1992).

However, a recent study focusing on phonetic L1 changes and its origins (Takahashi 2020) also found evidence for dissimilation effects in the productions of late bilinguals' L1 sounds. That study analyzed the production of 61 late L1 Japanese L2 English speakers, of whom 30 were immersed in an L2 environment. Results showed a restructuring of the L1 phonetic-phonological system, whereas both assimilation and dissimilation of L1 vowels (as well as VOT values) were observed. L2 production acuity (which was linked to immersion) turned out to be the main factor for assimilation effects of the L1 sound, whereas less production acuity but native-like L2 perception led to dissimilation effects of the L1 sound. The study further suggested that the direction of L1-restructuring (that is, whether and to what extent assimilation or dissimilation effects in the L1 occur) is not linked to new category formation in the L2. Instead, unlike what would be predicted by the SLM, the author suggests that dissimilation processes in L1 rather appear in less experienced learners and might disappear in favour of an emerging assimilation process, as soon as L2 production performance gets more native-like, thus with more experience.

Early bilingual speakers, who might be classified as more experienced bilinguals, often display dissimilation effects, though, even if the L1 and the L2 sounds are similar. With regard to VOT, new L2 category formation and dissimilation of the L1 category has been shown, e.g., by Flege & Eefting (1987a). With regard to vowel production, new category formation for similar L2 vowels was also consistently shown in the speech of early bilinguals (as compared to late bilinguals, who rather showed assimilation), with possible dissimilation of either the L1 vowel category (Guion (2003)), or with a dissimilation of the L2 category (Flege et al. 2003). However, some studies also reported bidirectional assimilation effects of similar vowels or plosives in early bilinguals, despite the formation of a separate category in both L1 and L2 (e.g., Baker & Trofimovich 2005, de La Fuente Iglesias & Perez Castillejo 2020, Simonet 2011, Antoniou et al. 2011).

Even though most available studies analyzed language combinations either with a new L2 sound contrast or with a single new (similar or different) L2 sound, which is mapped onto one single L1 sound, some studies also investigated language combinations in which more than one L1 sound are related to the new L2 sounds.

For example, the production of VOT in plosives in a group of late L1 German L2 Dutch bilinguals, immersed in a Dutch speaking environment in the Netherlands was investigated by Stoehr et al. (2017). Dutch features voiced and voiceless (short-lag) plosives, and German features voiced (short-lag, and, thus, similar to the Dutch voiceless plosives) and voiceless (stronger aspirated) plosives. The L2 Dutch “voiceless” short-lag plosives, and the L1 German “voiced” short-lag plosives were both produced in a native-like manner. The (L2) Dutch voiced plosives, which are produced with shorter VOT in Dutch than in German, were assimilated towards the L1 German voiced plosives. The VOT of the (L1) German voiceless plosives was produced shorter by bilingual speakers as compared to monolingual German speakers and thus assimilated towards the L2 Dutch voiceless plosives. Interestingly, assimilation was observed instead of dissimilation, even though dissimilation effects would help to distinguish sound contrasts, specifically in the case of more than two phonemes being closely related to each other. Nevertheless, separate categories were produced for all sounds. That is, the phonological contrast was maintained in both languages, and voiceless plosives and voiced plosives were also differentiated between L1 and L2, respectively.

Other studies investigating cross language mappings involving more than one related L1 sound in early bilingual speakers also showed assimilation effects. For example, Simonet (2011) found that the L1 Catalan phonemic /o/-/ɔ/ contrast was merged into one composite category, so that the L1 phonemic contrast was dissolved, and that this category was assimilated towards the production of L2 Spanish /o/ for those speakers whose dominant language was Spanish. Such a dissolving of an L1 phonemic contrast has also been shown for some of the speakers in the study of de Leeuw et al. (2017), where L1 Albanian L2 English speakers reduced and even dissolved their L1 /l/-/ɫ/ contrast due to a transfer of the L2 allophonic rules for /l/ versus /ɫ/. The dissolving of an L1 phonemic contrast due to the contact with an L2 that does not feature this contrast was also shown in a perceptual study by Celata & Cancila (2010). The Italian (Lucchese) English bilinguals showed a progressive impairment in the perception of gemination in their L1, depending on whether they were first or second generation immigrants. De La Fuente Iglesias & Perez Castillejo (2020), however, found that early Galician-Spanish bilinguals, who also have the phonemic /o/-/ɔ/ contrast in their L1 Galician, did maintain this contrast. The L1 vowel /o/ was also assimilated towards the production of L2 Spanish /o/, when Spanish was the dominant language. The L2 Spanish vowel /o/, however, was subjected to a dissimilation process. In the same study, the bilinguals’ productions of the L1 /e/-/ɛ/ contrast and the corresponding L2 sound /e/ was also investigated. The results on these sounds were similar, except for the production of L2 /e/, which was assimilated to L1 Galician /e/.

Studies considering further factors potentially influencing the degree of cross-language influence

Most studies focused on effects of a given group of bilingual speakers. If inter-speaker differences are addressed, a large degree of variation in the strength of cross-language effects is often reported. For example, whereas most speakers of their study showed (L1) assimilation effects, Evans & Iverson (2007) observed that three speakers did not show a change in their L1 vowel production, and one speaker showed a dissimilation process instead of an assimilation process (recall also the individual differences found in the studies of de Leeuw et al. 2013 and de Leeuw et al. 2017 on laterals presented above). In a study about one individual speaker whose L1 speech productions were found to be especially atypical in previous studies, insofar as this speaker displayed extreme L1 attrition, de Leeuw et al. (2018) aimed at describing these difference not only by means of quantitative data, but also interpreted the difference to other bilinguals with the help of qualitative analyses. It was shown that this particular speaker had an especially reduced use of L1 German over a long period of time, while at the same time being completely immersed in a monolingual English speaking environment.

A further factor which has been shown to influence the strength of cross-language interference in late bilingual speakers is speech style, that is, the degree of formality of speech productions. Casual speech, that is, spontaneous speech as produced in informal conversation, was found to elicit more L1 attrition than formal speech, that is, read speech (see e.g., Shockey 1984, Major 1992). In L2 production as well, formal speech tasks, such as reading tasks, are assumed to elicit higher proficient speech than spontaneous speech tasks (as discussed, e.g., in Birdsong 2007). Spontaneous speech tasks are more difficult, because the speakers would have to control more linguistic factors at a higher speaking rate.

Gender as a factor for the strength of cross-language interferences in late and experienced bilinguals has rarely been investigated. Some studies, however, reported differences in the speech of female and male bilinguals. Female speakers were shown to display less attrition than male speakers in de Leeuw et al. (2013). Note, however, that only three men were investigated in his study. Simonet (2010) found that female speakers were more prone to use the lateral variant of the more prestigious language than male speakers.

Altogether, cross-language mappings between similar sounds in L1 and L2 was mostly shown to lead to assimilation processes in both languages, specifically for late and experienced bilingual speakers. However, if assimilation of either L1 or L2, or both, was observed, it was not always clear whether separate categories were maintained. Some studies suggest large individual differences concerning the effect and the degree of the crosslinguistic influence and whether separate L1 and L2 categories are build or not. If separate categories were observed, a plausible reason could not be identified.

Furthermore, speech style was suggested to potentially account for the degree of observed L1 attrition.

1.3.2.2 Perceived cross-language mappings

Accent rating studies might be important in order to better identify the speakers showing either extreme L1 attrition or extremely successful native-like L2 acquisition. According to de Leeuw (2019), an extreme case of phonetic attrition might be identified if L1 productions of a speaker are perceived as foreign accented by (monolingual) native listeners of the L1. In the same way, an extreme case of native-like L2 acquisition might be identified if a bilingual speaker is perceived as being a native speaker in her/his L2 by native listeners of the L2. Rating experiments with monolingual listeners in combination with acoustic measures of bilinguals' speech productions might further help to define, first, at which threshold acoustic deviations might be perceived at all, and second, to which degree acoustic measurements might predict a perceived foreign accent.

Pronunciation at the segmental level alone might indeed accurately predict judgements of nativeness. With regard to accent ratings for the release burst of L2 French /t/, as produced by late bilingual speakers of American English, it has been shown that accurate judgements regarding the nativeness of a speaker's speech production can be made after only 30 milliseconds (Flege 1984). In previous studies, moreover, the acoustic production of some segments was shown to significantly correlate with global accentedness in the L2 of a speaker. For example, L2 VOT values of L1 Portuguese L2 English speakers were shown to be less native-like for those speakers who were also rated less native-like at the global level of pronunciation (Major 1987). Interestingly, however, some speakers in that study produced native-like L2 VOT values, although none of them were rated native-like with regard to global pronunciation. Vowel quality has also been shown to be linked to perceived foreign accent. For example, late L1 Arabic L2 English speakers were shown to obtain better ratings for their L2 word pronunciation when they produced more native-like L2 vowels (Munro 1993); some of the speakers were even rated as native-like-sounding. Further studies showed that also at the global level native-like production might be reached, even by late bilingual speakers. Bongaerts (2014), for example, showed that three out of 9 proficient late L1 Dutch L2 French bilinguals were rated as native-like by ten native listeners, that is, within the range of monolingual control speakers. And Birdsong (2007), in his study already mentioned above, showed that late L1 English L2 French speakers were likewise able to be perceived as native speakers of French at a global level of pronunciation. With regard to the link to segmental production, two of three bilinguals in that study who showed native-like acoustic parameters in all of their segmental productions were also rated as native-like in the global accent rating test. One of those three speakers, however, was rated significantly worse. Instead,

one other bilingual speaker, who failed to have native-like productions in a portion of the segments, but not in the rest, was also rated as having a native-like global accent. The results of that study suggest that the production of vowels is more strongly associated with global pronunciation ratings than the production of VOT, with the latter yielding no significant correlation. Birdsong suggested that such comparably small differences as produced in VOT production might not be perceived in the speech stream, and thus are not sufficient for the perception of a global foreign accent.

Another report for VOTs to be not, or only weakly, associated with the percept of foreign accent was provided by Riney & Takagi (1999). Instead, they found a strong correlation between the transfer of the Japanese flap for English /r/ and /l/ and L2 English global accent ratings.

Lateral productions have also been shown to contribute to the perceived degree of foreign accent in the L2 in a further study: Solon (2015) investigated L2 laterals produced by 20 intermediate L1 English L2 Spanish speakers, as compared to a control group of 4 monolingual Spanish speakers. Thirty-eight native listeners of Spanish living in Mexico rated isolated words containing alveolar or velarized laterals, that differed in degree of darkness and duration. Results indicated that both lateral velarization and longer duration of the lateral segment contributed to the perceived degree of foreign accentedness. Velarization was crucial only in medial word position, but not in word final position (word initial position was not included in the study), whereas an effect of duration was found independent of word position.

Most of the L1 accent rating studies described so far focused on global accent ratings, that is, on the examination of the accentedness of longer utterances, while they did not investigate the link between production and perception at a segmental or suprasegmental phonetic level (see also a summary in Bergmann et al. 2016). Results of rating experiments based on a picture retelling task showed that bilingual speakers are perceived as less native-like in their L1 compared to monolingual speakers, and that there is considerable inter-speaker variation, insofar as some speakers are rated as clearly native-like in their L1, whereas others are clearly rated as foreign-accented (see Munro et al. 1999 for L1 Canadian English L2 Alabama English, and de Leeuw et al. 2010 for L1 German L2 English/L2 Dutch speakers).

The amount of time in the L2 environment turned out to be one predictor for individual differences in the ratings of the L1 speech in the study of Munro et al. (1999). In the study of de Leeuw et al. (2010), the amount of language use, rather than the length of residence or age of arrival, was found to be the most important predictor. Furthermore, in that study, amount of switching between L1 and L2 turned out to be an additional predictor. Those speakers who used to regularly switch between the languages

were more likely to be perceived as foreign accented. The maintenance of a monolingual mode was, in contrast, beneficial for a more native-like perception of the bilinguals speech productions.

In a further study by Hopp & M. Schmid (2013), which was built on a subset of the speakers of the study of de Leeuw et al. (2010), L1 German ratings were additionally compared to ratings for L2 German speakers. The bilingual L2 German speakers were rated significantly worse than the group of L1 German speakers. The presence of these more “extreme” speech productions led to the result that the group of bilingual L1 German speakers did not anymore statistically differ from the group of monolingual L1 German speakers. However, an analysis of individual differences showed that 11 of these speakers were perceived to be non-native in their L1 German. No variable was found which could satisfactorily predict this variation.

Additionally, some studies also investigated the link between perception and production of L1 speech in bilingual speakers. An early example is the case study of Sancier & Fowler (1997). The speaker studied sounded more accented to native raters of L1 Portuguese after long stays in the L2 environment. This result correlated with the result of VOT measurements in L1 production, which approximated the L2 English norms after prolonged stays in the English-speaking environment (with longer VOT).

In the longitudinal study of Evans & Iverson (2007), acoustic analyses of vowels as well as global accent ratings of a reading passage (several seconds) were performed with 23 learners of a new variety of their L1. At the final testing stage, the majority of speakers was rated as more accented by 6 native listeners of their L1 dialect compared to the first testing, even though individual differences were observed. For most speakers, the change was only small, three speakers were not at all perceived to have an accent at the last recording, and one speaker was perceived as more native-like at the end than at the beginning. Individual accent ratings from each testing session correlated specifically with F2 values of three of the four vowels under investigation.

However, in a more recent study, segmental productions (of laterals and vowels) in the L1 of 33 late L1 German L2 English bilinguals were found to be not directly linked to perceived global accentedness in L1, as rated by 30 native monolingual German speakers (Bergmann et al 2016, see above). Also in the study on 10 late L1 Albanian L2 English bilinguals (de Leeuw et al. 2017, see above), the relation between accentedness ratings for isolated words, as performed by 5 monolingual native listeners of Albanian, and the acoustic analyses of the laterals within these words did not reveal a strong correlation. For some of the speakers, acoustically measured differences were not detected by the listeners, or in contrast, listeners rated some of the speakers as non-native-like, even though the acoustic values of their laterals showed no deviation. The authors thus suggested that the listeners

partly had based their ratings on other factors than lateral production. However, speakers that showed the most extreme deviations in lateral production were indeed rated as non-native-like.

The strength of the link between segmental production and perceived global accentedness in L2 productions might differ according to the phonetic segments under investigation (as illustrated above), and a simple and direct link does not seem to be possible. As not only segmental aspects, but also suprasegmental aspects of speech production are language specific, accent ratings often additionally rely on suprasegmental, more global speech characteristics (Kang 2010, Trofimovich & Baker 2006). The interplay between prosody and segmental characteristics and their relation to the perceived foreign accent has been investigated by Ulbrich & Mennen (2016). Results of their study showed that both segments and prosody had an influence on accent ratings, but also that listeners were more influenced by segmental characteristics than by prosody, as a change in segmental production was able to overrule a given impression at the prosodic level.

A significant correlation between either segmental or suprasegmental acoustic measures and accent ratings was also shown a study investigating L2 speech productions of late L2 learners of English with different L1 (Oganyan et al. 2021). Results of this study further showed that according to the L1, different acoustic characteristics were differently weighted with regard to their impact on the perceived accentedness in L2. The authors therefore suggested to take into account both segmental and suprasegmental characteristics in accent rating tests and to not “expect any particular acoustic dimension, segmental or prosodic, to generalize from one L1 speaker background to others”.

That prosodic aspects might also lead to the detection of a foreign accent in the L1 of bilingual speakers is suggested by several studies. Pitch patterns (Willems 1982) and tonal alignment patterns (Mennen 2004, de Leeuw et al. 2012), for example, were found to be influenced in an L1 by the L2, with strong individual differences. Mainly assimilation effects were observed, but some speakers also maintained the patterns of the respective languages or even showed dissimilation.

In sum, the acoustic production of some segments was shown to significantly correlate with global accentedness in the L2. However, this link was not always systematic, and differed in strength depending on the sound (vowels might be more reliable than VOT values) and also depending on the L1.

For L1 productions, some studies showed a link between segmental production and accent ratings, while others did not or only in cases of “extreme” attrition.

Native-like segment productions are more often found than native-like global accent ratings in the L2. However, some studies show evidence for a certain percentage of late L2 learners obtaining native-like ratings even for global pronunciation. Concerning L1, bilingual speakers are often globally rated as less native-like in their L1 than monolingual speakers. However, when additionally compared in their

L1 to L2 speakers of the L1, the overall difference between bilingual speakers and monolingual speakers of the L1 is importantly reduced. Nevertheless, a few bilingual speakers are clearly rated as non-native in their L1.

Even though there is indeed a link between segmental production and global accent rating, further properties, specifically at the prosodic level, might contribute to the impression of foreign accentedness, as has been suggested for accent ratings in the context of L2 acquisition.

1.4 Laterals

1.4.1 Laterals in Bosnian and Austrian German as spoken in Vienna

In the present study, laterals of late bilingual L1 Bosnian L2 German speakers living in Vienna are investigated. These speakers are part of a large group of about 90,000 people, who migrated from Bosnia to Vienna as adults in the 1990s, mostly due to the war in Bosnia, and of whom only a few returned to Bosnia. In this section the lateral variants in the relevant languages Bosnian, Standard Austrian German (SAG), and the Viennese dialect (VD) will be delineated in view of a possible cross linguistic influence. These three language varieties are the main contact varieties to which Bosnian migrants living in Vienna are confronted on a regular basis.

Relevant German varieties as spoken in Vienna

The German language spoken in Vienna, to which migrants are exposed in Vienna, is not one single homogeneous variety. As Vienna is a comparatively large metropolis, varieties are strongly differentiated by social class, ethnicity, and gender, rather than by geographic limits (see Labov 2001: 227). The predominant German varieties spoken in Vienna are Standard Austrian German (SAG) and the Viennese Dialect (VD). As the VD differs from SAG concerning the production of laterals, the relation between VD and SAG is explained more in detail here. Both SAG and VD belong to the Middle Bavarian dialects (MBD, as described in Moosmüller et al. 2015a). SAG in addition is influenced by Standard German as spoken in Germany (SGG). More precisely, SAG has MBD roots, which form the basis for segmental and suprasegmental pronunciation, but it is also strongly influenced by SGG, mainly concerning its phonological system (see Moosmüller et al. 2015a). In consideration of acceptability analyses which included social and regional characteristics, SAG as spoken today is defined as the variety spoken by people with an academic background, especially in the city of Salzburg and Vienna (see Moosmüller et al. 2015a, Moosmüller 1991). VD in contrast is typically spoken by people with lower educational status. Due to a generally stronger contact of younger speakers with the standard language (either SAG or SGG), younger speakers rather speak an intermediate variety between VD and SAG, even if they are raised in VD. The VD is therefore mostly spoken by older speakers (>40 years, see Moosmüller et al. 2016) and thus by speakers within the age-range of the bilingual Bosnian-German speakers investigated within the present study.

In addition to the local German varieties SAG and VD, German varieties as spoken in Germany (especially SGG, but also other varieties) are strongly present in Vienna, due to the high amount of immigrants from Germany living in Vienna⁵. However, SGG will not be treated as one of the main

⁵ German citizens build the second largest group of immigrants in Vienna, after Serbs and before Turks.

contact varieties for the speakers within the present study. First, because the regional origin of speakers with German citizenship is diverse. Second, a considerable amount of these German speakers are university students, and therefore, they are not a primary contact group of the Bosnian speakers investigated within the present study.

Laterals in the relevant German varieties as spoken in Vienna

In SAG, VD, SGG, and most German varieties spoken in Germany, the phoneme inventories contain only one lateral phoneme, which is a voiced plain alveolar lateral approximant (see e.g., Wängler 1961, Delattre 1965, Recasens 2012, Wodak-Leodolter & Dressler 1978). However, the lateral in the VD undergoes several phonological processes (see Moosmüller et al. 2015b, Kranzmayer 1956). In word final position and before consonants, the lateral is vocalized (/l/-> [ɐ], e.g., in <Tulpe> *tulipe* -> [ɖuɛɸm]), or, if a front vowel is preceding the lateral in these cases, the respective front vowel is rounded and the lateral is then absorbed (e.g., in <Geld>, *money* -> [gœ:ɖ]). In all other positions, the lateral phoneme is realized as a consonant. However, as a consonant, it can occur in two variants. Additionally to the alveolar lateral variant, as also pronounced in SAG and in most other German varieties, the VD contains a more velarized lateral variant. As also described in C. Schmid et al. 2015) and Moosmüller et al. 2016), the velarized lateral is primarily produced word-initially (e.g., in <leider>-> [tæ:da], *unfortunately*), after alveolar consonants (e.g., in <schlagen>-> [tɔ:ŋ], *to beat*), between back vowels (e.g., in <Holler>-> [hoɫa], *elder*), and word-finally in diminutives (e.g., in <Bankerl>-> [bɒŋkɐɫ]). The prosodically prominent word initial position makes the velarized lateral variant a particularly salient social marker (as mentioned above, the VD is associated to speakers with lower educational backgrounds). This role as a social marker has the consequence that the velarized lateral is subjected to stereotyping, that is, it is expected from all VD speakers (as has been shown by Moosmüller 1991, Moosmüller 2016). This leads to its avoidance (compare Moosmüller et al. 2016). In this respect, female and male speakers seem to behave differently. Compared to male speakers, female speakers, who were described to avoid non prestigious (often non-standard) variants in favour of more prestigious (standard) variants (e.g. Labov 1990, Chambers 1995, MacLagan et al. 1999), also tend to avoid the stigmatized velarized lateral variant of the VD, especially in the salient word-initial position. If female VD speakers realize a velarized lateral at all, it typically occurs only in unstressed, word-final position. Moreover, in lateral productions of female VD speakers, more graduality in the realization of alveolar and velarized laterals is observed, compared to the realization of male VD speakers. Thus, for female speakers, Moosmüller et al. (2015b) assume an alveolar lateral phoneme,

which is velarized in word-final position, due to a phonetically motivated process⁶. For male speakers of the VD, they assume an underlying velarized lateral phoneme. Due to the contact with the more prestigious SAG, an input switch rule (Wodak-Leodolter & Dressler 1978) leads to a higher application of the standard alveolar lateral variants in word initial position, as compared to other positions within the word. If the lateral is realized as an alveolar lateral in word final position, this is also due to the application of an input-switch rule, however, in this case, the whole (standard language) lexeme serves as input. Instead, if an alveolar lateral is produced in front vowel context, this is not triggered by an input switch rule, but by a phonetically motivated coarticulation process.

Bosnian as spoken in Bosnia

Bosnian as term for a standard language, as it is referred to today, is a relatively young phenomenon. The standard language evolved with the disintegration of Yugoslavia and the resulting emergence of new national states (see e.g., Thomas 2002). This relatively new development is also reflected in the various denominations which are in use by individual speakers for their language (see, e.g., Völkl 2006). The speakers of the present study for example use the term „Bosnian“, „our language“, „BCS“ (Bosnian Croatian Serbian), „Serbo-Croatian“, and „Croatian“. The denomination for the language spoken in Bosnia is sometimes also linked to ethnic or religious designations: “Bosniak”/ “Bosnian” for the language spoken by Muslims in Bosnia, “Croatian” for Catholics or people with Croatian descent, and “Serbian” for orthodox people or for people with Serbian descent. In the present study the term „Bosnian“ is used to refer to the language spoken by all people in the region of today’s Bosnia, emphasizing the geographical area instead of supposed ethnic differences. We justify this term by the observation that there is only little variation between the “new” standard languages Bosnian, Croatian, Serbian (and Montenegrin), and by the fact that within the region of today’s Bosnia, language varieties are rather homogeneous and only marginally depend on ethnic ascriptions (in contrast to, e.g., Croatia, where regional linguistic variation within the country is much larger, see Völkl 2006). Current investigations about language use in Bosnia or in other countries from former Yugoslavia are generally complicated by the instability of the new standard languages because of an ongoing codifying process for these languages. Tolimir-Hölzl (2011: 56) writes in this regard that “what initially looked like a merely terminological change for ideological reasons has developed into a gradually growing language change along ethnic lines, though still with a high degree of similarity between these official languages/linguistic varieties” (see also Brozović 2005: 12, and Greenberg 2004). The new political and

⁶ Specifically, because of the asynchronous timing of tongue gestures involved in lateral production in word-final position, where the wider dorsal constriction precedes the anterior closure (see Browman & Goldstein (1995))

ideological situation in post-Yugoslavia provoked a series of processes of “Ausbau”⁷ (see Škiljan 2004), which are, however, still ongoing in the respective new standard languages. Kordić (2009) claims that these languages are still better defined as polycentric standard languages (see also Thomas 2002). Even if the process of “Ausbau” would already be advanced, it would be unlikely that the phonetic level would be concerned. This is because speech production at the phonetic level happens rather unconsciously and is less controllable for the speakers than other linguistic levels. Moreover, the speakers of the present study already left Bosnia during the war, that is before a stronger spread of ethnic/political awareness, and they might therefore be generally less affected by potential language changes.

Laterals in Bosnian

The Protoslavlic language initially only had one lateral phoneme, which was an alveolar sound (hard /l/), to which a second lateral phoneme, a more palatal (soft) /l/ was added, still in Protoslavlic times (see, e.g., Holzer 2020). Unlike some other Slavic languages (e.g., Czech), Bosnian still features two lateral phonemes (for more details see below). The speakers of the present study largely confirmed what is described in the literature about dialectal variation within Bosnia (see Greenberg 2004; Völkl 2006): that is, dialectal variation within Bosnia mainly concerns lexical differences, as well as slight differences in grammar (e.g., grammatical gender). At the phonetic level, differences in the pronunciation of the Protoslavlic sound “jat” (that is, [iɛ] vs [i], according to the respective ijekavian and ikavian dialect regions in Bosnia⁸) were reported by the speakers (and see also the aforementioned literature), as well as in the production of /h/, which is often produced as velar fricative in Bosnian varieties, as an „oriental element” in the revitalization of Turkish loan words.

The two lateral phonemes in Bosnian are a voiced velarized alveolar lateral approximant and a voiced palatal lateral approximant. In Slavistics, these phonemes are often described as hard (alveolar or velarized) and soft (palatal or palatalized) laterals (see Petrovic & Grubisic 2010). There is hardly any acoustic or articulatory phonetic study about Bosnian (or Serbo-Croatian) laterals. The velarized lateral in Bosnian is generally described as darker (more velarized) compared to the German lateral (e.g., Maric, 2005; Gick et al., 2006; see also Vujičić 1979, for the Bosnian lateral and Recasens, 1995, for the

⁷ Ausbau-languages (according to the concept of Kloss (1967)) are usually defined as standard languages built on the basis of different dialects, so that the general linguistic difference between these languages is medium (as for example the differences between Standard German as spoken in Germany and Standard Letzeburgish). In polycentric standard varieties, which have an identical dialectal basis, the general linguistic difference between these languages is smaller (as for example the differences between Standard German as spoken in Germany and Standard German as spoken in Austria).

⁸ From a linguistic perspective, Bosnian is a western south Slavic language based on the Stokavian dialect, from which in Bosnia two principal dialects evolved: the ijekavian and the ikavian dialects (e.g., Greenberg (2004)).

German lateral, and Recasens 2012 for an overview of alveolar/velarized laterals in several languages, including Germanic and Slavic languages, though not in Bosnian).

The Bosnian velarized lateral is orthographically identical to the lateral in the main German contact varieties of the L1 Bosnian speakers living in Vienna, SAG and VD (<l>), whereas the Bosnian palatalized lateral is orthographically marked by two graphemes <lj>.

Most importantly, no regional or ethnical differences in lateral production within Bosnia were observed by the speakers of the present study. This also reflects what is reported in the literature, where variation in lateral production is reported to be marginal. In some regions, accumulated lenition of the palatal lateral is observed (/ʎ/ -> [j]), which is traced back to Turkish influences (see Peco 2001: 619, Halilović 2005, 2009: 48). However, this process is described to be instable, inconsequent and decreasing. Rare cases of productions of velar laterals are also observed, whereas the alveolar-velarized lateral is produced in parallel in those regions (Peco 2001: 613).

1.4.2 Articulation and Acoustics of Bosnian and German Laterals

Laterals are generally characterized by a complex articulation, which leads to a diversity of manners of articulation, often being left/right asymmetric and front-back asynchronous. Measures of laterals are often reported to be complicated (see e.g., Charles & Lulich 2019), and therefore more time-consuming, which might be a reason for the comparably smaller amount of cross-language studies investigating laterals (compared to, e.g., studies on Voice Onset Time). In the following, a review of studies is provided that relate articulatory and acoustic analyses of the laterals relevant for the present study, that is, laterals produced in Bosnian, in Standard Austrian German (SAG) and in the Viennese Dialect (VD). More specifically, the voiced palatal lateral approximant⁹ (as present in Bosnian), the voiced velarized alveolar lateral approximant¹⁰ (as present in Bosnian, and also present as a pronunciation variant in VD), and the voiced plain alveolar lateral approximant¹¹ (as present in SAG and in VD) are described.

⁹ The term “voiced palatal lateral approximant” will be abbreviated with “palatal lateral” in the following.

¹⁰ The term “voiced velarized alveolar lateral approximant” is in the following abbreviated with “velarized lateral”.

¹¹ The term “voiced plain alveolar lateral approximant” is in the following abbreviated with “alveolar lateral”.

Articulation

Articulatory, lateral sounds are generally defined by a closure at the mid-sagittal line of the vocal tract, articulated with the tongue, while the expiratory airstream escapes at one side or both sides of the tongue (see, e.g., (Ladefoged & Maddieson 1996)). In alveolar laterals, the closure is made between the front part of the tongue and the alveoles. In velarized laterals, this closure is often made at the same place of articulation, or more frontal, sometimes even in the dental region. Additionally, velarized laterals have a secondary articulation, which is a constriction in the velar, uvular, or pharyngeal region, made by the retraction of the tongue body.

Despite its label, it has been shown that the palatal lateral cannot be articulated at the palatal zone alone. Instead, the closure in palatal laterals is rather located more frontal, mostly at the alveolopalatal region, with a primary articulator comprising the tongue blade and the tongue dorsum. Sometimes palatal laterals even exhibit an alveolar front closure, which can also involve dental contact (see Recasens 2013). Compared to the two previously presented lateral types (plain alveolar vs velarized laterals), the closure in palatal laterals is characterized as being broader, covering additionally more retracted articulatory zones. Furthermore, in palatal laterals the tongue body is more raised and the tongue root more advanced (see also Recasens & Espinosa 2006).

Acoustic characteristics

Acoustically, laterals are generally characterized by well-defined formant-like resonances (see Ladefoged & Maddieson 1996: 193). The lower intensity in laterals compared to vowels is due to the presence of spectral zeros¹², which are caused by additional side branches to the main tube (from the cavity behind the primary closure in laterals and from the interdental channels) and by the coronal constriction (see Stevens 1998), and which occur frequently in the region of F3 or higher (ibid.). These additional channels cause additional resonances in the acoustic output of laterals. Due to the complex interaction of lateral formants, additional resonances, and spectral zeros, which are also subjected to variation because of inter-speaker differences in articulation (concerning the number of side channels, and the exact position of the closure), lateral sounds are difficult to describe in acoustic terms (ibid.).

In the following the articulatory characteristics of the relevant laterals described above are related to their acoustic characteristics in terms of the formants F1-F3. For an acoustic description of laterals in the alveolar-velarized region, a large-scale study involving 23 languages is available and is used as reference in the present study (see Recasens 2012). In order to describe the palatal lateral, a study on four different lateral sounds (including the alveolar and palatalized lateral) in three Central Australian languages (Tabain et al. 2016) and a study on alveolar and palatal laterals in Brazilian Portuguese

¹² Spectral zeros, or antiformants, are frequency regions in which the signal energy is relatively weakened.

(Charles & Lulich 2019) is used as reference. These studies also refer to established models of the relation between articulation and acoustics in laterals, especially to the models described by Fant (1960) (Stevens 1996; 1998).

F2

The strongest acoustic indicator for distinguishing the velarized lateral from the plain alveolar lateral is the second formant (F2; see, e.g., Thomas 2011, Sproat & Fujimura 1993, Carter & Local 2007). F2 depends on the place of articulation of the primary closure and the general shape of the tongue body (Ladefoged & Maddieson 1996: 193). The longer the cavity between the primary constriction and the glottis, the lower is the F2 (e.g. Stevens 1996). Related to this cavity is also the question, whether the articulation of the closure is more apical or more laminal. Laminal articulations result in higher F2 values, which has been explained by the higher tongue body position needed for a laminal articulation (Dart 1991: 63). According to Stevens (1996), F2 is a half-wavelength back cavity resonance, but according to Fant (1960), F2 is a posterior Helmholtz resonance. Tabain et al. (2016) more recently describe F2 as „the back cavity resonance of the system“.

In velarized laterals, F2 has a mean value of 992 Hz in back vowel context and of 1100 Hz in front vowel context. In alveolar laterals, F2 is clearly higher, that is, around 1222 Hz in back vowel context and around 171400 Hz in front vowel context (see Recasens 2012). Measured over all contexts, a mean F2 of 1619 Hz for alveolar laterals and, thus, clearly lower than the mean F2 of 2104 Hz for palatal laterals is reported by Tabain et al. (2016). Thus, F2 seems to be a good indicator for the differentiation between all three lateral types investigated within the present study (alveolar, velarized and palatal laterals, see also Table 1).

F1

The acoustic models of Stevens (1998) and Fant (1960) are consistent regarding F1. F1 is regarded as a Helmholtz resonance over the whole vocal tract, which is supported by Tabain et al. (2016) and Charles & Lulich (2019). F1, in contrast to F2, is higher in velarized laterals and lower in plain alveolar laterals and in palatalized laterals, but overall, laterals have a relatively low F1 frequency and differences in F1 between laterals are small (see also Table 1). In velarized laterals, Recasens (2012) reports a mean F1 of about 340 Hz in front vowel context and mean F1 of about 460 Hz in back vowel context. In alveolar laterals, the mean F1 is about 280 Hz in front vowel context and about 410 Hz in back vowel context (see also Oliveira et al. 2011 and Charles & Lulich 2019). For palatal laterals, reported mean F1 values range from about 280 to 420 Hz (see Teixeira et al. 2012, and also Charles & Lulich 2019).

F3

F3 is described as a half-wavelength back cavity resonance (Stevens 1996), or as a front cavity resonance (Fant 1960). The latter description is supported by Tabain et al. (2016) and Charles & Lulich (2019). For palatalized laterals, Teixeira (2012) reports an F3 between 2677 and 3658Hz (see also Charles 2019 for similar results). Tabain (2016) also confirms these values, reporting a mean F3 of 2896 Hz for palatalized laterals, which only slightly differs from F3 in alveolar laterals, for which she reports a mean of 2839 Hz. The mean values for F3 in alveolar and velarized laterals are lower than the mean F3 values of palatal laterals. According to Recasens (2012), the mean F3 values in alveolar laterals range from 2522 Hz in back vowel context to 2582 Hz in front vowel context. In velarized laterals occurring in front vowel context, the mean F3 is similar to the mean F3 of alveolar laterals (2551 Hz). If velarized laterals are articulated more anteriorly, F3 tends to be higher in velarized laterals (with a mean of 2639 Hz) compared to alveolar laterals, but only if velarized laterals are produced in back vowel context. See also Table 1 for a direct comparison of the averaged formant values for the respective lateral variants.

Table 1. Formant frequencies (F1-F3, in Hertz) for the three types of laterals described above (dark grey shaded: velarized laterals, clear grey shaded: alveolar laterals, white shaded: palatal laterals). The respective frequency values reported in the text are averaged in the table. If available, separate values for front- and back vowel context are shown as well.

	Velarized laterals			Alveolar laterals			Palatal laterals
	back vowel context	front vowel context	all contexts	back vowel context	front vowel context	all contexts	all context
F1	340	460	400	280	410	345	350
F2	972	1100	1036	1222	1714	1518	2104
F3			2595			2648	3032

Conclusions about Acoustic Features

It is important to highlight that the formant values of the different lateral phonemes might largely overlap, especially for alveolar and velarized laterals. This is because of language specific realizations of the same lateral phonemes on the one hand and because of position dependent realizations of the same lateral phonemes within languages on the other hand. This implies that there might be gradual variation from one language to another for a given lateral phoneme. Moreover, even in languages which display two distinguished lateral phonemes, these lateral phonemes might not be categorically opposed, at least in purely descriptive analyses without taking into account the phonetic context (see also Turton, (2015), on the observation of both graduality and categoricity in English lateral allophones). The articulatory and acoustic realization of alveolar and velarized laterals is governed by

phonetic principles, as especially F2, the strongest indicator for the manner of articulation, strongly depends on vowel context and on the position within the word (see also Table 1). In front vowel context, F2 tends to be higher than in back vowel context, and in word initial position, F2 tends to be higher than in word final position. This is in line with position dependent differences in articulatory configuration, that is, a higher and more anterior tongue body position for consonants in word initial position and also for consonants in front vowel context compared to the consonants in word final position and in back vowel context (see Recasens 2012, Browman & Goldstein 1995; Sproat & Fujimura 1993). This “intrinsic allophony” (as opposed to “extrinsic allophony” where these phonetically conditioned differences are especially strengthened) is less pronounced in velarized laterals than in plain alveolar laterals (see Recasens 2012, Recasens & Espinosa 2005).

For the description and the differentiation of lateral variants produced by the bilingual L1 Bosnian L2 German speakers living in Vienna who are investigated within the present study, the analysis of the first two formants (F1 and F2), especially F2, is assumed to be a sufficient indicator. As shown above, these two formants reveal the most pronounced differences between the three lateral variants. F3 is not assumed to add relevant information in the framework of the present study. As just discussed, the vowel context also has to be considered for a valid interpretation of the lateral productions, because the exact formant values can vary importantly dependent on the vowel context.

1.5 Relevant implications for the present study

The present study contributes to the current research on bidirectional cross-language influence at the phonetic level, by focusing on a less studied L1-L2 phoneme combination, and by following a broad perspective in addressing bidirectional influences. The large majority of existing studies only dealt with cross-language influences of one language onto the other, thus, either (predominantly) with phonetic L2 acquisition, or (more recently) with phonetic L1 attrition. The current study offers a broader perspective in the investigation of bidirectional phonetic cross-language influences, by investigating both the L1 and L2 lateral productions of bilingual speakers, including comparisons to native monolingual speakers of the respective languages. Moreover, the speech productions in both languages of the bilingual speakers are related to their perceived accentedness, which is also analyzed in the present study.

More specifically, the present study analyzes the production of laterals in highly experienced late bilingual L1 Bosnian L2 German speakers. Up to date, there are only few studies on how lateral production is influenced by bidirectional cross-language influence. Most of the previous studies dealing with phonetic cross-languages mapping in speech production investigated VOT in stop consonants, or formant characteristics of vowels. This might be due to the relatively high amount of time and the large effort required to analyze laterals. However, laterals are actually supposed to be highly susceptible to cross-language influences, because their differences mostly appear in fine phonetic detail, and thus, according to the SLM, they are expected to be susceptible to equivalence classification. Such cross-language assimilation effects for lateral productions has indeed been shown in L1 and L2 of early bilingual Catalan-Spanish speakers (Simonet 2010), and in L1 for late bilingual Albanian-English speakers (de Leeuw et al. 2017) and for late bilingual German/or Dutch-English speakers (de Leeuw et al. 2013).

Up to now, the focus on phonetic L2 acquisition studies was on the acquisition of a new phoneme or a new phoneme contrast in the L2, whereas the L1 only contained one corresponding “similar” phoneme. The present study investigates the inverse case: Bosnian, the L1 of the bilingual speakers, features a contrast of two lateral phonemes in its phoneme inventory, whereas in the bilingual speakers’ L2 German, only one lateral phoneme is used. The phonetic realization of the German lateral phoneme /l/ is more similar to one of the two L1 phonemes, that is, to /t/, than to the other of the two L1 lateral phonemes, that is, to /ʎ/. The L1 Bosnian /t/ and the L2 German lateral /l/ are considered as similar sounds in the present study based on the similarity in the following aspects: (1) identical orthographic representation <l> (in contrast to <lj> for the palatal lateral), (2) similar articulation, as it is in both cases an alveolar lateral approximant (in contrast, palatal laterals are articulated with a broader closure, additionally covering more retracted zones, mostly in the alveolopalatal region),

without differences in lip-rounding, which, according to the phonetic context, can be more alveolar or more velarized in both languages, leading to (3) presumably overlapping formant values across the two languages.

This peculiarity in L1 and L2 lateral phoneme inventory (the L1 featuring a phonemic lateral contrast and the L2 only having one lateral phoneme, as well as their relation) is one interesting aspect in analysing the laterals of Bosnian and German. Another interesting aspect is the language combination itself. Bosnian, and South-Slavic languages in general, have so far not been subject of investigations on cross-language influences at the phonetic level, although a large number of L1 Bosnian speakers (or BKS speakers in general) live in an L2 language environment. In the vast majority of studies on phonetic cross-language influences, the predominantly analyzed language is English, followed by Romance languages, notably French, Spanish, and sometimes Italian, and by other Germanic languages such as Dutch or German. Moreover, in L2 acquisition research, there is a vast number of speech perception or production studies on L1 speakers of an Asian language learning English.

