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Sound maintenance and change: Exploring inter-language phonetic influence in first-generation italo-australian immigrants[1]

The present study explores the phonetic influence exerted by late-acquired L3 English on the native dialect of four first-generation Italo-Australian speakers from Belluno, Northern Veneto, who moved to Sydney, Australia in the mid-late 1950s. We map phenomena of attrition, maintenance and/or loss in their spoken L1 (Veneto dialect) by investigating the fine phonetic details of selected voiceless coronal obstruents: the interdental [θ], shared with English L3 but absent in the phonological inventory of their L2 (Standard Italian, SI); [s] and [ʧ], present in all the three repertoires. Their dialectal productions are compared to those of four control speakers who were born and live in the same area of origin of the four first-generation Italo-Australian speakers.

Keywords: sociophonetics, dialect, language variation and change, heritage languages, Italo-Australian immigrants, fricatives, spectral moments.

1. *Introduction*

This contribution builds upon previous work carried out within the IRIAS project, which has already been presented and thoroughly discussed in Avesani, Galatà, Vayra, Best, Di Biase, Tordini & Tisato (2015) and Avesani, Galatà, Best, Di Biase, Vayra & Ardolino (2017). In this study, we acoustically analyse dialectal L1 productions of four first-generation Italo-Australian speakers included in the IRIAS Corpus who originate from Northern Veneto (specifically from the areas of Feltre and Cadore, Belluno province), and of four control-group Italian speakers, who were born and currently live in the very same places of origin of Italo-Australian immigrants. Our purpose is to test whether Italo-Australian speakers from Feltre and Cadore have maintained the fine-grained phonetic features of their L1 voiceless coronal obstruents /θ, s, ʧ/ in a long-standing contact with similar – but not phonetically identical – /θ, s/ of Australian English (AusEng); and to examine whether the fricative consonants and the fricative portion of the post-alveolar affricate have undergone any phonetic change with respect to same phones currently spoken by the control group of Italian speakers in Veneto.

[1] Authorship note: while the paper is the result of a joint collaboration and discussion between the four authors, main responsibility for this paper is divided as follows: § 1, 3, 5.1, 5.3, 6: Tordini, Avesani, Galatà; § 2: Tordini; § 4: Tordini, Avesani; § 5.2: Tordini, Galatà; § 5.4: Galatà; § 7: Avesani, Tordini.

Both the Italo-Australians and the control speakers have the local dialect as L1 and learned the Veneto regional variety of Italian when they entered the elementary schools at 6 years of age. They can be considered as early sequential bilinguals, but it should be reminded that the local dialect and regional Italian are two varieties that stand in a diglossic relationship within the speakers' linguistic repertoire: the local dialect is the language of everyday communication, within and outside the family, while regional Italian is used in more formal exchanges.

The Italo-Australian speakers were exposed to English upon arrival in the new country and learned it as their third language spontaneously, by immersion in the new society. While the local dialect kept being used within the family and the heritage community (due to a chain type of immigration), Italian widened its use to become the vehicular language of the larger community of Italian immigrants, converging towards shared forms and being permeated by English lexical items imported within an Italian morphological frame (Avesani et al., 2017). Given the length of residency of the Italo-Australian speakers in Australia exceeded five decades at the time of interview, they represent an interesting group, albeit small, to study processes of linguistic contact, cross-linguistic influence (CLI) and attrition.

The paper proceeds as follows: in § 2, we contextualize this study within the scope of primary language attrition, focusing on its manifestations in migration settings. In § 3, we offer a sociolinguistic overview on Italian immigrant communities in Australia and a brief description of the speakers' native Veneto dialect. In § 4, we present an influential theoretical framework relevant to the interpretation of our results, the Speech Learning Model and the predictions we can make based on that model. In § 5, the data collection procedure and the methodology employed for the acoustic analysis are described and in § 6 we will provide the outcome of the spectral analysis and the statistical results. Discussion and conclusions are presented in § 7.

2. *Primary language attrition: an insight into migration settings*

Many studies report evidence of primary language (L1) attrition[2] caused by a persistent contact with an L2 in a specific communication setting (Nagy, 2015). Nevertheless, it has been demonstrated that enduring contact and use of L2 are not the only factors triggering an impoverishment in the knowledge of a given linguistic code (see, for example: Andersen, 1982; Weltens, de Bot & van Els, 1986; Seliger, Vago, 1991; de Bot, Clyne, 1994; Schmid, 2011; Schmid, Köpke, 2013). Linguistic

[2] The notion of "attrition" is frequently included within the concept of "language loss", which is used as its cover term (Opitz, 2011: 10). While language loss is generally employed to indicate the phenomenon of change or reduction of linguistic skills, attrition specifically indicates «the loss of a language by a healthy individual (that is, loss which is not caused by brain injury or some pathological condition, such as aphasia or dementia)». Following the classification suggested in Weltens, de Bot & van Els (1986), this work will solely address phenomena of primary language loss in a second language (L2) environment, e.g. loss of specific native language features experienced by migrants.

and sociolinguistic attrition both within individuals and within language communities, in fact, occur frequently as a result of language shift, that is, when speakers consistently reduce (or abandon) the use of their L1 (Schmid, 2011). In general, the decline in competence caused by an asymmetric interaction between the linguistic systems normally can derive either from a functional reduction ("shifting") or a structural reduction ("attrition") in L1 (Schmid, Köpke, Keijzer & Weilemar, 2004; Celata, Cancila, 2010).

There is also evidence that migration settings offer a unique perspective to observe primary language attrition phenomena. The new social and linguistic environment is characterised by an extensive use of L2, which is permanently active and gradually becomes the medium of privileged communication in daily life (Kroll, Bobb & Wodniecka, 2006; Köpke, Schmid, Keijzer & Dostert, 2007: 3), by a decrease in native language use in everyday exchanges, and by a dramatic reduction of constant L1 input (Olshtain, 1989: 151). We can observe from a significant amount of studies that being immersed in an L2 environment has profound effects on adult migrants (Seliger, Vago 1991; Yağmur, 1997; Schmid et al. 2004; Köpke et al., 2007; De Leeuw, 2008; De Leeuw, Schmid & Mennen, 2010, among others). Namely, adult migrants who have a full native language proficiency and have learned an L2 after puberty (namely, late bilinguals) can reach a high proficiency also in the L2 and often reverse their language dominance in favour of the L2 (Mägiste, 1979; Opitz, 2011): these individuals are defined as "late L1 attriters" and are opposed to "child attriters", whose process of L1 acquisition is arrested or reversed (Opitz, 2011: 13).

