

## **Estudos da Língua(gem)**

*Questões de Aquisição da Linguagem*

### **L2 development and L1 attrition in an L1-dominant environment: analysing voice onset time in L1 Spanish and L2 English**

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Desenvolvimento de L2 e atrito de L1 em contexto dominante de L1:

*análise do VOT em Espanhol (L1) e Inglês (L2)*

Desarrollo de L2 (segunda lengua) y atrición lingüística en L1 (primera lengua)  
en contexto dominante de L1: *análisis de VOT en español (L1) e inglés (L2)*

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#### **ABSTRACT**

In this study, we investigate the occurrence of L1 attrition among Argentinean learners of English (L2) living in their home country, which constitutes an L1-dominant environment. We analyzed the production of Voice Onset Time in word-initial plosives in L1 Spanish by monolingual and bilingual participants. We carried out both an inferential analysis and an individual verification of each participant's production, which proved to be complementary. Our results suggest that not only is the L2 affected by the L1, but also the L1 can be modified in view of the contact with additional languages.

**Keywords:** L1 attrition; Voice Onset Time; Language as a Complex, Dynamic System; Spanish; English as a Second Language.

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\* Sobre os autores, ver página 182.

<b>Estudos da Língua(gem)</b>	Vitória da Conquista	v. 17, n. 2	p. 159-182	abr-jun de 2019
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DOI: 10.22481/el.v17i2.5345

ISSN electronic version: 1982-0534



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**RESUMO**

*Neste estudo, investigamos a ocorrência de atrito de L1 entre aprendizes argentinos de inglês (L2) residentes em seu país de origem, o que constitui um ambiente dominante em L1. Analisamos a produção do VOT em plosivas iniciais de palavras em espanhol L1 de participantes monolíngües e bilingües. Realizamos uma análise inferencial e uma verificação individual da produção de cada participante, que se mostrou complementar. Nossos resultados sugerem que não somente a L2 é afetada pela L1, mas também a L1 pode ser modificada em vista do contato com outros idiomas.*

**PALAVRAS-CHAVE:** *Atrito L1; VOT; Linguagem como sistema complexo e dinâmico; Espanhol; Inglês como uma segunda língua.*

**RESUMEN**

*En este estudio, investigamos la ocurrencia del fenómeno de atrición lingüística en la L1 entre estudiantes argentinos de inglés (L2) residentes en su país natal, lo que constituye un ambiente de L1 dominante. Analizamos la producción de Voice Onset Time en oclusivas iniciales en español (L1) por participantes monolíngües y bilingües. Se realizaron análisis inferenciales e individuales por participante. Ambos tipos de análisis, en conjunto, resultaron ser complementarios. Los resultados sugieren que no sólo la L2 puede ser afectada por la L1, sino que también la L1 puede ser modificada en función del contacto constante con las lenguas adicionales.*

**PALAVRAS-CLAVE:** *Atrición de L1; Voice Onset Time; Lengua como Sistema Dinámico y Complejo; Español; Inglés como Segunda Lengua.*

**1 Introduction**

There is no denying that a bilingual speaker's mind works differently from a monolingual one. When it comes to language development and cognitive functioning, it has been established that bilinguals are not the equivalent sum of two monolinguals added together (GROSJEAN, 1989), for the mathematics in it is more complex than it appears. As there can be several combinations of different sets of two, three or more languages that interact in the most various ways, it should come as no surprise that each bilingual speaker has a very unique language system in their brain.

This proposition is in line with the view of Language as a Complex Dynamic System (CDS)<sup>1</sup> (LARSEN-FREEMAN; CAMERON, 2008; DE BOT; LOWIE; VERSPOOR, 2007, 2011; DE BOT; LOWIE; VERSPOOR, 2013; BECKNER *et al.*, 2009; DE BOT, 2017, among others). According to

<sup>1</sup> In this paper, we use the term 'Complex Dynamic System' (CDS) instead of 'Complex Adaptive System' or 'Dynamic System'. In discussing the history and premises of Complexity Theory (LARSEN-FREEMAN, 2015) or Complex Adaptive Systems (LARSEN-FREEMAN; CAMERON, 2008; BECKNER *et al.*, 2009) as opposed to Dynamic Systems Theory (De Bot *et al.*, 2007), De Bot (2017, p. 51) concludes that when applied to applied linguistics and psycholinguistic studies, "there does not seem to be a reason for choosing one or the other to refer to the same phenomenon". Therefore, in this paper we opt to follow this conciliatory position.