With regard to the perceived accentedness of bilinguals' speech productions, previous studies (mainly on VOT and vowel production) showed that the segmental level contributes to the perceived accent of the speaker, and that the segmental level might even be relatively more important than suprasegmental features, at least in L2 production. However, little empirical research has investigated the actual correlation between (segmental) acoustic measurements and foreign accentedness in L1, or the relation between perceived accentedness in L1 and perceived accentedness in L2 of the same speakers. This gap is filled by the present study, which analyses the perceived accentedness of bilingual speakers in L2 as well as in L1. In addition to the investigation of the link between perceived and produced segmental accentedness in L1 of lateral sounds, the present study includes a preliminary investigation of the *relative* contribution of segmental aspects to the perception of foreign accentedness in full sentence context in L1. To that end, that preliminary investigation addresses the perceived accentedness of longer utterances produced in the L1 of the same bilingual speakers.

Previous studies on phonetic cross-language mapping mostly investigated group effects only quantitatively, whereas individual differences were mostly, if at all, only briefly mentioned. However, additional analyses of individual differences might add some relevant information on the actual characteristics of cross-language mappings. Specifically, these additional analyses might help to more accurately describe the possible degree of assimilation or dissimilation effects at the individual level, which otherwise, in purely quantitative analyses, might be levelled out to some extent. Especially in the field of research on L1 attrition, some authors argue for a combination of quantitative and qualitative analyses (e.g., Herdina and Jessner 2013, Cherciov 2013, Ben-Rafael & M. Schmid 2007, de Leeuw et al. 2018). The present study therefore combines quantitative analyses of group effects with

qualitative analyses of individual differences, in order to gain insight on the extent of individual variation and the reasons behind this variation in phonetic cross-language patterns.

1.6 Hypotheses

The aim of the present study is to investigate the effects of the long-term integration of an additional phonetic-phonological system into the L1 phonetic-phonological system of late bilingual speakers. This integration process will be investigated by specifically looking at lateral productions of L1 Bosnian-L2 German speakers, who migrated to Vienna at around age 28. Bosnian features a set of two laterals which are contrasted phonemically, whereas German has only one lateral phoneme. Thus, the bilingual speakers of the present study had to integrate a new L2 lateral sound into their L1 phonetic-phonological system. This new L2 lateral sound is similar, but not identical, to one of the two L1 lateral sounds, and contrasts with the second L1 lateral sound. In the present study, lateral sounds in L1 as well as in L2 are studied both with respect to their acoustic properties and their perceived accentedness, as rated by native monolingual speakers of Bosnian and German. Thereby, position and context effects are taken into account. Moreover, the effect of task (read versus spontaneous speech) is tested. The speaker pool of the present study was selected to be relatively homogeneous concerning biographic factors, such as age at onset of L2 acquisition, length of residence in the L2 environment, age at recording, education, and amount of input in L1 und L2. Also, the historic context at the time of migration, that is, the war in Bosnia, was chosen to be uniform across all speakers in the study. Homogeneity in these biographic factors was assumed to provide best chances to observe robust results (see hypotheses below) at the group level. Because a certain degree of between-speaker variability in lateral production and/or accentedness was still anticipated to occur, analyses of individual differences between bilingual speakers were carried out. In addition to the formal described above, qualitative interviews with the bilingual speakers were taken. The goal was to collect potentially valuable information for explaining these individual differences at a qualitative level.

Based on the previous research on bidirectional cross-language influences on L1 and L2 in late bilingual speakers in a migration setting and the predictions made by the SLM-r, the following hypotheses are formulated for the present study:

1. For the lateral productions in L1 Bosnian as produced by the group of late bilingual speakers, the following hypotheses are tested:
 - a) The production of the Bosnian palatal lateral phoneme /ʎ/ does not differ from productions of speakers of a monolingual control group.
 - b) The Bosnian velarized lateral phoneme /ɭ/ is produced less velarized as compared to productions of a control group of monolingual Bosnian speakers.

- c) The contrast between the two Bosnian lateral phonemes /t/ and /ʎ/ is weakened as compared to monolingual speakers. However, this weakening does not lead to a neutralization of the L1 lateral phoneme contrast.
 - d) Individual differences occur most prominently with regard to productions of /t/, but not with regard to productions of /ʎ/.
 - e) Accent ratings, as provided by monolingual listeners of Bosnian, reflect the phonetic-phonological restructuring of lateral production at the group level as well as at the level of individual speakers.
2. For the lateral productions in L2 German produced by the group of late bilingual speakers, the following hypotheses are tested:
- a) German /l/ is produced more velarized as compared to productions of a control group of monolingual German speakers.
 - b) Individual differences in the productions of German /l/ range from monolingual Bosnian production norms for /t/ to monolingual German productions norms.
 - c) The phonetic-phonological restructuring of /l/ in production is reflected by accent ratings of these productions, as performed by monolingual listeners of German.
3. For the comparison between the similar velarized lateral phoneme /t/ in L1 Bosnian and the alveolar lateral phoneme /l/ in L2 German, as produced by late bilingual speakers, the following hypotheses are tested:
- a) At the group level, the L1 and L2 categories are produced within one composite L1-L2 category.
 - b) Individual differences range from productions of two separate (native-like) categories for the L1 and L2 laterals to productions of L1 and L2 sounds within one composite L1-L2 category, which is situated in between the respective monolingual norms.

In the following section, some of the hypotheses are further specified:

H1a is motivated by the assumption that the L1 Bosnian palatal lateral phoneme is not similar enough to any of the closest German phonemes, specifically not to the German lateral, to form an equivalence class. Therefore, no relevant individual variation is expected for the production of the L1 Bosnian palatal lateral.

Instead, as formulated in H1b, the L1 Bosnian velarized lateral phoneme is expected to be subject to equivalence classification with the German alveolar lateral phoneme. These two similar lateral phonemes are expected to undergo a bidirectional assimilation process (as also formulated by H2a for

the L2 German lateral), leading to a merging of these two categories (as suggested by H3a). A related question, however, which will also be considered in the framework of the present study, is, whether the bilingual speakers nevertheless produce separate phonetic-phonological categories for these similar sounds in L1 and L2. As all bilingual speakers are highly experienced in their L2, due to a long-term stay in the L2 environment, it is assumed that most of them had enough L2 input to succeed in building a separate category for the L2 lateral. However, even though the bilingual group is kept relatively homogeneous with regard to biographic factors, individual differences resulting from differences in the amount and quality of input which individual speakers received in the respective languages, or from language attitudes, are expected. These individual differences might concern the degree of assimilation in the production of each of the two similar lateral phonemes (see H1d, and H2b), but therewith also whether two separate categories are used or whether they are completely merged (see H3b).

Furthermore, regarding the strength of assimilation in L2 lateral productions towards L1 laterals, the position of the laterals within the word might be relevant and will thus be taken into account in the present study. In addition to the hypotheses formulated above it could be expected that in L2 German productions, bilingual speakers produce the laterals more alveolar, that is, more native German-like, when the laterals occur in more prominent and thus more salient positions, where they are presumably more consciously controlled (e.g., in word-initial, and in stressed position) compared to laterals in less prominent positions (e.g., word-finally, unstressed). Furthermore, the possible occurrence of more velarized laterals in less prominent positions in speech productions of some speakers of the VD might also contribute to this position-dependent difference in L2 lateral production.

In addition to phoneme position, the present study takes into account possible effects of the degree of formality. This is because some of the studies presented in the literature review revealed stronger changes in the L1-L2 phonetic-phonological system in spontaneous speech productions as compared to read speech productions (Major 1992, de Leeuw 2019). It is thus assumed that assimilation processes between the similar laterals in L1 Bosnian and L2 German are stronger in spontaneous speech productions than in read speech productions.

Furthermore, with reference to H1c, the assimilation of the L1 Bosnian velarized lateral towards the L2 German alveolar lateral is supposed to weaken the phonemic lateral contrast in the L1. However, the phonemic contrast is not assumed to be completely neutralized. This is because one of the two laterals involved in the phoneme contrast, that is, the palatal lateral, is assumed to remain native-like in the L1 phonetic-phonological system. Moreover, a complete neutralization of the phoneme contrast is assumed to be blocked by the different graphemic representations for the two contrasting lateral phonemes (<l> vs. <lj>).

Concerning the perceived accentedness of the bilingual speakers in their respective languages, it is suggested that differences between bilinguals and monolingual reference speakers are detectable at a group level (as formulated in H1e for the Bosnian velarized lateral, and in H2c for the German alveolar lateral). Moreover, it will be studied whether listeners are also able to perceive more subtle differences in the lateral productions between individual speakers, and whether those are predicted by differences in the corresponding acoustic measurements. In addition to the perception study on the link between segmental lateral productions and perceived accentedness in isolated words (extracted from full sentences recorded), the present study also includes a preliminary study of the relation between perceived accentedness in words and in longer utterances (as mentioned above in the section “implications for the present study). Thus, if spontaneous speech is supposed to elicit more L1 attrition than read speech, and if, as suggested by research on L2 acquisition cited above, longer and specifically spontaneous utterances tend to lead to worse accent ratings, it is suggested that also in L1, the longer, spontaneous utterances of bilingual speakers are perceived as less native-like than their word productions.

2 Experiment 1: Laterals in speech production

The aim of Experiment 1 is the acoustic investigation of lateral production in both the L1 and the L2 of bilingual L1 Bosnian L2 German speakers living in Vienna, compared to monolingual speakers of the respective languages. The experiment studies /t/ and /ʌ/ lateral productions in L1 Bosnian (by bilingual speakers as compared to monolingual Bosnian speakers), as well as /l/ in L2 German (by bilingual speakers as compared to monolingual Austrian German speakers), and encompasses a comparison between productions of the similar laterals /t/ (L1) and /l/ (L2), both orthographically corresponding to <l>, by the bilingual speakers. First (chapter 2.2), analyses of group differences are presented and discussed. They describe the changes in lateral production to be expected in both L1 and L2. Such changes are attributable to a restructuring of the L1-L2 phonetic-phonological system in bilingual speakers according to the Speech Learning Model. Results are discussed specifically with respect to expected assimilation processes in L1 and L2, as well as with respect to the question whether bilingual speakers use separate phonetic-phonological categories for L1 and L2 lateral productions. Second, in chapter 2.3, individual differences between bilingual speakers in the production of L1 and L2 laterals are described and discussed. This allows to investigate whether and to what extent lateral production of a biographically homogeneous group of late and experienced bilingual speakers differ at the level of the individual speaker.

2.1 Methods

2.1.1 Participants

A bilingual group of 14 (7 female and 7 male) L1 Bosnian L2 German speakers living in Vienna (henceforth BoV group or bilingual group) was recorded in their L1 Bosnian as well as in L2 German. Additionally, a control group of 10 (5 female and 5 male) monolingual L1 Bosnian speakers living in Sarajevo (BoS, monolingual group¹³), and a control group of 12 (6 female and 6 male) monolingual L1 German¹⁴ speakers living in Vienna, half of them speakers of the Viennese dialect (VD) and the other half speakers of Standard Austrian German (SAG), was recorded.

Bilingual L1 Bosnian L2 German speakers living in Vienna were recruited via notices at the university, at the Bosnian embassy, in supermarkets, online through social media, and through direct contacting of Bosnian cultural associations. The criteria for the inclusion of speakers to the bilingual group were that they were all born and raised in the region of today's Bosnia and came to Austria as young adults, at the age of 20 or older, and that at the time of recording they had been living in Vienna for at least 15 years (mean age of arrival = 28 years, mean length of residence = 23 years, mean age at recording: 51 years, see Table 1). Note that one male speaker had been living in Vienna for only 13 years, but since he had some exposure to German prior to his arrival in Vienna, he was nevertheless included¹⁵. These criteria were set in order to ensure that at the time the participants moved to Vienna, Bosnian was already well established as their native language, and that at the time of recording they had long-term exposure to German through immersion. Seven participants reported some instruction in German in school in Bosnia, but significant active exposure to German began only after their arrival in Austria. In addition, several participants reported some prior exposure to other languages such as Russian, English or Arabic, but none of these languages had been used actively at any point in their lives. At the time of recording, for most participants German was the only, or the by far best-known foreign language.

The educational background of the bilingual BoV speakers was relatively homogeneous, as all acquired their university-entrance diploma at a secondary school in Bosnia and most of them also started or even finished university studies in Bosnia before moving to Austria. All speakers except one were married to another person of their L1 community. For most participants the time of emigration to Austria coincided with the war in Bosnia in the 1990ies. Demographic information and information

¹³ The term "monolingual" is used in the following to describe speakers who are "primarily monolinguals", because they live in their L1 environment and only use one language at a regular basis, even though some might have learned an additional language at some point in their lives (e.g., in school).

¹⁴ In the following, if not otherwise clarified, "German" refers to Austrian German as spoken by the two main varieties of German spoken in Vienna, Standard Austrian German and the Viennese dialect.

¹⁵ This speaker spent 2 years in Switzerland as a refugee.

on personal experiences and attitudes of all speakers was assessed in a qualitative interview. The BoV speakers were born in diverse regions of Bosnia. However, there is no evidence for regional variation concerning the phonemes investigated in this study. Information on personal experiences and attitudes will be used for a qualitative interpretation of the results.

Participants in the monolingual Bosnian control group (i.e., BoS) were recruited with the help of the Institut za jezik (*Institute of Linguistics*) and a contact to the elementary school Musa Ćazim Ćatić in Sarajevo. Participants were selected to comprise a comparable age range to the BoV speakers at the time of recording (mean age at recording= 47years, range 38-56 years). They were all born and still living in Bosnia, and never learned German. Most reported having learned one or more foreign languages in school (such as English, French, Russian, Turkish), but little active use or skills in conversation. Similarly to the BoV speakers, most BoS speakers had a university degree (except one male and one female speaker who finished secondary school).

Table 2. Details of Bilingual L1 Bosnian L2 German speakers living in Vienna (BoV): gender, age of arrival (AoA, equal to age of L2 acquisition), length of residence in the L2 environment (LoR), age at recording (AaR). Speakers p01-p07 are female speakers (white shaded), speakers p11-p17 are male speakers (grey shaded).

speaker	gender	AoA	LoR	AaR
p01	f	30	23	56
p02	f	34	17	51
p03	f	43	24	67
p04	f	29	24	53
p05	f	24	24	48
p06	f	24	22	46
p07	f	26	25	51
p11	m	32	25	57
p12	m	25	25	50
p13	m	25	22	57
p14	m	27	26	43
p15	m	24	13	37
p16	m	21	25	46
p17	m	26	25	51

Participants in the L1 German control group were partly recruited from a pool of SAG speakers and VD speakers available at the Acoustics Research Institute. Some had already participated in previous speech studies at the Institute. Other speakers were recruited via social media. Participants spanned the same age range as the BoV speakers, with a mean age of recording of 55 years. They were all born in Vienna, as were their parents. Six of the monolingual L1 German participants were speakers of SAG and therefore defined by their and their parents' higher educational background, compared to the six other monolingual L1 German speakers who were speakers of the VD and had no university entrance diploma from secondary school (i.e., Matura, see also Moosmüller 1991; Moosmüller et al. 2015a).

2.1.2 Materials and procedure

Read as well as spontaneous speech was recorded from all Bosnian speakers (BoV and BoS) in their L1 Bosnian, and from the bilingual speakers living in Vienna (BoV) and the L1 German speakers (SAG and VD) in German. The BoV speakers were first recorded in their L2 German and then, after a short break, in their L2 Bosnian.

German speech Materials

The German read speech task consisted of a list of 104 target words containing the German lateral. The written target words were embedded in short context sentences and occurred sentence medially. Forty-six sentences were constructed such that participants could be asked to finish the sentences as they thought fit in order to elicit more engaged speech as it would be in a pure reading task. The target words were balanced for position of the lateral in the word (word-initial, medial but morpheme-initial, medial, and final position), vowel context (front vs. back vowels preceding and following the lateral), and syllable stress (stressed, secondary stressed, or unstressed). Examples for words and carrier sentences in the German reading task are shown in Table 2 (see Appendix C for the whole list of sentences).

Table 2. Examples for German target words and the sentences in which these words were embedded in the German reading task.

Word	Sentence	English translation
leben	Sie <i>leben</i> nur einmal.	You only live once.
Volumen	Das <i>Volumen</i> ist groß.	The volume is large.
Kiel	Das ist in <i>Kiel</i> anders.	This is different in Kiel.
links	Da <i>links</i> ist...	There on the left is...

Spontaneous speech in German was elicited through a semi-structured biographic interview. This interview additionally served to gather information for a qualitative analysis of the acoustic measurements of the BoV speakers' lateral productions reported below. It spanned the following topics: overall biography, educational and social background, language background, language practice, and language attitudes, as well as emigration in the case of the BoV speakers (see Appendix D for the list of guiding questions).

Bosnian speech Materials

For the Bosnian read speech task, 18 minimal or near-minimal word pairs were selected such that they differed in the palatal versus velarized lateral (/ɫ/-/t/, e.g., *ljudi* - *ludi* "people" - "crazy")¹⁶. The target words were further selected according to the position of the lateral in the word and the vowel context. Across word pairs, laterals occurred with equal frequency in initial, medial, and final word position. A balance of occurrence in front vowel and back vowel context was attempted, but due to lexical restrictions not entirely possible. Importantly, both Bosnian speaker groups (BoV, BoS) were presented the same targets, equalizing potential biases. The target words were embedded in scripted dialogue sequences of which speakers were asked to read out the last sentence containing the target word. The remaining part of the dialogue served as context since some of the words were conjugated verb forms or infrequent words. Moreover, the dialogue sequences also served to elicit more engaged speech like in a pure reading task. Examples of dialogues are given in Table 3 (see Appendix E for the whole list of dialogue sequences).

In order to elicit the production of Bosnian laterals in spontaneous speech, speakers were asked to retell three picture stories from the "father and son series"¹⁷ (see Appendix F).

Table 3. Examples for Bosnian target words, and sentences in which these words were embedded in the Bosnian reading task.

Minimal pairs/ target words	Carrier dialogue with target sentence	English Translation
<i>ljudi</i>	Puno <i>ljudi</i> ima na ulici. <i>Ljudi</i> si rekao? Da, <i>ljudi</i> sam rekao.	Many people are in the street. You said <i>people</i> ? Yes I said <i>people</i> .
<i>ludi</i>	Imao sam <i>ludi</i> period. <i>Ludi</i> si rekao? Da, <i>ludi</i> sam rekao.	I had a crazy time. You said <i>crazy</i> ? Yes I said <i>crazy</i> .
<i>bolje</i>	Možete to i <i>bolje</i> napraviti. <i>Bolje</i> si rekao? Da, <i>bolje</i> sam rekao.	You could also do this better. You said <i>better</i> ? Yes I said <i>better</i> .
<i>bole</i>	Bole me noge. <i>Bole</i> si rekao? Da, <i>bole</i> sam rekao.	My legs hurt. You said <i>hurt</i> ? Yes I said <i>hurt</i> .

Procedure

The recordings of the BoV speakers were made between September 2015 and 2018 (mainly in 2016) in Vienna, Austria, at the Acoustics Research Institute of the Austrian Academy of Sciences in a sound-attenuated booth. One speaker was exceptionally recorded in his home since for time-constraints he

¹⁶ The list of Bosnian target words, embedded in (simple) carrier sentences, was originally developed at the "Institut für Slawistik" at the University of Klagenfurt.

¹⁷ [https://de.wikipedia.org/wiki/Kategorie:Datei:Vater_und_Sohn_\(e.o.plauen\)](https://de.wikipedia.org/wiki/Kategorie:Datei:Vater_und_Sohn_(e.o.plauen))

was unwilling to come to the institute. The recording setup included an Edirol Roland R-44 recorder and a suspended microphone in the sound booth (or a microphone placed on a table in front of the speaker for the one recorded at home). The signal was digitized at 44.1 kHz. The recordings were conducted by the first author. At first, a recording session in the speakers' L2 Austrian German was performed. In a second session, after a short break in between, the recordings of the L1 Bosnian speech tasks were performed. Although the L2 German environment of the recording session could have triggered language interference phenomena, due to the relatively long duration of the L1 Bosnian recordings it is not assumed that phonetic attrition could be explained by this situational language interference (alone). The recordings of the German read and spontaneous speech task took approximately 60 minutes. The recordings of the Bosnian read and spontaneous speech task took approximately 20 minutes.

The SAG and VD speakers were recorded within the same time interval, at the same place, and with the same equipment as the recordings of the BoV speakers. The recordings of the VD speakers were conducted by a dialect speaker (VD or Lower-Austrian dialect), the recordings of the SAG speakers were conducted by a standard speaker (SAG or Standard German German). In each case the recordings were performed by an employee of the Acoustic Phonetics Group of the Acoustic Research Institute in Vienna.

The BoS speakers were recorded in Sarajevo, during a research stay of the first author in June 2017. The recordings took place in a quiet room at the Institut za jezik (*Institute of Linguistics*) or in a quiet room of the elementary school Musa Ćazim Ćatić. The recordings were conducted using the same Edirol Roland R-44 recorder as for the BoV speakers and a microphone with a tripod which was placed on a table in front of the speakers. A native speaker of Bosnian, living in Sarajevo, served as translator and also conducted semi-spontaneous biographical interviews, which served to verify the biographic background of the speakers (see Appendix G).

In the German recordings, L1 and L2 German speaker groups (SAG, VD, and BoV) first were interviewed. Participants were free to answer as detailed as they considered appropriate during the interview. The order of the questions varied according to the dynamic of the respective interviews. Some of the speakers previously had already been interviewed for other speech experiments in the same manner, so that this previously elicited spontaneous speech material was also used in the present study. Second, participants read the sentences of the German read-speech task off a sheet of paper, and after a first round they were read a second time.

In the Bosnian recordings, both L1 Bosnian speaker groups (BoV and BoS) first read the sentences of the Bosnian read-speech task off a sheet of paper. After a first round, all sentences were read a

second time. Second, also the pictures for the stories to be re-told in the Bosnian spontaneous speech task were presented on paper. Participants were allowed to take as much time as they needed before the recording was started. They were told that they could re-tell the stories in whatever way they liked. After one story was finished, they got the sheet of paper with the next story until all three stories were narrated.

2.1.3 Data preparation

The phonetics software STx (Sound Tools Extended, Noll et al. 2019) was used for the entire data preparation process up to the extraction of the measures for statistical analyses. First, the recorded sentences of the read and spontaneous speech tasks were orthographically transcribed. In the case of read speech, the transcription was performed semi-automatically, that is, the software imported the written sentences from a text file with one sentence per line. Sentences in the text file were listed in the order they had to be read by the speakers. The sentences were automatically extracted from the text file and aligned with the acoustic signal of the read speech part of a speaker. That is, for each sentence, a segment was created in the acoustic signal in the order they were listed in the text file (which corresponded to the reading order). The length of the respective written sentences (i.e., determined by the number of letters) together with the duration of the whole acoustic signal of the read speech part of the respective speaker determined the duration of the assigned acoustic signal to a written sentence segment. As acoustic characteristics (i.e., pauses in the signal) were not taken into account for the automatic segmentation procedure, the exact segment borders still had to be adjusted manually. In the case of spontaneous speech, the transcription was performed manually.

Table 4. Complete list of speakers and total amount of laterals (both Bosnian lateral phonemes /t/ and /ɫ/) analyzed per speaker for each group. Numbers in brackets show the number of Bosnian velarized /t/ only. Below the individual speakers of one Speaker Group the total amount of laterals analyzed for the respective speaker group is given. Information is shaded per speaker group (BoV speakers: white, BoS speakers: light grey, SAG speakers: grey, VD speakers: dark grey).

BoV speakers	female	Speaker number	N of Bosnian laterals (/t/)	N of German laterals	male	Speaker number	N of Bosnian laterals (/t/)	N of German laterals
		p01	89 (53)	365		p11	97 (58)	285
		p02	116 (73)	309		p12	118 (78)	337
		p03	91 (60)	305		p13	95 (59)	285
		p04	92 (55)	274		p14	101 (58)	271
		p05	119 (78)	280		p15	113 (72)	264
		p06	108 (72)	279		p16	109 (67)	265
		p07	108 (66)	273		p17	94 (52)	269
		total n	723 (457)	2085		total n	727 (444)	1976
		monolingual control groups						
Bosnian: BoS speakers	female	p21	95 (55)	-	male	p26	82 (42)	-
		p22	77 (43)	-		p27	89 (48)	-
		p23	101 (57)	-		p28	84 (48)	-
		p24	80 (43)	-		p29	89 (46)	-
		p25	82 (43)	-		p30	99 (55)	-
		total n	435 (241)			total n	443 (239)	
German: SAG speakers	female	p286	-	229	male	p120	-	280
		p299	-	198		p130	-	298
		p344	-	233		p356	-	239
		total n		660		total n		817
German: VD speakers	female	p349	-	211	male	p342	-	186
		p389	-	199		p347	-	203
		p565	-	196		p380	-	205
		total n		606		total n		594

Next, in all utterances (read and spontaneous speech), the target words, the laterals, and the vowels surrounding the laterals were manually segmented and annotated by a trained phonetician. The boundaries of the laterals were determined by a drop in intensity relative to the surrounding vowel, changes in the spectral composition of the signal, formant transitions, and by auditory verification. Formant frequencies (F1 – F3) of the laterals were calculated using the linear prediction coding method (LPC), and, if necessary, were manually corrected. Mean formant values over the whole lateral segments were calculated. In order to normalize differences in vocal tract length, the distance between F1 and F2, as well as between F2 and F3, in bark was calculated for each lateral (mean F₂ - mean F₁, see Simonet, 2010, Nance, 2014). A total of 2326 L1 Bosnian laterals was analyzed, as well as a total of 6727 L1 and L2 German laterals (see Table 4 for an overview on the number of laterals analyzed per speaker group and per individual speaker).

In the following parts of the study, group effects in the production of L1 Bosnian and L2 German laterals by BoV speakers, with reference to L1 Bosnian and L2 German control groups, are statistically analyzed. Statistical group analyses are important in order to reveal the general, expectable, and possibly generalizable effects (generalizable for a larger group of BoV speakers, that is, speakers with similar biographical background). Second, an analysis of differences in the production of L1 Bosnian

and L2 German laterals between individual BoV speakers is performed (see Table 4 for an overview on the individual speakers and their individual labels per speaker group).

2.1 Analyses of group differences in production

2.2.1 Data analysis

For statistical analyses of all production data (Bosnian and German productions of the main group of interest, that is, BoV speakers, and of all other reference speaker groups), linear mixed-effects models were fitted using the lme4 package (Bates et al., 2015) in R (R core team, 2019). The restricted maximum likelihood (REML) method and Satterthwaite approximation were used for degrees of freedom. Mixed-effects models were applied in order to include a random-effects structure of random intercepts for participants and items and/or random slopes for given fixed factors. Random intercepts estimate participant or item variation around the mean. Random slopes capture differences in the sensitivity to the fixed effects (for more detailed discussions see Baayen, Davidson, & Bates, 2008; Barr, Levy, Scheepers, & Tily, 2013; Field, Miles, & Field, 2012).

If the model included only fixed factors with two levels, the factors were contrast coded to -0.5 and 0.5 in the order they are introduced in the text, such that effects and interactions can be interpreted relative to the grand mean (i.e., zero, which is mapped onto the intercept). Effects can then be interpreted as main effects¹⁸. If a factor with more than two levels was analyzed, then post-hoc tests were performed using the lsmeans function of the emmeans package (Lenth 2020), where p-values are reported including a Bonferroni correction. That is, p-values are multiplied by the number of post-hoc tests applied to counteract an inflation of type I errors due to the large number of comparisons. The Kenward–Roger approximation was used for the degrees of freedom, as implemented in the package lmerTest (Kuznetsova et al 2017).

The lateral productions of the main group of interest, the BoV speakers, were analyzed in five models. The first three compared the productions of the laterals in their L1 Bosnian as compared to BoS speakers' productions of these phonemes. Model 4 compared the BoV speakers' L1 Bosnian laterals to their productions in their L2 German. Finally, Model 5 compared the BoV speakers' L2 German laterals to those of the native German speakers.

Models for lateral production in L1 Bosnian

In order to analyze the bilingual speakers' (BoV) pronunciation of laterals in L1 Bosnian, compared to the pronunciation of the same laterals by the speakers of the monolingual control group living in Sarajevo (BoS), three models were built. Model 1 compared the pronunciation of the velarized L1 Bosnian lateral of the BoV and the BoS speakers, that is, whether one of the groups would produce a more velarized /ɫ/ than the other. Model 2 compared the pronunciation of L1 Bosnian /ʎ/ of BoV and

¹⁸ Note that effects are treated as significant in the present study, if $p < 0.05$.

BoS speakers, specifically, whether one of the groups would produce /ɫ/ with lower F2-F1 values than the other. Model 3 compared the difference between the two L1 Bosnian lateral phonemes /t/ and /ɫ/ in the speech of BoV speakers versus BoS speakers, that is, how well speakers of each group differentiate between the two L1 Bosnian lateral phonemes.

Model 1

For the analysis of the pronunciation of the Bosnian velarized lateral in the two speaker groups (BoS/BoV), a linear mixed-effects model was fitted with the F2-F1 difference of the laterals in bark as the dependent variable, and Task (read, spontaneous), Speaker Group (BoS, BoV), Gender (female, male) and all interactions as fixed factors. All factors were contrast coded to -0.5 and 0.5 in the order mentioned. Lateral Position (initial, medial, final) and Vowel Context (between preceding and following front vowels, between preceding and following back vowels, between preceding front and following back vowels, between preceding back and following front vowels, between preceding front vowel and following other sound, between preceding other sound and following back vowel) were entered as covariates that were not allowed to interact with any of the other factors. They were used to account for further variance. The random-effects structure of the model contained random intercepts for Participant and Word (i.e. item) and a random slope for Task over Participants (note that Task was the only within-participant factor of interest).

Model 2

For the analysis of the production of Bosnian /ɫ/ in the two speaker groups (BoV and BoS) the difference F2-F1 was used as the dependent variable. F3-F2 was also considered but given the lack of significant results, it will not be reported. Task, Speaker Group, Gender and all interactions were entered as fixed factors, and again, Context and Position were entered as covariates in order to control for context. Variables were contrast coded as described above. The random-effects structure of the model again included random intercepts for Participant and Word with a random slope for Task over Participant.

Model 3

Model 3 was built in order to investigate the phonetic contrast between the two L1 Bosnian lateral phonemes /t/ and /ɫ/ in the speech of BoV speakers versus BoS speakers. As in Model 2, the F2-F1 difference was used as dependent variable (and again F3-F2 did not provide any additional insights). Task, Lateral type (/t /, /lj/), Speaker Group, Gender, and the interaction between the four factors were entered as fixed factors. Lateral Position and Vowel Context again served as covariates in order to

account for further variance. Random intercepts were added for Word and Participant, as well as a random slope of Task over Participant.

Model for lateral production in L1 and L2 German

In order to analyze the BoV speakers' lateral production in L2 German, as compared to the pronunciation of the same laterals by monolingual L1 German speakers (VD, SAG) living in Vienna, a fourth model compared the production of German /l/ of BoV and VD and SAG speakers, that is, whether one of the groups would produce a more velarized /l/ than the other groups.

Model 4

In Model 4, the production of the German lateral /l/ as produced by the bilingual BoV speakers and the monolingual VD and SAG speakers was analyzed. A linear mixed-effects model was fitted with the F2-F1 difference in bark of the laterals as the dependent variable. Task (spontaneous, read), Gender (male, female), Speaker Group (BoV, SAG, VD), and all interactions were entered as fixed factors. The interaction of Lateral Position (initial, medial, final) and Speaker Group was also analyzed, as Lateral Position was previously shown in the literature to play an important role for input switch rules concerning the production of a more standard alveolar variant or a more velarized variant of the lateral in the VD (see introduction). Gender and Task were contrast coded to -0.5 and 0.5. Additionally, Vowel Context (between preceding and following front vowels, between preceding and following back vowels, between preceding front and following back vowels, between preceding back and following front vowels, between preceding front vowel and following other sound, between preceding other sound and following back vowel) was entered as covariates to account for further variance. The random-effects structure of the model contained a random intercept for Participant and Word and a random slope for Task over Participants.

Model for lateral production in L1 Bosnian as compared to L2 German

In order to analyze the bilingual speakers' pronunciation of laterals in L1 Bosnian, as compared to the same speakers' pronunciation of laterals in their L2 German, a fifth model compared the difference between /t/ in L1 Bosnian and /l/ in L2 German. Specifically, it was investigated whether BoV speakers would produce the phonemes differently in their L1 Bosnian as compared to their L2 German.

Model 5

In Model 5, L1 Bosnian /t/ as produced by BoV speakers was compared to the same speakers' productions of /l/ in their L2 German, in order to investigate the influence of L2 German on L1 Bosnian

and to assess, whether BoV speakers would produce two different lateral categories in their two languages (as would be indicated by a significant effect of Language)¹⁹.

Therefore, a linear mixed-effects model was fitted with the F2-F1 difference of the laterals in bark as the dependent variable, and Task (read, spontaneous), Language (L1 Bosnian/L2 German), Gender (female, male) and all interactions as fixed factors. All factors were contrast coded to -0.5 and 0.5 in the order mentioned. Lateral Position (initial, medial, final) and Vowel Context (between preceding and following front vowels, between preceding and following back vowels, between preceding front and following back vowels, between preceding back and following front vowels, between preceding front vowel and following other sound, between preceding other sound and following back vowel) were entered as covariates that were not allowed to interact with any of the other factors. They were used to account for further variance. The random-effects structure of the model contained random intercepts for Participant and Word (i.e. item) and a random slope for Task over Participants (note that Task was the only within-participant factor of interest).

Additional analyses

In addition to the linear mixed effects models described above, two further sets of analyses were performed on the raw data. First, following up on Model 3, the first additional analysis investigated the degrees of differentiation between the two Bosnian lateral phonemes by male and female speakers in each of the two Speaker groups by means of density pots. That is, the overall distribution of F2-F1 values in bark of the two Bosnian laterals (/t/ and /ʎ/) was inspected by plotting kernel density estimates, as computed by the density() function in R. Separate density plots are shown for male and female speakers, each comparing density distributions by BoV and BoS speakers. These plots were used to illustrate whether the two lateral phonemes /t/ and /ʎ/ are produced as separate phonemes or whether and to what extent the two categories overlap for male vs. female speakers of BoV vs. BoS speaker groups. It was also used to assess potential effects of phonological context (neighbouring phonemes and position in the word) that were only used as co-variates in the main statistical models. Two clearly separated peaks with a valley at zero between the two distributions would indicate an

¹⁹ Note that the SLM does not provide a clear definition for the use of two sound categories versus only one category. Within the framework of the present study, an acoustic differentiation is taken. That is, if the mean F2-F1 values in bark, which are the main criteria for a classification of laterals at the dark-clear continuum, are significantly different, then two lateral categories are assumed (for a summary, see Takahashi (2020), and see also Simonet (2010), who analyzes the number of categories by means of interactions between the factors speaker group and language in mixed effects regression models).

unequivocal distinction, an overlap of the two distributions would speak for a (partially) merged realization of the two lateral categories.

The second additional analysis followed up on Model 5. A correlation analysis of /t/ productions in L1 Bosnian and /l/ productions in L2 German, produced by BoV speakers, was performed. This was to further investigate the factor Language and whether there would be a correlation between acoustic measures of /t/ in L1 Bosnian and acoustic measures of /l/ in L2 German at the level of the individual speaker. This correlation analysis is based on the mean distance of F2-F1 values in bark of all individual BoV speakers in each of their languages. That is, for each speaker, a mean value for the F2-F1 distance in Bark of their /t/ productions in L1 Bosnian as well as an additional mean value for the L2 German /l/ productions was calculated and subjected to a correlation test for paired samples. A Pearson's product-moment correlation was calculated with the function `cor.test()` in R, which follows a t-distribution with $\text{length}(x)-2$ degrees of freedom.

2.2.2 Results for Model 1: /t/ in L1 Bosnian

In Model 1 the production of the Bosnian velarized /t/ as produced by the two speaker groups (BoV vs. BoS) was assessed. Statistical results for Model 1 are reported in Table 5 (see also Figure 1). Results show a marginally significant three-way interaction between Speaker Group, Gender, and Task, and a two-way interaction between Speaker Group and Gender. No other interactions or main effects were significant.

To further assess the nature of these interactions and their interpretation, two additional mixed-models were fitted for male and female speakers separately. Moreover, as Figure 1 suggested asymmetries between male and female BoV speakers, an additional submodel was build, in which only the subgroup of BoV speakers was analyzed (without SAG and VD speakers).

The models for the subgroups of female and male speakers were identical to the one described above, including the covariates, but except for the fixed factor Gender, which was now used to form subsets of the data. For male speakers, no significant effects were found (see Table 6 and Figure 1). For female speakers, in contrast, a significant effect of Speaker Group, and a significant interaction between Speaker Group and Task was found. The main effect for Speaker Group suggested that the distance between F2-F1 was larger for female BoV speakers than for female BoS speakers (see also Table 6 and Figure 1).

The interaction between Speaker Group and Task in the speech of female speakers was then again further assessed by fitting additional mixed-effects models on the subsets for Task. One model was

built for read speech and one model for spontaneous speech. These models showed that only for read speech was the difference between female BoV speakers and female BoS speakers significant ($b=-1.07$, $SE=0.37$, $df=10.03$, $t=-2.9$, $p=.02$). In spontaneous speech, only non-significant tendencies in the same direction could be observed (i.e., higher F2-F1 distances in the speech of female BoV speakers compared to female BoS speakers; $b= 0.52$, $SE= 0.31$, $df= 13.89$, $t=1.71$, $p= 0.11$, see also Figure 1).

Table 5. Relevant fixed effects returned by Model 1, a mixed-effects model fit to Bosnian /l/ produced by BoV and BoS speakers with F2-F1 distance in Bark as the dependent variable, lateral position, vowel context, Speaker Group (BoV vs BoS), Gender (male vs female), and Task (read vs spontaneous), and all interactions as fixed factors, and Participant and Word as random effects.

Model 1: /l/	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group	0.305	0.196	22.20	1.552	.135
Gender	0.063	0.196	44.07	0.322	.75
Task	0.115	0.19	128.16	0.601	.549
Speaker Group:Gender	0.949	0.39	22.00	2.424	.024*
Speaker Group:Task	0.246	0.18	26.53	1.405	.172
Gender:Task	0.206	0.17	26.13	1.185	.247
Speaker Group:Gender:Task	0.604	0.35	25.58	1.745	.093.

Additional models for female speakers split by Speaker Group, that is, to assess possible effects of Task, did not yield significant results in any of the female speaker groups (Task in female BoV speakers: $b= 0.376$, $SE= 0.268$, $df= 32.03$, $t= 1.405$, $p= 0.17$, Task in female BoS speakers: $b= 0.055$, $SE= 0.281$, $df= 45.822$, $t= 0.1552$, $p= .847$). This was despite Figure 1 suggesting a tendency for female BoV speakers to produce laterals in read speech with higher F2-F1 values than laterals in spontaneous speech.

The submodel only dealing with the subgroup of BoV speakers was also identical to the full model 1, including the covariates, but except for the factor Speaker Group. Results showed a significant interaction between Gender and Task ($b= 0.436$, $SE= 0.15$, $df=1430$, $t=2.93$, $p= 0.003$). When this model was further split by the factor Task (again otherwise identical to the previous models, except for the factor Task which was now used to build the submodels), results showed a significant Gender difference in read speech ($b= 0.72$, $SE= 0.25$, $df= 12.07$, $t= 2.88$, $p= 0.014$) but not in spontaneous speech ($b= 0.23$, $SE= 0.22$, $df= 12.87$, $t= 1.07$, $p= 0.31$).

Table 6. Relevant fixed effects returned by two subsets of Model 1, split by gender (male and female speakers). The mixed-effects models were fit to Bosnian /l/ produced by BoV and BoS speakers with F2-F1 distance in Bark as the dependent variable, lateral position, vowel context, Speaker Group (BoV vs BoS), and Task (read vs spontaneous), and all interactions as fixed factors, and Participant and Word as random effects.