Phenomena of attrition in communities of immigrants are generally related to several extralinguistic factors: the age of arrival in the host country (AoA) or the length of residence (LOR); the amount, frequency and context of input and exposure to the foreign language(s) (Schmid, Köpke, 2013). It is undebatable that the process of L2 acquisition in adults is also led by other factors, such as: motivation to integrate in the host country's social and professional community, aptitude, time and effort that the speaker employs in the language learning process, cultural identity. However, age of acquisition (AOA) of a second language has been acknowledged as a main factor in assessing bilinguals' competence and has therefore received considerable attention in this area of research in recent years (see e.g. studies by DeKeyser, Larsen-Hall, 2005; Hyltenstam, Abrahamsson; 2003; Kroll, de Groot; 2005; Ahn, Chang, DeKeyser & Lee-Ellis 2017, a.o., on age-related maturational constraints). However, it is still unclear whether the age at which a decreased L1-L2 contact begins can predict the extent of L1 attrition (Ahn et al., 2017). Moreover, the extent of attrition as a consequence of the predominant use of L2 does not seem to progress linearly over longer time-periods (e.g. de Bot, Clyne, 1994), thus making it difficult to describe its effects in a straightforward manner.

3. *The community of Veneto immigrants in Australia and their dialects*

As can be seen from a large number of studies on Italian immigrants in Australia (e.g. Bettoni, 1981; Tosi, 1991; Bettoni, 2000; Bettoni, Rubino, 1996; Rubino, 2006; Campolo, 2009; Caruso, 2010; Gallina, 2011; Rubino, 2014), there is general consensus about the social and linguistic composition of Italian communities. In the post-WWII years, a considerable amount of Italians left from regions in the south (Sicily, Calabria, Campania, Abruzzo) and from few regions in the north, notably from Veneto. While South America was the most common destination of Veneto immigrants, Australia attracted many of them due to a bilateral agreement for assisted immigration signed in 1951 between Australia and Italy (for further details, see Campolo, 2009; see also Avesani et al., 2015; Avesani et al., 2017).

Statistical surveys conducted after WWII in Italy revealed that the population's linguistic behaviour was strongly oriented towards dialectophony: only 35% of Italian citizens declared a regular and daily use of the national language, while the remaining 65% was divided between those who employed Italian only occasionally and those who made an exclusive use of the local dialect (De Mauro, 1972: ISTAT census of 1951).

Italians who left Veneto in the mid 40s-early 60s moving to Australia were mainly workers or farmers who mostly spoke their local dialect as L1 in everyday communication, both within the family and within the larger local community. They had learnt (regional) Italian at school, as an L2, and used it only in formal circumstances. Subsequently, they learnt AusEng as L3 only upon arrival in the country, almost exclusively by immersion (Tosi, 1991; Bettoni, Rubino, 1996) while maintaining the local dialect to communicate with the family and the network of other immigrants coming from the same areas of Veneto[3]. Once in Australia, the input from the same regional variety of Italian dramatically diminished, while at the same time the speakers were exposed to different varieties of regional Italian as spoken by the variegated Italian community. Italian gradually lost its status of "high" language used mainly for writing and spoken only in formal situations, and became the spoken vehicular language of the great Italian community of immigrants, acquiring in the process new traits that were absent in the original varieties spoken in Italy (for the development of the community language known as *Italo-Australiano* see for example Bettoni, Rubino, 1996; Tosi, 1991; Campolo, 2009). Progressively, English-L3 became the dominant language, but the native local dialect continued to be used in the family and with friends as long as they were available.

The issues of maintenance or change of the heritage languages, i.e. local dialect and regional Italian, by Italian immigrants in Australia have been addressed in the past by many studies, which were mainly focused on the effects of English-L3 on the native repertoire at a morphosyntactic and at a pragmatic level (e.g. Bettoni,

[3] Italian immigration to Australia, especially to rural areas, has followed the pattern of a "chain migration", which creates "districts in which emigrants are bound together by shared kinship ties based on a specific village" (Tosi, 1991: 337; Corazza, Grigoletti & Pellegrini, 2012).

1981; Bettoni, 2000; Bettoni, Rubino, 1996; Rubino, 2006; Caruso, 2010; Rubino, 2014)[4]. However, the regionally-differentiated speech characteristics of Italo-Australian speakers have been less often considered, although they are strong markers of their linguistic identity and their "foreign accent" (Avesani et al., 2015; Avesani et al., 2017).

In this paper, we explore whether a set of coronal obstruents of the Bellunese dialect have been maintained by emigrants who left their villages in Cadore and in the area of Feltre in the late fifties-early sixties. The specific aim of this study is to verify if and to which extent the fine phonetic properties of the native language can resist attrition after more than fifty years of contact with an L3 learned in adulthood, when the native and the late-learned languages share the same set of consonants but differ for their phonetic content.