<sup>2</sup> In this text, we will use the term 'subsystem' to refer to the L1 and the L2, following a series of

this view, language is always subject to change over time, consisting of countless agents interacting with each other. Language is also seen as adaptive because, as language subsystems<sup>2</sup> interact, their agents modify the larger language system, creating new interactions, so that the L1 and L2 subsystems may constantly change due to the speaker's experiences, which characterize language's complex and dynamic self-organizing capacity. In this sense, it is crucial to understand that the development of language is essentially dynamic because it depends on the interactions of a speaker's cognitive particularities with their experiences and social relations throughout time. This view of language allows us to disregard the traditional polarization between linguistic versus extralinguistic aspects, because elements such as change and development are also core aspects of the larger language system.

It should be noted that when we consider a multilingual speaker, there are also at least two different subsystems which are simultaneously active during real-time processing of a single language. In their daily lives, multilingual speakers are at various points along a situational *continuum* that induces a particular speech mode (GROSJEAN; LI, 2006; GROSJEAN, 1989; 1995; 2013). At one end of the *continuum*, bilingual speakers, for example, are in a monolingual speech mode in which they interact with other monolinguals of language A or B. At the other end of the continuum, bilinguals meet in a bilingual speech mode in which they are interacting with other bilinguals, with whom they normally mix languages. In the monolingual speech mode, the bilinguals adopt the language of the monolingual interlocutor and also deactivate, as they can, the other language (GROSJEAN, 2013). However, what has been emphasized is that bilingual speakers rarely totally disable the other language, never being in a totally monolingual speech mode, because the two languages are in constant interaction.

When it comes to perceptual models of L2, authors such as Flege (1995, 2003, 2007), Best (2001), Best and Tyler (2007) and Perozzo (2017) suggest that bilinguals cannot separate the phonetic-phonological categories of their L1 and L2 because they exist in the same phonetic-phonological space, that is, they coexist and are mutually influenced in the same frame. In this way, it can be concluded that if aspects of the L1 can be transferred to the L2, then, within an ever-changing language system, through its adaptation and self-organization, aspects of the L2 can also be transferred to the L1.

For a long time, studies regarding the development of additional languages in multilingual speakers have treated the influence among languages as strictly unidirectional. More recent studies, however, have since refuted this premise, assuming the influence among languages does not occur from one's first to the second language, from that to the third and so on, but rather in the opposite direction and among each other as well, which characterizes a multidirectionality of influences in the language system (LARSEN-FREEMAN; CAMERON, 2008; BECKNER *et al.*, 2009; DE BOT *et al.*, 2013; PEREYRON, 2017). Although the effects of this influence among languages can be observed in many different aspects of language, such as the lexicon, morphology, syntax, *etc.*, this paper focuses on change in the phonetic-phonological subsystem, which has been referred to as L2-L1 phonetic transfer,

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<sup>2</sup> In this text, we will use the term 'subsystem' to refer to the L1 and the L2, following a series of studies grounded on the dynamic view (De Bot *et al.*, 2007, De Bot, 2011, Lowie and Verspoor, 2015, Verspoor, 2015, Lowie, 2017, Opitz, 2017, Alves, *in press*, among others).

phonetic-phonological attrition, crosslinguistic influence, speech accommodation, among others, which we will mostly cover with the umbrella term of 'language attrition'<sup>3</sup>.