Female speakers	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group	0.766	0.315	10.982	2.432	.033*
Task	0.11	0.225	80.336	0.487	.628
Speaker Group:Task	0.615	0.248	39.58	2.477	.017*
Male speakers					
Speaker Group	-0.17	0.245	11.233	-0.694	.502
Task	0.199	0.232	69.281	0.859	.393
Speaker Group:Task	-0.098	0.259	13.149	-0.378	.711

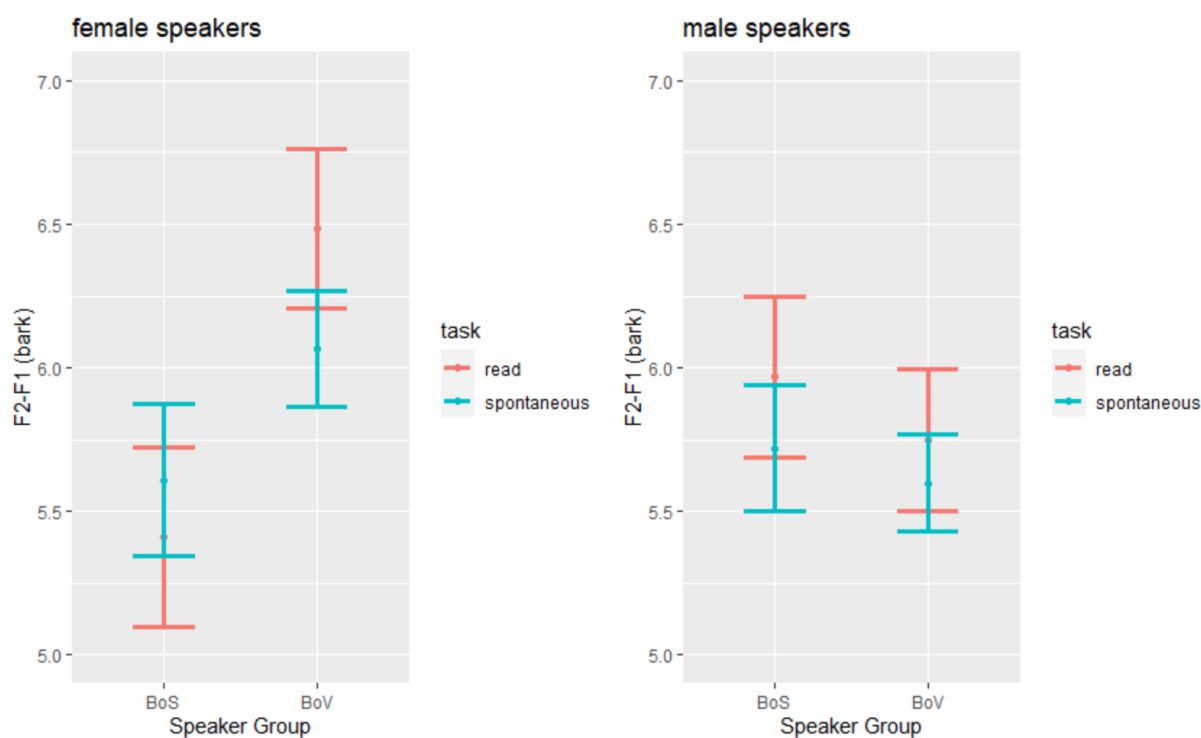


Figure 1. Means (+/- se) of F2-F1 (in bark) distance of /l/ in L1 Bosnian (y-axis) as a function of Speaker Group (BoV vs BoS, x-axis) and Task (read [red bars] vs spontaneous [blue bars]), plotted for female (left panel) and for male speakers (right panel) separately, estimated from the linear mixed effects model (Model 1).

In sum, the results for the first main model and its model-subsets on the pronunciation of the velarized Bosnian lateral by BoV and BoS speakers showed that laterals of female speakers differed depending on Speaker Group, especially in the read speech task, whereas laterals of male speakers did not differ significantly.

2.2.3 Results for Model 2: /ɬ/ in L1 Bosnian

Model 2 assessed the pronunciation of the Bosnian palatal lateral as produced by the two speaker groups (BoV vs. BoS). Results are reported in Table 7 (see also Figure 2). They showed significant main effects for Speaker Group and Gender. The effect of Speaker Group showed that BoV speakers produced their palatal laterals with a larger F2-F1 difference, thus more palatal than BoS speakers. The effect of Gender showed that female speakers generally produced palatal laterals with larger F2-F1 distances than male speakers. The effect of Task just failed to reach significance ($p=.08$). None of the interactions was significant.

Table 7. Relevant fixed effects returned by Model 2, a mixed-effects model fit to Bosnian /ɬ/ produced by BoV and BoS speakers with F2-F1 distance in Bark as the dependent variable, lateral position, vowel context, Speaker Group (BoV vs BoS), Gender (male vs female), and Task (read vs spontaneous), and all interactions as fixed factors, and Participant and Word as random effects.

Model 2: /ɬ/	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group	0.473	0.219	18.435	2.164	.044*
Gender	0.622	0.219	18.679	2.835	.011*
Task	0.375	0.208	59.773	1.798	0.077.
Group:Gender	-0.49	0.436	18.224	-1.123	0.276
Group:Task	-0.234	0.23	87.103	-1.019	0.311
Gender:Task	0.338	0.232	89.356	1.457	0.149
Group:Gender:Task	0.56	0.454	83.374	1.322	0.19

2.2.4 Results for Model 3: /t/ vs. /ɬ/ in L1 Bosnian

In Model 3, it was assessed whether BoS and BoV speakers would differentiate the two Bosnian lateral phonemes /t/ and /ɬ/ to the same degree. Here the main interest was about the main effect of Lateral Type and interactions of Speaker Group and Gender with this factor. The full results of the model are reported in Table 8. Results showed that Lateral Type was involved in a significant 3-way-interaction with Speaker Group and Gender, as well as in a significant 2-way interaction with Gender. Main effects were found for Lateral Type, Speaker Group, Gender and marginally also for Task (see also Figure 2).

In models on subsets of the data split by Gender (male speakers, female speakers) the interaction of Lateral Type and Speaker Group was still significant for both male and female speakers (male speakers: $b= 0.65$, $SE= 0.11$, $df= 1038.07$, $t= 5.89$, $p< 0.0001$, female speakers: $b= -0.8$, $SE= 0.14$, $df= 975.57$, $t= -5.71$, $p< 0.0001$, see also Figure 2). Further subsets by Speaker Group (BoV speakers vs. BoS speakers) showed that the difference of the F2-F1 values between the two phonemes remained significant in all Speaker Groups (male BoV speakers: $b= 3.65$, $SE= 0.16$, $df= 122.01$, $t= 22.78$, $p< 0.0001$,

male BoS speakers: $b = 2.9$, $SE = 0.16$, $df = 81.27$, $t = 18.67$, $p < 0.0001$, female BoV speakers: $b = 3.71$, $SE = 0.17$, $df = 99.94$, $t = 22.24$, $p < 0.0001$, female BoS speakers: $b = 4.4$, $SE = 0.18$, $df = 81.22$, $t = 24.51$, $p < 0.0001$).

Table 8. Relevant fixed effects returned by Model 3, a mixed-effects model fit to Bosnian /t/ vs. /ʎ/ produced by BoV and BoS speakers with F2-F1 distance in Bark as the dependent variable, lateral position, vowel context, Lateral Type (/l/ vs /ʎ/), Speaker Group (BoV vs BoS), Gender (male vs female), and Task (read vs spontaneous), and all interactions as fixed factors, and Participant and Word as random effects.

Model 3: /t/ vs. /ʎ/	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Lateral Type	3.362	0.127	311.627	26.389	<.0001***
Speaker Group	0.391	0.154	28.176	2.544	.017*
Gender	0.341	0.153	28.142	2.219	0.035*
Task	0.28	0.16	164.287	1.757	0.081.
Lateral Type:Speaker Group	0.08	0.153	1916.689	0.52	0.603
Lateral Type: Gender	0.614	0.152	1943.056	4.031	<.0001***
Speaker Group:Gender	0.278	0.306	27.717	0.908	0.372
Lateral Type:Task	0.034	0.252	331.388	0.136	0.892
Speaker Group:Task	-0.01	0.177	50.144	-0.058	0.954
Gender:Task	0.288	0.177	50.308	1.627	0.11
Lateral Type:Speaker Group:Gender	-1.512	0.301	2094.587	-5.026	<.0001***
Lateral Type:Speaker Group:Task	-0.375	0.306	1910.867	-1.224	0.221
Lateral Type:Gender:Task	0.059	0.304	1945.627	0.194	0.846
Speaker Group:Gender:Task	0.491	0.35	48.316	1.402	0.167
Lateral Type:Speaker Group:Gender:Task	0.099	0.602	2093.033	0.165	0.869

As can be seen in Figure 2, the mean values of the two lateral phonemes were clearly separated and the variance around the mean, as indicated by the standard error, did not overlap. It is also shown that the differences of F2-F1 values between the two phonemes tended to be larger in the speech of male BoV speakers compared to male BoS speakers, but smaller in the speech of female BoV speakers compared to female BoS speakers, as suggested by the interactions in the mixed-models reported above.

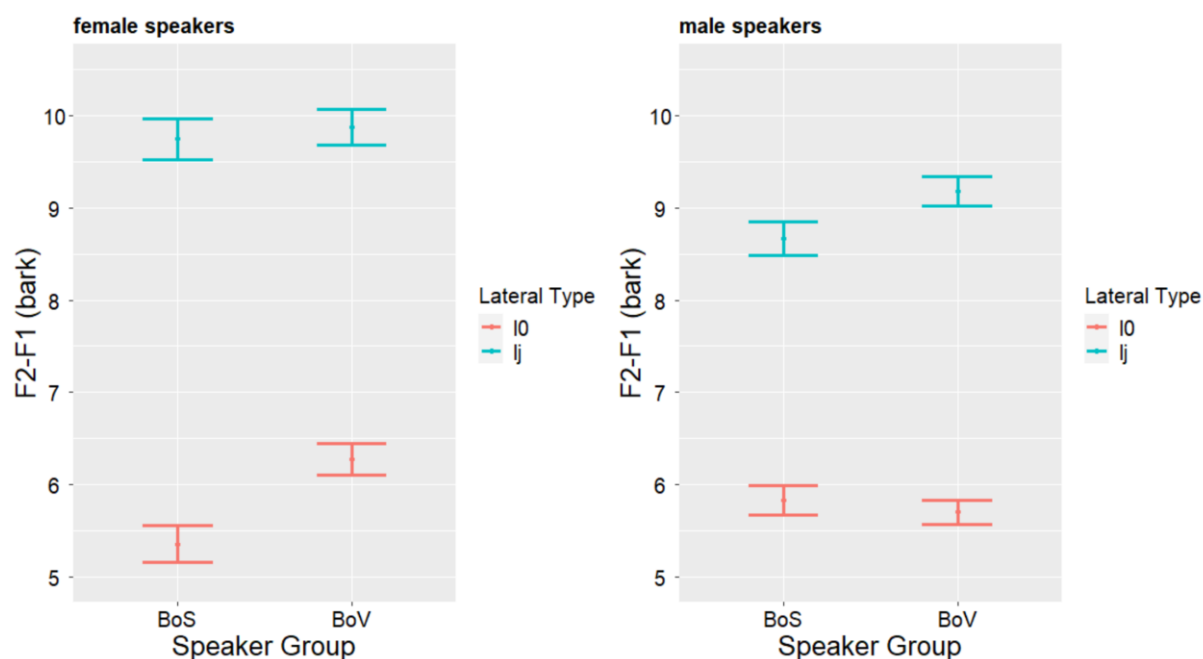


Figure 2. Means (+/- 1 se) of F2-F1 (in bark) distance of laterals in L1 Bosnian (y-axis) as a function of Speaker Group (BoV vs BoS, x-axis) and Lateral Type (/t/ [<l>, red bars] and /ɭ/ [<lj>, blue bars]), plotted for female (left panel) and for male speakers (right panel) separately, estimated from the linear mixed effects model (Model 2).

Additional analysis 1

Following up on Model 3, further analyses on the F2-F1 distributions within each L1 Bosnian lateral category (/t/, /ɭ/) were carried out. Figure 3 shows the overall distribution of F2-F1 values in the two Bosnian lateral phoneme categories. That is, the degrees of differentiation between the two Bosnian lateral phonemes /t/ and /ɭ/ by female (upper panels) and male (lower panels) speakers in each of the two Speaker groups were assessed by means of density pots. The distributions of F2-F1 values of laterals generally showed two separate peaks within each Speaker Group (BoV, BoS), one for each lateral category. However, when plotting laterals merged over all words including all phoneme contexts and all positions within the word, the two distributions always showed some overlap (see left panel in Figure 3). In male speech, this overlap was similar for BoV and BoS speakers, in female speech, the overlap was generally larger than in male speech, indicating that the two lateral phonemes were less well separated. Additionally, the velarized lateral /t/ in female BoV speech (red dotted line) was geared towards the palatal lateral (red continuous line). This was indicated by the lowest F2-F1 values in /t/ being higher in female BoV than in female BoS speech. In contrast, in the productions of male BoV speakers, both lateral categories were geared towards the more extreme sides. That is, the

category of velarized /t/ showed lower F2-F1 values, and the category of palatal /ɕ/ showed higher F2-F1 values as compared to the categories of BoS speakers.

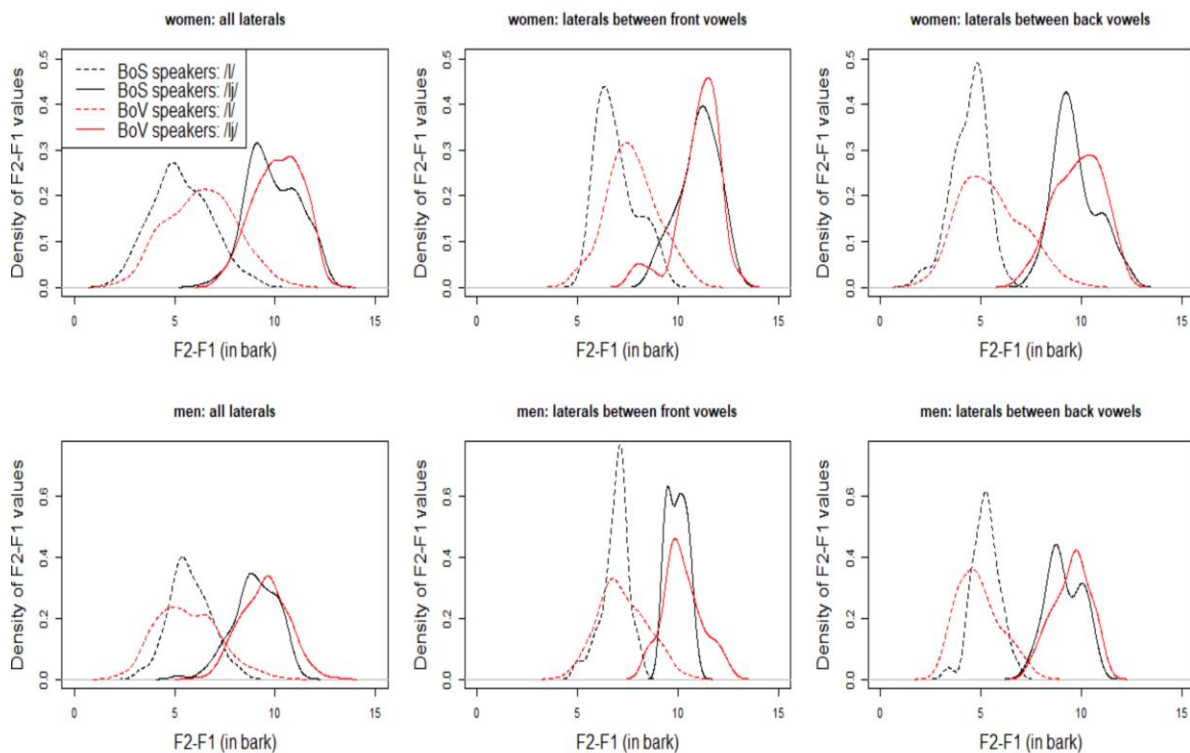


Figure 3. Density distributions of F2-F1 (in bark) of laterals in L1 Bosnian as a function of Speaker Group (BoV [red lines] vs BoS [black lines]) and Lateral Type (/t/[dotted line] and /ɕ/ [<lj>, solid line]), plotted for female speakers (upper panels) and for male speakers (lower panels) separately. Density distributions are shown for all laterals (left panel), for laterals between two front vowels (middle panel), and for laterals between two back vowels (right panel) .

The presence of a general overlap of F2-F1 values between the two Bosnian lateral categories might to a large extent be due to the vowel context, which, in the literature, was previously shown to have the strongest influence on the formant structure of laterals (see chapter 1.4). Therefore, additional plots with distributions of F2-F1 values of laterals for the contexts in which the least variation was expected are shown in Figure 3. In the middle panel of Figure 3 the distributions of F2-F1 values for the two lateral phonemes in front vowel context (laterals with preceding and following front vowels) are shown, and in the right panel of Figure 3 the distributions of laterals in back vowel context (laterals with preceding and following back vowels) are shown. In these two vowel contexts, little further contextually-triggered variation was expected. Figure 3 shows that BoS speakers always clearly separated the two lateral categories in these two vowel contexts (as indicated by two separate peaks and no overlaps of the density distributions of the F2-F1 values of the two phonemes /t/ and /ɕ/), even though female BoS speakers showed somewhat less separation in front vowel contexts. All BoV speakers (female and male) showed more overlap between the two categories than BoS speakers, and this larger overlap was even more pronounced in the speech of female than in the speech of male BoV

speakers. In the productions of female BoV speakers, the overlap was due to a shift of velarized /ɫ/ in the direction of higher F2-F1 values, especially in the back vowel context, and a larger variation of these values. In the productions of male BoV speakers, the overlap was due to a generally larger variation of F2-F1 values, which was accompanied by a shift of velarized /ɫ/ in the direction of lower F2-F1 values in back vowel context.

2.2.5 Results for Model 4: /l/ in L1 German and L2 German

In Model 4 the productions of the German /l/ as produced by the bilingual speakers and the two monolingual German speaker groups (SAG and VD) were analyzed. The interaction of Speaker Group and Position, as returned by the full Model 4, is discussed first. The main interest of this model was to reveal potential differences between the BoV and each of the L1 German groups, instead of analyzing the differences between SAG and VD speakers. Therefore, the full model was further split into two submodels (otherwise equal to the previous model). The first submodel analyzed the difference between BoV and SAG speakers, the second analyzed the difference between BoV and VD speakers. Results of the submodels regarding the effect of the factors Speaker Group, Gender, and Task are presented after the discussion of the interaction of Speaker Group and Position.

The interaction of Speaker Group and Position was analyzed directly from the full model. This is because previous studies showed that laterals in word-initial position are relatively more velarized in the VD as compared to SAG, assigning the status of a dialect marker to the velarized lateral in word initial position (see Chapter 1.4.1). Table 9 shows that the interaction of Speaker Group and Position was significant. However, since the factor Position had three levels (word initial, word medial, word final), further post hoc tests had to be performed in order to account for all contrasts of interest.

Table 9. Relevant fixed effects returned by the full Model 4 (interaction of Speaker Group and Position, further effects are listed in table 10 and 11), a mixed-effects model fit to German /l/ produced by BoV, SAG and VD speakers with F2-F1 distance in Bark as the dependent variable, vowel context, Gender, Task, Speaker Group (BoV vs SAG vs VD), Position (initial, medial, final), and the interaction between Speaker Group and Position as fixed factors, and Participant and Word as random effects. The intercept is productions in word initial position by BoV speakers.

Model 4 Speaker Group* Position	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
word medial (SAG)	0.043	0.078	6635	0.548	.584
word final (SAG)	-0.008	0.095	6462	-0.08	.936
word medial (VD)	0.193	0.081	6630	2.379	.017*
word final (VD)	0.324	0.104	6408	3.093	.002**

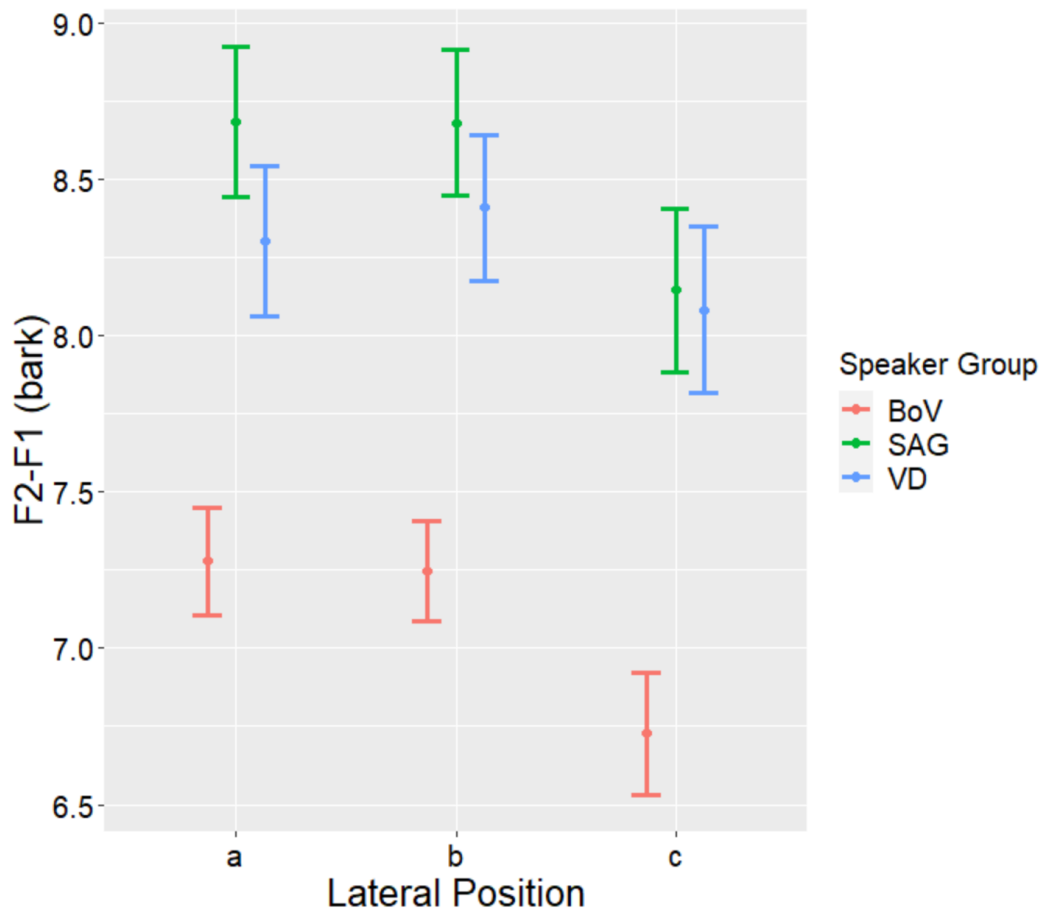


Figure 4. Means (+/- 1 se) of F2-F1 (in bark) distance of German laterals (y-axis) as a function of Speaker Group (BoV [red bars] vs SAG [green bars] vs VD [blue bars], x-axis) and Lateral Position within the word (a = word initially, b = word medially, c = word finally), estimated from the linear mixed effects model (from the full Model 4).

Results of the post hoc tests for the interaction of Speaker Group and Position are shown in Figure 4 and Table 10. The contrast between German laterals produced by BoV speakers and laterals produced by respectively VD or SAG speakers was always significant, for all lateral positions within the word (word initial, word medial, word final), except for laterals in initial word position as produced by BoV and VD speakers, where the contrast just failed to reach significance. However, none of the contrasts between laterals at the different word positions in VD and SAG was significantly different, neither within nor between Speaker Groups²⁰. Furthermore, Figure 4 revealed a general tendency (for all Speaker Groups) for word final laterals to have lower F2-F1 values than laterals in other word positions, however, this observation was not significant.

²⁰ There is a tendency for initial and medial laterals of VD speakers (but not for final laterals) to have lower F2-F1 values than laterals in these positions produced by SAG speakers. This result confirms that the groups of VD and SAG speakers are homogeneous enough to serve as an L1 German reference group for the bilingual BoV speakers. However, within the framework of the present study, a more detailed comparison between SAG and VD speakers cannot further be performed, because this would exceed the topic of this dissertation.

Statistical results for the factors Speaker Group, Gender, and Task of the full Model 4 are plotted in Figure 5. However, in order to statistically analyze these factors, the model was further split in two submodels, as explained above. Results for the first submodel (for BoV speakers compared to SAG speakers) are shown in Table 11. Results for the second submodel (for BoV and VD speakers) are shown in table 12. Results for both submodels showed significant main effects for Speaker Group (even though the difference between BoV speakers and SAG speakers is more significant than the difference between BoV speakers and VD speakers), for Gender, and Task. None of the two-way or three-way interactions of these main factors of interest was significant in neither of the two submodels. Laterals were generally produced by BoV speakers with lower F2-F1 values than by SAG and VD speakers. In female speech, overall, laterals were produced with higher F2-F1 values than in male speech. Laterals in read speech showed significantly higher F2-F1 values than laterals in spontaneous speech.

Table 10. Post-hoc contrasts (p-values are reported Bonferroni-corrected) for F2-F1 (in Bark) of German lateral productions measured for the factors Speaker Group (BoV, VD, SAG) and Position (word initial: a, word medial: b, word final: c), as estimated from the accordingly linear mixed model (full Model 4).

posthoc contrasts (Speaker group* Position)	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
BoVa – SAGa	-1.435	0.265	21.3	-5.423	.001
BoVb – SAGb	-1.478	0.264	21	-5.604	.001
BoVc – SAGc	-1.427	0.269	22.8	-5.304	.002
BoVa – VDa	-1.04	0.265	21.4	-3.923	.05
BoVb – VDb	-1.232	0.264	21.2	-4.663	.009
BoVc – VDC	-1.363	0.273	24	-4.995	.003
BoVa – BoVc	0.339	0.124	843.2	2.735	.421
BoVb – BoVc	0.255	0.113	808.8	2.253	1
BoVa – BoVb	0.083	0.082	968.2	1.02	1
SAGa - SAGb	0.041	0.097	1708.7	0.42	1
SAGb - SAGc	0.305	0.126	1208.7	2.415	1
SAGa - SAGc	0.346	0.136	1222.7	2.536	.748
VDa – VDb	-0.109	0.098	1834.3	-1.115	1
VDb – VDC	0.125	0.138	1628.3	0.907	1
VDa – VDC	0.016	0.146	1543.3	0.107	1
SAGa - VDa	0.394	0.313	21.3	1.26	1
SAGb – VDb	0.245	0.313	21.1	0.784	1
SAGc - VDC	0.065	0.322	23.7	0.201	1

Figure 5 (illustrating the main model 4) indicated asymmetries concerning differences between female SAG and VD speakers and Gender differences within BoV speakers, although none of the interactions

in the previous superordinate models was significant. Thus, additional submodels were built. These models were first respectively split by Gender and these models (split by Gender) then also by Task. Then, an additional submodel was build, in which only the subgroup of BoV speakers was analyzed (without SAG and VD speakers).

Results for the further submodels (split by gender) are also shown in Table 11 below (BoV vs SAG speakers) and Table 12 below (BoV vs VD speakers). Results for the submodel investigating BoV and SAG speakers (by gender) showed that both female and male BoV speakers differed significantly from SAG speakers, insofar as BoV speakers produced laterals with lower F2-F1 values. In female speech, the factor Task was significant and in male speech not, even though Figure 5 showed that also in the speech of male speakers, laterals in read speech tend to be higher than lateral in spontaneous speech. Further statistical analyses on subsets of Task showed that for male speakers, laterals differed significantly with regard to Speaker Group independently of Task (spontaneous speech: $b = 1.33$, $SE = 0.39$, $df = 9.19$, $t = 3.44$, $p = 0.007$, read speech: $b = 1.34$, $SE = 0.38$, $df = 8.9$, $t = 3.55$, $p = 0.006$), whereas in female speech, the significant difference between laterals of BoV speakers and laterals of SAG speakers was more pronounced in spontaneous speech compared to read speech (spontaneous speech: $b = 1.65$, $SE = 0.3$, $df = 9.9$, $t = 5.59$, $p = .0002$, read speech: $b = 1.43$, $SE = 0.55$, $df = 8.72$, $t = 2.61$, $p = 0.03$). Compared to VD speakers (see Table 11), female BoV speakers did not produce significantly different laterals, whereas male BoV speakers differed significantly from male VD speakers, insofar as male BoV speakers produced laterals with lower F2-F1 values than male VD speakers. In female speech as well as in male speech, this held for both speaking tasks (female speakers, spontaneous speech: $b = 0.27$, $SE = 0.52$, $df = 8.72$, $t = 0.53$, $p = 0.6$, female speakers, read speech: $b = 1$, $SE = 0.52$, $df = 8.73$, $t = 1.91$, $p = .09$, male speakers, spontaneous speech: $b = 1.23$, $SE = 0.4$, $df = 9.45$, $t = 3.1$, $p = 0.01$, male speakers, read speech: $b = 1.54$, $SE = 0.39$, $df = 8.94$, $t = 3.9$, $p = 0.004$). With reference to Figure 5, it can be assumed that the difference between the read speech of female BoV speakers and the spontaneous speech of female SAG speakers was not significant neither, because laterals in spontaneous speech of female SAG speakers were situated in the same F2-F1 area as laterals in read speech of female VD speakers, and the latter laterals did not differ significantly from laterals in the speech of female BoV speakers. The submodel only dealing with the subgroup of BoV speakers showed that the difference between female and male speakers was indeed significant ($b = 1$, $SE = 0.3$, $df = 12.04$, $t = 3.28$, $p = 0.007$), as well as the factor Task ($b = 0.57$, $SE = 0.15$, $df = 16.02$, $t = 3.75$, $p = 0.002$). The interaction of these two factors was not significant ($b = 0.23$, $SE = 0.28$, $df = 12.19$, $t = 0.82$, $p = 0.43$).

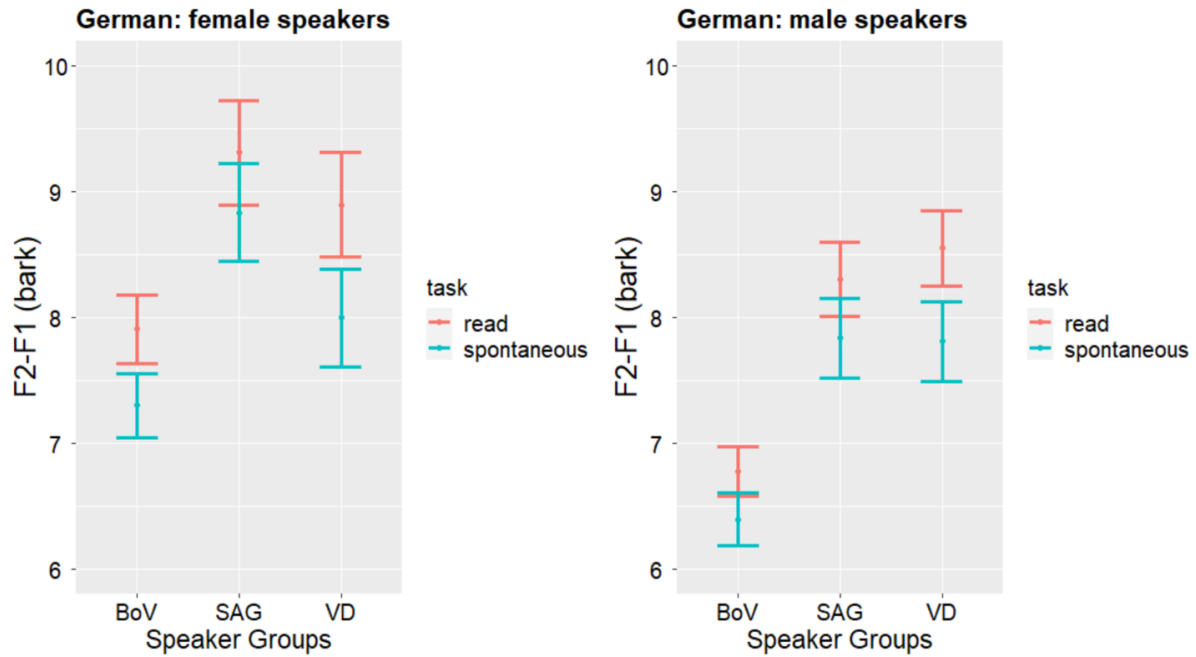


Figure 5. Means ($\pm$ 1 se) of F2–F1 (in bark) distance of German laterals (y-axis) as a function of Speaker Group (BoV vs SAG vs VD, x-axis) and Task (read [red bars] vs spontaneous [blue bars]), plotted for female (left panel) and for male (right panel) speakers separately, estimated from the linear mixed effects model (full Model 4).

Table 11. Above: Relevant fixed effects returned by a subset of Model 4, a mixed-effects model fit to German /l/ produced by BoV and SAG speakers (without VD speakers) with F2-F1 distance in Bark as the dependent variable, vowel context, Lateral Position, Gender (f vs m), Task (read vs. spontaneous), Speaker Group (BoV vs SAG), and all interactions as fixed factors, and Participant and Word as random effects. Below (grey shaped): The same model, but for the subsets of female speakers and male speakers, respectively.

BoV vs SAG	<i>b</i>	SE	df	<i>t</i>	<i>p</i>					
Speaker Group	1.44	0.26	17.23	5.58	<.0001***					
Gender	0.99	0.28	16.1	3.8	.003**					
Task	0.52	0.15	20.45	3.48	.002**					
Speaker Group: Gender	-0.02	0.51	16.1	-0.04	.97					
Gender: Task	0.25	0.28	16.11	0.9	.383					
Speaker Group: Task	-0.04	0.26	16.54	-0.14	.89					
Speaker Group: Gender: Task	-0.3	0.52	16.31	-0.58	.568					
BoV vs SAG (by Gender)	Female speakers					Male speakers				
	<i>b</i>	SE	df	<i>t</i>	<i>p</i>	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group	1.54	0.4	8.58	3.89	.004**	1.35	0.32	8.68	4.14	.003**
Task	0.65	0.21	9.37	3.05	.01*	0.41	0.22	9.39	1.9	.089
Speaker Group:Task	-0.13	0.38	8.29	-0.34	.74	0.07	0.39	8.22	0.19	.853

Table 12. Above: Relevant fixed effects returned by a subset of Model 4, a mixed-effects model fit to German /l/ produced by BoV and VD speakers (without SAG speakers) with F2-F1 distance in Bark as the dependent variable, vowel context, Lateral Position, Gender (f vs m), Task (read vs. spontaneous), Speaker Group (BoV vs VD), and all interactions as fixed factors, and Participant and Word as random effects. Below (grey shaped): The same model, but for the subsets of female speakers and male speakers, respectively.

BoV vs VD	<i>b</i>	SE	df			<i>t</i>	<i>p</i>			
Speaker Group	1.05	0.29	17.1			3.68	.0019**			
Gender	1	0.31	16			3.25	.005**			
Task	0.49	0.17	19.17			2.9	.009**			
Speaker Group: Gender	-0.73	0.56	16.1			-1.3	.21			
Gender: Task	0.24	0.33	15.88			0.74	.47			
Speaker Group: Task	0.3	0.3	16.55			1	.33			
Speaker Group: Gender: Task	-0.15	0.6	16.25			-0.24	.81			
BoV vs VD (by Gender)	Female speakers					Male speakers				
	<i>b</i>	SE	df	<i>t</i>	<i>p</i>	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group	0.7	0.45	8.46	1.55	.158	1.39	0.35	8.71	4	.003**
Task	0.62	0.28	8.7	2.18	.058	0.45	0.19	9.69	2.34	.042*
Speaker Group:Task	0.27	0.51	8.14	0.54	.6	0.33	0.34	8.53	0.95	.37

In sum, the results for Model 4 and its submodels on the pronunciation of the German lateral /l/ by bilingual L2 German speakers and by monolingual L1 German speakers (VD, SAG) show that laterals were generally produced with significantly lower F2-F1 values in the bilingual speaker group (that is, more velarized) than in the monolingual speaker groups. Moreover, across all speaker groups (BoV, SAG, VD), laterals in read speech had higher F2-F1 values than laterals in spontaneous speech, as well as laterals produced by female speakers as compared to male speakers. The difference in the production of laterals between BoV speakers and SAG speakers and between BoV speakers and VD speakers held for all lateral positions within the word. Only for laterals in initial word position as produced by BoV and VD speakers the contrast between BoV and VD speakers just failed to reach significance.

Further submodels allowed to investigate these main effects more in detail (as suggested by asymmetries in the plotted effects of Model 4, see Figure 5). Whilst there was a general effect of Speaker Group insofar as BoV speakers had lower F2-F1 values in their L2 German laterals as compared to the productions of L1 German speakers (both SAG and VD speakers), results of the submodels showed that laterals produced by female BoV speakers did not differ significantly from laterals produced by female VD speakers, but differed significantly from laterals produced by female SAG speakers. However, the plotted results also suggested that laterals in read speech produced by female BoV speakers were not significantly different from laterals of female SAG speakers that were produced in spontaneous speech neither. In the same way it can be noted that lateral productions in the speech

of female BoV speakers were neither different from laterals produced by male VD and male SAG speakers. Thus, female BoV speakers generally produced L2 German laterals that did not differ significantly from lateral productions of most monolingual German speakers. Male BoV speakers, in contrast, produced their L2 German laterals generally significantly different (with lower F2-F1 values) from all L1 German speaker groups.

2.2.6 Results for Model 5: /t/ in L1 Bosnian and /l/ L2 German

Model 5 was concerned with the productions of /l/ by the BoV speakers only. It assessed the production of the phoneme /t/ in their L1 Bosnian as compared to the phoneme /l/ in their L2 German. This was to investigate the bidirectional cross language influence of the lateral phonemes in L1 Bosnian and L2 German, and specifically to investigate whether BoV speakers produced distinct lateral categories in their L1 Bosnian as compared to their L2 German or whether they merged the lateral categories of the two languages. The presence of two lateral categories would be indicated by a significant effect of the factor Language on the F2-F1 values of the laterals, whereas a merging of the two lateral categories would be indicated by a non-significant result for the factor Language (see above, chapter 2.2.1). Results are reported in Table 13. A significant three-way interaction between Language, Gender, and Task, and two two-way interactions between Language and Task and between Gender and Language was found. The main effects of Gender, Language and Task were all significant. Only the interaction between Gender and Task was not significant.

To further assess the nature of the interactions, the model was split by Gender (see Table 14). The models for the subsets of female and male speakers were identical to the one described above, including the covariates, but except for the fixed factor Gender, which was now used to form subsets of the data. Results for the model of female speakers showed that the two-way interaction of Language and Task was not significant, but significant main effects were obtained for both Task and Language, respectively (see also Figure 6). That is, female speakers overall produced laterals with higher F2-F1 values in read speech compared to spontaneous speech, and also when they occur in L2 German as compared to L1 Bosnian. However, as suggested by the estimates, the effect of Language was considerably stronger ($b = -1.131$, see Table 13) than the effect of Task ($b = 0.575$).

Results for the model of male speakers showed a significant interaction between Language and Task. A significant main effect was found for Language, but not for Task. This is illustrated in Figure 6, which showed that laterals of male BoV speakers had generally lower F2-F1 values (i.e., were more velarized) in L1 Bosnian than in German, and even more so in read speech.

A further splitting of the sub-model of male speakers by Task (otherwise identical to the previous model, except for the fixed factor Task, which now served to form further subsets of the data), allowed to describe the effect of Language more in detail. Language turned out to be a significant factor in both tasks, however, as suggested by the interaction and confirmed by the estimates here, the effect was larger in the read speech task (Language: $b = -0.83$, $SE = 0.201$, $df = 87.62$, $t = -4.136$, $p < 0.000$) than in the spontaneous task (Language: $b = -0.347$, $SE = 0.127$, $df = 332.229$, $t = -2.733$, $p = 0.007$). That is, laterals of male BoV speakers had higher F2-F1 values (and thus were less velarized) in German read speech compared to spontaneous speech and compared to Bosnian speech. All in all, these results for the submodels suggested that male BoV speakers indeed significantly distinguished between the laterals in their L1 and L2, insofar as laterals in L2 German had significantly higher F2-F1 values than laterals in L1 Bosnian. Moreover, the factor Language had a stronger influence on the production of laterals than the factor Task, because this latter factor did not influence male speakers and the two languages to the same extent (recall that in the previous models on /t/ in L1 Bosnian, Model 1, and /l/ in L2 German, Model 4, Task was found to be a significant factor for male speakers in L2 German, but not in L1 Bosnian).

It can thus be concluded that the factor Language had the most important effect on the F2-F1 values of laterals produced by BoV speakers, both by female and by male speakers, with laterals showing higher F2-F1 values in German (being less velarized) than in Bosnian.

Table 13. Relevant fixed effects returned by the full Model 5, a mixed-effects model fit to productions of BoV speakers for their L1 Bosnian /t/ and L2 German /l/, with F2-F1 distance in Bark as the dependent variable, lateral position, vowel context, Gender (male vs female), Language (L1 Bosnian vs L2 German), and Task (read vs spontaneous) and all interactions as fixed factors, and Participant and Word as random effects.