The dialect spoken in the province of Belluno belongs to Northern Veneto, one of the five linguistic sub-system in which the Veneto dialects are traditionally divided (e.g., Zamboni, 1974; 1988). The set of coronal obstruents of this system includes the unvoiced obstruents /θ, s, ʧ/[5]. Examples are: [θimiˈtɛːro] ("cemetery", Standard Italian [ʧimiˈtɛːro]); [ˈsapa] ("hoe", Standard Italian [ˈʦapːa]), [ˈʧeːza] ("church", Standard Italian [ˈkjeːza]). Note that none of the Veneto dialects presents the post-alveolar fricative /ʃ/. /s/ and /ʧ/ are shared by all languages, while /θ/ is shared only by English and Belluno dialect[6] and is missing in Standard Italian. Phonetically, [s] is an apico-alveolar fricative in Belluno dialect while is a lamino-denti-alveolar in Standard Italian. In a previous work (Avesani et al., 2015) we analysed the dialect of two speakers from Belluno and we found empirical evidence that singleton [s] in intervocalic position has a retracted place of articulation: it sounds more like [ʃ] and the acoustic properties of its frication noise (Center of Gravity) do not differ from those of the fricative release of the postalveolar affricate [ʧ]. Such a retraction is attested also in the regional Italian spoken in those areas, as indicated by the detailed auditory analysis of Canepari (1984). The phonetic details of Bellunese /s/ also differ from those of Australian English /s/. In fact, /s/-retraction is a gradient sound change that has taken place in several varieties (i.e. "dialects") of English, but not in Received Pronunciation nor Australian English (Baker, Arcangeli & Mielke, 2011). It is also worth mentioning recent studies by Stevens, Harrington (2016) and Stuart-Smith, Sonderegger, McAuliffe, Mcdonald, Mielke, Thomas & Dodsworth (2018), which have demonstrated that the precursors of such retraction lie in the lower frequency spectral energy for /s/ in /str/ than

[4] With the notable exception of Horvath (1985), who conducted a sociophonetic analysis on the Sydney speech community including groups of Italian immigrants. However, the origin of the Italian speakers is not specified, thus hindering a proper comprehension of their linguistic and sociolinguistic features and the impact of English on their native variety.

[5] In the present study, as in the previous ones, we do not analyze allophones of /ʃ/ but the fricative release [ʃ] of the postalveolar affricate /ʧ/, and we will refer to it as [(t)ʃ]. Such a choice has been induced by the scarcity of occurrences of /ʃ/ in the corpus.

[6] Note that among the five Veneto subsystems [θ] occurs only in the Northern one.

in singleton /s/ and that the phonetic bases of /s/-retraction are subject to "dialectal" and social factors[7].

The afore-mentioned interlinguistic phonetic differences will enable us to make predictions about maintenance or attrition of L1 coronal sounds in contact with similar phonetic categories in L3.

4. *Cross-language phonetic interference: a theoretical framework*

Within the broader phenomena of attrition, L1 change due to extensive use of L2 is traditionally identified through headings such as "cross-language interaction/influence" (CLI), "reverse interference", "convergence" and is reported at all linguistic levels (Pavlenko, 2004; Schmid, Köpke, 2013). With reference to the sound structure, it has been clearly demonstrated that L2 experience can exert a considerable influence on L1 oral productions to the point of triggering a phonological restructuring of its elements (e.g., Chang, 2012; Flege, 1987, 1995, 2007; Flege, McKay & Meador, 1999; Flege, Schirru & McKay, 2003; Major, 1992, 2010). In the last few decades, issues related to cross-language phonetic interaction have been addressed by a significant amount of studies. Recognition of L2 influence on L1 speech has been extensively discussed in the works of Flege (1987, 1995), within the theoretical framework of the Speech Learning Model (SLM). Other influential models have addressed CLI, such as the Perceptual Assimilation Model (PAM) and its extension PAM-L2 (Best, 1995; Best, Tyler, 2007) and the Second Language Linguistic Perception model (L2LP: Escudero, 2005). However, PAM-L2 did not specifically address the effects of L2 on L1 and Escudero's model focuses on vowel learning.

The starting point of SLM is that even proficient late bilinguals are likely to experience restructuring in the L1 as a consequence of L2 experience at a phonetic level (Schmid, 2011)[8]. Contrary to the hypothesis of a critical period, the SLM assumes that the capacity for speech learning remains intact across the life span (Flege et al., 2003) such that a specific L1 phonetic category «[...] continues to develop in adulthood under the influence of all sounds identified with that category» (Chang, 2012: 250). According to Flege's model, elements making up the L1 and L2 phonetic subsystems of a bilingual exist in a "common phonological space", and so will necessarily influence one another (see also Bergmann, Nota, Sprenger & Schmid, 2016). Namely, L1 and L2 sounds are posited to exist in a shared system in which the sounds interact through two distinct mechanisms. The first mechanism, "category assimilation", is thought to operate when a new L2 category fails to be established despite audible differences between it and the closest L1 speech sound. The formation of a new phonetic category in L2 will be blocked if instances of an L2 speech category continue to

[7] The phenomenon of /s/-retraction has also been investigated by Mereu (2017) in the Sardinian variety spoken in Cagliari. The author demonstrates that the realization of /s/ as the local stereotype [ʃ], i.e. the substandard variant, is correlated to stylistic variation.

[8] A similar assimilatory process towards L2 phonetic settings has recently been found even in the L1 of beginner learners (Chang, 2012).

be identified as instances of an L1 category, either because it is perceived as the same sound or as similar to an existing sound in the native system (i.e. more or less deviant exemplar of a L1 phone) via a mechanism of "equivalence classification". In both cases «a single phonetic category will be used to process perceptually linked L1 and L2 sounds» (Flege, 1995: 239; Flege et al., 2003; de Leeuw, 2008; Bergmann *et al*., 2016). SLM predicts that a "merged" category will develop over time, and that it will subsume the phonetic properties of the perceptually linked L1 and L2 speech sounds. On the production side, given that a single, merged L1–L2 category is used to produce corresponding speech sounds in the L1 and L2, the SLM predicts that «[...] the more a bilingual approximates the phonetic norm for an L2 speech sound, the more [his/] her production of the corresponding L1 speech sound will tend to diverge from L1 phonetic norms» (Flege et al., 2003: 469-470).

The second mechanism through which L1 and L2 phonetic segments interact is called "phonetic category dissimilation". It operates when a new category has been established for an L2 speech sound, that is when a newly encountered L2 sound is perceived to be sufficiently dissimilar from the nearest L1 sound ("dissimilar sounds" were originally named as "new" in Flege, 1987). The newly established L2 phonetic category will shift away from the closest L1 sound by a mechanism of category dissimilation, because «bilinguals strive to maintain phonetic contrast between all of the elements in their combined L1-L2 phonetic space in the same way that monolinguals strive to maintain phonetic contrast among the elements making up their (L1-only) phonetic space» (Flege et al., 2003: 470). The predictions on the production side are that the phonetic properties of a new L2 category and the closest L1 category will diverge from one another and that the productions of bilinguals will display values that are more extreme than in monolinguals. Summarizing, L1 and L2 sounds are posited to exist in a shared system, where there is a general pressure to keep them distinct, and to be related to each other on an allophonic, rather than a phonemic, basis.