Within the aforementioned conception that language is a Complex Dynamic System, Kupske (2016) defines 'language attrition' as the force resulting from the contact of two or more bodies, in this case, two languages that interact, but do not stabilize, as they present a constant tendency for movement (KUPSKE, 2016, p. 39-40). Following this characterization, the process of language attrition can be understood as a non-pathological loss of native aspects of a bilingual speaker's L1 as a result of the presence of another language. Kupske (*op. cit.*) verifies, for example, that a person who has been immersed for more than four years in an L2-dominant environment may have their L1 attrited and therefore produced differently from their monolingual peers in their L1-dominant original setting. What the author describes is that, with time, the interaction and co-influence between languages may lead to change in a previously stable subsystem.

As Schmid and de Leeuw (2018) point out, it took years of research for linguists to disregard the traditional definition of language attrition as the partial or total loss of one's L1 characteristics due to the addition of an additional language. Schmid and Köpke (2017) actually define language attrition as the "phenomena that arise in the native language of a sequential bilingual as the consequence of the coactivation of languages, crosslinguistic transfer or disuse, at any stage of L2 development and use" (SCHMID; KÖPKE, 2017, p. 2). However, de Leeuw (2017) observes that the two authors' definition of bilinguals is extended to all types of bilinguals, both early and late bilinguals, and even bilinguals who developed the two or more languages simultaneously. According to de Leeuw (2018), a more refined definition of language attrition would be along the lines of "structural changes in the L1 of a late sequential bilingual, provided that established acquisition of the L1 precedes L2 acquisition is ensured" (LEEUEW, 2018, p. 4). It should be noted that de Leeuw's observation is important by reason of other areas of research on language attrition, such as L1 attrition in young children who migrate to an L2-dominant environment, for example. In this case, some authors would characterize the changes in the L1 as a result of incomplete L1 development (PARK, 2018).

In fact, in a thorough review of the literature regarding language attrition, de Leeuw (2018) resumes the already established conception that a language system can change throughout the entire lifespan and continues to focus on change in a language system during adulthood. Regarding specifically language attrition led by the addition of new languages in the system, that is, cross-linguistic influence between the L1 and the L2, what the author verifies is that the phonetic-phonological subsystem of one's L1 is subject to change due to the influence of an additional language even if said language starts to develop after the person is already an adult. For example, the author revisits Flege's

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<sup>3</sup> It should be noted that both De Leeuw, Mennen, and Scobbie (2012) and De Leeuw (2018) differentiate the terms 'phonetic attrition' and 'phonological attrition'. Given this dichotomy, we consider that the choice of the term is dependent on the phonological primitive assumed by the researcher. As in this paper we defend a non-dichotomous view between 'phonetics' and 'phonology', in this paper we will use the terms 'language attrition' or 'phonetic-phonological attrition' indistinctly.

(1987) study with two groups of English-French and French-English adult bilinguals who had their acoustic categories "merged" after being immersed in an L2-dominant environment. Even though this study never calls it "language attrition", the phenomenon observed within the groups matches de Leeuw's definition of the term. However, the author reinstates the importance of observing inter-subject variability in the result analyses, even if it is possible to point out certain common characteristics and patterns of change in what represents a group.

In order to illustrate the importance of analyzing the variability among subjects in a study of language attrition, we can use Schmid and Köpke's (2017) proposition that every single bilingual is an L1 attriter. According to the authors, the process of language attrition begins at the very start of the L2 development, precisely because, from a dynamic point of view, we cannot separate one language from the other once there is coactivation that may affect the processing or production in the language in use. Again, the importance of the time factor should be emphasized because, as time passes, this interaction may eventually lead to change or restructuring of the subsystems as a result of the crosslinguistic influence. Furthermore, Schmid and de Leeuw (2018) propose that the effects of this phenomenon can be observed from the L1 to the L2 and from the L2 to the L1 in a *continuum* where development is gradual, but not necessarily linear. Adopting this idea and therefore understanding that there is no clear way to establish two different points in this development *continuum*, the proposition that every bilingual is an attriter becomes more tangible, and the necessity of considering the variability among subjects becomes more sustainable.