Model 5: /t/ in L1 Bosnian vs. /l/ in L2 German	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Gender	0.753	0.28	12.243	2.686	.02*
Language	-0.835	0.093	372.096	-8.994	<.0001***
Task	0.385	0.152	23.808	2.525	.019*
Gender:Language	-0.494	0.089	4836.3	-5.578	<.0001***
Gender:Task	0.41	0.262	13.158	1.562	.142
Language:Task	-0.388	0.183	422.875	-2.123	.034*
Gender:Language:Task	0.375	0.177	4837.148	2.12	.034*

Table 14: Relevant fixed effects returned by two subset of **Model 5**, one for **female speakers** only and one for **male speakers** only. These reduced mixed-effects models (compared to the full Model 5) were fit to productions of BoV speakers in their L1 Bosnian /t/ and L2 German /l/, with F2-F1 distance in Bark as the dependent variable, lateral position, vowel context, Language (L1 Bosnian vs L2 German), and Task (read vs spontaneous) and the interaction of Language and Task as fixed factors, and Participant and Word as random effects.

Female speakers	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Language	-1.131	0.109	332.42	-10.33	<.0001***
Task	0.575	0.223	8.661	2.58	0.031*
Language:Task	-0.217	0.219	367.236	-0.992	0.322
Male speakers					
Language	-0.531	0.106	270.978	-5.001	<.0001***
Task	0.259	0.201	9.535	1.29	.227
Language:Task	-0.494	0.21	312.015	-2.352	.019*

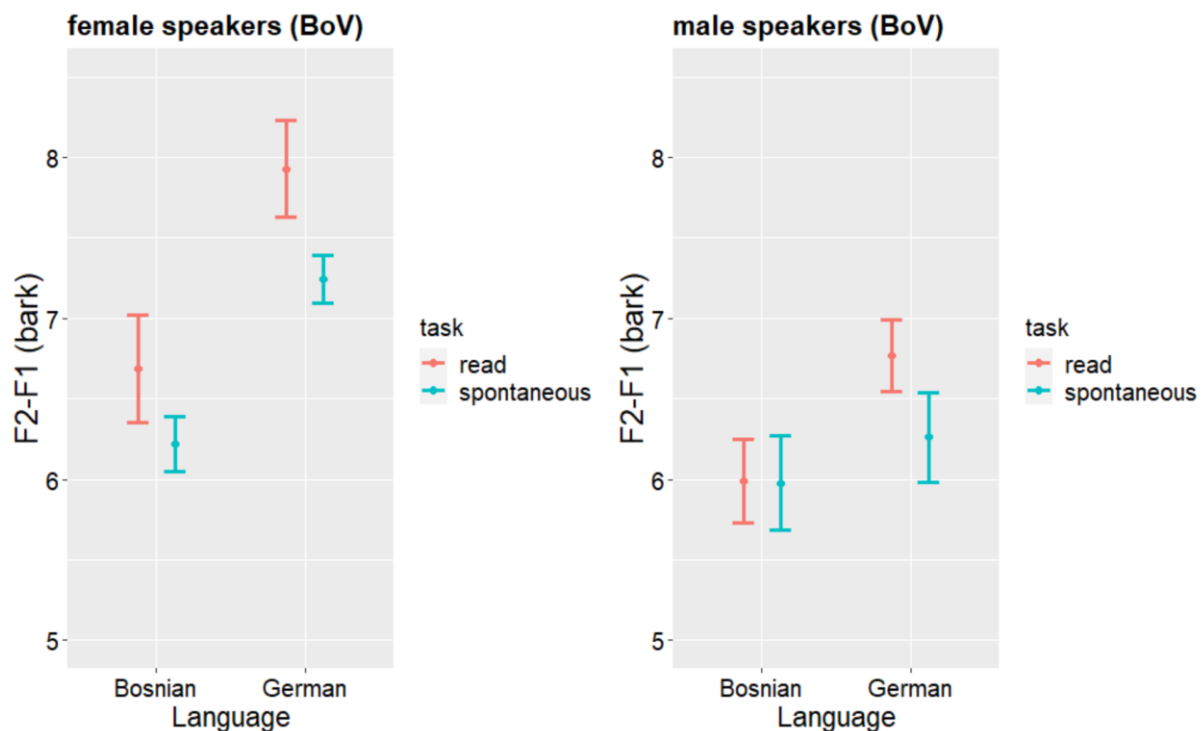


Figure 6. Means (+/- 1 se) of F2-F1 (in bark) distance of /l/ (y-axis) produced by BoV speakers as a function of Language (L1 Bosnian vs L2 German, x-axis) and Task (read [red bars] vs spontaneous [blue bars]), plotted for female (left panel) and for male (right panel) speakers separately, estimated from the linear mixed effects model (full Model 5).

In sum, the results for Model 5 and its model-subsets on the pronunciation of the similar lateral phonemes in L1 Bosnian and in L2 German by BoV speakers showed that laterals generally differed depending on Language, insofar as the F2-F1 values are higher (that is less velarized) in L2 German than in L1 Bosnian. Only in the spontaneous speech of male speakers, the Language difference was small (but still significant). For male speakers, the significant Language difference was mainly due to the high F2-F1 values of laterals in L2 German read speech. Women showed a significant influence of Language more generally over all speaking tasks. Moreover, female speakers overall showed significantly higher F2-F1 values in their laterals compared to male speakers, which was mainly due to gender differences in lateral productions in L2 German (as also reported in Model 4 concerning Gender effects in L2 German lateral productions).

Additional analysis 2

Following up on Model 5, a correlation analysis was performed to investigate whether there would be a relation between the productions of laterals in L1 Bosnian and the production of laterals in L2 German as produced by BoV speakers, at the level of the individual speaker. This additional analysis showed indeed a significant correlation between laterals in the two languages. The more the laterals were produced with high F2-F1 values in L1 Bosnian, the higher the F2-F1 values of the laterals were also in L2 German (corr= 0.661, $t= 3.048$, $df= 12$, $p= 0.01$, see also Figure 7). This suggests that the use of the second language German indeed had an influence on the lateral productions of bilingual speakers, due to cross language mapping between L1 and L2 productions.

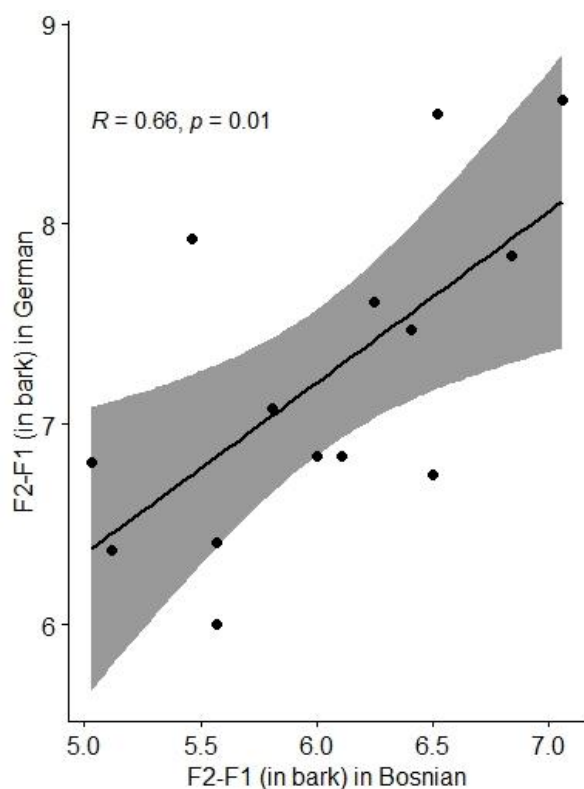


Figure 7. Correlation between mean F2-F1 (bark) values in Bosnian /l/(x-axis) and in German /l/(y-axis) produced by individual BoV speakers. Linear regression line (black line) and 95% confidence interval (grey shaped).

2.2.7 Summary and Discussion of group differences in production

The first part of Experiment 1 statistically assessed the production of the Bosnian lateral phonemes /t/ and /ɬ/, and the German lateral phoneme /l/ by the group of bilingual speakers who had emigrated from Bosnia to Vienna as adults and had been living in their L2 environment for at least 15 years. The L1 Bosnian productions of the bilinguals were compared to the productions of monolingual speakers of Bosnian and the L2 German productions of the bilinguals were compared to the productions of monolingual speakers of German. The native speaker reference groups had spent all their lives in their L1 environment (for the native speakers of Bosnian this was the region of today's Bosnia and for the native speakers of German this was Austria, predominantly Vienna). L1 Bosnian /t/ productions of the bilingual speakers were also compared to their own productions of /l/ in their L2 German. This was to assess different angles of possible phonetic cross-language mappings in late bilingual speakers, specifically assimilation processes in the restructuring of the L1-L2 phonetic-phonological system.

For lateral productions in L1 Bosnian it was hypothesized that bilingual speakers might produce the Bosnian velarized lateral phoneme /t/ with a lesser degree of velarization than the monolingual Bosnian speakers (i.e., larger F2-F1 difference), hence closer to the L2 German lateral. This was hypothesized because the Bosnian velarized /t/ was supposed to be more similar to the Austrian German lateral phoneme /l/ than the Bosnian palatal lateral /ɬ/. The Bosnian palatal lateral, however,

was not expected to be modified due to the contact with German, as it was supposed to be different enough from the German lateral phoneme to trigger an equivalence classification. An additional indication of restructuring of the L1 phonetic-phonological system was hypothesized to surface as a smaller produced difference between the two Bosnian laterals by the bilingual (BoV) speaker group than by the monolingual (BoS) group. This would have been manifested presumably through an approach of the velarized lateral in the direction of the palatal lateral (that is, higher F2-F1 values of the velarized lateral), triggered by the aforementioned influence of the L2 German plain alveolar lateral on the L1 Bosnian velarized lateral. For the production of laterals in L2 German it was hypothesized that bilingual speakers might produce the German alveolar lateral with a higher degree of velarization than L1 German speakers (i.e., with a smaller F2-F1 difference), hence closer to the similar L1 Bosnian velarized lateral, as the two similar lateral phonemes in L1 Bosnian and L2 German are presumably mapped onto each other in the phonological systems of the languages.

Based on the statistical models comparing L1 Bosnian Speaker Groups, results showed the following pattern of results: First, that female bilingual speakers indeed produced the L1 Bosnian velarized lateral phoneme significantly different, that is, less velarized, compared to the group of female monolingual L1 Bosnian speakers living in Sarajevo, thus showing an assimilation process. The /t/ productions of the female bilingual speakers also differed from the male bilingual speakers, insofar as the productions of female speakers were less velarized. These differences between female BoV speakers and BoS speakers as well as between female BoV speakers and male BoV speakers were most obvious in read speech, although a tendency for a difference between female BoV speakers and female BoS speakers was also observed in spontaneous speech. In contrast to the female BoV speakers, male bilingual L1 Bosnian speakers living in Vienna did not differ from monolingual speakers living in Sarajevo.

Second, concerning the production of palatal laterals, significant group effects were found, in this case contrary to the initial hypothesis. Bilingual speakers generally produced palatal laterals with larger F2-F1 differences than monolingual BoS speakers, thus showing a dissimilation effect. Furthermore, it was found that female speakers in both L1 Bosnian groups (BoV and BoS) produced palatal laterals with larger F2-F1 differences than male speakers. This difference might be related to differences in vocal tract length. Even though in the present study formant frequencies were normalized by using the bark scale and by analyzing the difference between F2 and F1, differences in vocal tract length might possibly still become apparent in sounds with higher F2 frequencies, even though they might not occur

in sounds which are back vowel-like with lower F2 frequencies (as the velarized laterals)²¹. This would explain why gender specific differences are found in palatal laterals but not in velarized/alveolar laterals (note that for Bosnian /ɬ/, no gender difference within the monolingual BoS group was found).

Third, the L1 Bosnian lateral phoneme contrast between /ɬ/ and /ʎ/ was found to be maintained by BoV speakers, as indicated by a significant effect of Lateral Type. The additional analyses of the kernel density distributions showed that despite the maintenance of the two peaks the two lateral categories slightly overlapped in all speaker groups. This overlap, however, was more pronounced in the speech of BoV speakers as compared to BoS speakers and within the group of BoV speakers even more in the productions of female compared to male speakers. This is in accordance with the initial hypothesis. According to this hypothesis the production of one of the two L1 lateral phonemes, that is, the palatal lateral which has no counterpart in L2 German, would remain stable, and would continue to build a phonemic contrast with the other L1 lateral category, now surfacing as a composite category for L1 Bosnian /ɬ/ and L2 German /l/. The phoneme contrast was supposed to be maintained because of the different orthographic representations for the two L1 lateral phonemes, which is assumed to cause a higher awareness about the difference between the two phonemes and therefore to inhibit a more important reduction of this contrast.²² Within the scope of the maintained contrast, however, gender specific differences within the BoV group were observed: even though women as well as men showed dissimilation effects, insofar as they produced the palatal lateral more palatal than the speakers of the BoS group (with reference to the velarized lateral phoneme, that is, with even higher F2-F1 values), the contrast between the two lateral phonemes /ɬ/ and /ʎ/ was slightly reduced in the speech of female BoV speakers and slightly enlarged in the speech of male BoV speakers. This effect is likely driven by the differences found for the production of the velarized lateral: although in both L1 lateral categories the F2-F1 distance in productions of female BoV speakers is larger as compared to female BoS speakers, the contrast between female BoV and female BoS speakers is much larger in velarized laterals than in palatal laterals, so that the overall distance between the two lateral categories is reduced in the productions of female BoV speakers as compared to female BoS speakers. Male BoV speakers, in contrast, did not evidence a change in the production of the velarized lateral, but showed a dissimilation effect for the palatal lateral, leading to an enlarged lateral phoneme contrast as compared to monolingual male speakers.

²¹ See Fant (2004), who describes that F2 and F3 of back rounded vowels, and not of front vowels, are similar in production of female and male speakers, due to a supposed compensatory mechanism in perceptually relevant formants.

²² However, the role of orthography in crosslinguistic influence at the phonetic level was not a research question of the present study and therefore will not be further discussed.

A further statistical model analyzing the difference in the production of German laterals as produced by bilingual speakers (in their L2 German) and by monolingual VD and SAG speakers (in their L1 German) revealed that male bilingual speakers indeed confirmed the initial hypothesis insofar as they produced the German lateral phoneme significantly more velarized than the group of monolingual speakers. The differences between male BoV speakers and all L1 German control groups was significant over all conditions. Additionally, male BoV speakers produced German laterals also significantly different (more velarized) from female BoV speakers. Female BoV speakers, however, did not differ significantly from VD speakers. Compared to SAG speakers, laterals of female BoV speakers were significantly different only in some of the comparisons. That is, female BoV speakers in general differed significantly from male SAG speakers, but only partly from female SAG speakers (e.g., laterals in the read speech of female BoV speakers did not differ from laterals in spontaneous speech produced by female SAG speakers). This general tendency for laterals of BoV speakers produced in read speech to be closer to laterals of monolingual speakers produced in spontaneous speech might be due to the circumstance that it is spontaneous speech that BoV speakers hear the most when they are in contact with German speech. And in the more consciously articulated read speech, BoV speakers succeed the best to reproduce this reference they hear for lateral productions in German. That this effect of task was also found within the L1 German reference groups is not surprising, if the sociolinguistic status of the Viennese Dialect is considered. The velarized lateral has been described as a marker of the rather negatively evaluated Viennese dialect (see C. Schmid et al. 2015; Moosmüller 2016). This leads to the application of an alveolar lateral variant (with higher F2-F1 values) by VD and also SAG speakers in more formal situations.

The last statistical model investigating the difference between laterals in L1 Bosnian and L2 German as produced by bilingual BoV speakers showed that F2-F1 values were significantly higher (i.e., laterals are more alveolar) in L2 German than in L1 Bosnian. Therefore, at the group level of BoV speakers, independently of Gender and Task, the emergence of a distinct lateral category for each language (L1 Bosnian and L2 German) is suggested. An additional correlation analysis showed that laterals in L1 Bosnian and L2 German were related at the level of the individual speaker, insofar as F2-F1 values are increasing in L2 German with increasing F2-F1 values in L1 Bosnian. The less an L1 lateral was produced in a native-like manner in L1, the more the L2 lateral was produced in a native-like manner in L2. This suggests that in lateral production the strength of L1 restructuring is related to the strength of L2 restructuring.

Triggered by the equivalence classification and changes in the production of the similar L1 /t/ and L2 /l/, a chain shift in the restructuring of the phonetic-phonological system also leads to the dissimilation process of the second L1 lateral phoneme /ʎ/. This dissimilation effect might be explained

by the need of keeping the L1 lateral phoneme categories /ɬ/ and /ɮ/ distinct. In summary, the results show that the restructuring of the L1-L2 phonetic-phonological system is a complex, bidirectional process.

2.2 Analyses of individual differences in production

Results of the statistical group analyses performed in the preceding chapter identified general group effects. Bilingual speakers (BoV) produced laterals with higher F2-F1 values, thus less velarized, as compared to monolingual L1 Bosnian speakers (BoS), and they produced laterals with lower F2-F1 values, thus more velarized, as compared to monolingual L1 German speakers (SAG and VD). Moreover, female bilingual speakers differed from male bilingual speakers by producing less velarized laterals.

Nevertheless, these significant mean differences in lateral productions between speaker groups did not inform on the strength and the nature of inter-individual variation regarding the reorganization of the L1-L2 phonetic-phonological space *within* the group of BoV speakers. As already outlined in the introduction chapter, language proficiency is usually characterized by vast individual differences, especially in the context of multilingualism. This might even be true for a group of speakers who share a large number of (primarily the more controllable biographic) factors, as it is the case of the bilingual speakers of the present study. However, the nature of individual differences is rarely investigated in detail. Individual differences in the reorganization of the L1-L2 phonetic-phonological space due to the contact with a second language largely depend on language external, subjective factors, which develop dynamically over the course of L2 contact. Therefore, they cannot be revealed by considering mean data (at the group level). A particularly interesting question arising from the results of the group analysis performed in the previous chapter is whether the gender difference in the group of BoV speakers is due to the factor gender itself (possibly because of biological factors, or because of (social) roles associated with the biological gender), or whether it might better be explained by other, more subjective factors. Analyses of individual differences within the respective groups of female and male speakers might give a first hint for an explanation about the role of the factor gender, by identifying those individual bilingual speakers who differ the most from or are most similar to the monolingual reference groups. Building on this, a qualitative analysis of information collected in the interviews, which is performed in chapter 4, further addresses the role of the factor gender or other potentially relevant factors influencing language proficiency in bilingual speakers. Note that the studied group of bilingual speakers was composed to elicit homogeneous biographic factors in order to facilitate the identification of more subjective language external factors that shape individual variability.

The present chapter presents analyses of individual differences in the production of L1 Bosnian and L2 German laterals as produced by BoV speakers in comparison to the respective monolingual reference speakers.

2.3.1 Data analysis

First, descriptive analyses are performed over all lateral productions in all contexts. That is, a description is given of how individual BoV speakers produce the lateral sounds in L1 Bosnian relative to monolingual BoS speakers, and how they perform with regard to the L2 German lateral sound relative to monolingual SAG and VD speakers. This is done by plotting and interpreting the mean F2-F1 values in bark per speaker.

Second, the significance of differences between individual BoV speakers in the production of the similar L1 /t/ and L2 /l/ sounds are statistically analyzed. This is to investigate inter-speaker differences in lateral realization in L1 and L2 respectively, and furthermore to investigate the intra-speaker differences between the laterals in the two languages. This latter analysis is specifically to see, whether speakers use two separate categories for L1 /t/ and L2 /l/, or whether they build one single, composite L1-L2 category. A use of separate lateral categories would be indicated by a significant effect of the factor Language on the lateral productions in L1 Bosnian and L2 German as produced by the individual speakers (as also done in the group analysis in Model 5, see section 2.2.6). A merging of the lateral productions in L1 Bosnian and L2 German though would be indicated if the factor Language would not yield significant effects. In order to perform analyses of these inter-speaker and intra-speaker differences, a linear mixed effects model similar to model 5 used in the production experiment was built. Separate models were built for female and male BoV speakers, as the factor Gender was not of interest anymore. Again, the F2-F1 difference in bark served as the dependent variable. Language (German, Bosnian), Participant (p01-p07 for female BoV speakers and p11-p17 for male BoV speakers) and the interaction between the latter two factors were entered as fixed factors. A random intercept was added for Word. Task (spontaneous, read) and Vowel Context were entered as a covariates and served to account for further variance. As this model served as a basis to interpret speaker-specific differences in the production of laterals in L1 and L2, only the interaction of Speaker and Language was analysed. Posthoc tests were used, because the factor speaker had 7 levels, respectively. They were performed using the `lsmeans` function of the `emmeans` package (Lenth 2020), where p-values are reported including a Bonferroni correction. That is, p-values are multiplied by the number of post-hoc tests applied to counteract an inflation of type I errors due to the large number of comparisons. The Kenward–Roger approximation was used for the degrees of freedom, as implemented in the package `lmerTest` (Kuznetsova et al 2017).

2.3.2 Results

Descriptive analysis of individual differences in the production of Bosnian /ɤ/ and /ʌ/

Figure 8 shows individual mean values for the production of Bosnian velarized /ɤ/. Recall that in the group analysis in Model 1 in section 2.2.2, we found an interaction between Gender and speaker Group. In line with this we find the three groups of male BoV speakers, male BoS speakers, and female BoS speakers largely overlapping. Of the female BoV speakers, who differed in the group analyses from the other groups, however, only two female BoV speakers produced laterals that were clearly located around the mean values of the lateral productions of the other Speaker Groups (p02 and p05). Two other female BoV speakers, p04 and p07, produced laterals with mean values outside one standard deviation of the BoS reference groups (of both male and female BoS speakers). None of the male BoV speakers produced laterals with clearly deviating F2-F1 values as compared to the group of male and female BoS speakers.

Figure 9 shows individual mean values for the production of Bosnian /ʌ/. Even though the group means between BoS and BoV speakers were generally slightly shifted, insofar as the F2-F1 values in bark were mostly higher in the productions of individual BoV speakers as compared to individual BoS speakers (thus reflecting the results of the group analysis, see Model 2, section 2.2.3), there were no

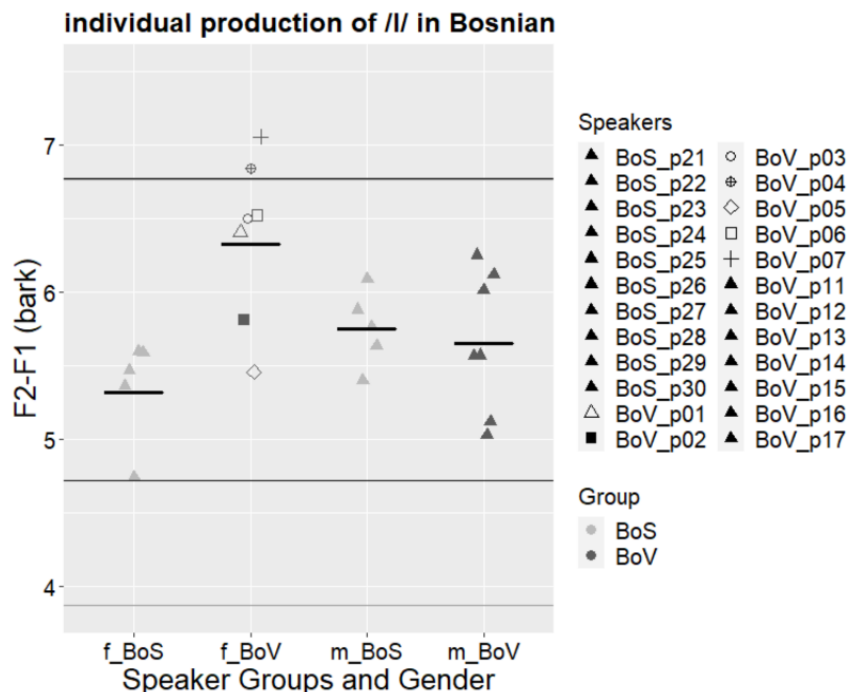


Figure 8. Mean F2-F1 (in bark) of Bosnian /ɤ/ productions for each individual speaker, grouped by Speaker Group (BoS vs BoV) and by gender (f= females vs m= males). Short horizontal crossbars indicate the group mean F2-F1 (bark) value, long horizontal lines indicate 1 sd of the mean F2-F1 (bark) values of BoS speakers (light gray= female BoS speakers, dark gray= male BoS speakers).

particularly conspicuous mean values of individual BoV speakers. One male BoV speaker had a mean lateral value outside the range of one standard deviation of the male BoS speakers, yet still within the range of the female BoS speakers. The highest mean F2-F1 value was reached by a female BoS speaker, whose values were located outside the range of one standard deviation from the mean value of all female BoS speakers. The range of individual F2-F1 values for Bosnian /ɭ/ was generally rather large, however, all other speakers produced their laterals within one standard deviation of the mean reference values of male and female BoS speakers. Thus, in general, the individual productions of the palatalized Bosnian lateral phoneme /ɭ/ did not exceed the general group effect found in the overall statistical analysis of Experiment 2a.

Individual differences were only conspicuous with regard to the female BoV speakers production of the velarized lateral phoneme /ɬ/, which is the lateral phoneme more similar to the L2 German plain alveolar lateral phoneme /l/. In order to exclude the possibility that individual differences might only be attributable to an imbalance of the vowel context, mean values of laterals in the most contrasting vowel contexts (i.e., the front vowel context, and the back vowel context), in which no important variation due to general coarticulatory constraints was expected, were investigated. This was because

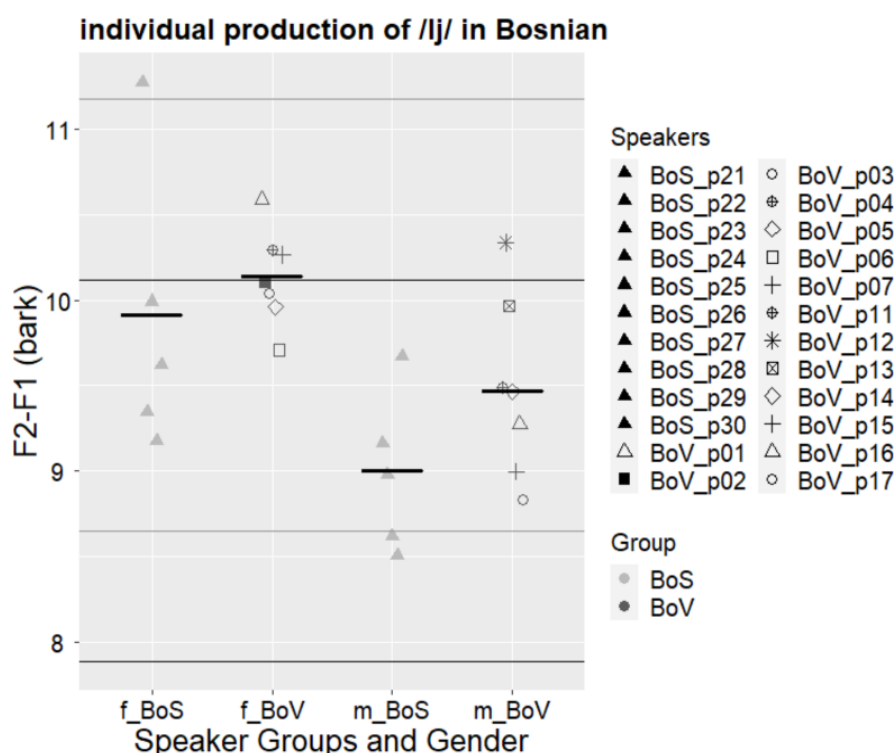


Figure 9. Mean F2-F1 (in bark) of Bosnian /ɭ/ productions for each individual speaker, grouped by Speaker Group (BoS vs BoV) and by gender (f= females vs m= males). Short horizontal crossbars indicate the group mean F2-F1 (bark) value, long horizontal lines indicate 1 sd of the mean F2-F1 (bark) values of BoS speakers (light gray= female BoS speakers, dark grey= male BoS speakers).

laterals are generally known to show a strong gradual variation of F2-F1 values along the alveolar-velarized continuum according to vowel context (see also introduction chapter 1.4.2). Because of this inherent difference in lateral production due to vowel context, different vowel contexts might lead to different degrees of cross language influence (in accordance with the view of the SLM that phonetic cross-language mappings are performed at the level of position-dependent allophones rather than at the phonemic level). Note that in the analysis of group differences, vowel context was accounted for in the linear mixed-effects models.

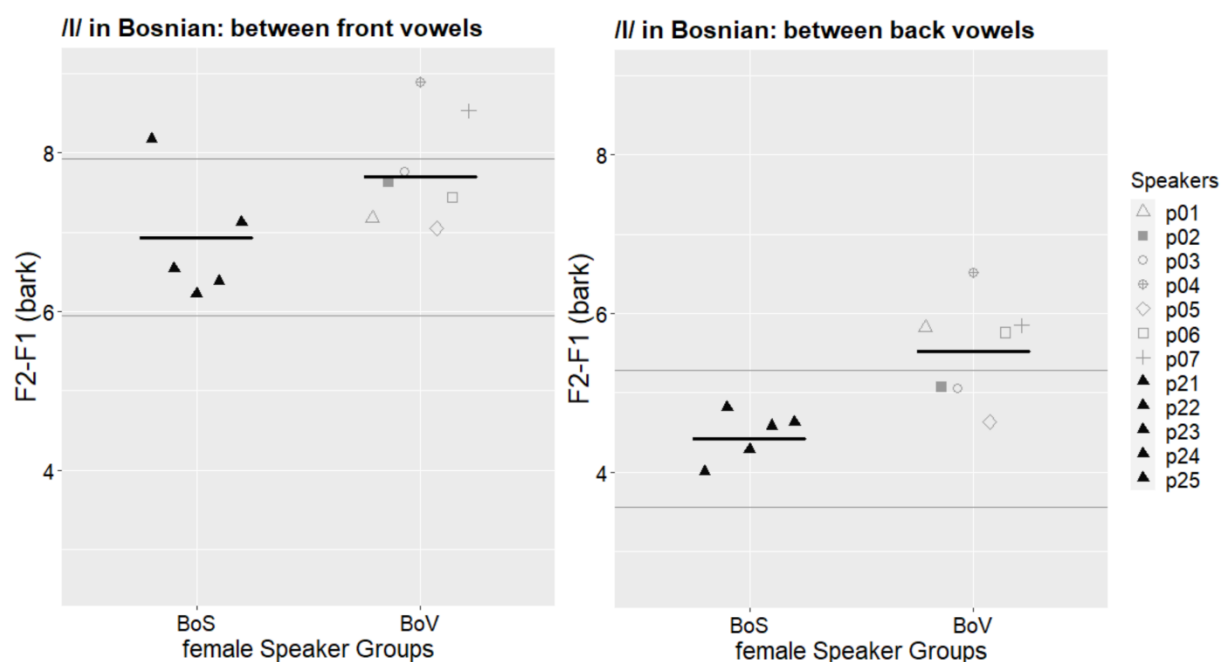


Figure 10. Mean F2-F1 (in bark) of Bosnian /t/ productions for each individual female (BoV and BoS) speaker (p01-p07 are female BoV speakers, p21-p25 are female BoS speakers), grouped by Speaker Group (Bos vs BoV). Short horizontal crossbars indicate the group mean F2-F1 (bark) value, long horizontal lines indicate 1 sd of the mean F2-F1 (bark) values of female BoS speakers. The left plot shows laterals produced between two front vowels, the right plot shows laterals produced between two back vowels.

The distributions of laterals in front vowel context (Figure 10, left panel) and in back vowel context (Figure 10, right panel) showed that the two female BoV speakers p04 and p07, who were shown to produce L1 /t/ with the most deviating mean F2-F1 values when measured over all contexts (e.g. higher F2-F1 values as compared to all other individual BoV and BoS speakers), also produced their laterals with clear distance to the laterals of the BoS speakers (i.e., outside one standard deviation of the mean reference value of BoS speakers) in both front- and back vowel context. Additionally, two other female BoV speakers (p06 and p01) also produced laterals with more than one standard deviation apart from the mean of the female BoS reference speakers, though only in the back vowel context. In front vowel context, but not in back vowel context, one of the female BoS speakers also produced laterals scarcely outside one standard deviation of the female BoS speakers.

In summary, the previous analyses and descriptions about the production of /t/ in L1 Bosnian showed that, while female BoV speakers as a group differed from male BoV speakers and from BoS speakers in general, some of the female BoV speakers stood out from their group with even higher F2-F1 values as compared to the other individual speakers. Male BoV speakers, in contrast, did not show noticeable individual differences. Concerning the production of the L1 Bosnian palatal lateral phoneme /ʎ/, productions of individual speakers did not exceed the general group effects found in the overall statistical analysis, insofar as BoV speakers generally produced palatal laterals with higher F2-F1 values than BoS speakers.

Descriptive analysis of individual differences in the production of German /l/

Figure 11 shows individual mean values for the production of German /l/. Overall, the main group patterns found in the results of the statistical group analysis were maintained when individual differences were descriptively analysed over all contexts. That is, laterals in L2 German were generally produced more velarized, that is, with lower F2-F1 values, by BoV speakers than by monolingual German speakers. However, single speakers stood out of their group.

In the group of female BoV speakers, two speakers (p06 and p07) produced L2 German laterals with F2-F1 values very close to the mean values of the VD and SAG reference groups. In contrast, two other female BoV speakers (p02 and p03) produced L2 German laterals with values outside one standard deviation of female monolingual German reference speakers and clearly located close to the mean of the F2-F1 values of the male BoV speakers in their L2 German. One of these two female speakers, p03, produced lateral values even outside one standard deviation of male VD and SAG reference speakers. In the group of male BoV speakers, only one speaker (p12) clearly differed from the other male BoV speakers. He produced laterals with higher F2-F1 values, which laid within one standard deviation of the mean values of all L1 German reference speakers, of both male and female L1 German reference groups. However, the mean of his F2-F1 values was still located at the lower end of the German reference range, and was lower than the lowest mean values of any individual monolingual L1 German speaker.

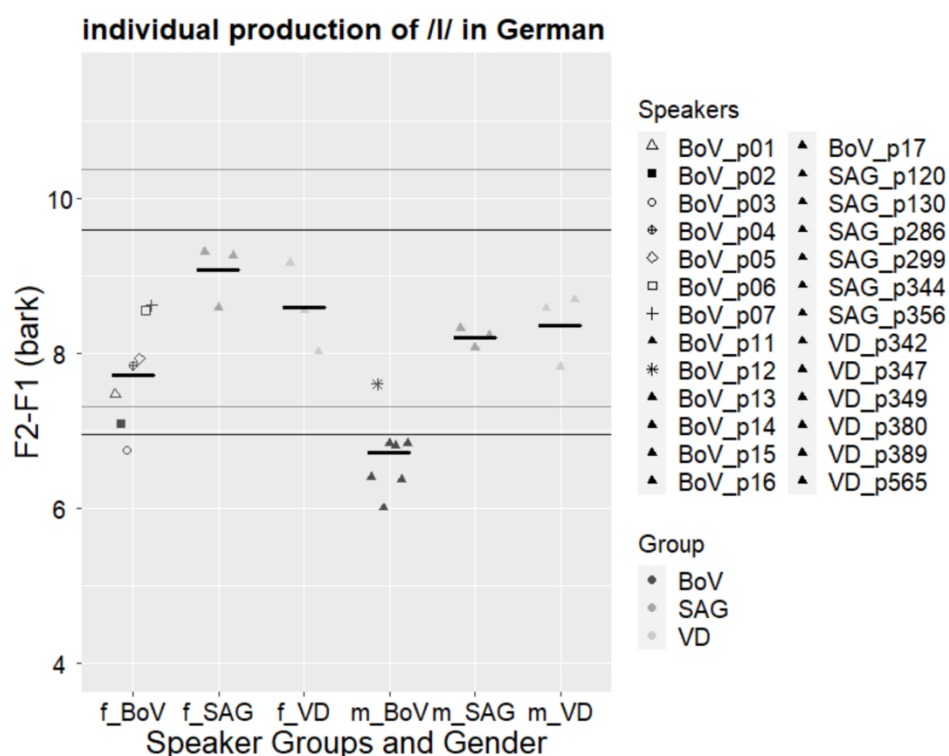


Figure 11. Mean F2-F1 (in bark) of German /l/ productions for each individual speaker, grouped by Speaker Group (BoV vs SAG vs VD) and by gender (f= females vs m= males). Short horizontal crossbars indicate the group mean F2-F1 (bark) value, long horizontal lines indicate 1 sd of the mean F2-F1 (bark) values of L1 German (SAG and VD) speakers (light gray= female L1 German speakers, dark grey= male L1 German speakers).

Similar to the descriptive analysis of individual differences in the production of Bosnian velarized /ɫ/, mean values of individual lateral productions for German laterals in front vowel context and in back vowel context were additionally investigated, in order to exclude the influence of a possible imbalance of the vowel context. Figure 12 (left panel) showed that the front vowel context did not yield different results for individual lateral realizations as compared to the overall analysis of individual differences. All speakers produced laterals with higher F2-F1 values in front vowel context as compared to laterals in other vowel contexts. Individual differences between speakers were smaller in front vowel context compared to measures over all contexts, but the general pattern of individual differences as measured over all contexts remained stable. The male BoV speaker (p12) who was the only one having a mean F2-F1 value within the range of the German reference speakers when his lateral productions were analyzed over all contexts, was even closer to the mean values of German reference speakers in front vowel context than in other contexts.

In back vowel context, the pattern of distribution of individual F2-F1 values also looked very similar to the pattern observed over all contexts, except for the generally lower F2-F1 values. In the group of female BoV speakers, p06 and p07 were still the closest to the mean values of the L1 German reference speakers, and p02 and p03 still had clearly lower F2-F1 values in back vowel context, that time both were staying outside one standard deviation of the German reference groups (of both female and male speakers). In back vowel context, this also held for a third female BoV speaker, p01. In the German lateral productions of male speakers, none of the BoV speakers obviously differed from the other speakers of his group and nobody had mean lateral values within the range of one standard variation of the L1 German reference groups.

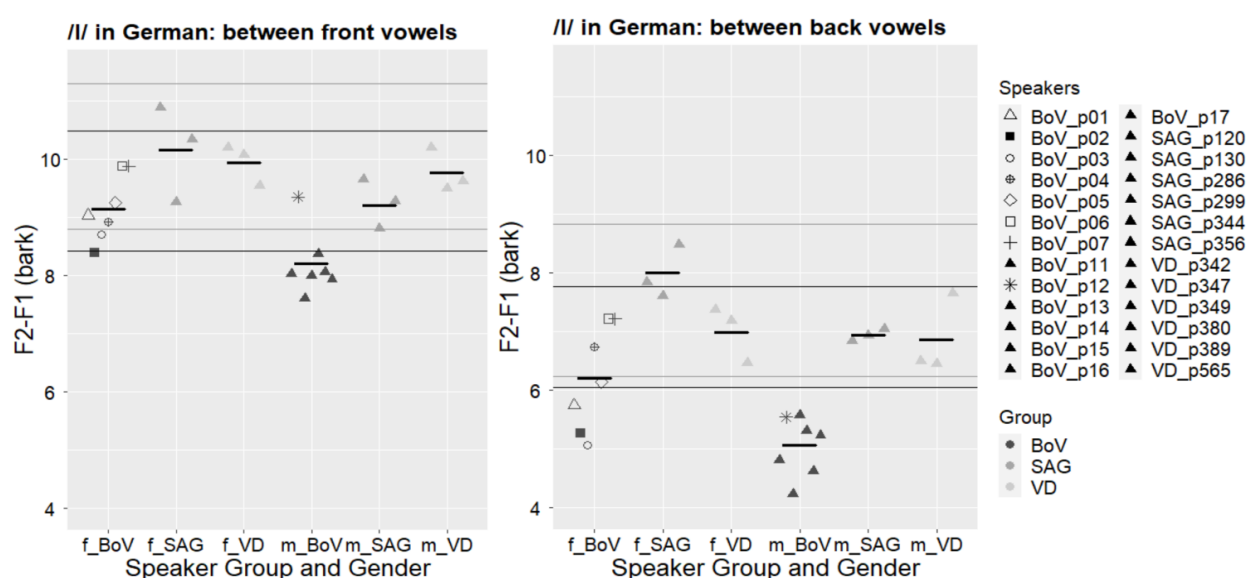


Figure 12. Mean F2-F1 (in bark) of German /l/ productions for each individual speaker, grouped by Speaker Group (Bos vs SAG vs VD), and gender (f= female speakers, m= male speakers). Short horizontal crossbars indicate the group mean F2-F1 (bark) value, long horizontal lines indicate 1 sd of the mean F2-F1 (bark) values of L1 German (SAG and VD) speakers ((light grey= female L1 German speakers, dark grey= male L1 German speakers). The left plot shows laterals produced between two front vowels, the right plot shows laterals produced between two back vowels.

In summary, the previous analyses and descriptions about the production of /l/ in L2 German showed that especially individual female BoV speakers stood out from their group, either by having mean F2-F1 values close to the male BoV speakers, thus more velarized than other female BoV speakers, or by having mean F2-F1 values especially close to the German reference groups, thus more alveolar than other female BoV speakers. In the group of male BoV speakers, one speaker also produced laterals close to the mean lateral values of the German reference groups, unlike the rest of his group, but not in all vowel contexts.