In the present study, we will explore if regressive CLI occurs from L3-English on L1-Belluno dialect. Phonetic/phonological influence exerted by a third language on the native system has so far received insufficient attention, with respect to the larger amount of studies concerning patterns of L2 interaction with L1 in late bilinguals (Cabrelli Amaro, 2012: 32; see also De Angelis, 2007; Hammarberg, 2001; Rothman, Cabrelli Amaro & de Bot, 2013, for a review). Moreover, the distinction between L3/*Ln* and L2 acquirers has been often neglected, although the former display a larger phonological awareness, as well as wider linguistic repertoire (Gut, 2010). Consequently, their multilingual competence makes it more likely for CLI to occur. As Cabrelli Amaro (2017) further highlights, most studies on CLI have addressed progressive transfer from the L1 and/or L2 to the L3, to the detriment of L3 regressive transfer (i.e. when L3 affects the L2 and/or L1).

Extending the predictions of the SLM to involve also L3, we could posit that the phonetic elements of all languages of our multilingual speakers, L1 dialect, L2 Veneto Italian and L3 AusEng exist in a common phonological space and are related to one another on an allophonic basis. In our specific case, the phonological subset

of coronal obstruents we investigate /θ, s, ʧ/ is shared by the three languages, but we know that at least the phonetic properties of /s/ differ in L1-dialect and L3-English. /s/ in Belluno dialect (as in other dialectal varieties of the Veneto region) has a retracted place of articulation such that it sounds similar to the postalveolar /ʃ/.

Based on the assumptions and empirical results of the SLM, we can predict that if the Veneto immigrants have failed to create a new L3 phonetic category for English /s/, either because they perceived it as the same sound or because they perceived it as deviant with respect to the Belluno /s/ but still classified it as equivalent to the/s/ of their L1, the acoustic properties of the frication noise of /s/ in the Belluno dialect should be intermediate between those of the native category and those of English /s/, as the immigrant speakers merged the L1 and L3 category. However, as we can assume that after 50 years of residency in the English-speaking country the immigrant speakers have approximated the L3 phonetic norms, we expect that in time their productions diverged from the L1 norms; that is, we expect that the /s/ of the multilingual speakers will be *less* retracted than in the speech of monolingual Veneto speakers living in Veneto. Conversely, if they have formed a new L3 category, we expect that due to the mechanism of phonetic category dissimilation the properties of the frication noise of /s/ as spoken in Belluno dialect will shift away from the properties of English /s/, and therefore that /s/ produced by the Belluno immigrants in their L1 dialect will be *more* retracted than in Italian monolingual speakers.

5. *Materials and methods*

5.1 Origins of the informants

The data used in the present study stem from the *Italian Roots in Australian Soil* corpus (IRIAS[9]; Avesani et al., 2015; Avesani et al., 2017; Galatà et al., in prep.) containing elicited speech samples of dialect L1, Italian L2 and Australian English L3 and providing a significant contribution to the linguistic situation of an Italian immigrant community in an English-speaking country.

Our specific aim here is to carry out a sociophonetic investigation on Italian immigrants from the areas of Cadore and Feltre (in the province of Belluno, Veneto), with the purpose to detect the degree of attrition exerted by the L3 on their native dialect, by considering the variability of selected voiceless coronal fricatives (Avesani et al., 2015). To allow an accurate contrastive analysis, coronal obstruents produced by immigrants are compared to the same target consonants produced by a control group of Italians born and living in their very same villages of origin. Data for the control group have been collected along the same lines and with the same procedure described in Avesani et al. (2015) and Galatà et al. (in prep.).

Sociolinguistic information for both groups of speakers can be found in Table 1.

[9] See the project's webpage at http://irias.filefaustralia.org/.

For the Italo-Australian group (Ita-Au), 4 first-generation Italo-Australian speakers from the area of Belluno have been selected from the IRIAS speech corpus: two male speakers (GPZ and MZN) and two female speakers (CZM and ACS)[10]. From Table 1, we see that they are balanced with respect to: age (from 72 to 82 years), local dialect as L1 (Cadorino and Feltrino varieties), number of years of experience of English as expressed by length of residence (LoR) in Australia (range in years = 51-57). Moreover, the age they started to acquire regional Italian as L2 corresponds for all of them with the beginning of primary school in Italy at age 6. The age of arrival (AoA) in Australia also represents the age they began to learn English as L3 (AoA Eng) by spontaneous immersion. Similarly, the Italian control group (Ita) is composed of two males (ALM and SPR) and two females (BCL and RDP). Their age ranges from 59 to 75, and they match the Italo-Australians for L1-dialect (Cadorino and Feltrino varieties) and competence of Italian as L2 (learned in primary school since age 6). As for Age, while the Italian control speakers from Feltre are comparable to the immigrants from the same area (75 and 74 years old, respectively) the 2 control speakers from Cadore (BCL and ALM) are younger than their Italo-Australian counterparts (on average 60.5 and 78 years old, respectively) and report to have a higher level of education (secondary and middle schools vs primary and middle schools).

Table 1 - *Italo-Australian speakers' sociolinguistic information: Age = age (in years) at time of recording; LoR = Length of Residence in Australia; AoA Eng = Age of Arrival and onset of Acquisition of English; NA = not available*

Group	*ID*	*Sex*	*Age*	*AoA Eng*	*LoR*	*Dialect L1*	*L2*	*L3*	*Level of education*	*Profession*
Ita-Au	CZM	F	74	17	57	Cadorino	Ita	Eng	primary school	housewife
	GPZ	M	82	29	53	Cadorino	Ita	Eng	primary school	craftsman
	ACS	F	78	23	55	Feltrino	Ita	Eng	NA	NA
	MZN	M	72	21	51	Feltrino	Ita	Eng	NA	NA
Ita	BCL	F	62	NA	NA	Cadorino	Ita	NA	secondary school	employee
	ALM	M	59	NA	NA	Cadorino	Ita	NA	middle school	farmer
	RDP	F	73	NA	NA	Feltrino	Ita	NA	primary school	nanny
	SPR	M	75	NA	NA	Feltrino	Ita	NA	primary school	craftsman

5.2 Data selection and preparation

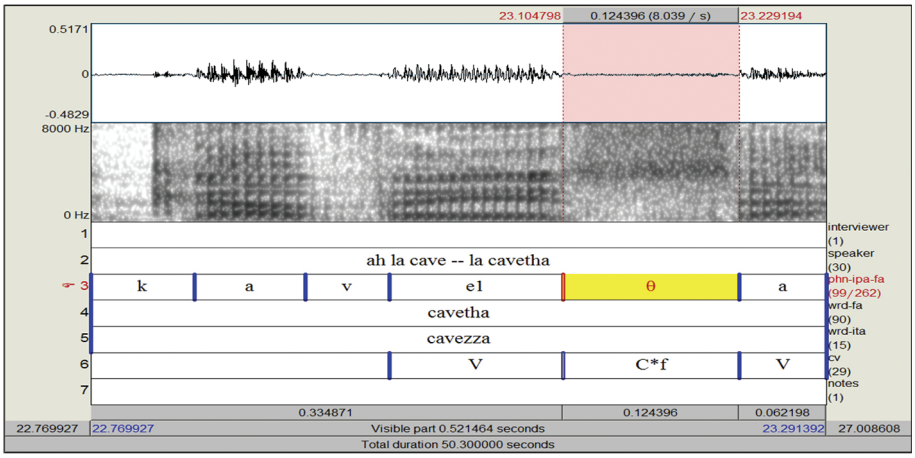
In the present study, data preparation was achieved using a different strategy with respect to the previous works (cfr. Avesani et al., 2015 and Avesani et al., 2017).

First, an orthographic transcription of the audio files (about 2 hours per speaker) was performed by one of the authors by means of ELAN (version 4.9.4). The resulting transcribed *.eaf files were first processed through the Chunk Preparation tool (Reichel,

[10] Dialectal productions of 2 out of 4 participants (e.g. CZM and GPZ) have been already analyzed in Avesani et al. (2015).

Kisler, 2014) to generate derived tiers as input for the Forced Alignment (FA) procedure[11]. From the FA, we obtained two tiers, respectively containing an orthographic word level segmentation (*wrd-fa*) and an IPA phone level segmentation (*phn-ipa-fa*). Then, we added two more tiers: the Italian translation of the target dialectal word (*wrd-ita*) and the target consonant's manner of articulation (*cv*) as well as its preceding or following phonetic context. An example of the resulting *.TextGrid structure is shown in Figure 1 (for more in-depth details, see Galatà et al., in prep).

Figure 1 - *A screenshot of the resulting data organization on the different tiers*



5.3 Acoustic analysis

Consistently with previous work (Avesani et al., 2015; Avesani et al., 2017) and to create a homogeneous set of data, in this study we performed an acoustic analysis only on the set of dialectal voiceless coronal fricatives [θ], [s] and on the fricative release of [ʧ] (from now on [(t)ʃ]) by using an adapted version of a Praat script by Di Canio (2013)[12].

The spectral features of a fricative sound are given by the shape and the size of the oral cavity in front of the constriction (see e.g., Shadle, 1985). Voiceless fricatives /s/ and /ʃ/ are produced through a constriction in the upper anterior portion of the oral cavity between the tongue-tip or tongue-blade (Jones, McDougall, 2009: 280),

[11] The Chunk Preparation and the WebMAUs (Munich AUtomatic Segmentation system) tool employed for the FA procedure are both available from: https://clarin.phonetik.uni-muenchen.de/BASWebServices/interface.

[12] The original script by Di Canio (retrieved from: http://www.acsu.buffalo.edu/~cdicanio/scripts.html) extracts the first four spectral moments (center of gravity, standard deviation, skewness, and kurtosis), global intensity and duration for each fricative. Discrete Fourier Transformations (DFTs) are averaged for each token using time-averaging (based on Shadle, 2012). Prior to the analysis, a 300 Hz low pass cut-off filter was applied to all the recordings to remove any F0-related influence. Then CoG, SDev, Skew and Kurt were computed over the central 80% of the fricative segment's duration using 5 DFTs with an analysis window set to 10ms.

whereas the post-alveolar is produced with a more posterior place of articulation. Therefore, realizations of /ʃ/ are supposed to involve lower frequency concentrations of energy with respect to /s/ (respectively, with a spectral peak at around 2.5-3 kHz and around 4 to 6 kHz, according to Jongman, Wayland & Wong, 2000). On the other hand, the interdental /θ/ generally displays a broad range of peaks above 5 kHz, which is attributed to the relatively short front cavity (Fuchs, Toda & Żygis, 2010; Narayanan, Alwan, 2000).

In this work, we performed a spectral moment analysis[13], in which the power spectrum is treated as a probability distribution (Li, Edwards & Beckman, 2009), to classify the dialectal productions of target coronal fricatives. As previously illustrated in Avesani et al. (2015), we measured: duration, spectral moments (M1=Center of Gravity, M2=Standard Deviation, M3=Skewness, M4=Kurtosis). The Center of Gravity (CoG)[14] provides information about where the energy is concentrated: a higher CoG mirrors a more advanced place of articulation. The Standard Deviation (SDev) measures the variance in the energy distribution and indirectly indicates the degree of laminality: the higher the SDev, the higher the laminality of a given fricative. Skewness indicates the (a)symmetry of the distribution of energy around the average, and is related to the CoG, since the tilt in spectrum correlates with the location of the constriction. Kurtosis indicates the peakedness/flatness of the spectrum and correlates with the degree of laminality of the fricative.