Linear mixed-effects model of individual differences in the production of /t/ in L1 Bosnian and /l/ in L2 Austrian German by bilingual speakers

In order to elaborate more on individual differences in the production of the similar /t/ in L1 Bosnian and /l/ in L2 German between bilingual BoV speakers, a linear mixed effects models as described above was built, separately for male BoV speakers and for female BoV speakers, most crucially with Speaker and Language as fixed factors as well as the interaction between these factors. Results of the models are plotted in Figure 13.

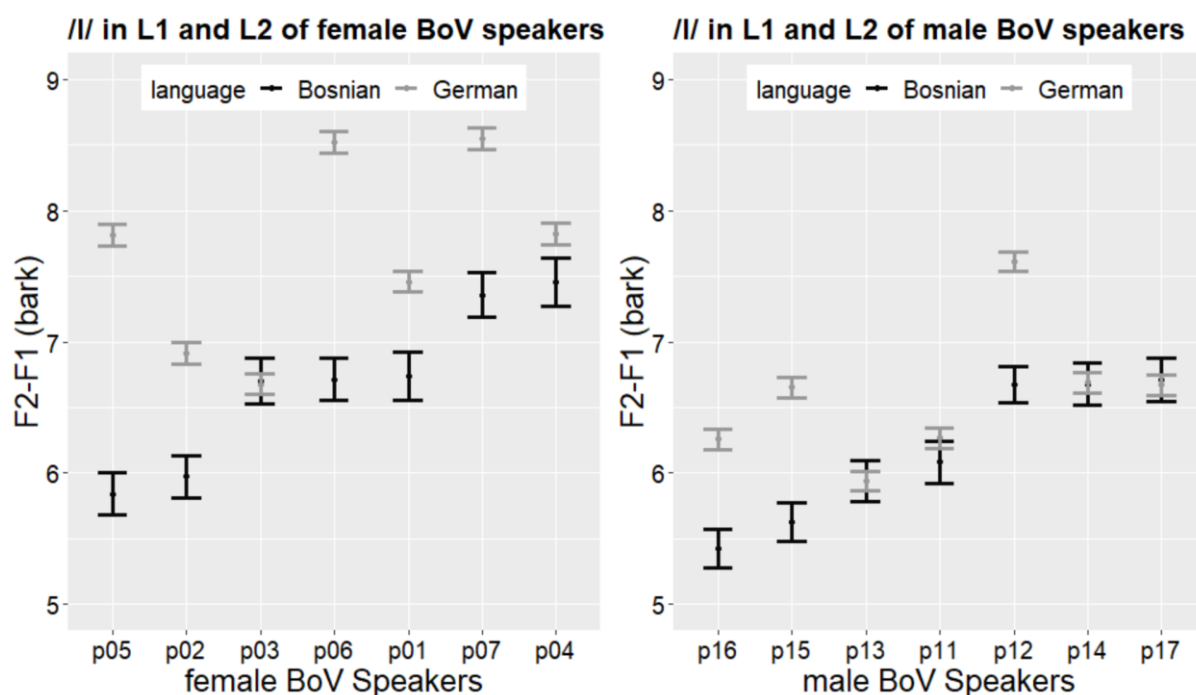


Figure 13. Means (and ± 1 se) of F2-F1 (in bark) distance of L1 /t/ and L2 /l/ produced by individual BoV speakers as a function of Language (L1 Bosnian [grey] vs L2 German [black]), plotted for female (left) and for male (right) speakers separately, estimated from the accordingly linear mixed effects model. Individual speakers are ordered according to F2-F1 (in bark) values in their L1 Bosnian, from low to high values.

First, the results for the significance of interspeaker differences are presented. For the sake of readability, only results of those individual speakers for whom deviating mean F2-F1 values (compared to their own Speaker Group) were observed, are presented here in the text. Complete results for all contrasts analyzed with the post hoc analyses of the statistical model are shown in Appendix H.

With regard to lateral productions in L1 Bosnian, p04 and p07 were consistently shown to have relatively high F2-F1 values in the first descriptive analyses of individual differences, thus the farthest away from the values of the L1 Bosnian reference group.

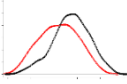
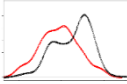
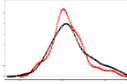
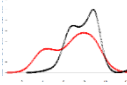
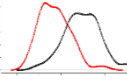
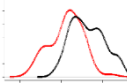
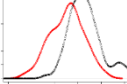
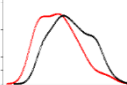
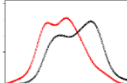
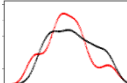
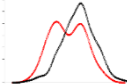
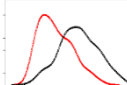
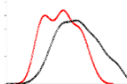
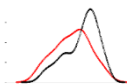
However, in the statistical analysis, they differed significantly only from the two speakers with the lowest F2-F1 values, p02 and p05, who were shown to have the lowest F2-F1 values in their Bosnian /l/ productions, with values very close to the mean value of the L1 Bosnian reference speakers (especially p05). Notably those two speakers with the lowest values, p02 and p05, statistically differed

not only from the most "deviant" speakers, p04 and p07, but also from other female BoV speakers (i.e., both differed significantly from p06 and p01, and p05 additionally differed significantly from p03). In other words, in fact p05 and p02 appeared the most deviant of the female BoV speakers with regard to their F2-F1 values, insofar as they had the most native-like L1 /l/ productions, as was shown in the descriptive analysis.

With regard to lateral productions of female BoV speakers in L2 German, p06 and p07 were consistently shown to produce relatively high F2-F1 values in the descriptive analysis of individual differences. The mean values of their L2 German laterals were as high as the mean values of the monolingual German reference groups. In contrast, p02 and p03 were consistently shown to produce laterals with relatively low F2-F1 values, which were always outside one standard deviation of the monolingual German reference speakers. Statistical analyses of the contrasts between individual speakers showed that these deviations were indeed significant. P06 and p07 did not differ from each another, but respectively differed significantly from all other female BoV speakers. The same held for p02 and p03, who did not differ from each another, but respectively from all other female BoV speakers. With regard to lateral productions of male BoV speakers in L2 German, p12 was shown to produce relatively high F2-F1 values in the descriptive analysis of individual differences, except for the back vowel context, where he did not differ from other male BoV speakers. The statistical analysis confirmed that his lateral productions indeed significantly differed from the lateral productions of all other speakers.

Second, results for the contrast between L1 and L2 laterals of all BoV speakers are presented in Table 15. The analysis of the intraspeaker differences concerning the lateral productions in L1 Bosnian and L2 German was conducted specifically to see whether speakers used two separate categories or one common category for laterals in L1 and L2. The use of two separate categories was indicated by a statistically significant contrast. Results revealed that five out of seven female speakers (p01, p02, p05, p06, p07) and three out of seven male speakers (p12, p15, p16) appeared to have built two separate categories for the similar laterals /t/ and /l/ in their L1 Bosnian and L2 German.

Table 35. Post-hoc contrasts (*p*-values: Bonferroni-corrected) for F2-F1 (bark) of /t/ and /l/ measured as a function of Language (L1 Bosnian vs L2 German) for all individual BoV speakers, as estimated from the accordingly linear mixed model. Right, allocated to each speaker, density distributions of F2-F1 (bark) values of L1 Bosnian /t/ (red) and L2 German /l/ (black).

/l/ in L1 Bosnian and L2 German	<i>b</i>	SE	df	<i>t</i>	<i>p</i>	
female speakers						
p01: L1 Bosnian vs L2 German	-0.7	0.2	2025	-3.49	.045*	
p02: L1 Bosnian vs L2 German	-0.93	0.18	1810	-5.21	<.0001***	
p03: L1 Bosnian vs L2 German	0.03	0.2	1924	0.17	1	
p04: L1 Bosnian vs L2 German	-0.35	0.2	1991	-1.74	1	
p05: L1 Bosnian vs L2 German	-1.97	0.18	1713	-11.04	<.0001***	
p06: L1 Bosnian vs L2 German	-1.81	0.18	1857	-10.13	<.0001***	
p07: L1 Bosnian vs L2 German	-1.22	0.19	1896	-6.5	<.0001***	
male speakers						
p11: L1 Bosnian vs L2 German	-0.18	0.17	1726	-1.04	1	
p12: L1 Bosnian vs L2 German	-0.93	0.16	1491	-6.03	<.0001***	
p13: L1 Bosnian vs L2 German	0	0.17	1747	0.02	1	
p14: L1 Bosnian vs L2 German	-0.01	0.18	1791	-0.06	1	
p15: L1 Bosnian vs L2 German	-1.03	0.16	1584	-6.27	<.0001***	
p16: L1 Bosnian vs L2 German	-0.84	0.16	1660	-5.03	<.0001***	
p17: L1 Bosnian vs L2 German	0.04	0.18	1885	0.2	1	

Nevertheless, as common in the production of alveolar lateral sounds, the variance of F2-F1 values in the respective lateral categories of the individual speakers was strong. This variance is illustrated in the density plots of the distribution of F2-F1 values of laterals in L1 and L2, separately for each individual speaker (see Table 15). Speakers whose lateral productions were significantly different in

the two languages seemed to avoid the extreme lateral values of one language in the productions of the other language. That is, the lowest F2-F1 values which a speaker produced in L1 Bosnian were absent in the productions of L2 German. And the highest F2-F1 values which a speaker produced in L2 German were absent in the productions of L1 Bosnian. The speakers who produced their L2 German laterals with the closest F2-F1 values to the mean of the German reference speakers had relatively strongly separated categories for the similar laterals in both languages (in the group of female BoV speakers p06: $b=-1.81$, and p07: $b=-1.22$, and in the group of male BoV speakers p12: $b=-0.93$). However, also other speakers had similarly strongly separated categories, even though they produced their L2 German laterals with lower F2-F1 values. Speaker p05, who showed the lowest F2-F1 lateral values in L1 Bosnian (together with p02) and rather high F2-F1 values in L2 German (but significantly different from p06 and p07, who had the highest values), even had the most obviously separated categories (as indicated by $b=-1.97$).

2.3.3 Summary and discussion of individual differences in production

The present section on individual differences between bilingual speakers in L1 and L2 lateral production showed that the results of the statistical group analysis were not as straightforward at the level of individual speakers. Concerning the production of the phoneme /ʎ/ in L1 Bosnian, the overall group trend was best confirmed by results of the individual analyses. Palatal laterals produced by bilingual speakers were produced with higher F2-F1 values than by monolingual BoS speakers, thus showing a dissimilation effect. A closer look at the productions of the mean F2-F1 values of individual speakers did not identify individual BoV speakers who stood out compared to other speakers. The group means and the distributions of the individual mean values were solely slightly shifted in general, but still showed a strong overlap between the individual mean values of BoV and BoS speaker groups.

Concerning the production of the phoneme /t/ in L1 Bosnian, the mean values of the individual speakers in the two BoS groups and the male BoV group were also largely overlapping. A more detailed descriptive analysis of individual female speakers showed that most bilingual females produced the velarized lateral with larger F2-F1 distances compared to all other speakers (compared to all BoS speakers and to male BoV speakers), thus indicating a less velarized production of the Bosnian /t/ in female BoV speech. The productions of two of the female BoV speakers, p04 and p07, were especially salient, insofar as they were even less velarized than the productions of other female BoV speakers. The statistical analysis revealed that the overall differences found in the descriptive analysis reached significance. The female speakers with the higher F2-F1 values in their Bosnian /t/ productions, p04 and p07, differed significantly from p02 and p05, the speakers with the lowest F2-F1 values, which fell

close to the mean of BoS reference speakers. These two speakers with the lowest F2-F1 values (p02 and p05) were even further apart from the other individual female BoV speakers, with the most significant differences to other female speakers. Thus, within the group of bilingual female BoV speakers, native-like /t/ productions were relatively unusual.

Furthermore, in the descriptive analysis of individual differences, the individual productions of the most „extreme“ phonetically motivated variants of the velarized lateral phoneme /t/ in L1 Bosnian were investigated. That is, the expected most velarized variant, which occurs in back vowel context, and the expected least velarized variant, which occurs in front vowel context. Here, it was shown that in addition to p04 and p07, who still showed the largest deviation from the mean value of the female BoS reference speakers towards the higher F2-F1 values in native-like German laterals, two more female BoV speakers (p06 and p01) produced laterals with clearly higher F2-F1 values than the monolingual BoS reference speakers. That is, the lateral productions of these speakers also fell clearly outside the range of the reference speakers, but only in back vowel context, and not in front vowel context. Therefore, it seemed that it is the back vowel context, in which the Bosnian velarized lateral phoneme /t/ is most prone to phonetic attrition. Laterals occurring in back vowel context, where the most extreme velarizations of laterals can be expected due to coarticulatory effects, are de-velarized by more individual speakers than laterals in front vowel context. This might be due to the higher salience of these “extremely” velarized laterals, at least compared to German laterals. In German lateral productions laterals are produced as plain alveolar laterals, and if they are velarized, then only because of the phonetic context and to a lesser extent than in Bosnian (see chapter 1.4 of the introduction and, e.g., Recasens 2012). Thus, up to a certain degree of velarization, even in German, a velarized lateral might still be considered as typical context-specific and speaker-specific variant. Only the more extreme realizations would be salient and therefore more susceptible to cross-language mappings - here the influence of the plain alveolar laterals of L2 German (as produced in SAG and also primarily in VD).

Altogether, concerning the bilinguals’ productions of the velarized lateral in their L1, it was observed that male speakers did not differ from monolingual L1 Bosnian speakers, whereas most, but not all, of the female BoV speakers differed from the monolingual L1 Bosnian reference groups, and even more so in back vowel context.

Together with the correlation analysis of lateral productions in L1 and L2, it might be assumed that those of the female speakers who differed from the monolingual reference group, indeed showed a readjustment of the L1 phonetic-phonological lateral category for the Bosnian velarized lateral phoneme /t/, probably due to the phonetic influence of the L1 German lateral phoneme. In terms of the SLM, this would represent an assimilation process, which is one indication of phonetic attrition.

Phonetic attrition in the form of dissimilation was not observed in the bilinguals' productions of the velarized lateral, as none of the bilingual speakers produced laterals with lower F2-F1 values than the monolingual reference speakers.

Concerning the production of the phoneme /l/ in L2 German, the descriptive analysis of individual speakers showed that most bilingual L1 Bosnian speakers produced laterals with F2-F1 values below all individual L1 German speakers, and thus more velarized. In the group of male BoV speakers, all but one speaker produced laterals with F2-F1 values more than one standard deviation apart from the mean value of L1 German reference speakers. The only male BoV speaker (p12) whose German lateral productions were within the range of the L1 German speakers was shown to significantly differ from the rest of the individual speakers of his group. Within the female BoV group, only two speakers, p02 and p03, produced laterals with F2-F1 values below the range of the German reference speakers. Statistically, they differed significantly from all other speakers of their group, by producing laterals with lower F2-F1 values, thus more velarized. The two speakers with the highest F2-F1 values, p06 and p07, fell close to the mean of the German reference speakers and also differed significantly from all other speakers of their group. However, the descriptive analysis again showed that in back vowel context, the weighting was slightly different. Compared to other contexts, more BoV speakers produced laterals with clearly lower F2-F1 values than the German reference speakers in back vowel context. For example, speaker p12, who generally produced laterals with significantly higher F2-F1 values than other male BoV speakers, clearly did not differ from the other speakers of his group in back vowel context, that is, he also fell below the range of monolingual L1 German reference speakers. And within the group of female BoV speakers in back vowel context, one more speaker (additionally to p02 and p03), p01, produced laterals with F2-F1 values falling below the range of plus/minus one standard deviation of L1 German reference speakers.

This suggests that for some of the speakers, the cross-language influence between L1 Bosnian and L2 German had a different effect on laterals depending on vowel context. The influence of L1 Bosnian on the L2 German lateral productions differed according to vowel context in productions of both speakers p12 and p01. These speakers generally produced laterals with F2-F1 values within the range of L1 German speakers, except for laterals occurring in back vowel context. And in L1 Bosnian, laterals were differently influenced by L1 German in the productions of p01 and p06. These two speakers generally produced their L1 Bosnian laterals within the range of monolingual L1 Bosnian reference speakers, except for the back vowel context, in which they produced laterals with higher F2-F1 values, and thus more approached the L2 German lateral values.

An additional analysis of the differences between the production of the similar lateral phonemes in L1 Bosnian and L2 German as produced by the individual BoV speakers indicated that the majority of

individual female BoV speakers produced two different categories, whereas the majority of individual male BoV speakers produced one composite sound category for the lateral sounds in L1 and L2. Those speakers whose L1 and L2 lateral productions significantly differed showed two separate peaks in the density distribution of their lateral productions. However, even in the productions of those speakers, the distributions of F2-F1 values within the two lateral categories were still overlapping, due to the gradual nature of lateral production of laterals on the alveolar-velarized continuum (as outlined in chapter 1.4.2). Though the differences between the two categories were most likely due to a shift of the distributions of F2-F1 values within the respective categories: the “extreme” values produced in one language appeared to be omitted in the other language. Specifically, the lowest F2-F1 values occurring in L1 Bosnian laterals were omitted in L2 German lateral productions, and the highest F2-F1 values in L2 German were omitted in L1 Bosnian. This tendency suggests, at first view, that those speakers who produced the most native-like L2 German sounds (here: the most similar to monolingual L1 German speakers), succeeded in building a new, additional category for the L2 sound, as also assumed in the SLM. The best chances for observing the formation of two separate categories were suggested for the speakers who had the most native-like German /l/ productions in their L2 German. The three speakers with the most native-like L2 German /l/ productions within their speaker group (p06, p07 in the group of female BoV speakers, and p12 within the group of male BoV speakers) indeed all significantly differed between their similar L1 /t/ and L2 /l/ category. Nevertheless, native-like L2 productions seemed to be not the only premise for the occurrence of two significantly different categories, as other speakers also had built two separate categories. However, further relations between the degree of native-likeness in L1 or L2 lateral productions and the occurrence of either a composite category, or two separate categories for the similar L1 and L2 laterals could not be established. The nine bilingual speakers with the lowest F2-F1 values in L2 German, thus the speakers who differed from the monolingual German reference groups with F2-F1 values clearly below the range of L1 German speakers, for example, showed inconsistent patterns. That is, out of the three female speakers (p02, p03 and additionally p01, albeit only in back vowel context) and the six male speakers (all but p12) with the lowest F2-F1 values in L2 German, four used significantly different lateral categories for L1 Bosnian and L2 German, and five built one composite category for the similar lateral sounds in the two languages.

No relation was observed between the degree of assimilation of L1 /t/ towards L2 /l/ and the preference for a composite, or for two significantly different sound categories in L1 and L2. The speakers who had the lowest F2-F1 values in L1 Bosnian, that is, falling within the range observed for the monolingual Bosnian reference group, showed heterogeneous patterns concerning the number of lateral categories in L1 Bosnian and L2 German. The female BoV speakers with the lowest F2-F1 values in their L1 Bosnian were p02, and p05, and, in back vowel context, also p03. P05 was the speaker with

the strongest separation of L1 and L2 lateral categories, p02 produced significantly different categories as well albeit with a larger overlap between the categories, and p03 produced a composite L1-L2 phonetic-phonological category. In the group of male BoV speakers, all speakers had low F2-F1 values in L1 Bosnian. However, three out of seven speakers had built two separate categories for their similar L1 and L2 laterals, namely p12, p15, and p16. Also, for the speakers who had the highest F2-F1 values in L1 Bosnian, that is, the most assimilated lateral productions towards the L2 German lateral production, no relation with the number of categories for the L1 /t/ and L2 /l/ could be found. The two speakers with the highest F2-F1 values (p04 and p07) differed with respect to the number of categories in the production of the similar L1 and L2 laterals. P07 generally produced two significantly different categories, whereas p04 only showed one composite L1-L2 category.

Altogether, the analysis of individual differences suggests that the assumption of a reorganization of the L1-L2 phonological space must be put into perspective. All seven female speakers showed some sort of reorganization due to the presence of the L2, either by some degree of assimilation of the L1 Bosnian lateral /t/ towards the L2 German lateral /l/, or at least by having built two significantly different lateral categories in L1 and L2 (in the case of p02 and p05). Four of the seven male BoV speakers, however, neither assimilated the L1 Bosnian lateral /t/, nor had built separate lateral categories in L1 and L2. That is, these four speakers did not at all show a reorganization of their L1 L2 lateral space.

3 Experiment 2: Accentedness ratings

3.1 Experiment 2a: L1 Bosnian accentedness ratings

Experiment 2a was designed to rate the L1 Bosnian speech productions of the bilingual L1 Bosnian L2 German speakers living in Vienna (BoV speakers). Since Experiment 1 revealed acoustic differences between speaker groups, Experiment 2a specifically aims at testing whether these differences are actually perceptually relevant to monolingual L1 Bosnian listeners. In other words, it is tested whether the shifts in the acoustics of BoV speakers' productions causes them to be perceived as speaking with a foreign accent in their L1. This would confirm the assumption of L1 attrition, that is suggested by the acoustic differences to the monolingual BoS group.

Specifically, with regard to lateral productions in L1 Bosnian, the speaker groups investigated in Experiment 1 (BoV and BoS) primarily differed with regard to the production of velarized /ɫ/. The acoustic difference between groups was especially striking in read speech productions, where laterals of BoV speakers were produced with significantly higher F2-F1 values as compared to laterals in the speech of monolingual L1 Bosnian speakers living in Sarajevo (BoS speakers). Additionally, a gender difference was found in the productions of BoV speakers, insofar as female speakers produced laterals in their L1 Bosnian with even higher F2-F1 values than their male counterparts.

Therefore, Experiment 2a investigated whether perceptual ratings by monolingual Bosnian listeners reflect those acoustic differences found in Experiment 1. Furthermore, Experiment 2a investigated whether the productions of velarized /ɫ/ analyzed in Experiment 1 correlate with the perceptual ratings of those productions. . As the acoustic lateral production is supposed to play a crucial role for ratings at the word level, a focus of the rating experiment lies on ratings of words in isolation, which were cut out of their original sentence context. In order to examine whether the ratings of isolated words are representative for the accentedness of more naturalistic speech, that is, in longer and spontaneous utterances, Experiment 2a also includes a number of longer utterances from the spontaneous speech task of Experiment 1 as a control condition.

3.1.1 Methods

3.1.1.1 Participants

Thirty native speakers of Bosnian (15 female, 15 male), who had not participated in the production experiment, took part in a web-based accent rating experiment. They were recruited via Bosnian contacts in Vienna and Sarajevo who forwarded the link to friends, family and colleagues. Participants received an expense allowance for their participation. Criteria for participation were that they were born, raised, and currently living in the region of today's Bosnia, that Bosnian was their only native language, that they had no knowledge of German, and that they had no hearing problems. In the final sample, all listeners were between 20 and 40 years of age and reported to affiliate themselves with the Bosnian (rather than Croatian or Serbian) speech community in Bosnia. Approximately half of the listeners indicated that they had learned a foreign language but not German.

3.1.1.2 Material

A subset of tokens from the production tasks in Experiment 1 were used for accentedness ratings. Only Bosnian words with the velarized lateral were chosen, since only there differences between the BoV and BoS speakers' lateral productions were found. Six target words from the read-speech task were selected to cover different positions of the lateral within the words (two in initial, two in medial, and two in final position) as well as vowel context. One of the two laterals at each respective word position occurred next to a front vowel, the other next to a back vowel (in medial position, only the preceding vowel differed, whereas the following vowel was the same). The selected words were *bile* (verb infinitive: *biti*, *to be*, participle, active, plural, feminine), *bole* (verb infinitive: *boljeti*, *to hurt*, third person plural, feminine, *boljeti*), *lila* (*purple*, colour, adjective, feminine), *ludi* (*mad*, adjective, masculine, singular), *koral* (*enclosure*), *metal* (*methyll*). In addition, 2 utterances from the spontaneous speech task (picture retelling task) were chosen such that they comprised the first utterance which formed a meaningful unit of each of the two first picture stories.

Recordings of these words and sentences were taken from all 14 bilingual BoV speakers (7 female, 7 male) and a subset of four of the monolingual BoS speakers (two female, two male) as a native reference. BoS speakers were chosen at random but were the same for all participants. Note that the production of laterals by the BoS group was quite homogeneous hence it appeared unnecessary to apply specific selection criteria (see results of the production experiment). Fewer BoS than BoV speakers were selected because they mainly served as a reference for monolingual native speakers. Given that even the accent of the BoV speakers in their L1 Bosnian might not be strong, despite attrition phenomena observed in the production task, the addition of too many BoS speakers (who

were expected to be rated having no or very little accent) was avoided in order not to bias participants towards reporting only the highest scores.

The words to be presented in the rating experiment were cut out of the respective sentences in which they had been recorded. The point of cutting was selected through listening and visual inspection of the spectrogram. It was located at a change in amplitude and spectral composition of the signal. Cuts were set at positive going zero crossings. A linear amplitude ramp was applied to the beginning and the end of the word to avoid audible cracks. Additionally, a silence of 50 milliseconds was added before and after each target word, to avoid a too abrupt presentation or a truncation of a part of the signal by the presentation software.

The target utterances from the spontaneous speech task were cut out of the stories by applying similar criteria to cutting of the words from the reading task. Note that utterances were selected such that they built a meaningful intonation unit. Depending on the content of the utterances and speaking rate the duration of the selected utterances ranged from 4 to 12 seconds (mean duration of 8.5 seconds). The intensity of all words and utterances presented during the experiment was normalized for RMS amplitude, so that the maximal level of the signal energy of all target words and utterances was the same.

3.1.1.3 Procedure

The rating experiment was conducted as an online experiment created in Psychopy 3 (Peirce et al. 2019, v2020.1.3), in June 2020. It was run via the platform pavlovia.org (see Bridges et al. 2020). The listeners could participate in the experiment from their homes, but they were asked to be in a quiet room and to use headphones. They were informed that the experiment was created as part of a bigger project at the Austrian Academy of Sciences and that their data was anonymized before being saved and analysed. After they followed the link to the experiment website, they could start the experiment by entering a self-chosen participant code. The data was only saved if the participants finished the experiment. At the beginning, a detailed description of the experimental procedure was presented in written form to the participants in their native language Bosnian.

The experiment consisted of two main parts. In the first part participants were asked to rate the words in isolation and in the second part they rated the sentences from the spontaneous speech task. The first part started with six practice trials (one for each target word) to familiarize the participants with the procedure and for them to better understand the context in which the words had been uttered. This was because words were cut out of sentences and hence the intonation and grammatical form may have sounded odd in isolation if not being informed about this fact.

On each practice trial, participants were first presented visually with the scripted dialogue that had served as a context in the production task. After participants had read the dialogue, that is two seconds after the onset of the visual presentation of the dialogue, the sentence containing the target word was presented auditorily. Then a second screen appeared that matched the screens on the trials of the main part of the experiment. Participants saw only the target word written on the screen with a 5-point rating scale underneath. The word was presented auditorily in isolation 0.25 seconds after the onset of this screen. Listeners were asked to rate the strength of the accent of the speaker for this word from 1 (labelled as strong accent) to 5 (labelled as native-like) by clicking with the mouse on the number of the scale on the screen. Only the endpoints of the scale were labelled, whereas the numbers 2, 3, and 4 were only indicated by a bar. These example trials were not used for analyses.

After the completion of the six practice trials, the experimental trials were presented. In these trials, only the words in isolation were presented. On each trial listeners saw the target word written on the screen with the rating scale underneath. Twenty-five milliseconds afterwards, the audio file of the respective target word (in isolation) was presented automatically. Listeners logged their rating about the nativeness of the pronunciation of the target by clicking with the computer mouse on the respective number of the scale. After the response had been logged, the experiment automatically moved on to the next trial with an inter-trial-interval of 0.5 seconds. All six target words produced by each of the 18 speakers were presented twice in randomized order, resulting in a total of 216 trials.

After this first part involving words in isolation, listeners were informed (by means of a written text) that they now moved on to a second part in which they had to rate longer utterances which were cut out of a picture retelling story. The rating scheme was similar to the word ratings. However, on each trial, listeners now only saw the rating scale (including the labelling as described above), without further written information on the screen. Twenty-five milliseconds after the rating scale appeared on the screen the audio file of the utterance was presented automatically. As in the ratings of the words in isolation, the ratings about the nativeness of the pronunciation were entered by clicking with the computer mouse on the 5-point scale from 1 (strong accent) to 5 (native-like), presented on the screen. The two target sentences produced by all 18 speakers were presented in randomized order resulting in a total of 36 trials for the rating of utterances from the spontaneous task.

Listeners could take all the time they needed for the ratings (of both, words in isolation and the utterances) but it was not possible to delete or repeat a rating, or listen to a given word or utterance more than once. After a rating was given, the next trial was presented automatically. After the completion of the ratings, listeners had to answer a short questionnaire about their gender, age, native language, and experience with foreign languages. The whole experiment took approximately 20-30 minutes to complete.

3.1.1.4 Data analysis

The statistical analysis was carried out by means of a linear mixed-effects model to assess whether the productions of the bilingual BoS speakers were rated as more accented than productions of the BoS speakers. Note that both speaker groups had Bosnian as their L1, so differences in ratings are likely the consequence of the speakers' language learning history, specifically the bilingualism of the BoV group. A linear mixed-effects model was fitted with the lme4 package (Bates et al., 2015) in R (v4.0.0, R core team, 2020), using the restricted maximum likelihood (REML) method and Satterthwaite approximation for degrees of freedom. Linear mixed-effects models are generally deemed acceptable also for the analysis of interval data from a rating scale, not only for rational data (Sullivan & Artino, Jr, Anthony R 2013, see also Bergmann et al. 2016, Mitterer et al. 2020).

The dependent variable was the rating value of the 5-point scale (from 1 = strong accent to 5 = native-like). Fixed factors were Speaker Group (BoS, BoV), Utterance Length (word, sentence), and Speaker Gender (f, m), as well as the interactions between these factors (including the 3-way interaction). Listener Experience with foreign languages (yes, no), and Listener Gender (f, m) were entered as covariates in order to control for further possible variance, but were not further investigated. All factors were contrast coded to -0.5 and 0.5 in the order of levels mentioned, such that effects and interactions can be interpreted relative to the grand mean (i.e., effects can be interpreted as main effects), as was done in the analyses of the production experiment (see chapter 2.2.1). The random effects structure of the model contained a random intercept for Speaker, Listener, and Word, as well as a random slope for Utterance Length over Speaker.

In addition to the linear mixed-effects model, a correlation analysis of /t/ productions in L1 Bosnian produced by BoV speakers, and the rating of these productions by native L1 Bosnian listeners was performed. The correlation analysis aimed at further investigating the link between lateral production and accent rating, and specifically to see whether the ratings are indeed affected by the acoustics of the laterals. The correlation analysis was conducted for the subset of data of the BoV speakers and was based on the mean rating value for each individual BoV speaker, and on the mean F2-F1 values in Bark as reported in the production task. Acoustic data were only considered from the subset of /t/ productions that was also used for the rating experiment. A correlation analysis for paired samples was performed by calculating a Pearson's product-moment correlation in R, with the function `corr.test()`, which follows a t distribution with `length(x)-2` degrees of freedom.

3.1.2 Results

Results of the linear mixed-effects model assessing the accent ratings for the Bosnian velarized /ɤ/ as produced by the two speaker groups (BoV vs. BoS) are reported in Table 16. Results showed a

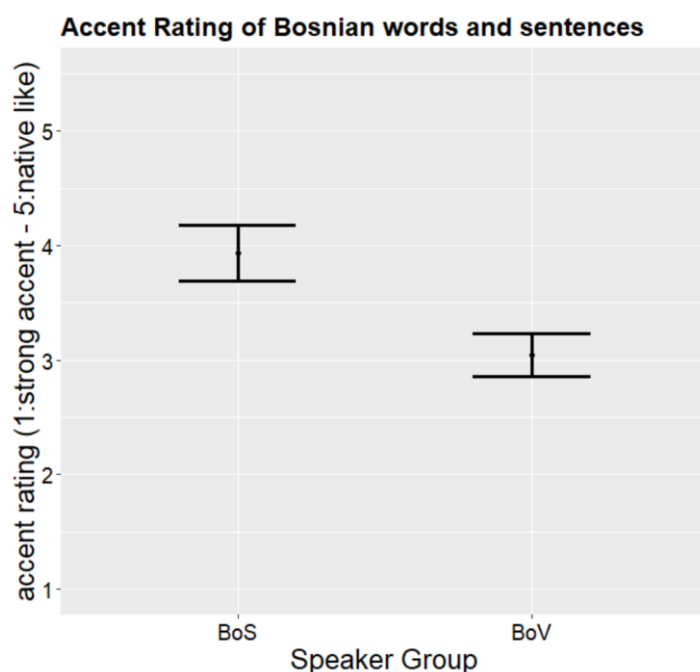


Figure 14. Means (± 1 se) of rating values obtained for productions in Bosnian (y-axis), grouped by Speaker Group (BoS vs BoV), estimated from the linear mixed effects model.

Table 16. Relevant fixed effects returned by a mixed-effects model fit to ratings (on a 5-point scale) for productions in Bosnian by BoV and BoS speakers with the rating value as the dependent variable, language competences of the rater, gender of the rater, gender of the speaker, Utterance Length (word vs sentence), and Speaker Group (BoV vs BoS), and the interaction between Speaker Group and Utterance Length as fixed factors, and Speaker, Word, and Listener as random effects.

	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group	-0.884	0.255	10.446	-3.469	.006**
Utterance Length	-0.331	0.372	11.018	-0.89	.393
Speaker Gender	-0.066	0.255	10.446	-0.258	.801
Speaker Group: Utterance Length	-0.02	0.408	13.333	-0.049	.962
Speaker Group: Speaker Gender	-0.208	0.509	10.446	-0.408	.692
Utterance Length: Speaker Gender	0.293	0.408	13.333	0.719	.485
Speaker Group: Utterance Length: Speaker Gender	-0.497	0.816	13.333	-0.609	0.553

significant effect of Speaker Group such that the productions of BoV speakers were rated as being less native-like than the productions of the BoS speakers (see also Figure 14). Monolingual BoS speakers received a mean rating score of 3.94 on a 5-point rating scale, and BoV speakers were rated with 1 point less in average (3.05). No other effects or interactions were significant.

The correlation analysis of the rating values for the L1 Bosnian /t/ laterals in isolated words produced by BoV speakers and the F2-F1 values of the subset of the same words showed a strong correlation between the two factors ($r = -0.678$, $t = -3.194$, $df = 12$, $p = 0.0077$, see also Figure 15). The higher the F2-F1 values of Bosnian /t/ (i.e., the less velar their laterals were produced), the more likely these speakers were perceived as having a non-native-like pronunciation.

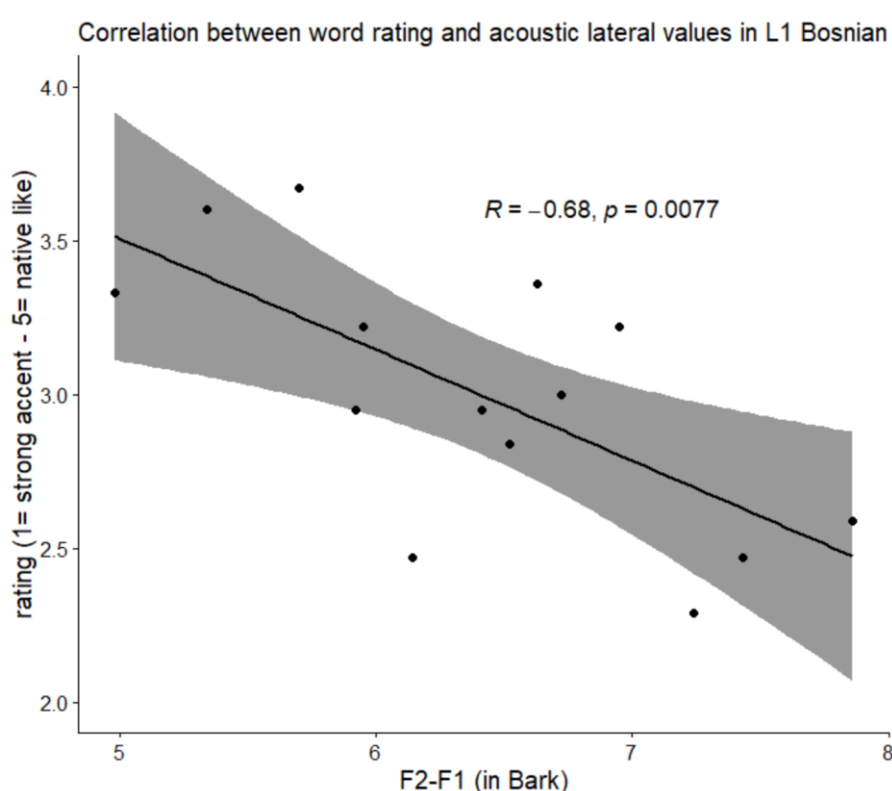


Figure 15. Correlation between the mean rating value for Bosnian words (y-axis) and the mean F2-F1 (bark) value for Bosnian /t/ productions (x-axis) in these same words (as measured in the production experiment in chapter 2) for all individual BoV speakers. Linear regression line (black line) and 95% confidence interval (grey shaped).

3.1.3 Summary and Discussion of L1 Bosnian accentedness ratings

The accent rating study assessed how native listeners of Bosnian without knowledge of German rate the accentedness of words containing the Bosnian velarized lateral phoneme /t/ as produced by bilingual speakers who had emigrated to Vienna as adults and had been living in their L2 environment for at least 15 years. Ratings of the bilinguals' productions were compared to ratings of the productions of monolingual speakers of Bosnian who had spent all their lives in their L1 environment. Specifically,

it was hypothesized that the bilingual speakers (BoV group) might be perceived as less native-like than the monolingual speakers (BoS group), thus reflecting the acoustic results of the production experiment.

Results indeed showed that the productions of BoV speakers were rated as less native-like than the productions of BoS speakers. Furthermore, a correlation analysis showed that the production of laterals was strongly linked to how the words containing these laterals were perceived by native listeners. This suggests that the reorganization of the L1 phonetic space due to the contact with a second language (specifically a change in the production of L1 Bosnian /ɬ/) indeed contributes to a perceived "foreign accent" in the L1, indicating that this change in fine phonetic detail could be interpreted as phonetic attrition.

Speaker gender did not influence the ratings. Thus, the results of the production experiment, in which the factor (speaker) gender was a significant predictor for the degree of velarization in the production of L1 Bosnian /ɬ/, were not fully reflected in the accent ratings. The acoustic analysis in Experiment 1 revealed a significant difference between male and female BoV speakers, insofar as female BoV speakers had significantly higher F2-F1 values in the productions of Bosnian /ɬ/ as compared to BoS speakers, whereas male BoV speakers did not differ significantly from male BoS speakers. Interestingly, the productions of male BoV speakers were rated as comparably foreign accented as the productions of female BoV speakers, indicating that lateral production might not have been the only source for accentedness, even in word productions presented in isolation. The possible influence of further linguistic factors (albeit without analysing the influence of concrete factors), was investigated by additional accentedness ratings of longer utterances. However, Utterance Length was shown to not influence the ratings, neither for BoS nor for BoV speakers. Thus, additional linguistic factors as present in longer utterances obviously did not add relevant information to the perceived accentedness of L1 speech in isolated words extracted from their sentence contexts. This indicates that phonetic cues, as present at the word-level, could to some extent predict the overall perceived accentedness in the L1 speech of late bilingual speakers. However, the factor utterance length was not systematically investigated within the scope of the present study. The (relatively small amount of) longer utterances which were used for comparison therefore primarily served as a control condition, in order to verify the naturalness of the isolated words extracted from sentence context.

To explore how accurately fine phonetic detail can be perceived by monolingual listeners, further analyses of individual differences between speakers are performed. For the results for laterals in L1 Bosnian this was done to shed light on the discrepancy between group effects in production and in accent rating. Individual differences in accent rating are described in chapter 3.3.

3.2 Experiment 2b: L2 German accentedness ratings

Experiment 2b was designed to assess how a subset of the L2 German speech productions of bilingual L1 Bosnian L2 German speakers (BoV), acoustically analyzed in Experiment 1, are rated for a foreign accent. Since Experiment 1 showed differences in acoustic measures of German laterals between bilingual BoV speakers and monolingual L1 German (SAG and VD) speakers, as well as between male and female BoV speakers, Experiment 2b aims at testing whether accent ratings by monolingual German listeners reflect these acoustic differences.

The acoustic difference between BoV speakers and the two L1 German speaker groups was especially striking in the productions of *male* BoV speakers who produced their laterals with significantly lower F2-F1 values (that is, more velarized) than the two L1 German speaker groups. Female BoV speakers, in contrast, produced laterals with similar F2-F1 values compared to L1 German speakers.

As in Experiment 2a for L1 Bosnian, Experiment 2b also assessed the degree of correlation between the German acoustic lateral measures performed in Experiment 1 and the corresponding accent ratings.