5.4 Data cleaning, data exploration and statistical analysis

Data cleaning, data exploration and statistical analysis were carried out in R (R Core Team, 2018). Complying with the literature (e.g. Fant, 1960; Shadle, Mair, 1996, among others) that reports how lip-rounding affects fricative spectra, the vocalic context that would mostly affect the fricative spectra, i.e. /u/, was excluded from the current analysis and we selected only those fricatives that occurred before /a/, /e, ɛ/ and /o, ɔ/, with the purpose of balancing the anticipatory coarticulatory influence of the following vowel (see also Avesani et al., 2015). From a total of 1518 observations in the selected contexts, we retained 1443 observations after removing a few evident outliers (due mainly to overlapping noise in the recording), all the word final fricatives and all those fricatives with a duration shorter than 37 ms. The final dataset is summarized in Table 2 and Table 3.

For the statistical analysis, linear mixed-effects models (LMMs) were fitted using the *lmer* function of the *lme4* package and the *lmerTest* package in R. We built

[13] Spectral moment analyses are commonly found in literature for the identification and description of stable acoustic cues of fricative noises (e.g., Hughes, Halle, 1956; Stevens, 1960; Shadle, 1985, 2012; Jongman et al., 2000; Harrington, 2010). Yet, Spinu, Lilley (2016) show that cepstral coefficients allow to classify the fricatives for place of articulation with a 10% more accuracy than spectral moments (95%). However, the analysis based on spectral moments in the latest studies provide an accuracy rate in the classification of fricatives that can be as high as 85%.

[14] For an accurate description of spectral moments, see e.g. Forrest, Weismer, Milenkovic & Dougall (1988); Jongman et al. (2000); Jones, McDougall (2009); Li et al. (2009).

up the full model by adding one predictor at a time from a baseline model (*null. model*) including only the intercept as predictor. The baseline model was fitted for each of the dependent variables (e.g. CoG, SDev, Kurt and Skew) by entering the factor *speaker* as random effect with *phonelabel* ([θ] vs [s] vs [(t)ʃ]) nested within *speaker* (to account for the repeated measures design). The additive models were fitted one by one using R's *update()* function by adding potential predictors as fixed effects and their interactions. Models were compared with the *anova()* function from the package *stats4* in R and goodness of fit of each model was assessed by means of Akaike's Information Criterion (AIC). *P*-values of overall effects were determined using Likelihood Ratio Tests (L.Ratio), as implemented in the *anova()* function. Both baseline and additive models were fitted and compared using maximum likelihood (ML) method. Deviations from homoscedasticity or normality have been checked by visual inspection of residual plots. For comparability purposes, the same structure of the model fitted for the dependent variable CoG was used for the other dependent variables SDev, Kurt and Skew. The chosen models were re-fitted to the data using residual maximum likelihood (REML) estimation to obtain unbiased estimates of the covariance parameters (West, Welch & Galecki, 2014: 334). Further inspection followed with pairwise post-hoc analysis (Tukey adjusted) using the *emmeans* package with a 95% confidence level and Kenward-Roger correction of degrees-of-freedom. For the post-hoc analysis we report on the outcomes by providing the estimated marginal mean and the associated standard error (±SE).

Table 2 - *Number of observations grouped by phone and speaker*

	speaker							
	ACS	CZM	BCL	RDP	MZN	GPZ	ALM	SPR
θ	86	32	57	33	48	35	43	38
s	173	23	79	18	114	16	70	112
ʃ	82	37	83	12	93	44	55	60

Table 3 - *Number of observations grouped by phone, speakers group and dialect*

		dialect	
	group	Cadorino	Feltrino
θ	Italians (Ita)	100	71
	Italo-Australians (Ita-Au)	67	134
s	Italians (Ita)	149	130
	Italo-Australians (Ita-Au)	39	287
ʃ	Italians (Ita)	138	72
	Italo-Australians (Ita-Au)	81	175

6. *Results*

In Table 4, we report the results of each model fitted for the four dependent variables CoG, SDev, Kurt and Skew. The predictors entered in each model are the following: *gender* (female vs. male); *phonelabel* ([θ] vs. [s] vs. [(t)ʃ]); *group* (Italians (Ita) vs. Italo-Australians (Ita-Au)); *dialect* (Cadorino vs. Feltrino); three two-way interaction terms *phonelabel*group, phonelabel*dialect* and *group*dialect*.

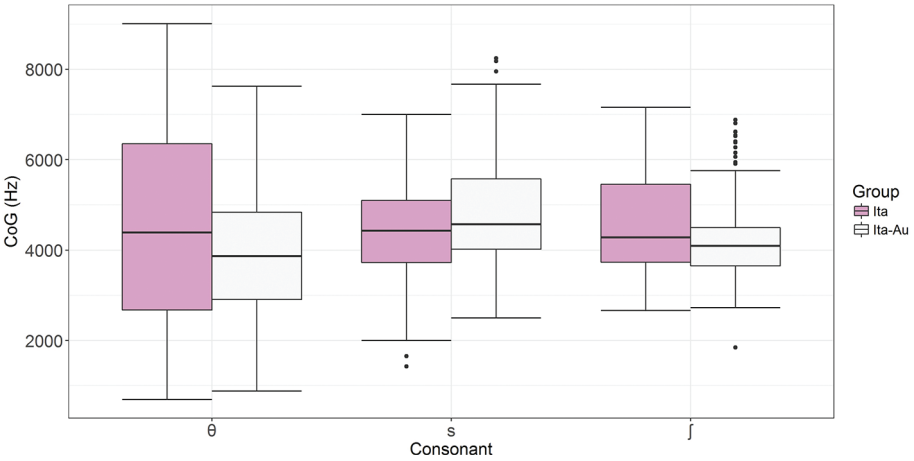
Table 4 - *Results of the four LMMs fitted for the dependent variables CoG, SDev, Kurt and Skew with b estimates and standard errors in parentheses and significance level p for significant predictors in the analysis*

	CoG	SDev	Kurt	Skew
Intercept	5821.199***	3103.086***	-1.615	-0.039
	(309.289)	(197.388)	(5.086)	(0.532)
gender male	-1215.106***	-303.291*	6.511	1.094**
	(188.265)	(119.684)	(4.179)	(0.417)
phonelabel [s]	-378.155	-1080.293***	2.944	0.415
	(394.642)	(252.176)	(3.501)	(0.446)
phonelabel [(t)ʃ]	-374.246	-1026.882***	2.742	0.331
	(394.946)	(252.285)	(3.504)	(0.446)
group Ita-Au	-1155.245**	-23.765	7.302	0.986
	(376.861)	(239.378)	(6.364)	(0.661)
dialect Feltrino	-1854.285***	-461.418	6.496	1.261
	(376.499)	(239.253)	(6.362)	(0.661)
phonelabel [s] * *group* Ita-Au	191.858	-409.641	6.807	0.554
	(461.576)	(293.234)	(4.091)	(0.520)
phonelabel [(t)ʃ] * *group* ItAu	-31.288	-442.589	8.701*	0.815
	(460.749)	(292.975)	(4.085)	(0.519)
phonelabel [s] * *dialect* Feltrino	1291.722**	479.538	-5.033	-0.841
	(461.674)	(293.251)	(4.091)	(0.520)
phonelabel [(t)ʃ] * *dialect* Feltrino	1212.977**	487.923	-6.555	-0.949
	(460.735)	(292.971)	(4.084)	(0.519)
group Ita-Au * *dialect* Feltrino	1535.140***	562.708*	-13.250	-1.434
	(376.875)	(239.433)	(8.358)	(0.834)
Observations	1443	1443	1443	1443
Log Likelihood	-11987.310	-10899.310	-5152.900	-2051.968
Akaike Inf. Crit.	24002.620	21826.630	10333.800	4131.936
Bayesian Inf. Crit.	24076.460	21900.470	10407.640	4205.779
Note:	*p <0.05; **p <0.01; ***p <0.001			

Examining the results in Table 4, and starting with Center-of-Gravity (CoG), we find a significant effect of *gender* ($F(1, 12.76) = 41.657$, $p < .0001$). This is in line with what reported in the literature (e.g., Jongman et al., 2000), and the results of

the fitted model show that male speakers have overall lower CoG values as compared to female speakers (male = 3678.5 ± 132.3 SE; female = 4893.6 ± 134.5 SE). Concerning the interaction *phonelabel*group*, single pairwise comparisons between the Italians and the Italo-Australians reveal to be non-significant. At a first glance, these results might suggest that the place of articulation of each target consonant does not present relevant differences across the two groups (Figure 2).

Figure 2 - *Boxplots for CoG values (in Hz) per group and type of consonant*



Nonetheless, a significant difference emerges for the interaction *group*dialect* (F(1, 12.85) = 16.592, p = .0013): a post-hoc analysis reveals that there is a marginal difference within the speakers originating from Cadore, such that the group of Italian speakers has CoG values globally higher than the Italo-Australian ones ($Ita_{Cadorino}$ = 4962.8 ± 184.6; $Ita\text{-}Au_{Cadorino}$ = 3861.1 ± 193.4; p = .0735). Within the group of Italians, there is also a marginal difference between the Cadorino and Feltrino speakers (p = .0908), with CoG values globally higher in the fricatives of the speakers from Cadore ($Ita_{Cadorino}$ = 4962.8 ± 184.6; $Ita_{Feltrino}$ = 3943.5 ± 193.8).

The *phonelabel*dialect* interaction represented in Figure 3 is significant (F(1, 12.82) = 4.934, p = .0257) and a post-hoc analysis shows that: the CoG for [θ] in the Cadorino speakers is significantly higher compared to the Feltrino speakers ($\theta_{Cadorino}$ = 4636.0 ± 231.1; $\theta_{Feltrino}$ = 3549.3 ± 229.4; p = .0509); for Feltrino speakers, [θ] is only marginally different from [s] in that the first one is lower than the second one ($\theta_{Feltrino}$ = 3549.3 ± 229.4; $s_{Feltrino}$ = 4558.8 ± 227.7; p = .0878); for the Cadorino speakers, no significant difference is detected among the three fricatives.

As for Standard Deviation, we found a significant effect of *gender* (F(1, 12.70) = 6.422; p = .0253), *phonelabel* (F(2, 12.68) = 32.671; p <.0001) and a significant interaction *group*dialect* (F(1, 12.73) = 5.523; p = .0358). The other predictors and interactions such as *phonelabel*group* and *phonelabel*dialect* are non-significant.

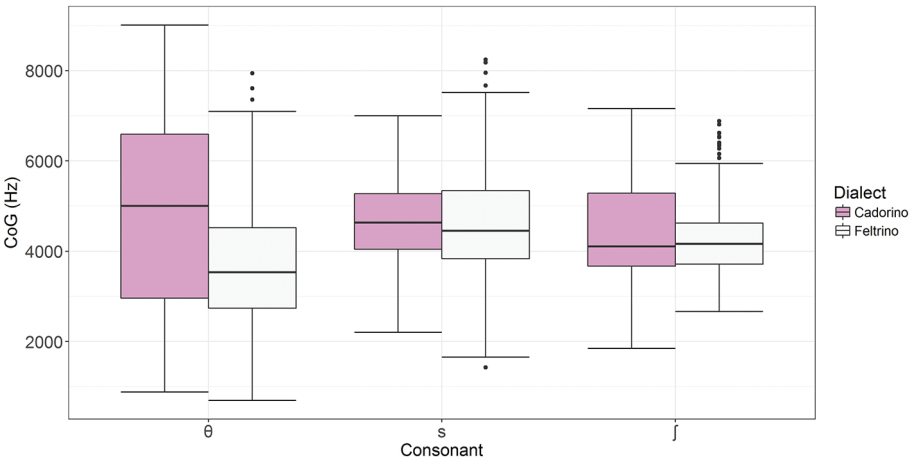
The results of a post-hoc analysis show that: the difference in SDev for *gender* is due to females having higher SDev values compared to males (female = 2317.9 ± 85.1;

male = 2014.7 ± 84.3; p = .0854); for *phonelabel,* [θ] differs from [s] (p < .0001) and from [(t)ʃ] (p < .0001) with higher SDev values for [θ] (2849.5 ± 103.5) compared respectively to [s] (1804.2 ± 103.8) and [(t)ʃ] (1845.3±103.7). SDev for [s] is not significantly different from [(t)ʃ] (p = .9578); despite the significant *group*dialect* interaction (F(1, 12.73) = 5.523; p = .0356), none of the pairwise comparisons results significant.