3.2.1 Methods

3.2.1.1 Participants

Thirty-one native speakers of Standard Austrian German (SAG, 22 female, 9 male), who had not previously participated in the production experiment, took part in the accent rating experiment. They were recruited amongst colleagues and friends, and via a webpage for job advertisements. Participants received an expense allowance for their participation. Participation requirements were that they had at least a university entrance diploma as their highest educational degree (i.e., Austrian "Matura"), the same held for at least one of their parents, that they and at least one of their parents were born in or in the vicinity of Vienna, that they declared themselves being speakers of the standard variety of German in Austria, and that they had no hearing problems. All listeners were between 20 and 40 years of age and indicated speaking at least English as a foreign language, with some reporting knowledge of additional languages. However, none had learned Bosnian, Croatian, or Serbian.

3.2.1.2 Material

A subset of tokens from the German production tasks in Experiment 1 was used for accent ratings. Fourteen target words from the read-speech task, with a lateral occurring in word-medial position, were selected to cover different vowel contexts. This included five words with front vowels preceding and following the lateral, five words with back vowels preceding and following the lateral, two words with a front vowel preceding and a back vowel following the lateral and two words with a back vowel preceding and a front vowel following the lateral. The selected words were Basilikum (basil), Militär (military), Pelikan (pelican), Religion (religion), Zivilist (civilian), Belag (covering), Philosoph (philosopher), solide (solid), Zentrale (head quarter), Isolation (isolation), Kalorien (calories), Katalog (catalog), Schulung (instruction), Volumen (volume).

Recordings of these words were taken from all 14 bilingual BoV speakers (7 female, 7 male) and a subset of 8 of the German reference speakers (four SAG and four Viennese Dialect (VD) speakers, respectively two female and two male speakers) of the production experiment. SAG and VD speakers were chosen at random but were the same for all participants. Again, as in Experiment 2a, no specific selection criteria for SAG and VD speakers were applied, as the productions of SAG and VD speakers were relatively homogeneous (see results of the production experiment). Fewer SAG and VD speakers than BoV speakers were selected because they mainly served as a reference for monolingual native speakers. The selection of too many reference speakers was avoided in order to avoid a bias towards reporting extremer non-native ratings only.

The words to be presented in the German rating experiment were prepared in the same manner as the words for the Bosnian rating experiment. That is, they were cut out of the respective sentences, then a linear amplitude ramp was added to the beginning and the end of the word in order to avoid audible cracks, and a silence of 50 milliseconds was added before and after each target word. The intensity of all words presented during the experiment was normalized for RMS amplitude, so that the maximal level of the signal energy of all target words and utterances was the same (for more details see Experiment 2a).

3.2.1.3 Procedure

The rating experiment was conducted in a quiet, sound-attenuated booth at the Acoustics Research Institute of the Austrian Academy of Sciences in Vienna, in February and March 2020. The experiment was created in Psychopy 3 (Peirce et al. 2019, v2020.1.3). The experiment was started by the experiment supervisor who allocated anonymised participation codes to each listener. All listeners

used headphones during the whole experiment. The loudness was pre-adjusted and could not be changed independently. In order to enter their responses participants had to use the computer mouse.

Listeners received a brief oral introduction about the procedure of the experiment. Listeners were informed that their data was anonymized before being saved and analyzed and that they were allowed to interrupt the experiment at any time in order to ask questions or to stop the experiment. They were further informed that four times during the experiment a screen would appear with written information about the possibility to take a short break during which they were allowed to get out of the booth if they wanted. In each case, participants could autonomously continue the experiment via mouse click. At the beginning of and during the experiment, the relevant information about the experimental procedure in German was again presented in written form to the participants on the screen.

Before the start of the actual experimental trials, eight practice trials were given, in order to familiarize the participants with the procedure. The first two of the practice trials were preceded by a screen with the written text of the sentence from which the to-be-rated word was taken. The whole sentence containing the target word was presented auditorily 1.5 seconds after the text of the respective sentence appeared on the screen. This was to better understand the original context in which the words had been uttered and to avoid that listeners were distracted by the unusual, decontextualised intonation of the isolated words they had to rate. These two complete practise trial sentences further served as examples for “accented speech” on the one hand versus “native speech” on the other hand. Then a second screen appeared on which participants only saw the target word, cut out of the respective sentence, written on the screen with a 5-point rating scale underneath. The word was presented auditorily in isolation 500 milliseconds after the onset of this screen. Listeners now had to rate the strength of the accent of this word by clicking with the computer mouse on a number of the 5-point scale on the screen. The endpoints of the scale were labelled (1= strong accent, 5= native-like), whereas the numbers 2, 3, and 4 were only indicated by a bar. After having rated the target word of the respective target trial, the next screen with the next practise trial appeared automatically. Six more practise trials in addition to the first two were presented to the listeners, though without the first screen presenting the whole context sentence in written and auditory form. That is, in these six last practise trials, only the isolated word was presented and had to be rated. The example trials were not used for analyses.

After the completion of the eight practice trials, the experimental trials were presented. The screens of the experimental trials matched the screens of the practise trials of those presenting the words in isolation. On each trial listeners saw the target word written on the screen with the rating scale underneath. The audio file of the respective target word (in isolation) was presented automatically 0.5

seconds later. Listeners logged their rating about the accentedness of the target by clicking with the computer mouse on the respective number of the scale. After a response had been given, the experiment automatically moved on to the next trials with an inter-trial-interval of 0.5 seconds. All 14 target words produced by each of the 22 speakers were presented twice in randomized order, resulting in a total of 616 experimental trials. Listeners could take all the time they needed for the ratings. It was not possible to listen to a target word more than once or to change an already logged rating. After the completion of the ratings, listeners had to answer to a short questionnaire about their gender, age, native language, and experience with foreign languages. The questionnaire was filled out together with the experiment supervisor on a computer. For each participant, it took approximately 50 minutes to complete the whole experiment.

3.2.1.4 Data analysis

The statistical analysis was carried out by means of a linear mixed-effects model to assess whether the productions of the bilingual BoS speakers were rated as more accented than productions of the SAG or VD speakers. As German is the L2 for BoV speakers, but the L1 for both SAG and VD speakers, differences in ratings are likely due to the influence of the BoV speakers' L1 Bosnian. A linear mixed-effects model was fitted with the lme4 package (Bates et al., 2015) in R (v4.0.0, R core team, 2020), using the restricted maximum likelihood (REML) method and Satterthwaite approximation for degrees of freedom, as has been done for the analysis of the production experiment and for the Bosnian rating experiment.

The dependent variable was the accent rating on the 5-point scale (from 1 = strong accent to 5 = native-like). Fixed factors were Speaker Group (BoV, SAG, VD), Speaker Gender (f, m) as well as the interaction between Speaker Group and Speaker Gender. The factor Speaker Gender was contrast coded to -0.5 and 0.5 in the order of levels mentioned, such that effects can be interpreted as main effects, as it was done in the analyses of the production experiment (see section 2.2.1). The factor Speaker Group was not contrast coded, because it had three levels. The Speaker Group of BoV speakers was mapped onto the intercept so that the contrasts to the two L1 German Speaker Groups (SAG and VD) could directly be interpreted²³.

In addition to the linear mixed-effects model, a correlation analysis of the rating values for the German words in isolation as produced by BoV speakers and the acoustic values of the laterals in these

²³ Here, only results for contrasts involving the BoV speakers are reported. Additional analyses conducted by the author revealed that words produced by the two German control groups (SAG and VD) did not receive significantly different rating. A more detailed analysis of the difference between SAG and VD speakers would go beyond the framework of the present study and might be a topic for further studies.

words was performed. This was in order to further investigate the link between L2 production and how these productions are perceived by native listeners, in other words, to see whether the ratings were indeed affected by the acoustic values of the laterals. The correlation analysis was conducted for the subset of data of the BoV speakers and was based on the mean rating value for each individual BoV speaker, and on the mean F2-F1 values in Bark for each individual BoV speaker (as measured in the production task). Acoustic data were only considered from the subset of German /l/ productions, that was also used for the rating experiment. A correlation analysis for paired samples was performed by calculating a Pearson's product-moment correlation in R, with the function `corr.test()`, which follows a *t* distribution with $\text{length}(x)-2$ degrees of freedom.

3.2.2 Results

Results of the linear mixed-effects model assessing the accent ratings for German /l/ produced by the bilingual L2 German speakers and the L1 German speakers (SAG, VD) are reported in Table 17. Results showed a significant effect of Speaker Group. Words produced by BoV speakers received significantly lower ratings (a rating of 2.5 in average), that is, they were perceived as being less native-like by L1 German listeners, as words produced by SAG speakers and as words produced by VD speakers (a rating of 4.6 in average, see Table 17, and Figure 16). The interaction between Speaker Group and Gender as well as the factor Gender alone was not significant.

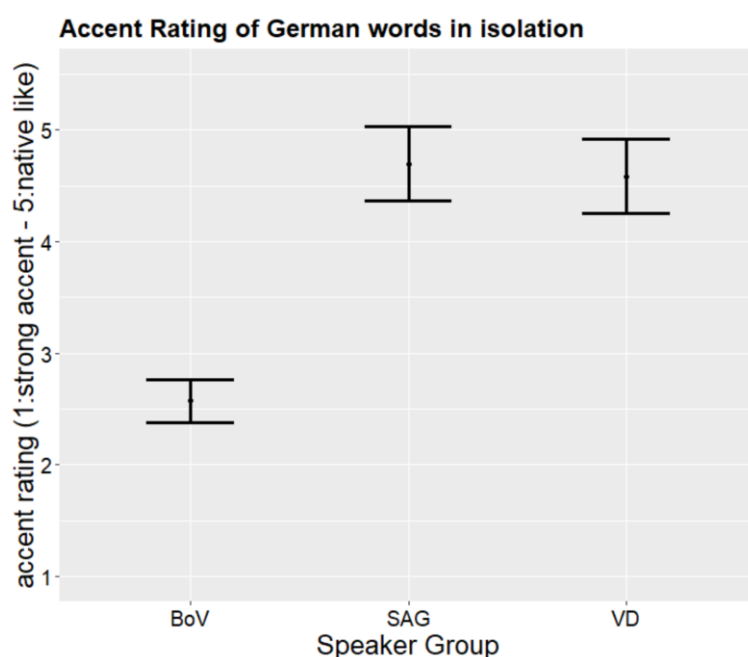


Figure 16. Means (± 1 se) of rating values obtained for productions in German, grouped by Speaker Group (BoV vs SAG vs VD), estimated from the accordingly linear mixed effects model.

Table 17. Relevant fixed effects returned by a mixed-effects model fit to ratings (on a 5-point scale) for productions in German by BoV, SAG, and VD speakers with the rating value as the dependent variable, Speaker Gender (female speakers vs male speakers), and Speaker Group (BoV vs Sag vs VD), and the interaction between Speaker Group and Speaker Gender as fixed factors, and Speaker, Word, and Listener as random effects. The intercept is ratings of productions of BoV speakers.

	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
Speaker Group (SAG)	2.124	0.398	16	5.335	<.0001***
Speaker Group (VD)	2.011	0.398	16	5.052	.0001***
Speaker Gender	-0.066	0.375	16	-0.177	.862
Speaker Group (SAG):Speaker Gender	0.045	0.796	16	0.057	.955
Speaker Group (VD): Speaker Gender	0.314	0.796	16	0.395	.698

The correlation analysis of the rating values for the L2 German lateral in isolated words as produced by BoV speakers and the acoustic measures of the laterals within these same words produced by the same speakers showed a significant correlation between the two factors. The higher the F2-F1 values of the German laterals produced by BoV speakers, the more likely these speakers were perceived as having a native-like German pronunciation ($r = -0.66$, $t = 3.04$, $df = 12$, $p = 0.01$, see also Figure 17).

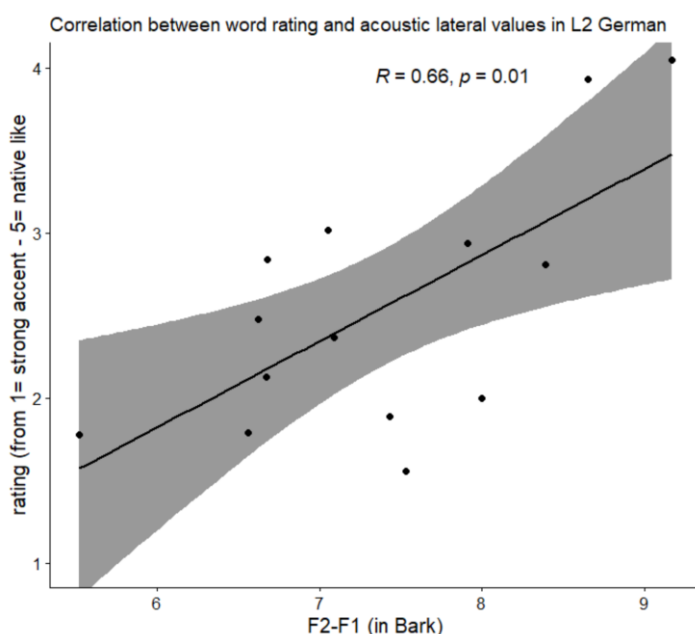


Figure 17. Correlation between the mean rating value for German words (y-axis) and the mean F2-F1 (bark) value for German /l/ productions (x-axis) in these same words (as measured in the production experiment in chapter 2) for all individual BoV speakers. Linear regression line (black line) and 95% confidence interval (grey shaped).

3.2.3 Summary and Discussion of L2 German accentedness ratings

Experiment 2b assessed how German words containing the lateral phoneme /l/ produced by bilingual speakers who had emigrated to Vienna as adults and had been living in their L2 environment for at least 15 years were perceived by native listeners of German, with regard to their accentedness. Ratings of the bilinguals' German productions were compared to ratings of the productions of L1 German speakers living in their L1 environment. Specifically, it was hypothesized that the bilingual speakers (BoV) might be perceived as less native-like than the L1 German speakers (SAG and VD), as suggested by the acoustic results of the production experiment.

Results of the rating experiment indeed showed that L2 productions of BoV speakers were rated as less native-like than productions of L1 German speakers. However, the factor Gender which had been shown to have a significant influence on the production of laterals in L2 German by BoV speakers (see Experiment 1), was not significant in the rating experiment. This had already been shown for the relation between productions in L1 Bosnian and their accentedness ratings, where significant gender differences in production were not reflected in the ratings by monolingual L1 Bosnian listeners.

Results additionally showed that L2 German productions of BoV speakers were rated lower than their L1 Bosnian productions by monolingual listeners of the respective language. Furthermore, L1 German speakers received a higher mean rating score than monolingual L1 Bosnian speakers in Experiment 2a. This might be due to the fact that the range of accentedness was different: In productions of Bosnian, the difference between monolingual and bilingual speakers might have been less obvious than the difference between monolingual and bilingual speakers in productions of German, so that bilingual speakers were more clearly rated as non-native speakers of German than as non-native speakers of Bosnian. A correlation analysis showed that the mean rating value of all rated German words of a speaker was strongly linked to the mean acoustic value of the laterals for these words. This suggests that the production of laterals strongly contributes to the perception of a foreign accent in the L2.

3.3 Analyses of individual differences in accent ratings

This chapter aims at exploring speaker-specific effects in the obtained rating values for the accentedness of L1 and L2 productions of bilingual speakers (BoV) as compared to the ratings obtained for monolingual L1 Bosnian speakers (BoS) and L1 German speakers (SAG and VD). Specific goals are to find out a) to what extent individual bilingual speakers were rated as less native-like compared to the monolingual speakers, b) to identify individual bilingual speakers who differ the most from the group results, c) to characterize the degree of variation within the speaker groups, and to relate the speaker-specific ratings to the corresponding acoustic lateral measures.

3.3.1 Data analysis

First, descriptive analyses of mean rating values of all individual speakers are performed. That is, individual mean rating values are plotted that show how individual BoV speakers are rated in their L1 Bosnian relative to monolingual BoS speakers, and how they are rated in their L2 German relative to L1 German speakers. Second, analyses of variance of the individual rating scores obtained by speakers of the BoV group, separately for gender, are calculated. In order to analyze whether contrasts of individual speakers are indeed significant or not, multiple comparison tests are performed. As the variance in ratings is comparable across all individual BoV speakers²⁴, one-way analyses of variance are performed with the function `aov()` in R, and for multiple comparison tests, Tukey Honest Significant Differences of this analysis of variance were computed with the R function `TukeyHSD()`.

²⁴ For L1 Bosnian, the standard deviation for individual speakers ranged from 1.5 to 1.7 in the ratings of female and male BoV speakers, respectively, and for L2 German, the standard deviation was between 0.8 and 1.2 for female BoV speakers and between 1.2 and 1.4 for male BoV speakers (only p13 differed to a greater extent from the other BoV speakers by showing a smaller standard deviation of 0.8)

3.3.2 Results

Analysis of individual differences in the rating of L1 Bosnian productions

Figure 18 shows mean rating values obtained for productions in L1 Bosnian by individual BoV and BoS speakers. Most bilingual L1 Bosnian speakers were clearly perceived as having a stronger foreign accent compared to monolingual BoS speakers. However, no speaker of either of the speaker groups (BoV or BoS) was given the worst or the best possible rating scores (that is, a rating score of 1 or of 5). Mean values of individual BoV speakers were gradually distributed between points 2 and 4, in both groups of female and male speakers equally. From Figure 18 it can be concluded that in the group of female BoV speakers, p02 got visibly the most similar ratings to the monolingual reference group, whereas p04, p06 and p07, who are clustered together, clearly got the worst ratings, with a score of 2.5 on average. P01, p03 and p05 are also clustered, their mean rating scores are situated in between these two extremes. The multiple comparison tests, performed for the subset of BoV speakers alone, showed that these individual differences in the ratings of the productions of female BoV speakers were

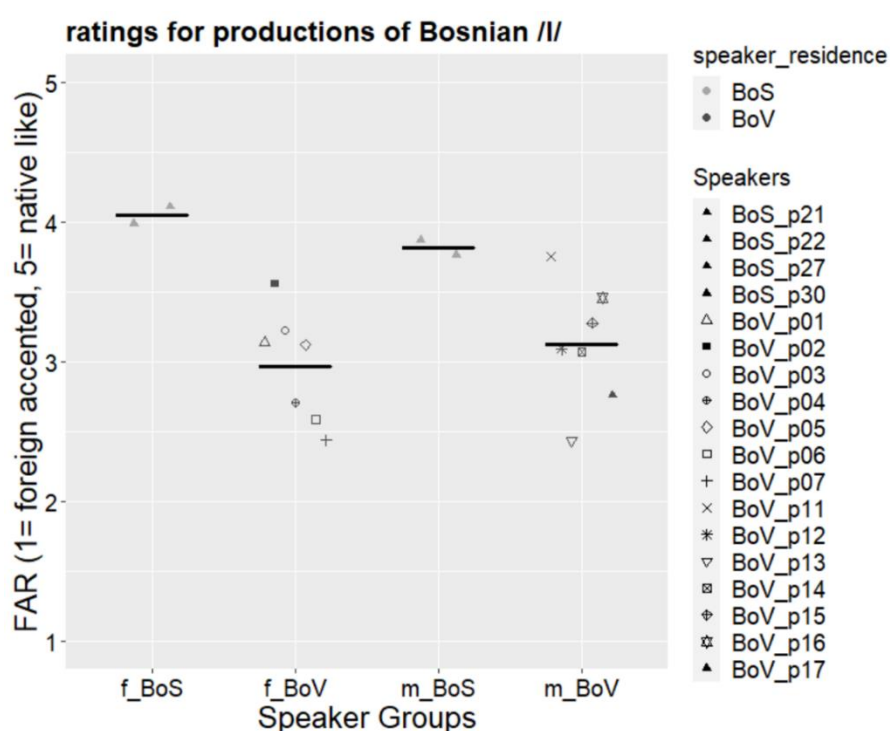


Figure 28. Means of rating values obtained for productions in Bosnian for each individual speaker, grouped by Speaker Group (BoS vs BoV) and by Gender (f= females vs m= males). Short horizontal crossbars indicate the group mean F2-F1 (bark) value.

indeed significant (see Table 18), except for the described clusters. In the group of male speakers, p11 received the best ratings, similar to the ratings obtained by monolingual BoS speakers. The worst rating was given to p13 and p17, also with rating scores as low as 2.5 in average, as for the worst ratings for female BoV speakers. The four speakers p12, p14, p15, and p16 were in between these extremes. For

male speakers, the multiple comparison tests (see Table 18) showed that no individual speaker (and no cluster of individual speakers) differed significantly from all other speakers, so that there were more overlaps between speakers within the group of male BoV speakers as compared to the group of female BoV speakers. However, p11, the speaker with the best rating score, was only similarly rated to p16 and significantly differed from all other speakers. And p13, the speaker with the lowest rating score, just failed to reach significance in the difference to speaker p17, and was significantly different from all other speakers. And p17 in turn just failed to reach significance in the difference to the ratings of p14 and p12, so that the ratings of these speakers (p13, p17) can also be classified as clearly diverging insofar as they are lower as compared to ratings for other individual speakers of the same group.

Table 18. Results of multiple comparison tests performed on the one-way analysis of variance of accent ratings for bilingual speakers' German lateral productions. Left panel= female BoV speakers (grey shaded), right panel= male BoV speakers (white shaded).

Female BoV speakers	<i>diff</i>	<i>lwr</i>	<i>upr</i>	<i>p adj</i>	Male BoV speakers	<i>diff</i>	<i>lwr</i>	<i>upr</i>	<i>p adj</i>
P01-p02	0.42	0.09	0.75	0.004**	P11-p12	-0.66	-0.99	-0.33	<0.0001***
P01-p03	0.86	-0.25	0.42	0.99	P11-p13	-1.32	-1.64	-0.99	<0.0001***
P01-p04	-0.43	-0.76	-0.1	0.003**	P11-p14	-0.68	-1.01	-0.35	<0.0001***
P01-p05	-0.01	-0.35	0.32	1	P11-p15	-0.48	-0.8	-0.15	0.0004***
P01-p06	-0.55	-0.88	-0.22	<0.0001***	P11-p16	-0.3	-0.62	0.03	0.11
P01-p07	-0.7	-1.03	-0.37	<0.0001***	P11-p17	-1	-1.32	-0.66	<0.0001***
P02-p03	-0.34	-0.67	-0.002	<0.05*	P12-p13	-0.66	-0.98	-0.33	<0.0001***
P02-p04	-0.85	-1.18	-0.52	<0.0001***	P12-p14	-0.02	-0.35	0.31	1
P02-p05	-0.44	-0.77	-0.1	0.002**	P12-p15	0.18	-0.14	0.51	0.65
P02-p06	-0.97	-1.3	-0.64	<0.0001***	P12-p16	0.36	0.04	0.69	0.02*
P02-p07	-1.12	-1.45	-0.79	<0.0001***	P12-p17	-0.33	-0.66	-0.003	0.05
P03-p04	-0.52	-0.85	-0.18	<0.0001***	P13-p14	0.63	0.3	0.96	<0.0001***
P03-p05	-0.1	-0.43	0.23	0.97	P13-p15	0.84	0.51	1.17	<0.0001***
P03-p06	-0.64	-0.97	-0.3	<0.0001***	P13-p16	1.02	0.69	1.35	<0.0001***
P03-p07	-0.79	-1.12	-0.45	<0.0001***	P13-p17	0.32	-0.01	0.65	0.06
P04-p05	0.42	0.08	0.75	0.004**	P14-p15	0.21	-0.12	0.54	0.51
P04-p06	-0.12	-0.45	0.21	0.94	P14-p16	0.39	0.06	0.72	0.01*
P04-p07	-0.27	-0.6	0.06	0.21	P14-p17	-0.31	-0.64	0.02	0.08
P05-p06	-0.53	-0.87	-0.2	<0.0001***	P15-p16	0.18	-0.15	0.51	0.67
P05-p07	-0.68	-1.02	-0.35	<0.0001***	P15-p17	-0.52	-0.85	-0.19	<0.0001***
P06-p07	-0.15	-0.48	0.18	0.841	P16-p17	-0.7	-1.03	-0.37	<0.0001***

Analysis of individual differences in the rating of L2 German productions

Figure 19 shows mean rating values obtained for productions in L1 and L2 German by individual BoV speakers and SAG and VD speakers. Most bilingual L1 Bosnian speakers were clearly perceived as having a stronger foreign accent compared to L1 German speakers. In the group of female BoV speakers, the mean rating scores for individual speakers ranged from very low scores (1.5) to high scores (4), the highest scores being similar to the scores obtained by monolingual L1 German speakers. In the area of the lowest rating scores there was one cluster of four speakers (p01, p02, p03, p05). In the middle of the rating range for female BoV speakers, there was only one speaker (p04), and clearly separated from these speakers and close to the high rating values of L1 German speakers, there was another cluster of two speakers, p06 and p07. The multiple comparison test, again performed on the group of BoV speakers alone, showed that these individual differences between BoV speakers of different clusters were indeed significant. Even within the cluster of the lowest rated female BoV speakers, most individual differences were significant (although the differences were clearly small, that is between 0.2 and 0.4 points of the rating scale). In the group of male speakers, the mean rating scores for individual speakers were gradually distributed from 1.8 to 3, thus there were no individual speakers who reached similar scores to the L1 German reference speakers. The highest ratings were obtained

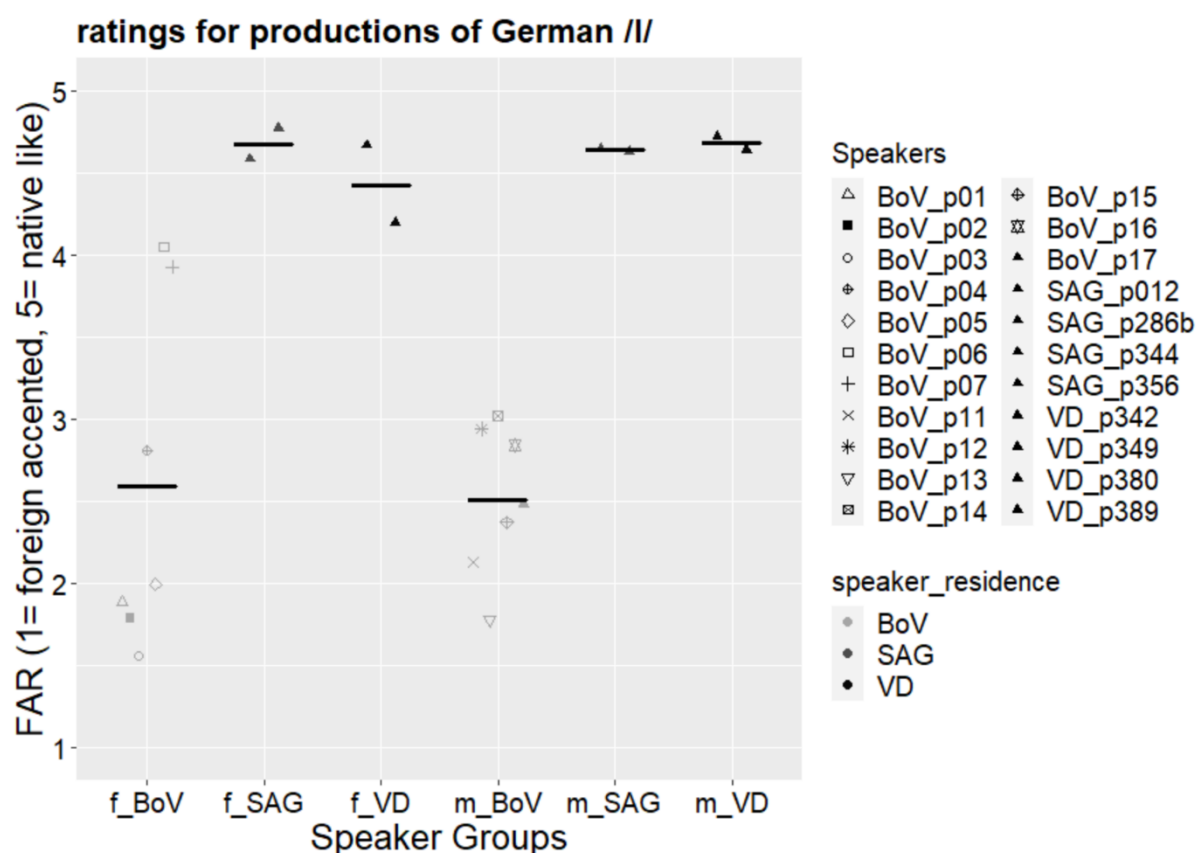


Figure 19. Means of rating values obtained for productions in German for each individual speaker, grouped by Speaker Group (SAG vs VD vs BoV) and by Gender (f= females vs m= males). Short horizontal crossbars indicate the group mean F2-F1 (bark) value.

by a cluster of three speakers, p12, p14, p16 (with a mean rating score of 3, respectively), followed by p17, p12, p11, and p13 with the lowest scores (gradually worse ratings, to less than 2 points). Here the multiple comparison test also confirmed that the differences within a cluster are not significant.

Table 19. Results of multiple comparison tests performed on the one-way analysis of variance of accent ratings for bilingual speakers' German lateral productions. Left panel= female BoV speakers (grey shaded), right panel= male BoV speakers (white shaded).

Female BoV speakers	diff	lwr	upr	p adj	Male BoV speakers	diff	lwr	upr	p adj
P01-p02	-0.1	-0.25	0.05	0.46	P11-p12	0.81	0.64	0.98	<0.0001***
P01-p03	-0.33	-0.48	-0.17	<0.0001***	P11-p13	0.89	-0.52	-0.18	<0.0001***
P01-p04	0.93	0.78	1.07	<0.0001***	P11-p14	0.88	0.72	1.06	<0.0001***
P01-p05	0.11	-0.04	0.26	0.32	P11-p15	0.24	0.07	0.41	0.0005***
P01-p06	2.16	2.01	2.31	<0.0001***	P11-p16	0.71	0.54	0.88	<0.0001***
P01-p07	2.04	1.89	2.19	<0.0001***	P11-p17	0.35	0.18	0.52	<0.0001***
P02-p03	-0.23	-0.39	-0.07	<0.001***	P12-p13	-1.16	-1.33	-0.99	<0.0001***
P02-p04	1.02	0.87	1.17	<0.0001***	P12-p14	0.08	-0.09	0.25	0.82
P02-p05	0.21	0.06	0.36	<0.001***	P12-p15	-0.57	-0.74	0.4	<0.0001***
P02-p06	2.26	2.11	2.41	<0.0001***	P12-p16	-0.1	-0.27	0.07	0.57
P02-p07	2.14	1.99	2.29	<0.0001***	P12-p17	-0.46	-0.63	-0.29	<0.0001***
P03-p04	1.25	1.1	1.41	<0.0001***	P13-p14	1.24	1.07	1.41	<0.0001***
P03-p05	0.44	0.28	0.59	<0.0001***	P13-p15	0.59	0.43	0.76	<0.0001***
P03-p06	2.49	2.34	2.65	<0.0001***	P13-p16	1.06	0.89	1.23	<0.0001***
P03-p07	2.37	2.21	2.53	<0.0001***	P13-p17	0.7	0.53	0.88	<0.0001***
P04-p05	-0.82	-0.97	-0.67	<0.0001***	P14-p15	-0.65	-0.82	-0.48	<0.0001***
P04-p06	1.24	1.09	1.39	<0.0001***	P14-p16	-0.18	-0.35	-0.01	0.03*
P04-p07	1.11	0.97	1.27	<0.0001***	P14-p17	-0.54	-0.71	-0.37	<0.0001***
P05-p06	2.05	1.9	2.2	<0.0001***	P15-p16	0.47	0.3	0.64	<0.0001***
P05-p07	1.93	1.78	2.08	<0.0001***	P15-p17	0.11	-0.06	0.28	0.51
P06-p07	-0.12	-0.27	0.03	0.197	P16-p17	-0.36	-0.53	-0.19	<0.0001***

3.3.3 Summary and Discussion of individual differences in perception versus production

The present chapter aimed at clarifying whether the speech productions of individual speakers within the groups of female/male bilingual (BoV) speakers were rated similarly to each other or whether there would be significant differences between individual speakers. This variability was investigated with reference to the variability within the groups of monolingual speakers of the respective languages (chapter 2.2.7). It was further compared to the variability observed in the corresponding speech production data (chapter 2.3.3). The goal was to identify those individual bilingual speakers who overall deviated most in L1 or L2 productions from the respective monolingual speakers or from other

bilingual speakers. This further served as basis for the conduction of qualitative analyses of speaker-specific factors potentially contributing to the atypical productions of these speakers.

Bosnian

The overall group effects of the L1 Bosnian rating experiment suggested that BoV speakers were generally perceived as less native-like sounding in their L1 Bosnian as compared to monolingual speakers still living in the L1 environment, with a 1-point difference on a 5-point rating scale. A correlation analysis further indicated that the accentedness ratings were strongly linked to the productions of laterals within the same words that were rated. It was concluded that the reorganization of the L1 phonetic space (a diverging production of the L1 Bosnian /t/), occurring because of the use of a further language, contributed to a perceived "foreign accent" in the L1.

The analysis of the individual differences in accent ratings for productions in L1 Bosnian then showed that the group of BoV speakers was heterogenic, that is, there was considerable variation around the group means reported in the statistical group analysis. Most of the individual bilingual L1 Bosnian speakers were clearly perceived by monolingual BoS listeners as having a stronger foreign accent compared to monolingual BoS speakers. However, the ratings for individual BoV speakers ranged from values within the range achieved for monolingual BoS speaker to values being clearly associated with foreign accented production. The groups of female and male BoV speakers showed a comparable amount of between-speaker variability of ratings for their L1 Bosnian productions. In female speech, ratings for p04, p06, and p07 were significantly worse than for p01, p03 and p05, and ratings for p02 were significantly better than for all other speakers. In male speech, ratings for p13 were significantly worse than for speaker p17. Speakers p12, p14 and p15 tended to obtain better ratings than the previously mentioned speakers, whilst p11 and p16 received significantly better scores than all other male BoV speakers.

Within the group of female BoV speakers, the ratings for individual L1 Bosnian productions thus largely reflected the results of the analysis of individual differences in corresponding lateral production. P04 and p07 were shown to produce laterals with significantly higher F2-F1 values in their L1 Bosnian compared to monolingual speakers and compared to other female BoV speakers, which was reflected in their ratings. P06 was additionally rated as clearly more foreign accented compared to monolingual Bosnian speakers and compared to the rest of female BoV speakers, just as p04 and p07. This is striking because in production, L1 Bosnian laterals produced by p06 only differed from laterals of other L1 Bosnian speakers when they were produced in back vowel context and not in other contexts. This pattern in the production data was also observed for p01, whose productions were, however, not rated with a comparable low score as those of p06. A further difference between p06

and other speakers, that might have contributed to a comparably “worse” rating for her L1 Bosnian productions, was her individual lateral production in L2 German, which she produced with the highest F2-F1 values from all BoV speakers (indistinguishable from native L1 German speakers), and thus clearly distinct from p01, who showed lower F2-F1 values in her L2 German laterals. These acoustic values of L2 German laterals were also mirrored in the ratings for the bilingual speakers’ lateral productions in L2 German, where p06 received clearly better scores than p01. P02 was one of the female BoV speakers whose acoustic lateral values in L1 Bosnian was closest to the mean of the monolingual BoS speakers and who received the best rating scores for her L1 Bosnian productions. But the acoustic measures of L1 Bosnian lateral productions of p05 were also very close to the values of BoS speakers (even closer than the laterals of p02), even though this was not reflected in the individual results of the Bosnian rating experiment. Here, the same observations were made as for p06 and p01: p05 performed clearly better in the production of L2 German laterals than p02 and was also perceived slightly more native-like in L2 German than p02. For individual female BoV speakers it can thus be concluded that the acoustic lateral productions largely predict the foreign accent rating scores, and that the pattern of individual differences in the productions of L2 German laterals even better predicts the pattern of individual differences in rating values of L1 Bosnian speakers.

Within the group of male BoV speakers, the ratings for individual L1 Bosnian productions reflected the results of the acoustic analysis of individual differences in lateral productions to a lesser extent than it was the case for female BoV speakers. Whilst in the production data the individual speakers of the male BoV group were not distinguishable at all from the individual speakers of the monolingual male BoS group, the data of the rating experiment showed a diverging picture. The mean rating values of individual male BoV speakers hardly overlapped with the mean rating values of individual male BoS speakers, that is, almost all male BoV speakers received lower ratings than male BoS speakers. The lowest ratings for productions in L1 Bosnian were obtained for speakers p13 and p17. Neither of these two speakers showed such a result in case of the acoustic measurements. However, a reconsideration of the acoustic production data revealed that p13 was most probably rated lower because of a generally deviating articulatory setting resulting particularly in suprasegmental deviations²⁵ in both L1 Bosnian and L2 German productions. Therefore, the low rating of p13 seemed to be unrelated to the production of the lateral phoneme /l/ and, thus, unrelated to cross-language mapping. In the case of speaker p17, a potential reason for lower ratings might have been the different recording setting, as he was the only BoV speaker who was recorded at home rather than in the sound booth of the Acoustics Research Institute. On the other hand, in the ratings for his German productions, this

²⁵ Such as mumbling, without further influencing segmental characteristics or fluency in general. A more detailed, pathological description of the speech characteristics, however, cannot be given within the framework of the present study.

circumstance does not seem to have had an impact. A new look at Figure 18 suggests that these two deviating speakers might have prevented the finding of a general gender effect in the perceptual experiment which had been found in the production experiment. Still, the remaining male BoV speakers differed in their accent ratings from the male BoS speakers, unlike in the acoustic analysis of their lateral productions.

Taken together, it can be concluded that the ratings of L1 Bosnian speech productions are strongly related to the productions of the lateral phoneme /t/. Listeners even distinguished differences between individual speakers observed phonetically. However, the ratings seem to be further influenced by additional linguistic cues, resulting from cross-language mappings from L2 to L1, which might shift the absolute rating scores to some extent. One indicator for the possible presence of such additional linguistic cues leading to the stronger perceived accentedness in L1, even at the word level, is the lateral production in L2 German. The closer the acoustic measurements of the L2 German lateral segments produced by BoV speakers are to the measurements of monolingual L1 German speakers, and the closer the ratings for German productions of BoV speakers are to the ratings of monolingual German speakers, the more the ratings for BoV speakers in their L1 Bosnian productions are shifted towards the lower scores.

German

The group effects of the German rating experiment generally suggested that BoV speakers were perceived as less native-like in their L2 German than L1 German speakers (both SAG and VD speakers), with a 2-points difference on average on a 5-point rating scale and, thus, with a larger difference than in L1 Bosnian to the monolingual Bosnian speakers (where the difference was only 1 point). Also, for the German productions, a correlation analysis indicated that the accentedness ratings were directly related with the productions of laterals within the words which were rated.

As has already been discussed for the ratings of Bosnian productions, a large variation between individual BoV speakers was observed for ratings of German productions. Most of the individual bilingual L1 Bosnian speakers were clearly perceived by monolingual German listeners as having a stronger foreign accent in their German productions as compared to monolingual German speakers. In total, only two (female) BoV speakers (p06, p07) received rating scores very close to monolingual German speakers, while all other BoV speakers had an at least 1-point distance to the lowest-rated monolingual German speaker. Rating values for male and female BoV speakers were differently distributed over the rating scale. As just mentioned, two female speakers received clearly the best scores. But it is also within the group of female speakers where the worst absolute scores were found (p02 and p03). Male BoV speakers mostly received medium ratings between 2 and 3 (with p13 again

having the lowest ratings, just as for his L1 Bosnian productions, and p12 and p14 with the highest ratings), whereas only one of the female BoV speakers (p04) received a medium score of 2.8 points. Female speakers, thus, overall received the most extreme rating scores, that is the absolute best and the absolute worst scores. For female BoV speakers a strong relation between individual lateral productions in L2 German and individual rating scores obtained for the L2 word productions was found. The best rating scores, similar to the scores obtained by monolingual German speakers, were reached by p06 and p07 whose acoustic lateral measurements were exactly within the range of L1 German speakers. Furthermore, p02 and p03, who received the worst ratings, also had F2-F1 values that differed most from monolingual German speakers in lateral production. Concerning the relation between lateral productions and accent ratings of individual male BoV speakers, the rating results for German productions again reflected the acoustic measurements of the production experiment to a lesser extent than in female speech. On the one hand, again because speaker p13 was rated clearly lower than the other male BoV speakers (recall, however, that this was not related to his lateral productions, as explained above). On the other hand, because p12, who clearly showed the most similar acoustical values to the German reference speakers and significantly differed from the other speakers of his group, did not show this pattern in his accent ratings. He was in fact one of the best-rated male BoV speakers (together with p14 and p16), whose acoustic lateral productions did not differ from other BoV speakers, neither in L1 Bosnian nor in L2 German. Moreover, even though the ratings for p12, p14 and p16 were the best within the group of male BoV speakers, they obviously differed from the ratings of monolingual German speakers, and thereby also from the best rated female BoV speakers. A possible reason could be that p12 only scarcely produced L2 German laterals within the range of L1 German speakers. Therefore, his L2 German lateral productions might still have been too distinct from the monolingual German reference speakers. If speaker p13 was excluded from the analysis of individual differences, the worst ratings for L2 German lateral productions of male BoV speakers were clearly higher as the worst ratings for female BoV speakers. This result was not predicted by the production data. In contrast, the individual male BoV speakers all produced German laterals with lower F2-F1 values than female BoV speakers, thus further apart from the laterals produced by L1 German speakers. While from this it was expected that male BoV speakers received lower rating scores for their L2 German productions than female BoV speakers, but instead, they actually received *better* scores than female BoV speakers.