For Skewness, a significant effect of *gender* was found (F(1, 2.95) = 6.8925; p = .0802) with female speakers having lower Skew values (0.9 ± 0.3) compared to males (1.9 ± 0.3) while all other main effects and interactions are non-significant.

As for Kurtosis, no significant main effects are found.

Figure 3 - *Boxplots for CoG values (in Hz) per type of consonant and dialect (Cadorino vs Feltrino)*



7. *Discussion and conclusions*

In this paper, we acoustically explored spoken dialectal productions of Italo-Australian immigrants from the areas of Cadore and Feltre, Veneto, compared to those of Veneto speakers born and living in their same villages of origin. Specifically, we performed analyses on the four spectral moments (CoG, SDev, Skew, Kurt) of the frication noise of selected voiceless coronal obstruents: the interdental [θ], occurring both in their native dialectal variety (Cadorino and Feltrino, respectively), and AusEng L3 but absent in the phonological inventory of their L2 (the regional variety of Standard Italian); [s] and the fricative portion of ʧ, present in all the repertoires. Our purpose was to identify possible phenomena of attrition, maintenance and/or loss in their fine-grained speech features, after decades of persistent contact with English.

Statistical analyses on acoustic results revealed that the factor *gender* is highly significant for three out of four spectral moments: fricatives as spoken by females

have higher values of CoG and lower values of Skew, both indexing a smaller size of their vocal tract, and higher values of SDev.

As for the fricatives' identity (factor *phonelabel*), our data show that the sibilant fricative [s] and the fricative release of [(t)ʃ] in the dialect of either group of speakers do not differ for any spectral moment, with mean CoG values for [s] that approximate those for [(t)ʃ], indicating a clear retraction of [s] (the estimated mean CoG for [s] and [ʃ] is respectively 4554 and 4518 Hz for Italians, and 4358 and 4099 Hz for Italo-Australians). On the contrary, Tabain (2001) and Jones, McDougall (2009) report that in Australian English [s] has significantly higher CoG values than [(t)ʃ] (such values are similar in other varieties of English: see Harrington, 2010; Shadle, 2012).

Moreover, a significant SDev and a significant post-hoc analysis indicate that [θ] differs from [s] ($p < .0001$) and from [(t)ʃ] ($p < .0001$) for the variance in the energy distribution. That is, [θ] has a low intensity and a spread spectrum, as well as a higher SDev with respect to [s] and [(t)ʃ] (similarly to what reported for AusEng by Tabain, 2001; Jones, McDougall, 2009, and for other varieties of English by Jongman et al., 2000). Coherently with EPG data obtained by Tabain (2001) for Australian English, [θ] reveals a greater acoustic instability and a greater articulatory variability than the sibilant fricatives: in fact, we observe a greater dispersion for [θ] as compared to [s] and [(t)ʃ], both across groups (Figure 2) and across dialects (Figure 3).

A post-hoc test on the significant interaction *phonelable*dialect* has revealed a difference induced by the local variety of dialect on the spectral properties of [θ], such that the dental fricative of speakers originating from Cadore has higher values of CoG than speakers originating from Feltre. One possible source of such acoustic difference could be related to the lower age of the Italian speakers from Cadore (averagely, 60.5 y.o.) with respect to the Italo-Australian speakers from the same area (averagely, 78 y.o.). Italian and Italo-Australian speakers from Feltre are balanced in age (respectively, 75 y.o. and 74 y.o. on average) and do not show such acoustic difference. It could be hypothesized that either the local dialect of the Italians in Cadore has undergone a change after the Italo-Australians left the region or, more likely, that we are facing individual differences. However, we are conscious that the limited number of subjects here analyzed does not allow to assess whether these results are representative of a more general trend, or whether they are due to an idiosyncratic linguistic behaviour of the two younger Veneto speakers from Cadore. The analysis of more speakers will help in solving the question.

Two are the conclusions that can be drawn from the present study. First, on the methodological side, the spectral moment analysis – despite the limitations recently shown by Spinu, Lilley (2016) – remains a valid tool to study the spectral properties of fricative sounds, as in our data SDev successfully separates the sibilant from the non-silbilant fricatives. Second, on the theoretical side, the results on our limited set of speakers do not confirm the predictions based on the SLM about L3 influence on native L1 dialect. The Italo-Australian speakers have not formed

a new category for Australian English [s], as the CoG values do not indicate that dissimilation has taken place between the native [s] and the Australian English [s]. Had it been the case, we would expect that the dialect [s] would be pronounced by the Italo-Australian speakers even more backward in the vocal tract, showing lower CoG values, than by Italian speakers. Second, Italo-Australian speakers have not assimilated their native [s] to the Australian English [s] either, as on the one hand CoG values of Italo-Australian [s] are not intermediate between the native and the corresponding Australian English [s]; nor, on the other hand, are they closer to the Australian English values as we could have expected if they had approximated the L3 norm after so many years of contact with Australian English.

What we can argue is that the phonetic properties of the native [s] have been maintained as such by the Italo-Australian speakers and that there is no evidence from production that the L1 and L3 consonants are represented in a shared phonetic space in the mind of these speakers.

As a final note, we believe that the homogeneity encountered in the sociolinguistic features of Italo-Australian speakers might play a relevant role in explaining their linguistic behavior. In fact, these subjects report that their social networks are generally circumscribed to their families and other members of the immigrant community, with limited external interactions. Moreover, both males and females reveal in their interviews that they feel more comfortable in employing their native dialect, rather than English, in everyday communication. Ultimately, it is worth reminding that none of them has received a formal education in Australia. Arguably, this has implied a substantial limitation in the amount of L3 to which they have been exposed through the years.

Yet, these analyses should be extended to a wider number of subjects, in order to verify whether the results obtained so far could be fully reliable and representative of the overall linguistic situation of the Bellunese community in Australia.

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