A possible explanation might be the role of the lateral sound in the interplay of the Viennese Dialect (VD) and Standard Austrian German (SAG). As illustrated in the introductory chapter in section 1.4.1, the velarized lateral variant is a salient marker of the VD. As this dialect is rather negatively evaluated, compared to other Austrian varieties, the velarized lateral tends to be avoided in more formal situations and generally by female speakers, who rarely ever velarize their laterals. However,

concerning the ratings of the German production data, it cannot be assumed, that female BoV speakers were confused with dialect speakers and negatively rated because of their dialectal pronunciation. The ratings of (the worst rated) female BoV speakers are in fact so low that one can clearly conclude that they were recognized as non-native speakers. It might be, though, that the velarization of the German lateral had an unconscious effect on the rating of BoV speakers and that, despite of similar acoustic values for female and male speakers, female speakers were rated worse than male speakers because female speakers are generally less associated with velarization. If velarization occurs in the speech of female speakers this might be perceived as more salient than in the productions of male speakers. Velarization could trigger the general impression of “distance to the standard variety”, and more so for female speakers. It should be noted here again that, first, the speakers were all rated by SAG speakers. And, second, that female speakers of the VD were indeed also lower rated, on average, than male speakers of SAG and VD, even though their production data was comparable: In the monolingual German groups, only the female SAG speakers stood out with higher F2-F1 values in lateral productions, whereas all other monolingual German speakers produced laterals with similar F2-F1 values.

Another possible explanation for the disproportional worse ratings of female BoV speakers for their L2 speech could be that female L2 speakers are generally expected by the listeners to yield more native-like L2 production than male L2 speakers. Recall that in the production data female speakers revealed more native-like laterals in their L2. However, in the literature the author is aware of, there is no clear evidence for a general female advantage in L2 pronunciation learning, not to mention regarding expectations about female or male L2 speech in perception. It is often informally assumed that female speakers are more successful in their L1 as well as in further languages learned later in life. However, gender differences in L2 acquisition have rarely been addressed in formal studies (Moyer 2016, but see, e.g., Payne & Lynn 2011, and van der Slik et al. 2015). Gender differences in general (as primarily investigated in L1 research) might often be best explained by gender stereotypes and social roles (e.g., Eckert & Sally McConnell-Ginet 1999, Barbu et al. 2015), because social roles lead to the situation that girls are more supported in their L1 acquisition, and they also lead to the situation that more girls are interested in foreign languages at school or university than boys (Wucherer & Reiterer 2018). Concerning L2 sound acquisition in such a learning situation, male speakers seem to outperform female speakers in phonetic speech imitation ability (pronunciation), which has been attributed to a more open-minded, extravert and motivated personality (Wucherer & Reiterer 2018). However, the L2 learners in the present study are not classroom language students, that is, they did not decide voluntarily to learn a specific foreign language, but rather, they were more or less forced to migrate to the L2 environment. Most probably, the speakers in the present study encounter different preconditions concerning the acquisition of their L2 compared to classroom language learners, insofar

as these attitudinal factors toward language acquisition, common in (at least) our society, might play a minor role in the context of migration. Particularly in the context of migration, gender must rather be seen as a social construct which has an impact on the amount of opportunities to use the L2 and finally on what is called “ultimate attainment” (see Moyer 2016).

In some immigration communities female speakers have way less access to input from native speakers of the L2, or less possibilities for practice, especially, when they stay at home and do not work. In this case, they will rely more on their L1 and show a stronger accent in their L2 as compared to their partners and children. However, in the present study, the basic scenario is different. Female and male BoV speakers as a group did not differ concerning their professional lives and contacts with native speakers.

Within the scope of L1 variation studies, it has been found that female speakers tend to avoid non-standard and stigmatized forms (either old or new forms) in favour of more prestigious forms. In this function, female speakers were described to play a leading role in (non-stigmatized) sound change (e.g., Labov 1990, Chambers 1995, Maclagan et al. 1999). This was often attributed to a higher awareness of female speakers of social status, connected to social pressures (see Trudgill 1974). This finding holds especially for female speakers in the middle social classes, that is, those classes most characterized by social mobility, going along, on the one hand, with the presence of more linguistic variation and, on the other hand, with more possibilities for mobility (see review in Moyer 2016). The situation of immigrants, especially in case of the speakers of the present study who all had a good education and a relatively good social status at the time of their arrival (at least compared to the situation most refugees currently face in Europe)²⁶, was likewise characterized by possibilities of mobility. With respect to L2 sound learning, female bilingual speakers in a migration setting might also be more aware of native-like and, specifically, of standard like sounds in the L2. This could result in a sound change by allowing a stronger influence of the more prestigious L2 on their L1-L2 phonetic-phonological system. Thereby, L2 sounds would be produced more native-like, and they would have a stronger influence on the L1 sounds (e.g., Shin 2013, and van Ness 1995, for the leading role of female immigrant speakers on changes of lexical aspects in their L1) .

The results of the present study indeed suggests a female advantage in L2 acquisition, which appears to be reflected by more native-like L2 productions, but also in a restructuring of the L1 phonetic system, that is, in L1 attrition. However, the productions of some of the female BoV speakers deviated from the monolingual German speakers, being similar to the productions of the male BoV speakers. Interestingly, the worst ratings for L2 German productions were obtained for members of the female

²⁶ See, e.g. this newspaper article: <https://www.derstandard.at/story/2000030611094/warum-die-integration-der-bosnien-fluechtlinge-klappte-und-es-heute>

speaker group, not the male one. In L1 Bosnian, some of the female BoV speakers were exactly within the range of monolingual Bosnian speakers and also received the best ratings. These results suggest that, if gender is an indicator for the strength of reorganization of the L1-L2 phonetic system after contact to a second language, it is at least not the only factor and there appear to be additional factors which are probably more relevant for a restructuring of the phonetic system than the factor gender. The present study does not suggest a general biological foundation of gender differences. This is in line with previous research, which fails in drawing concrete conclusions about gender-specific neural organization and language processing (see overview in Moyer 2016).

To sum up, most individual bilingual speakers were rated as more foreign accented in L1 as well as in L2 compared to monolingual speakers of the respective languages. However, results showed significant variation of the perceived accentedness within the groups of both female and male BoV speakers. In L1 Bosnian, the variance of individual ratings was comparable for female and for male speakers. In L2 German, however, rating values for female speakers showed a larger variance than those for male speakers, due to the native-like ratings obtained for some female speakers for none of the male speakers. This variation in perceived accentedness across individual speakers was strongly linked to their individual speech productions. However, not the entire variability in ratings could be linked to the variability in production. It was suggested that cross-language mappings of additional phonetic characteristics besides the laterals (probably even at the word level alone) from L2 to L1 might have contributed to the perceived accentedness in L1. For perceptual ratings of L2 German, it was suggested that sociopsychological factors might have led the listeners of the rating experiment to provide different ratings for the more velarized laterals depending on the gender of the speaker, resulting in relatively worse ratings for some of the female speakers in comparison to their acoustic values of their lateral productions. Moreover, it was suggested that the native-like L2 German ratings which were obtained for some female speakers and not for male speakers is to some extent compatible with the sociolinguistic theory about female speakers preferring more prestigious linguistic variants in order facilitate social mobility.

4 Qualitative analyses of individual differences in selected speakers

In the previous chapters it was shown that BoV speakers as a group differed significantly both from monolingual speakers of their L1 Bosnian and from monolingual speakers of their L2 German. This difference was found in both production and their received accent ratings. That is, productions of the similar lateral phonemes in both languages were assimilated to each another. Specifically, female speakers as a group showed phonetic L1 attrition in their Bosnian /t/ productions, by producing Bosnian /t/ with higher F2-F1 values, that is, less velarized. At the same time female speakers' L2 German /l/ productions were more target-like than productions of male BoV speakers, that is, again, less velarized.

However, individual variation was found between bilingual speakers concerning the strength and the manner of restructuring of their L1-L2 phonetic-phonological system. This was even more conspicuous as the group of BoV speakers as a whole was relatively homogeneous concerning overall biographical factors. That is, factors such as age of arrival in the L2 environment, age of acquisition of the L2, length of residence, age at recording, educational status, and family situation (e.g. L1 of the partner, having children) were all highly comparable between the BoV speakers (see chapter 2.1.1). Individual differences in production were especially striking in the group of female BoV speakers. Some of these female speakers were shown to produce the Bosnian velarized /t/ comparable to productions of monolingual Bosnian speakers, whereas other female BoV speakers clearly assimilated the velarized Bosnian /t/ to the plain alveolar German /l/. The same held true for lateral productions in L2 German, which ranged within the female BoV group from productions clearly assimilated to the velarized productions of L1 Bosnian to alveolar productions similar to those produced by monolingual German speakers. The individual male speakers, however, were not shown to assimilate their velarized L1 Bosnian lateral, and only a few succeeded in building a new category for their plain alveolar L2 German lateral. These individual differences in production were, to a large extent, reflected by accent ratings of the individual speakers. It was suggested that the reason for some of the female bilingual speakers showing strong phonetic L1 attrition and native-like L2 productions and ratings might be attributed to women's higher awareness of more prestigious linguistic variants, and possibly also to their higher awareness of the relationship between language use and social mobility.

In the present chapter a description of the most striking differences between individual speakers by means of the information collected in the qualitative interviews will be presented. Information about language attitudes on L1 and L2 will be considered, as well as about social roles, and the amount and quality of contact to L1 German speakers.

The focus will be placed on the speakers who showed the most restructuring of their L1-L2 phonetic-phonological system and aims at interpreting these individual differences with regard to the other BoV speakers. Therefore, specifically the interviews with three of the female BoV speakers, p04, p06, and p07, will be analysed in detail. P06 and p07 show strong L1 attrition and at the same time these two speakers show the most target-like L2 productions. P04 differs from these speakers insofar as she is amongst the strongest L1 attriters, but she is not, unlike the other two, amongst the speakers with the most target-like L2 productions or ratings. Moreover, p04 does not show distinct L1 and L2 lateral categories, instead, she produces one composite L1-L2 lateral category, which is strongly assimilated to the L2 German /l/ category. This contrasts with p06 and p07, who both developed separate lateral categories for Bosnian /t/ and for German /l/.

In the following, information extracted from the qualitative interviews with these three female BoV speakers (p04, p06 and p07) is first given separately for each speaker. Thereby, the focus lies on factors which were not requirements for participation and which are less simple to measure, like amount and quality of L1 and L2 language use, language attitudes, and biographic experiences in the L1 and L2 environment. Thereafter, a summary of the most striking factors that might have contributed to a stronger restructuring of the L1-L2 phonetic-phonological system of these speakers is given and compared to information on these same factors given by other BoV speakers. Concerning the comparison with other speakers, the focus lies on speakers with the most divergent results as compared to p04, p06 and p07: that is, specifically the interviews with the female speakers p02 and p03, and with the male speakers p11, and p15 are considered. In the group of female speakers, p02 did not show phonetic attrition in L1 Bosnian. In L2 German, p02 and p03 were the two female BoV speakers with the least target-like productions. In the group of male BoV speakers, none of the speakers showed especially much or especially little attrition in L1 Bosnian as compared to group mean. However, in L2 German, two male speakers with significantly less target-like productions as compared to other male BoV speakers were identified, that is p11 and p15, who produced composite L1-L2 laterals and did not show any sign of L1-L2 phonetic-phonological lateral restructuring. Information about the remaining BoV speakers is also considered for the qualitative interpretation of individual differences, albeit less systematically.

4.1 Information on speaker p04

P04 is one of the female speakers with the most phonetic L1 attrition, as measured acoustically by the lateral formants and perceptually by the accent ratings. Her productions in L2 German, however, are significantly worse than those of the speakers with the closest values to monolingual German reference speakers. She produces one composite, merged category for /l/ in L1 Bosnian and L2 German.

What catches the attention the most in the interview with p04 is that she went through terrible personal experiences before her emigration from war-torn Bosnia (as well as also p06, see next section), amongst them a perilous flight, the assassination of a near family member, and sexual harassment. She describes her feelings towards Bosnia and the people living there at the time of emigration as follows²⁷:

(1) *“I think, as I sat down in the bus and as I looked at our house one more time, I knew that I would never live there again [...] not that I hate them, I have since been able to forgive, but the people that live there aren’t the people that I knew, now when I’m in [TOWN NAME REMOVED] [...] at first I saw in all these men people who have killed people, because I know so many of them by name and their surnames [...] they were my schoolmates, they were people that I knew, that were our neighbors and I have the feeling that if it were to happen again tomorrow [...] I have the feeling they wouldn’t react any differently, I don’t know, I have that feeling.”*

This citation, as well as many others in the course of the interview, also reflect her overall and long-lasting mistrust against other ethnic groups living in Bosnia (e.g., Serbs and Croats). This experience and this mistrust are probably some of the main reasons for her initially rare visits to Bosnia. At this time, she again visits Bosnia every two months to care for her elderly mother who is ill.

On the other hand, she has positive associations with her arrival in Austria, thanks to several encounters with cooperative people, who helped her with donations, or spoke up for her, especially regarding accommodation and employment. With a lot of effort, she managed to establish herself in Austria and achieved a position associated with a comfortable living standard and social recognition. She declares speaking L1 Bosnian and L2 German each about 50% of the time, and, most crucially, she also speaks mostly (though not exclusively) German with her children at home. Her two children were already born in Bosnia but are young enough that they started preschool/school after their arrival in Vienna. However, as she had to work long hours, she did not have much time to get to know to a lot of L1 German speakers via her children. Also in her professional field, the quality of German input was

²⁷ For the original German transcriptions of these excerpts from the recordings, see Appendix I. The text here only provides the English translations.

probably reduced due to the fact that she always worked in a care home for the elderly, where she was surrounded by many colleagues who spoke German as L2 and not as L1.

4.2 Information on speaker p06

P06 is one of the speakers with the most phonetic L1 attrition, but only if measured perceptually with the accent ratings given by monolingual Bosnian speakers. Acoustically, her L1 Bosnian /l/ productions were less strongly assimilated towards the productions of the German monolingual speakers than those of p04 and p07. In her L2 German productions, she was one of the speakers with the closest values to monolingual German reference speakers. She distinguished significantly between her L1 and L2 /l/ productions by producing two separate lateral categories.

Similar to p04, and p06 she encountered traumatic experiences due to her dangerous flight from war-torn Bosnia to Austria, affected by fear for the lives of her family and the assassination of close relatives and friends. P06 describes her traumatic experiences in a very reflective manner, as is also shown in the following extract of her interview:

(2) *"[...] these are like these gaps in my memory, yeah and I kept thinking, ok um I was never in psychiatric treatment for the war, for all the things and that stuff, I've always been able to manage things in my life [...]. But because I'm learning about with these things and am uh studying in that field [...] and now we've covered like these psychosomatic illnesses and learned about them, now I see again and again where I once was and where I am now [...] but it is somehow totally normal that in that kind of extreme situation in which one experiences traumas and all sorts of things, that these gaps in memory develop [...] I really have to sit down, make an effort and really think or somehow make notes and look ... chronologically try."*

A further description of these terrible experiences also explains why she did not return to Bosnia for a long time:

(3) *"In the past it was hard, because half of friends were massacred, killed and the likes, the other half is, you know, the people that killed them, unfortunately, and that's hard, so I've never been back to my city since the war, since 1991, so 25 years, and I wouldn't like to go because I know that only Serbians live there [...] now last summer we went on a holiday trip through Bosnia, we visited many cities [...] and so we discovered Bosnia in a new way through the task that we set ourselves, to make their parents' country uh attractive to our children, that they learn to love, to respect it and to treasure it."*

These extracts from the interview, amongst others, reveal that the contact to her home country was and still is minimal, even though it now increasing because she wants to show her home country to her children.

Furthermore, she also has strongly positive associations with her arrival in Austria, thanks to people in her surrounding who invited her to join in social activities and helped her find accommodation. She managed to find good jobs and to gain appreciation, albeit through a lot of commitment and self-organized further education.

Other statements suggest that she uses L1 Bosnian in Austria less than most other BoV speakers. This is primarily, because her language environment at work had always been predominantly German and she worked long hours (up to 70 hours a week). The quality of German input was also high, as she worked a lot with monolingual L1 German speakers. Additionally, her three children were all born in Austria and she claims to have always spoken mostly German with them. Nevertheless, she still uses her L1 Bosnian daily, partly at home, partly with Bosnian friends.

4.3 Information on speaker p07

P07 is also one of the speakers with the most phonetic L1 attrition, both measured acoustically by the F2-F1 values of her laterals and also perceptually by the Bosnian accent ratings. In her L2 German productions, she was one of the speakers with the closest values to monolingual German reference speakers, which was also confirmed by the German accent ratings. She distinguishes between her L1 and L2 lateral phonemes /l/ by producing two significantly different lateral categories.

P07 emigrated to Austria shortly before the beginning of the war because of her husband's employment in Austria. Thus, the war was not directly the reason for the emigration, and she did not have comparable traumatic experiences to those of p04 and p06. Instead, in her interview her strong motivation to use the German language, together with a comparably strong reduction in the use of L1 Bosnian, is conspicuous. This reduction in the use of Bosnian was mainly due to reduced L1 Bosnian use in Austria and additionally due to only rare visits to Bosnia (that is less than once a year), at least in the first half of her stay in Austria. Her husband spent a lot of time at work, and she had no relatives or Bosnian friends in Vienna. She was thus on her own and quickly realized, as she says, that high proficiency in the L2 was the key to good integration and better opportunities (socially and professionally), especially in order to take better care of her children and for their education. She claims to speak mostly German at home with her children. Just as p04 and p06, she was received warmly upon arrival in Austria. Furthermore, she made long-term relationships with native German

speakers, and consequently had a comparably high amount of qualitatively high (in the sense of native-like) input in German.

The following quote from the interview illustrates that she (more than other BoV speakers) considers relationships with L1 German speakers and knowledge of the German language important:

(4) *„Yeah, I got lucky and said, every foreigner should have an Austrian, in order to learn about the culture, the language and everything through them, that's how I did it, I had really close contact with people [...] if you meet someone with such closeness and talk about everything, then you also become a friend of the family and get to know them, and everything, it's really [...] yeah, just like an exchange, they learn from us, I learn about here and, yeah, I think it's really great, you know this this ghettoization and just only sticking with one's own kind, I don't think that's good at all.“*

4.4 Comparison with other speakers and interpretation

Following the interviews with p04, p06 and p07, presented in the previous sections, it seems likely that the factors amount of language use, quality of input a speaker receives in the respective language, and motivation to learn the L2 language are all good indicators for more target-like productions in the L2 and simultaneously for less target-like productions (i.e., phonetic L1 attrition) in the L1. The amount of language use was as indicated for example by having children who are born in the L2 country or at least who were of preschool age after arrival, furthermore by the language spoken at home, by the L1 of close friends or colleagues, or by the number of visits to the L1 country per year. The quality of input a speaker receives in the respective language depends for example of whether the input comes from monolingual speakers or from L2 speakers. The motivation to learn the L2 language was indicated for example by the conviction of the importance of being proficient in the language of the L2 country, for better opportunities for oneself or one's children. Additionally, these factors might be shaped and strengthened by the (sometimes extreme) experiences a speaker had with speakers of the L1 and L2. In the following, the information about these factors given by the individual speakers and analyzed in the previous section will be interpreted and compared to information given by other BoV speakers, specifically to information of the speakers with the most native-like productions in their L1 and the least target-like productions in their L2. These are, as outlined above, the two female speakers p02, p03, and the two male speakers p11, and p15. Because some of the factors might be interwoven with one another, small repetitions might occur in reporting and comparing these factors between the individual speakers.

4.4.1 Extreme experiences connected to L1 Bosnian or L2 German language use

The speakers analyzed in the previous sections all had extreme experiences either with speakers of their L1 or with speakers of their L2. Two of them, p04 and p06, had very traumatic experiences in their L1 environment before their emigration, and they all, p04, p06, p07, had good experiences upon their arrival in the L2 country, by meeting friendly and helpful people who encouraged and motivated them.

None of the other BoV speakers (female or male), indicated comparable traumatic experiences to p04 and p07.²⁸ P02 did not escaped from war-torn Bosnia until the end of the war and did not have traumatic experiences personally, even though she was aware of what happened (especially of what happened in Srebrenica) and left the country because of the fear that the war would continue and even worsen in her region.

(5) *"[...] I didn't go through a lot of the things that some women went through, and I don't have that feeling, fear, when I'm somewhere, because I've been in, never been in a concentration camp, and that's another feeling altogether, but there are women, that have, really that have been through a lot, and of course, that's another feeling [...]."*

P11 came to Austria shortly before the beginning of the war for professional reasons, and p15 only migrated to Austria after the war. It is conspicuous that almost all BoV men of the present study, except for p13, migrated to Austria either shortly before or shortly after the war. And even p13 (as the only male speaker who arrived in Austria precisely during the war in Bosnia) left Bosnia at the very beginning of the war in order to finish his studies in Croatia before going to Austria. This differs from the group of female BoV speakers, where most of the speakers migrated during the war. The interview data thus indeed suggests that the strength of traumatic experiences might be a valid indicator for the strength of phonetic L1 attrition. However, one of the three speakers with the most L1 phonetic attrition, p07, has not made traumatic experiences linked to the war in Bosnia, as she (as the only female BoV speaker) already came to Austria shortly before the war. Further factors should thus be considered to explain strong phonetic attrition and target-like L2 productions.

²⁸ Certainly the war is a big issue for all of the BoV speakers. In the framework of the present study, we do not want to establish a hierarchy of the most traumatic experiences. The BoV speakers came with a broad range of individual experiences to Austria, some of them migrated only coincidentally during the war, others were truly escaping from war, some after having personally lived through bad experiences, others emigrated at the right time, or preventively. Moreover, the experienced hostile actions differed depending on the region within Bosnia. However, it can be stated on the basis of the interview data that the two BoV speakers with the most obvious traumatic experiences are within the group of the three strongest phonetic L1-atriters.

A positive reception in the L2 country, due to meeting helpful people, is another factor common among the three speakers with the strongest phonetic attrition. Most of the other speakers did not report having such strongly positively connotated experiences with helpful people upon their arrival in Austria. Rather they claimed to have experienced both support and also distrust. P02 did not report an especially good or bad reception by monolingual German speakers, instead, she rather stressed the large number and frequent contacts she has with other Bosnian speaking people. P03 reports one coincidental encounter with an especially friendly person who helped her and her family find an apartment. However, apart from this occasion, no other encounters with L1 German speaking people are mentioned. Instead, she reports having had to work very hard, and that her jobs (in a care home and in supermarkets) were a step down socially. This was because before, in Bosnia, she had a leading position in the marketing division of a newspaper. P11 even reports negative experiences connected to his reception in Austria, mainly in relation with prejudices towards his religion, especially through politics. However, he also had good encounters with people who spoke German as their first language, which he explained with his (and his family's) friendly nature. According to him, such encounters were more common in the countryside than in Vienna, where everything is more anonymous and where people rather stay among themselves, in his case among other L1 Bosnian speakers. Finally, p15 came to Vienna for his studies and was thus in an international surrounding without the explicit need of help of monolingual German speakers, with whom he only rarely had contact.

To summarize, extreme experiences made with speakers of a given language are shown to have an important influence on the strength of cross-language mappings. In the present study, traumatic experiences made in the context of the L1, and especially good experiences in the context of L2 use, might both give more space to the L2, with stronger influences on the L1. It might be assumed that such extreme experiences influence other factors that are important for a further development of the respective languages of bilingual speakers, such as amount of use of the L1 and the L2, and the quality of input (input received from native/monolingual speakers).

4.4.2 Amount of using L1 and L2

Having young children who went to preschool in Austria (already before the age of three) is another common factor of p04, p06 and p07. This factor might be a good indicator for the amount of usage of the L1 Bosnian and L2 German. With younger children, the probability of speaking more often in the L2 and less in the L1 increases, especially when the children grow up and when the L2 becomes their dominant language. In fact, all of the three strongest attriters declare often speaking German with their children, also at home. That means not only that their use of L2 German is increased, but at the same time that the quantity of their use of L1 Bosnian is strongly reduced. In contrast, even though

p02 also has two children, they were already older than 10 years at the time of migration. P03 also has two children, but like with p02, her children were already older at the time of migration, they were even already university students. P11 also has children, two of whom were born in Bosnia before migration and two who were born after the migration to Austria. P11 exclusively speaks Bosnian at home and also expects other family members to speak exclusively Bosnian at home. Therefore, for him, the circumstances of having young children who were born in Austria does not lead to a decrease in the use of the L1 Bosnian. P15 has no children. Other BoV speakers either do not have children, had children who were less than 3 years old at the time of recording, or also claim speaking exclusively Bosnian with them at home. This is explained in a representative way by speaker p16:

(6) „[...] at home we speak only BKS and both sons [...] are being raised bilingual, in that way we are really wary of making the mistake and starting to speak to them in German, that means that at home it's almost hardcore how our native language is spoken, because from kindergarten on and with television German is the uh the main language anyway and that is really so overwhelmingly strong that that um we have to struggle our way through it.”

A smaller input in L1 Bosnian might further also be due to rare visits to Bosnia. Two of the three strongest attriters (p06, p07) only rarely visit Bosnia, that is, less than once per year. P04, even though she is also amongst the strongest attriters, initially visited Bosnia rarely, but meanwhile visits Bosnia more often in order to care for her sick mother. Most of the other BoV speakers visit Bosnia more often. P02 is an active member of Bosnian associations and cares a lot about Bosnian culture and memory and the support of families in need in Bosnia. For this reason, she visits Bosnia on a regular basis, several times per year. P11 also spends time in Bosnia several times per year, as does p15 who visits Bosnia on a regular basis to see his sister and friends who are living in Sarajevo. Most of the remaining BoV speakers also visit Bosnia several times a year. Some of the BoV speakers even have properties in Bosnia which they visit regularly (p12, p14). Only p16 states that he goes to Bosnia only once a year. However, he additionally meets with old Bosnian friends who are widespread over the world once per year somewhere else. To conclude, the three speakers with the most L1 attrition and/or the most target-like lateral productions in L2 German have a higher input in German, and at the same time a reduced input in Bosnian. This is due to their language use at home, and to rare visits to Bosnia.

4.4.3 Quality of input in L1 and L2

As all the speakers except for p15 have partners who also speak Bosnian as their L1, it can be assumed that, overall, the quality of input in the L1, in terms of native-like input, is comparable across speakers and rather good. P15 does not have a partner, but nor does he show strong assimilation effects. Differences in the quality of input therefore might rather result from the amount of time they effectively see their partners. All of the three strong attriters most probably saw their partners less often compared to other BoV speakers. In the case of p04 and p06 the reason was long working hours. P04 even reported having had a burnout because of too extensive work, and p06 claimed working up to 70 hours per week. P07 on the other hand was not employed, but her partner was often absent because of his work.

In addition to partners, close friends might also contribute to the quality of input from L1 speakers, as well as the use of media (e.g., television, newspapers, books). The speakers with the least L1 Bosnian attrition and at the same time the least target-like L2 German productions (p02, p03, p15, p11) state having a lot of friends who speak Bosnian as their first language and also reports reading a lot in Bosnian. P11 is additionally specifically interested in and concerned about the Bosnian language and cultivates Bosnian whenever possible, also in internet blogs. Furthermore, the quality of L1 input might also be traced back to input received by monolingual Bosnian speakers as living in the L1 environment (in Bosnia), which thus relates to the number of visits to Bosnia, as described above.

The quality of input also seems to play an important role in L2 German productions of BoV speakers. The reason for the less target-like productions of p04 in her L2 German, as compared to p06 and p07, might lie in the quantity, and even more so in the quality, of German input. P06 and p07 received a comparably high input in German and mostly from monolingual L1 German speakers. P06 because she worked in a German speaking environment, where she had most contact with native German speakers. Additionally, she spoke German to her three children already from their birth on. P07 because she was especially conscious about the importance of learning the L2 German for herself and for her four children and therefore she was especially motivated to learn German after her arrival. She was not employed after her arrival in Austria, but this gave her the time to learn German, with the explicit help of native speakers she met at the beginning of her stay and with whom she became friends. P04, in contrast, had two children who were born in Bosnia. After her arrival, she indeed worked a lot, but in an environment where German was only spoken approximately half of the time. Moreover, German in her professional environment, a residential care home for the elderly, was spoken by a lot of speakers who were non-native speakers of German and thus probably had accented German productions.

This implies that on the one hand, p06 and p07 had a reduced input in Bosnian, as mentioned above. And on the other hand, they had a lot of input in their L2 German, specifically, as spoken by native German speakers. This might explain the attrition in their L1, as well as the target-like productions in the L2, and also the development of two separate categories for the two similar lateral phonemes in L1 Bosnian and L2 German. P04, in contrast, received relatively more “accented” input in the L2 German. This might also explain both the lower degree of “native-likeness” in her German, and why she did not build two separate lateral categories for her L1 and L2 productions.

The speakers with the least native-like German productions indeed had clearly less qualitatively high input in German. P02 presumably had much less contact to L1 German speakers due to the older age of her children upon their arrival in Austria and due to her job. First, she worked as a cook and then in a care job. She explicitly claimed to have had less contact to people with German as L1. She mostly meets Bosnian people or people with diverse cultural/language backgrounds. P03 also had much less contact to L1 German speakers, also because of the older age of her children at the time of migration and also because of her professional environment. She also worked in the field of care initially and then in supermarkets, where she eventually became a manager. Both of these are jobs in which the percentage of other speakers with a non-native accent in their L2 German is typically relatively high. P11 is rarely in contact with L1 German speakers, even though he has children who were born and raised in Austria. This is mainly because he is in early retirement. A further reason according to him is that it is more difficult to make friends with L1 German and easier to make L1 Bosnian friends in a big anonymous city such as Vienna. P15 does not have children and has thus fewer opportunities to use German. In the course of his (Slavic) studies he mainly met more international students, especially with students who also speak a South-Slavic language as L1.

(7) “[...] I also did once um like an investigation for myself and then I thought, yes, I live in Vienna and I have more [...] more groups of friends um from other countries, they’re all foreigners, well they’re mostly foreigners, more, maybe seventy percent foreigners, from South Eastern Europe, Eastern Europe and a bit from Asia, and I have really few Austrian pals, really few and then I wondered, why and why it doesn’t work and happen and then, the Slavs, they they have a connection [...] they understand each other maybe more, because [...] there are things that can’t be translated and more than anything [...] the matter of feelings [...] there’s a barrier or [...] one always finds [...] the easier path and not the harder one.”

In the group of male BoV speakers, p12 is the only one who stands out from the other speakers of his group insofar as he produced more native-like German laterals (except for the back vowel context), although this is not reflected in his German accent ratings. Nevertheless, this difference in production compared to other male BoV speakers might reflect the relatively higher native German input in his professional environment, which is a catholic church. Thus, he had relatively more high quality input

in German, as compared to most other speakers. However, in his case, this did not go along with an equally high quantity of input in German. His partner also migrated from Bosnian, and they do not have children. Moreover, he often goes to Bosnia (where he even owns a property). Other BoV speakers show different patterns of quantity and quality of L1 and L2 input and use, but these patterns are rather “in between” the more extreme information given by the speakers who also have the more extreme values in production and accent rating. Solely in the case of p14 one might have expected more target-like German productions because of his probably relatively high quality input of German as spoken by native German speakers in his professional environment, as he works as a teacher in an upper school. Maybe this advantage concerning the quality of German input is relativized due to his intense use of Bosnian instead of German in other areas of life (as he visits Bosnia relatively, has many Bosnian friends in Vienna and speaks exclusively Bosnian at home).

To conclude, the quality of input in L1 and L2 received by the three speakers who showed the largest restructuring of their L1-L2 phonetic-phonological system was largely reduced in their L1 and largely increased in their L2. The reduction of native-like L1 input was due to the circumstance that they saw their partners to a lesser extent than other BoV speakers (because of either their or their partners’ extensive working times). The increase of native-like L2 input resulted from the frequent use of L2 with their children, with monolingual German friends, or at work, where they had much contact to native speakers of German. However, as the example of other bilingual speakers showed, the access to qualitatively high input in German alone did not seem to be sufficient for the acquisition of more native-like pronunciation, without at the same time having a high quantity of native-like input. Thus, extensive private use of the L1 Bosnian seemed to importantly influence L2 German productions, even if the bilingual speakers otherwise had regular contact to native German speakers.

4.5 Summary of qualitative analyses of individual differences

In summary, stronger individual differences in L1 and L2 productions between the bilingual speakers of the present study are found to mostly rely on the quantity and especially on the quality of input a speaker receives in the respective languages, which is in turn strongly connected to extreme (both positive or traumatic) experiences a speaker makes in these languages, rather than on gender. In the case of the present study, traumatic experiences made in the L1 environment and positive experiences made upon arrival in the L2 environment led to more target-like L2 productions (p04, p06, and p07) and also to stronger L1 attrition (only p06 and p07). Thus, in the case of these speakers with the most conspicuous L1 or L2 productions, the aforementioned factors seem to explain the strength of reorganization of their L1-L2 phonetic-phonological system. In the case of the speakers with less conspicuous speech productions, however, the relationships are not as straightforward. Single factors such as quantity or quality of input alone are less strongly related to a restructuring of the L1-L2 phonetic-phonological system. Instead, the complex interplay of diverse factors in diverse areas of life must be taken into account. Learning the more prestigious standard language pronunciation might be seen as important by some of the speakers in order to be socially mobile, especially when they have young children whom they want to present with good opportunities.

5 General discussion

This study examined the production of laterals in Bosnian and German by late, experienced bilingual speakers who migrated as adults from Bosnia to Vienna around the time of the war in Bosnia. The study contributes to the literature on bidirectional phonetic cross-language mappings in late bilingual speakers by (i) studying a language combination which has not been investigated so far in studies on cross-language mappings, (ii) examining the acquisition of the L2 German lateral sound /l/, which is similar in production to one of the two L1 Bosnian lateral phonemes, that is, to /t/, but not to the other, that is, to /ʎ/, (iii) examining productions in both L1 and L2, and (iv) by taking a broad perspective: Group effects as well as individual differences in production were analyzed acoustically (by measuring F2-F1 in bark) in Experiment 1, and perceptually by means of accent ratings in Experiment 2. Lateral productions of bilingual speakers were compared to productions of monolingual speakers of the respective languages. Moreover, qualitative interviews were conducted to support the interpretation of individual differences between bilingual speakers.

5.1 Evaluating the hypotheses

In the following, the results of the present study are linked to the hypotheses formulated in chapter 1.6. First, results are discussed with respect to cross-language mappings from the L2 to the L1, second with respect to cross-language mappings from the L1 to the L2, and third, concerning the relation between L1 and L2 sounds, that is, whether one composite or two separate categories are used. In order to obtain a broad perspective, the acoustic analyses at the group level are directly compared to the corresponding analyses of individual differences and also to the accent rating at the group and individual speaker level.

Bilinguals' productions in their L1 Bosnian with reference to Bosnian monolinguals

Results on cross-language influences from the L2 German to the L1 Bosnian showed that Hypothesis H1a, predicting that the palatal L1 lateral would not be influenced by cross language mapping, is not supported. Instead, the palatal lateral showed a dissimilation process in the productions of bilingual speakers as compared to the productions of monolingual Bosnian speakers.

Hypothesis H1b, which predicted an assimilation of the velarized L1 lateral phoneme towards the similar L2 lateral phoneme /l/, resulting in a significant difference between bilingual speakers and monolingual speakers, was only supported for the group of female bilingual speakers, but not male bilingual speakers.

Hypothesis H1c predicted that the contrast between the two L1 lateral phonemes would be weakened, but not completely dissolved. This was supported by the results for the female speakers. For them the assimilation of the L1 Bosnian velarized lateral towards the alveolar L2 German laterals was stronger than the dissimilation of the L1 Bosnian palatal lateral. In contrast, male speakers strengthened the contrast between the two L1 lateral phonemes.

Hypothesis H1d, which predicted no individual differences in the production of the palatal lateral, was supported by the analyses of individual differences between speakers. The individual mean acoustic values for the palatal lateral were slightly, and, at the individual level, gradually shifted away from the mean values of monolingual Bosnian speakers, without clear individual differences.

Hypothesis H1d was also confirmed regarding individual speakers' productions of the velarized lateral, for which larger individual differences were observed. However, this only held for female speakers. Some female speakers showed particularly strong assimilation effects towards the L2 German lateral, while some other female speakers did not differ at all from the monolingual reference speakers. Thereby, the speakers with native-like productions differed more from the group mean than the speakers with the strongest assimilations to the L2 German lateral.

Hypothesis H1e, which predicted that accent ratings conducted by monolingual Bosnian listeners would reflect the acoustic measures of the velarized lateral, at the group level as well as at the level of the individual speakers, was also confirmed. The bilinguals' productions of the velarized lateral were generally perceived as more accented than the productions of monolinguals, thus indeed indicating phonetic L1 attrition. Besides, phonetic cross-language mappings might have had an additional, reinforcing, effect on accent ratings of some of the speakers. Specifically, that is, because male bilingual speakers, even though they did not differ from monolingual speakers in production, were perceived as more accented than monolingual speakers. Additionally, those speakers with relatively high L2 German proficiency (as measured acoustically by their L2 lateral productions), received even worse L1 accent ratings as compared to what would have been predicted by their acoustic L1 lateral values alone. Ratings for words and longer utterances did not differ significantly from each other, indicating that ratings of laterals in the context of words provide a valid measure of the perceived accentedness on a more global level.

Bilinguals' productions in L2 German with reference to German monolinguals

Hypothesis H2a was about the cross-language influences of L1 Bosnian on L2 German and predicted that German laterals are produced more velarized by bilingual speakers as compared to monolingual German speakers. This was supported, however, gender-specific differences were found. Whereas the productions of male bilinguals generally differed significantly from monolingual German groups, the

productions of female bilingual speakers only differed from female SAG speakers, but not from male SAG speakers and not from VD speakers.

In line with Hypothesis H2b, individual differences between bilingual speakers were found for productions of the L2 lateral phoneme, with a wider variance in the group of female bilingual speakers than in the group of male speakers. The L2 productions of individual female speakers ranged from strongly assimilated towards the L1 velarized lateral phoneme to native-German-like.

As predicted by hypothesis H2c, the results for the production of the L2 German lateral, at the group level as well as at the individual level, were also reflected by accentedness ratings. As a group, bilingual speakers, independently of gender, were perceived as less native-like than monolingual German reference speakers. Individual differences between bilingual speakers were also largely reflected by the accent ratings. None of the male speakers was rated as a native German speaker, whereas the productions of female speakers showed a large variance, reflecting the production data. Some of the female speakers received extremely high ratings of their L2 German productions, that is, the same ratings as monolingual German speakers. And some of the female speakers received extremely low ratings. Specifically, they were rated even worse than predicted by the acoustic measures of their lateral productions, also in relation to their male counterparts. This outcome was attributed to sociopsychological factors in the perception of the velarized lateral as a marker of the negatively evaluated Viennese dialect, which is especially uncommon in female speech.

Bilinguals' L1 and L2 lateral categories

Hypothesis H3a, predicting that the similar lateral phonemes /t/ in L1 Bosnian and /l/ in L2 German would be produced within one composite category, was not confirmed. As a group, bilingual speakers differed significantly between their similar L1 and L2 lateral phonemes, indicating the presence of two separate lateral categories.

However, as predicted by hypothesis H3b, individual speakers behaved differently. Whilst those speakers with the most target-like German lateral productions produced separate categories for their L1 and L2 laterals, the other speakers produced either separate categories or one composite L1-L2 category, without showing a relation to the degree of native-likeness in the respective languages.

5.2 Contribution to the state of the art

The results of the current study contribute to the general literature on speech development in adult learners. Specifically, the present study investigated speech productions and their perceived accentedness in both, the first language and second language of bilinguals, who migrated to an L2 environment as adults. The bilinguals' speech productions were compared to speech productions of monolingual speakers of the respective languages. The parallel investigation of both L1 and L2 within the same speakers allows to test the particular bidirectional effects in cross-language phonetic mappings. Bidirectional effects are often assumed in the literature, but in fact had been rarely investigated explicitly with respect to both languages of the same bilingual speakers (but see, e.g., Stoehr et al. 2017, Barlow 2014).

Crucially, in both of their languages, the bilingual speakers of the present study as a group are less proficient than monolingual speakers, in line with the view that “a bilingual is not two monolinguals in one person” (Grosjean), and with the view that there is inevitably reciprocal influence between all of the languages a speaker uses on a regular basis (see, e.g., Flege and Bohn 2021). A reorganization of the L1-L2 phonetic-phonological space, triggered by the acquisition of the second language, was indeed shown for most of the bilingual speakers. Overall, L2 productions strongly correlated with L1 productions, insofar as more target-like L2 /l/ productions entailed more attrition of the similar L1 /ɫ/. Results point to a complex restructuring of the L1-L2 phonetic-phonological space, in which all (closely) related sounds of the bilingual speakers are involved, that is, all three lateral sounds. The acquisition of the similar L2 lateral sound /l/ not only relates this new L2 sound to its most similar L1 lateral phoneme /ɫ/, but also triggers a dissimilation of the other, more different L1 lateral phoneme /ʌ/. Other studies which investigated sound productions of late bilinguals whose L1 featured two contrasting phonemes that were opposed to a single phoneme in L2 mostly found assimilation in the productions of all related phonemes, even of the more “different” L1 phonemes (see Stoehr et al. 2017, de Leeuw et al. 2017, or Simonet 2011 for early bilinguals, but see de La Fuente Iglesias & Perez Castillejo 2020 who also found dissimilation in one of the two 2-1 vowel mappings investigated in early bilinguals).

Nevertheless, the results of the present study also support the view that the overall representation of sounds in the phonetic-phonological space remains malleable at any phase in life, including L1 sounds (see e.g., de Leeuw & Celata 2019, Flege & Bohn 2021), which are still often assumed to be stable. However, at the level of the individual speakers, the present study also showed that, if only the similar L1 and L2 sounds are investigated, there is no obligatory reciprocal influence. That is, some of the speakers of the present study showed a native-like production in either L1 or in L2, simultaneously resulting in a less target-like production in the respective other language. Therewith, the present study

also shows evidence for the possibility to achieve native-likeness in L2 production, at least at the segmental level (e.g., Birdsong 2007, Major 1987, M. Schmid et al. 2014a), even if the L2 sound is similar to an L1 sound and therefore assumed to be more difficult.

The present study further supports some of the main claims stated in the revised Speech Learning Model (Flege & Bohn 2021). The SLM-r states that an L1 and an L2 sound, which are judged as being similar (or which are not distinguished at all) by L2 learners, will be assimilated towards each other and, moreover, these sounds will be produced within one composite L1-L2 phonetic category. Even for experienced learners it is assumed unlikely that they learn to produce two separate categories for similar L1 and L2 sounds. If, however, a sound in L1 and a sound in L2 are judged as being different, they will be produced within two separate categories, which might trigger a dissimilation process. The results of the present study support these assumptions with respect to the direction of the processes involved, that is, concerning assimilation or dissimilation. The similar lateral phonemes L1 Bosnian /t/ and L2 German /l/ were indeed assimilated towards each other, whereas the different L1 lateral phoneme /ʎ/ dissimilated from both the L2 German /l/ and from the L1 Bosnian /t/. Even though these processes were found to differ in strength across individual speakers, the direction of these processes was the same across all speakers.

However, with respect to the formation of a new category, which is assumed to be “the key determinant of how phonetic systems and subsystems reorganize” according to the SLM-r (Flege & Bohn 2021: 41), the results of the present study show a more heterogeneous picture. Approximately half of the speakers succeeded in producing two separate categories for their similar L1 and L2 sounds, despite some evidence for assimilation. These findings are in line with what has been shown, for example, by Simonet (2010), or, more recently, by Takahashi (2020), who both also reported new category formation despite cross-language assimilation effects (see also Stoehr et al. 2017, and de Leeuw et al. 2013). The results of the present study indicate that it is possible to learn to distinguish similar sound pairs in L1 and L2 only at a later stage of the L2 acquisition process. That is, speakers might have classified L1 /t/ and L2 /l/ as similar at a first stage of L2 acquisition, resulting in the production of a composite lateral category for these two sounds, before increasing input in the L2 over time led them to build two separate categories. This assumption is supported by the observation that those speakers, who produced the most target-like values in the L2, all used separate categories for their production of L1 /t/ and L2 /l/. However, results of the present study suggest that production acuity is not a necessary condition for the formation of a new L2 sound category. That is, because even some of the speakers with the least target-like L2 productions succeeded in building a new L2 category, insofar as they separated L1 and L2 categories, without simultaneously showing a dissimilation of the L1 category.

In addition to results for a given group of bilingual speakers, the present study showed a general gender difference, as well as some stronger individual differences in L1 and L2 production, which were analyzed by means of information collected in qualitative interviews. The female bilingual speakers of the present study all showed some degree of phonetic-phonological restructuring of their L1-L2 lateral system, which was not found for all individual male speakers. Furthermore, female speakers generally showed a stronger restructuring of their lateral system than the male speakers, insofar as their L2 German productions were more target-like and their L1 Bosnian productions were less native-like than those of male speakers.

The speaker's sense of the relation between the production of more prestigious linguistic variants and possibilities for social mobility might have contributed to the higher L2 proficiency of some (specifically female) speakers, as suggested by sociolinguistic theory (as discussed in Moyer 2016, and also suggested by the results of Simonet 2010). Independently from gender, information extracted from the qualitative interviews more specifically suggested that the amount and quality of input in the L2, specifically when leading to a reduced quantity and quality of L1 input, had the strongest effect on the degree of L1-L2 phonetic-phonological restructuring. The present study furthermore pointed to the particularly importance of extreme experiences with the respective languages for the development of these factors. Specifically, traumatic experiences made in an L1 context (here, in relation to the war in Bosnia), and particularly positive experiences made in the L2 context (here, the acceptance and support by monolingual L2 speakers) might both have contributed to a relatively stronger and long-lasting identification with the L2 language and culture, as well as to a relatively stronger abandonment of the L1 language and culture.

6 Conclusions

The present study on lateral productions of late Bosnian-German bilinguals supports some of the main predictions by the Speech Learning Model. Specifically, the regular use of two languages caused mutual assimilation between similar L1 and L2 laterals and dissimilation of the more different L1 lateral. At the group level, the present study, thus, suggests inevitable bidirectional influence of both L1 and L2 in speech productions of bilingual speakers. At the level of the individual speaker, the present study shows that L1 and L2 proficiency are strongly linked, but that a *bidirectional* influence is not necessarily inevitable, whereas *unidirectional* influence is inevitable. The degree of assimilation between similar L1 and L2 sounds is strongly speaker-dependent, respectively ranging from native-like productions to productions strongly assimilated towards the other language and being indistinguishable from productions of monolingual speakers of the other language.

With regard to new category formation in L2, the present study, however, does not support the prediction by the SLM that (1) late learners are unlikely to build a new category for L2 sounds which are similar to the closest L1 sounds and that (2), if at all, speakers with more extensive L2 input are able to build a new L2 category for those similar L2 sounds. While speakers with most target-like L2 laterals produced separate categories for the similar L1 and L2 laterals, other speakers did not show a relation between category formation and L2 proficiency. This indicates that the amount of input alone, which differed between speakers, does not predict the occurrence of new category formation.

Overall, the present study provides further evidence for the unconscious interaction of phonetic-phonological systems in late bilingual speakers. With regard to L1 productions, the present study further supports the view that the phonetic-phonological system remains malleable across lifetime.

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Appendix A: Abstract

According to the Speech Learning Model the phonetic-phonological systems of bilingual speakers are subjected to bidirectional cross-language mappings. Similar sounds in first language (L1) and second language (L2) approach each other, resulting in one composite L1-L2 category. Previous studies mostly investigated unidirectional influences, and rarely considered the relation to perceived accentedness or individual differences. Moreover, these studies involved English, Dutch, some Romance, or Asiatic languages, with a focus on plosive consonants or vowels.

The present study investigated bidirectional influences in L1 and L2 lateral productions by 14 L1-Bosnian-L2-German speakers who migrated as adults to Vienna during the Bosnian war. Ten monolingual L1-Bosnian speakers and 12 monolingual L1-German speakers served as control groups. Whilst Bosnian features a palatal and a velarized lateral phoneme, German features only one alveolar lateral phoneme, which is more similar to the velarized than to the palatal L1-lateral. The present study was designed to approach bidirectional influences from a broad perspective: both group effects and individual differences in production were analyzed acoustically (by measuring F2-F1 in bark) and by means of accent rating studies. Qualitative interviews were conducted to support the interpretation of individual differences.

Results showed a dissimilation of the palatal lateral, without conspicuous individual differences. Concerning the similar L1 and L2 laterals, however, bidirectional assimilation was observed, to different degrees at the individual level. All women restructured their L1-L2 lateral system, with the largest deviances from monolingual Bosnian laterals, and the smallest deviances from monolingual German laterals. Men did not show assimilation of L1-laterals, and only three out of seven produced a separate L2 category. Those speakers who produced nativelike L2-laterals used separate categories, whereas others either used one composite or separate L1-L2 categories. Moreover, results showed a relation between lateral production and perceived accentedness. However, speakers with better L2-ratings even received worse L1-ratings than revealed by L1-production data. Bilinguals were rated as more accented than monolinguals, independently of gender, with a larger interspeaker difference in females. Qualitative analyses suggested that the strongest individual differences in production and rating result from extreme language experiences, as well as from quantity/quality of language use.

The present study thus supports some of the main predictions by the Speech Learning Model, insofar as bidirectional assimilation is found for similar sounds, whereas dissimilation is found for the more different L1 sound. However, with regard to new category formation, the results do not provide evidence for a link between L2 input quantity or L2 proficiency and category formation. Overall, the present study provides further evidence for the inevitable interaction (although not necessarily bidirectional) of phonetic-phonological systems in late bilingual speakers. The findings contribute to the view that the phonetic-phonological system remains malleable across lifetime. This is specifically suggested by strong L1 attrition and by target-like L2 productions of some of the speakers.

Appendix B: Zusammenfassung

Gemäß dem Speech Learning Model kommt es bei bilingualen Sprecher*innen zu beidseitiger Beeinflussung der phonetisch-phonologischen Systeme, wobei sich ähnliche Laute in Erstsprache (L1) und Zweitsprache (L2) einander annähern, bis hin zur Produktion einer gemeinsamen Lautkategorie. Bisherige Studien untersuchten meist nur unidirektionale Einflüsse und berücksichtigten wenig bis gar nicht den Zusammenhang mit einem wahrgenommenen Akzent oder individuelle Unterschiede. Darüber hinaus wurden vornehmlich das Englische, Niederländische, sowie einige romanische und asiatische Sprachen untersucht, mit dem Schwerpunkt auf Plosiven und Vokalen.

Die vorliegende Arbeit untersuchte die beidseitige Beeinflussung von Lateralproduktionen in Erst- und Zweitsprache bei 14 L1-Bosnisch-L2-Deutsch Sprecher*innen, die im Erwachsenenalter während des Bosnienkrieges nach Wien kamen. Als Referenzgruppen dienten 10 monolinguale Sprecher*innen des Bosnischen und 12 des Deutschen. Während das Bosnische zwei Lateralphoneme aufweist, ein palatales und ein velarisiertes, weist das Deutsche nur ein alveolares auf. Dieses L2-Lateralphonem ist dem velarisierten L1-Phonem ähnlicher als dem palatalen. Die vorliegende Studie analysierte beidseitige L1-L2 Beeinflussungen aus einer breiten Perspektive: Gruppeneffekte sowie individuelle Unterschiede wurden akustisch anhand von Formantmessungen (F2-F1 in Bark) in der Produktion und, darauf aufbauend, anhand von Akzent-Bewertungs-Studien untersucht. Informationen aus qualitativen Interviews dienten als Basis für Interpretationen individueller Unterschiede.

Die Ergebnisse zeigten eine Dissimilation des palatalen Laterals ohne auffällige individuelle Abweichungen. Hinsichtlich der ähnlichen L1 und L2 Laterale hingegen zeigte sich individuell ausgeprägte beidseitiger Assimilation. Alle Frauen zeigten eine Umstrukturierung des L1-L2-Lateral-Systems, mit den größten Abweichungen zu monolingualen Bosnischen Lateralproduktionen und den geringsten Abweichungen zu monolingualen Deutschen Lateralproduktionen. Männer assimilierten L1-Laterale nicht, und nur drei von sieben bildeten eine separate L2-Kategorie. Jene Sprecher*innen, die L2-Laterale zielsprachig produzierten, benutzten separate Kategorien, während die übrigen Sprecher*innen entweder gemeinsame oder getrennte L1-L2-Kategorien produzierten. Weiters zeigte sich ein Zusammenhang zwischen der akustischen Lateralproduktion und dem wahrgenommenem Akzent. Jedoch bekamen diejenigen Sprecher*innen mit besseren L2-Bewertungen schlechtere L1-Bewertungen als alleine durch die L1-Produktionsdaten vermutet. Bei bilingualen Sprecher*innen als Gruppe wurde geschlechtsunabhängig ein stärkerer Akzent als bei monolingualen Sprecher*innen wahrgenommen, mit größerer inter-individueller Differenz bei Frauen. Qualitative Analysen legen nahe, dass die stärksten individuellen Unterschiede in Produktion und Bewertung auf extreme Sprach-Erfahrungen, sowie auf Quantität/Qualität des Sprachgebrauchs zurückzuführen sind.

Damit bestätigt die vorliegende Arbeit einige der Hauptaussagen des SLM, insofern als eine beidseitige Assimilation in der Produktion der ähnlichen L1 und L2 Laterale beobachtet wird, und eine Dissimilation des verschiedenen L1 Laterals. In Bezug auf die Herausbildung einer neuen L2 Kategorie jedoch zeigen die Ergebnisse keinen Zusammenhang mit L2 Input oder L2 Kompetenz. Insgesamt bestätigen die Ergebnisse der Studie, dass es eine unausweichliche Interaktion aller Laute (wenn auch nicht zwingend beidseitig) im phonetisch-phonologischen System bilingualer Sprecher*innen gibt und dass das phonetisch-phonologische System auch mit zunehmendem Alter formbar bleibt. Dies wird besonders durch die starke L1 attrition und die zielsprachige L2 Aussprache einiger Sprecher*innen gezeigt.

Appendix C: German reading task – list of sentences

Lesen Sie die folgenden Sätze vor und ergänzen Sie sie gegebenenfalls. Machen Sie bitte vor jedem neuen Satz eine kleine Pause.

- 1) Das Volumen ist groß.
- 2) Sie bringen ein Spiel oder einen Film mit.
- 3) Wenn Alkohol illegal wäre ...
- 4) Das Ventil ohne Deckel ist dort.
- 5) Die linke Tür führt nach draußen.
- 6) Der Halunke ist schnell.
- 7) Das Symbol ist ...
- 8) Der Katalog ...
- 9) Der Schilaufl ...
- 10) Ich mache Seelachs zum Abendessen.
- 11) Sein Profil ist ...
- 12) Wir müssen noch das Personal anrufen.
- 13) Es ist eine resolute Stimme.
- 14) Sein Vokabular ist gewachsen.
- 15) Die Kalorien ...
- 16) Die Isolation macht traurig.
- 17) Wenn du Lust hast, komm später vorbei.
- 18) Das Solo ...
- 19) Sie lesen ...
- 20) Die Schulung ...
- 21) Der Spekulant ist gerissen.
- 22) Der Kanal ist schmutzig.
- 23) Sie blieb gestern ...
- 24) Die Evolution ist beeindruckend.
- 25) Der Slalom ...
- 26) Das Cola ...
- 27) Die Nibelungen sind eine Sage.
- 28) Das Spiel ist ...
- 29) Das ist die Belustigung für ...
- 30) Die Bilanz ist negativ.
- 31) Der Exilant ...
- 32) Der Belag stört ihn.
- 33) Der Epilog ...
- 34) Ich finde Alabaster sehr schön.
- 35) Der Kanal am Stadtrand ...
- 36) Die Pilotin ...
- 37) Er gelobt Besserung.
- 38) Wenn du lesen magst, setz dich hier her.
- 39) Es ist ein relativ gutes Ergebnis.
- 40) Ihr Profil alleine reicht mir nicht.
- 41) Die Religion ...
- 42) Der Pelikan ...
- 43) Im Silo lagert Heu.
- 44) Das Melodrama nimmt ein Ende.
- 45) Die lustige Berta kommt heute.
- 46) Sein melodioser Vortrag gefällt mir.
- 47) Wo Liebe ist, da ist ...
- 48) Der Zivilist ...

- 49) Das Solarium ...
- 50) Der Monolog dauert lange.
- 51) Er wird durch Alkohol unhöflich.
- 52) Dieses Merkmal ist ...
- 53) Schlafen gelegt hat er sich.
- 54) Die Gliederung sollte übersichtlich sein.
- 55) So lockst du ihn dorthin.
- 56) Bald haben wir Kiel erreicht.
- 57) Ein interessanter Platz ist ...
- 58) Die Locken ...
- 59) Ein Buch gelesen hat sie.
- 60) Die Gelehrte ...
- 61) Das ist ein belebter Ort.
- 62) Da links ist ...
- 63) Das Personal ist immer pünktlich.
- 64) Der subtile Unterschied fällt ihr auf.
- 65) Sie lachen über ...
- 66) Das sterile Zimmer mag ich nicht.
- 67) Meine geliebte ...
- 68) Silikon ist leicht.
- 69) Das Militär ...
- 70) Ich werde Basilikum in die Soße geben.
- 71) Die Diele ...
- 72) Die Limonade ist ...
- 73) Der Philosoph ...
- 74) Da leben viele Adler.
- 75) Die Schule ...
- 76) Da lachen ja alle.
- 77) Die Zentrale ...
- 78) Ein Kilo Äpfel ...
- 79) Wenn du Limonade magst, dann empfehle ich dir diese.
- 80) Sie sollten dieses Merkmal untersuchen.
- 81) Das Ventil ist ...
- 82) Sie loben ...
- 83) Ich habe die Spiele mitgebracht.
- 84) Meine Ziele ...
- 85) Schau dir den Nil an.
- 86) Ein Kavalier ...
- 87) Die Situation ist eskaliert.
- 88) Sie simulieren ...
- 89) Sie inhalieren den heißen Dampf.
- 90) Du lobst ihn nie.
- 91) Nägel in die Wand schlagen ist ...
- 92) Das ist in Kiel anders.
- 93) Ich schließe die Tür immer ab.
- 94) Sie leben nur einmal.
- 95) Die Lunge meines Vaters ist kaputt.
- 96) Der Glaube ist ...
- 97) Der solide Bau gibt Vertrauen.
- 98) Sie polieren die Armaturen.
- 99) Mein Olivenöl ...
- 100) Der korpulente ...

- 101) Die Rivalität zwischen ...
- 102) Die Liebe ist ...
- 103) Das ist ein totalitärer Staat.
- 104) Die Koalition ...
- 105) Das Symbol unter dem Teller ist wichtig.
- 106) Sie hat ein maskulines Auftreten.
- 107) Oliver ist ...
- 108) So lustig ist das nicht.
- 109) Der Nil erstreckt sich durch Afrika.
- 110) Ich werde es dazulegen.

Appendix D: German spontaneous speech task – guiding questions for the interviews

- 1) Geburtsdatum
- 2) Geburtsort/-land
- 3) Hauptsächlicher Wohnort der ersten 20 Lebensjahre
- 4) Wer sind/waren Ihre Eltern: Geburtsort, Schulbildung und Beruf
Wann sind diese an den eigenen (Ihren) Geburtsort gezogen?
- 5) Wann aus Bosnien weggegangen? Wann nach Österreich gekommen?
- 6) Wie häufig ist der Kontakt zum Herkunftsland? Auf welchem Weg findet dieser statt
(Besuche in Bosnien, Gegenbesuche hier, schriftlich...)
- 7) Höchste Schulbildung: Was haben Sie gelernt und haben Sie gearbeitet/arbeiten Sie?
- 8) Sprachen (Sprachverwendung, Spracheinstellung):
Welche Sprachen wurden gelernt/werden gesprochen / auf welchem Niveau?

Deutsch: Wann angefangen, Deutsch zu lernen?
Wie (Sprachkurs oder nur Immersion)?
In welchem Kontext wird Deutsch gesprochen?
Welche Gefühle sind damit verbunden?
Auch Lesesprache?
Was ist besonders auffällig/schwierig (Wörter, Aussprache)?
Standard vs Dialekt?

Bosnisch: In welchem Kontext wird Bosnisch gesprochen?
Welche Gefühle sind damit verbunden?
Bosnisch als Nationalsprache (Bezeichnung Bosnisch?)
z.B auch: Wie leicht können Sie mit Serben/Kroaten kommunizieren? Wo sind die größten Schwierigkeiten?

Welches ist zur Zeit die am häufigsten gebrauchte Sprache?
zB in folgenden Bereichen: Familie: Eltern, Geschwister, Partner, Kinder;
Freundeskreis; Beruf; Hobbies; evtl Religion; Administration (Behördengänge, wie Versicherungen, Meldung, Bank und Post...)

Welche Sprachen sprechen die Menschen, mit denen Sie (am häufigsten) zu tun haben?
- 9) Welche Haltung/Empfindungen Bosnien gegenüber (o. ehemaliges Jugoslawien oder dem jew. Heimatort)
- 10) Würden Sie erzählen, WIE Sie nach Österreich gekommen/geflüchtet sind?
- 11) Haben Sie sich angenommen gefühlt oder hatten Sie mit Schwierigkeiten zu kämpfen?

12) Wie wird das Leben in Wien empfunden? (Heimat, Exil...?)

13) Wenn Sie Österreich und Bosnien vergleichen können: gibt es etwas (materielles oder aber auch Verhaltensweisen etc), das Ihnen hier in Österreich fehlt, was Ihnen aber aus Bosnien (oder aus Erzählungen darüber) in Erinnerung ist?

- Umgekehrt: Was schätzen Sie (ob materiell oder immateriell) an Österreich/Wien, im Gegensatz zu Bosnien/Ihrem Herkunftsland?
- Würden Sie sich als Österreicher*in, als Bosnier*in oder anders bezeichnen?

Appendix E: Bosnian reading task – list of dialogue sequences

Pročitajte prve dvije rečenice u sebi, a treću na glas.

1) „On je velika ljiga.“

- „Ljiga si rekao?“

- „Da, ljiga sam rekao.“

2) „Bocel nam služi za dizanje tereta.“

- „Bocel si rekao?“

- „Da, bocel sam rekao.“

3) „Ljiljan je cvijet.“

- „Ljiljan si rekao?“

- „Da, ljiljan sam rekao.“

4) „Valj je slovenska riječ za *valjak*.“

- „Valj si rekao?“

- „Da, valj sam rekao.“

5) „Pištolj je opasan.“

- „Pištolj si rekao?“

- „Da, pištolj sam rekao.“

6) „On je lagan.“

- „Lagan si rekao?“

- „Da, lagan sam rekao.“

7) „Metilj je ružni parazit.“

- „Metilj si rekao?“

- „Da, metilj sam rekao.“

8) „Bile su jako lijepe.“

- „Bile si rekao?“

- „Da, bile sam rekao.“

9) „Val možeš jahati.“

- „Val si rekao?“

- „Da, val sam rekao.“

10) „Nemile žene puno prigovaraju.“

- „Nemile si rekao?“

- „Da, nemile sam rekao.“

11) „On se ljulja.“

- „Ljulja si rekao?“

- „Da, ljulja sam rekao.“

12) „Kocelj je bio knez.“

- „Kocelj si rekao?“

- „Da, kocelj sam rekao.“

13) „Ona je žela pšenicu.“

- „Žela si rekao?“

- „Da, žela sam rekao.“

- 14) „Udaljen je za pedalj.“
- „Pedalj si rekao?“ - „**Da, pedalj sam rekao.**“
- 15) „Treba mi jedna rola.“
- „Rola si rekao?“ - „**Da, rola sam rekao.**“
- 16) „Prva liga nogometša.“
- „Liga si rekao?“ - „**Da, liga sam rekao.**“
- 17) „Bole me noge.“
- „Bole si rekao?“ - „**Da, bole sam rekao.**“
- 18) „Metil je napravljen kemijskim procesom.“
- „Metil si rekao?“ - „**Da, metil sam rekao.**“
- 19) „Kula je od pijeska.“
- „Kula si rekao?“ - „**Da, kula sam rekao.**“
- 20) „On je baš lutkast.“
- „Lutkast si rekao?“ - „**Da, lutkast sam rekao.**“
- 21) „Koralj je u moru.“
- „Koralj si rekao?“ - „**Da, koralj sam rekao.**“
- 22) „Bilje raste iz zemlje.“
- „Bilje si rekao?“ - „**Da, bilje sam rekao.**“
- 23) „Nemilje je suprotno od milja.“
- „Nemilje si rekao?“ - „**Da, nemilje sam rekao.**“
- 24) „Kulja je loša ocjena.“
- „Kulja si rekao?“ - „**Da, kulja sam rekao.**“
- 25) „Lila je boja.“
- „Lila si rekao?“ - „**Da, lila sam rekao.**“
- 26) „Ljaga je mrlja na tvom imenu.“
- „Ljaga si rekao?“ - „**Da, ljaga sam rekao.**“
- 27) „Imao sam ludi period.“
- „Ludi si rekao?“ - „**Da, ludi sam rekao.**“
- 28) „Možete to i bolje napraviti.“

- „Da, bolje sam rekao.”

- „Da, ljutkast sam rekao.“

- „Da, ljutkast sam rekao.“

- „Da, pedal sam rekao.“

- „Da, pedal sam rekao.“

- „Da, ljudi sam rekao.“

- „Da, ljudi sam rekao.“

- „Da, postol sam rekao.“

- „Da, postol sam rekao.“

- „Da, rolja sam rekao.“

- „Da, rolja sam rekao.“

- „Da, lula sam rekao.“

- „Da, lula sam rekao.“

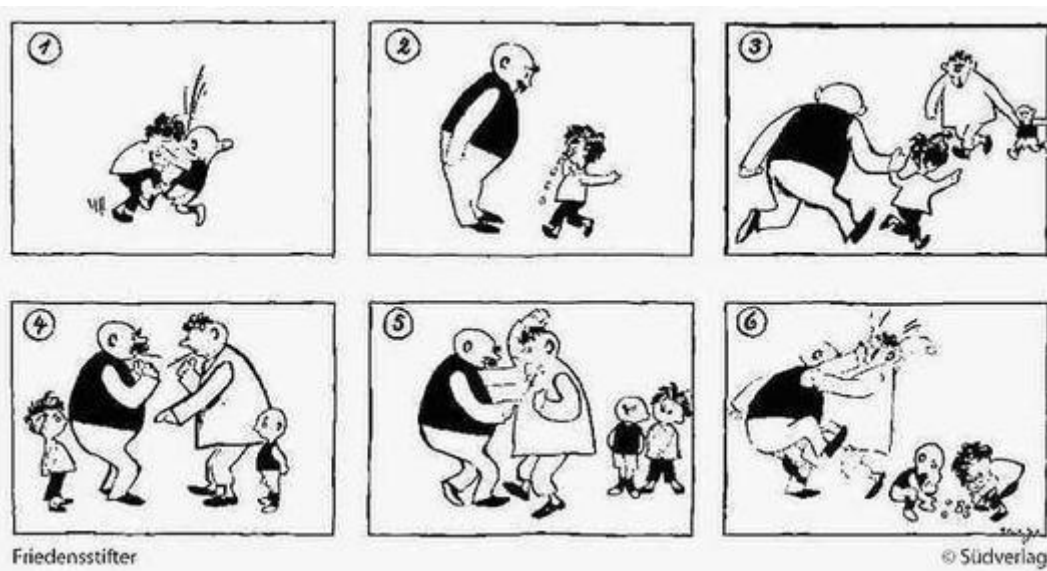
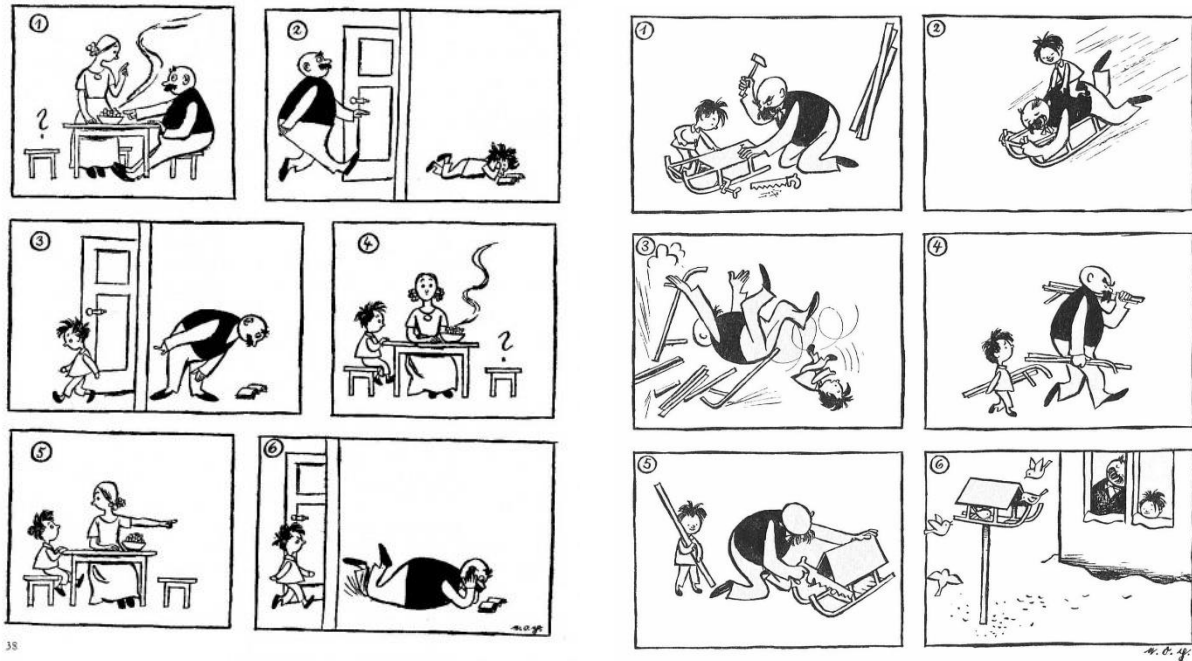
- „Da, želja sam rekao.“

- „Da, želja sam rekao.“

- „Da, koral sam rekao.“

- „Da, koral sam rekao.“

Appendix F: Bosnian spontaneous speech task – picture stories



Appendix G: Bosnian – guiding questions for the biographic interviews with monolinguals

Molim Vas pročitajte pitanja i na njih usmeno jedno po jedno odgovorite.

Uzmite si vremena za odgovore koliko Vam treba.

- 1) Kako se zovete, gdje i kad ste rođeni?
Gdje ste živjeli do svoje dvadesete godine?
- 2) Kako se zovu Vaši roditelji, gdje i kad su rođeni, gdje sad žive i koliko dugo?
- 3) Što su Vaši roditelji radili?
Koja je njihova profesija?
- 4) Da li ste živjeli izvan BiH?
Ako da, gdje i koliko dugo?
- 5) Koju ste najvišu školu završili - OŠ / SSS / VŠS / FAKULTET ?
Koje zvanje ste završili?
Što sada radite?
- 6) Koji je Vaš materinji jezik?
Pričate druge jezike? Koje?
Gdje i kako ste ih naučili? Kojom ocjenom biste ocijenili znanje tih jezika od 1 do 5 i zašto?
- 7) Kojim jezikom sada najčešće govorite?
Na kojem jeziku najčešće razgovarate sa svojom obitelji i prijateljima?
- 8) Što mislite o Bosanskom jeziku kao nacionalnom jeziku?
Gdje su sličnosti i razlike između Bosanskog, Hrvatskog i Srpskog jezika? Gdje nalazite eventualne poteškoće u komunikaciji na Hrvatskom i Srpskom?

Appendix H: Tables of post-hoc contrasts of the statistical model analyzing individual differences between BoV speakers in production

Female BoV speakers: Bosnian /l/	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
P01-p02	0.78	0.22	2478	3.56	.034*
P01-p03	0.05	0.23	2423	0.24	1
P01-p04	-0.71	0.23	2451	-3.05	0.21
P01-p05	0.92	0.22	2466	4.26	.002**
P01-p06	0.05	0.22	2453	0.23	1
P01-p07	-0.57	0.22	2458	-2.57	.92
P02-p03	-0.73	0.21	2514	-3.41	0.06.
P02-p04	-1.49	0.22	2518	-6.75	<.0001***
P02-p05	0.14	0.2	2516	0.68	1
P02-p06	-0.73	0.2	2519	-3.58	.032*
P02-p07	-1.35	0.21	2510	-6.54	<.0001***
P03-p04	-0.76	0.23	2482	-3.37	.07.
P03-p05	0.86	0.21	2512	4.1	0.004**
P03-p06	0	0.21	2478	-0.02	1
P03-p07	-0.63	0.22	2491	-2.9	0.34
P04-p05	1.62	0.22	2504	7.52	<.0001***
P04-p06	0.76	0.22	2494	3.48	.05
P04-p07	0.13	0.22	2495	0.6	1
P05-p06	-0.87	0.2	2505	-4.36	.001***
P05-p07	-1.49	0.21	2513	-7.24	<.0001***
P06-p07	-0.62	0.21	2505	-3	0.25

Female BoV speakers: German /l/	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
P01-p02	0.54	0.09	2342	5.87	<.0001***
P01-p03	0.78	0.09	2346	8.44	<.0001***
P01-p04	-0.36	0.1	2364	-3.75	.02*
P01-p05	-0.36	0.1	2466	-3.62	.03*
P01-p06	-1.06	0.1	2377	-11	<.0001***
P01-p07	-1.09	0.1	2340	-11.29	<.0001***
P02-p03	0.24	0.1	2333	2.48	1
P02-p04	-0.91	0.1	2346	-9.137	<.0001***
P02-p05	-0.9	0.1	2463	-8.95	<.0001***

P02-p06	-1.61	0.1	2356	-16.24	<.0001***
P02-p07	-1.63	0.1	2335	-16.52	<.0001***
P03-p04	-1.14	0.1	2345	-11.54	<.0001***
P03-p05	-1.14	0.1	2457	-11.3	<.0001***
P03-p06	-1.85	0.1	2351	-18.67	<.0001***
P03-p07	-1.87	0.1	2333	-18.88	<.0001***
P04-p05	0.01	0.1	2463	0.08	1
P04-p06	-0.7	0.1	2366	-6.96	<.0001***
P04-p07	-0.73	0.1	2347	-7.19	<.0001***
P05-p06	-0.71	0.1	2466	-6.94	<.0001***
P05-p07	-0.74	0.1	2457	-7.18	<.0001***
P06-p07	-0.03	0.1	2371	-0.26	1

Male BoV speakers: German /l/	<i>b</i>	SE	df	<i>t</i>	<i>p</i>
P11-p12	-1.34	0.08	2235	-16.21	<.0001***
P11-p13	0.33	0.09	2240	3.88	.0001***
P11-p14	-0.42	0.09	2212	-4.86	.0001***
P11-p15	-0.38	0.09	2214	-4.44	.0009***
P11-p16	0.01	0.87	2248	0.11	1
P11-p17	-0.4	0.09	2222	-4.68	.0003***
P12-p13	1.67	0.08	2226	20.22	<.0001***
P12-p14	0.92	0.08	2200	11.01	<.0001***
P12-p15	0.95	0.08	2212	11.26	<.0001***
P12-p16	1.35	0.08	2248	15.89	<.0001***
P12-p17	0.93	0.08	2224	11.14	<.0001***
P13-p14	-0.75	0.09	2206	-8.72	<.0001***
P13-p15	-0.72	0.09	2219	-8.25	<.0001***
P13-p16	-0.32	0.09	2255	-3.7	.02*
P13-p17	-0.73	0.09	2227	-8.5	<.0001***
P14-p15	0.03	0.09	2189	0.38	1
P14-p16	0.43	0.09	2221	4.89	.0001***
P14-p17	0.01	0.09	2197	0.17	1
P15-p16	0.39	0.09	2218	4.48	.0007***
P15-p17	-0.02	0.09	2180	-0.21	1
P16-p17	-0.41	0.09	2226	-4.7	.0002

Appendix I: Transcriptions of excerpts from original German recordings

(1)

„Glaube, als ich im Bus gesessen bin, als ich unser Haus nochmal angeschaut habe, ich hab gewusst ich werde dort nie mehr leben [...] nicht dass ich sie hasse, verzeihen konnte ich inzwischen, aber da sind nicht mehr die Leute, die ich gekannt habe, die dort jetzt noch leben, wenn ich jetzt in [TOWN NAME REMOVED] bin [...]am Anfang habe ich in alle diese Männer Leute gesehen, die die Leute getötet haben, weil die kenne ich so viele mit Namen und Familiennamen [...]das waren meine Schulkollegen, das waren Leute, die ich gekannt habe, das waren unsere Nachbarn, und so ein Gefühl, wenn das morgen wieder passiert [...] ich habe so ein Gefühl, sie werden nicht anders reagieren, ich weiß es nicht, es ist ja so ein Gefühl.“

(2)

„[...] da gibt es so diese Wissenslücken, ja und dann habe ich immer wieder gedacht, ok äh ich war nie in psychischer Behandlung von dem Krieg, von all diesen Sachen und so, ich hab mein Leben immer gut meistern können [...]. Da ich mich aber damit beschäftige und in diese Richtung äh studiere [...] und jetzt haben wir also diese psychosomatischen Krankheiten behandelt und darüber eben gelernt, dann sehe ich immer wieder wo ich einmal war und wo bin ich jetzt [...] aber das ist ja irgendwie ganz normal, dass man in solchen extremen Situationen wo man Traumas und alles Mögliche erlebt hat, dann auch äh diese Wissenslücken bekommt [...] ich muss mich jetzt wirklich hinsetzen und ganz genau überlegen oder irgendwie mitnotieren und schauen ...chronologisch versuchen.“

(3)

„ [...] früher war es schwer, weil die Hälfte meiner Freunde wurde massakriert umgebracht und so, die andere Hälfte ist ja die Hälfte, die sie umgebracht hat leider, und das ist dann schwer, so ich war in meiner Stadt seit dem Krieg, seit neunzehneinundneunzig, nie wieder, so fünfundzwanzig Jahre und ich würde auch nicht gern hingehen weil ich weiß dass da nur Serben leben [...] jetzt letzten Sommer haben wir eine Bosnien Tour gemacht, wir haben viele Städte besucht [...] und also wir entdecken Bosnien neu durch eben diese Aufgabe die wir uns äh gestellt haben, dass wir unseren Kindern das Land ihrer Eltern einmal ähm schmackhaft machen, ja dass sie es lernen zu lieben, zu respektieren und zu schätzen ja“.

(4)

„ja und ich habe auch Glück gehabt und habe gesagt, jeder Ausländer soll einen Österreicher haben, dass er durch ihn die Kultur und alles, Sprache, alles lernt, so habe ich gemacht, wirklich so enge Kontakte habe ich gehabt mit Leute [...] wenn man sich intensiv mit jemand so trifft und über alles spricht, dann wird man Freund mit der Familie und kennt die, alles Mögliche, es ist wirklich [...] ja genau wie tauschen, sie lernen von uns, ich lerne von hier und ja ich finde das wirklich super, ja diese diese Ghettoisierung und nur unter sich zu bleiben finde ich überhaupt nicht gut.“

(5)

„[...] ich habe vieles nicht erlebt, was manche Frauen erlebt haben, und ich hab nicht so ein Gefühl, Ängstlichkeit, wenn ich irgendwo, weil ich Konzentrationslager oder so was kenne, nicht kenne, und es ist ein anderes Gefühl, aber es gibt Frauen, die sich davon, wirklich, die vieles erlebt haben, ist natürlich anderes, andere Gefühle [...].“

(6)

„[...] wir sprechen daheim ausschließlich BKS und die beiden Söhne [...] werden zweisprachig erzogen, wo wir uns stark davor hüten, den Fehler zu machen, dass wir anfangen mit denen Deutsch zu sprechen, das heißt daheim wird beinhart hardcore die Muttersprache gesprochen, denn ab dem Kindergarten und mit Fernsehen ist Deutsch sowieso die äh die Hauptsprache und die ist sowas von erdrückend stark, dass das äh wir uns eigentlich da durchkämpfen müssen.“

(7)

„[...] ich hab das auch mal so ähm eine Forschung für mich selbst gemacht und dann habe ich gedacht, ja ich leb ja in Wien und ich hab ja mehr [...] so Freundeskreise äh aus Ausland, es sind alles Ausländer, also es sind viele Ausländer, mehr, vielleicht siebzig Prozent Ausländer, die aus Südosteuropa, Osteuropa oder auch ein bisschen Asien, und die österreichischen Kollegen hab ich sehr wenig, sehr wenig und dann habe ich auch mal mich gefragt, wieso und wieso das nicht so funktioniert und geht und dann, ja die Slawen, die die haben eine Verbindung [...] die verstehen sich ein bisschen vielleicht mehr, weil [...] es gibt ja Sachen, die man nicht übersetzen kann und vor allem [...] die Gefühlssachen ja [...] es gibt eine Barriere oder [...] man findet immer [...] den leichteren Weg als den schweren.“