It should be noted that this proposition is in line with Lowie and Verspoor's (2015) view of variability as the main aspect to be analyzed in studies regarding the development of languages. According to the authors, from the point of view of language as a Complex Dynamic System, the development of a language is not something to be achieved and finalized. It is, in turn, a process. In this sense, since each individual has very particular characteristics, each process is unique, hence the reason for importance of variability. Furthermore, the authors suggest that the very existence of individual variation is a driving force for change due to the system's core ability of self-organizing. On the other hand, the authors acknowledge the fact that carefully selected groups of individuals may present some patterns of development, and may even seem similar or homogenous, but each person still has their own history, and therefore studies should consider group and individual analyses as complementary (LOWIE; VERSPOOR, 2019).

In line with this, Park (2018) points out some variables affecting language attrition that may lead to greater variability, some key factors being i) age, ii) pre-attrition attainment, iii) literacy, iv) attitudes and motivation, v) typological proximity between languages, and vi) manner of instruction. Although there is no rule in this regard, the author proposes that the first three may be relatively correlated, which can be understood as the tendency of a younger individual to be "less proficient" (that is, having a shorter time to develop) in their L1 comparing to their older peers. Literacy, attitudes and motivation and manner of instruction can all be put in a category of social aspects of language learning and are intrinsically related to the individual's history. These can also be linked to variables such as level of education, length

of residence in L2-dominant setting, and even amount and nature of contact with the language.

As we consider these learners' variables, we might enquire whether L1 attrition could also take place in an L1-dominant environment, that is, when the L2 is being learned in the country where the learners' L1 is being predominantly spoken. This enquiry proves relevant not only in shedding light on the variables that take a place in language attrition, but also on the discussion on the interconnectedness in the L1 and the L2 subsystems, mainly when the exposure to the additional language is more restricted. With this in mind, in the present study we aim to investigate the occurrence of L1 attrition among Argentinean learners studying English in Argentina. We will investigate the production of Voice Onset Time (VOT)<sup>4</sup> in word-initial voiceless plosives in Spanish (L1) and English (L2) by both monolinguals and bilinguals. Unlike Spanish, word-initial /p/, /t/ and /k/ in English are aspirated (that is, produced with a larger positive VOT interval). Therefore, bilinguals are expected to present larger intervals in their L1 productions of these consonants, given the interconnectedness of the two languages. In order to verify the occurrence of attrition, in this investigation, we aim to carry out three analyses: (i) a comparison of the VOT values in L1 Spanish and L2 English by the bilingual group; (ii) a comparison between the VOT values produced by monolinguals and bilinguals in L1 Spanish; (iii) an analysis of the individual data by each participant in the two groups. With these three analyses, we aim not only to provide evidence of how the L1 can be affected by additional languages (cf. KUPSKE, 2016; PEREYRON, 2017), but also highlight the individual differences among participants in the same group, by providing additional evidence of the importance of analyzing individual trajectories in L2 development (LOWIE; VERSPOOR, 2015; 2019).

## 2. Method

Twenty college students from Argentina took part in the study. They were originally from the city of Mar del Plata (state of Buenos Aires – Argentina) and had not lived in another Argentinean city; therefore, all of them spoke the same L1 dialect. Participants were divided into two groups: (i) monolinguals and (ii) bilinguals<sup>5</sup>.

The monolingual participants were taking their university degree at a private university in the city of Mar del Plata, Argentina. They were pursuing different majors, but none of them was related to the field of Language and Linguistics. As they were college students, their ages ranged from 18 to 22 years.

<sup>4</sup> The term *Voice Onset Time* refers to the length of time between the explosion of the plosive segment and the onset of voicing (LISKER; ABRAMSON, 1964). In word-initial voiceless stops in English, VOT is said to be Positive, as there is a long interval of time between the burst and the beginning of the vibration of vocal folds in the following vowel. For a state of the art on 50 years of VOT studies, see Abramson; Whalen (2017).

<sup>5</sup> Following Finger and Ortiz-Preuss (2018), we recognize that nowadays it is monolingualism, not bilingualism, that should be considered as an exception. As the authors point out, bilingual individuals "move on a continuum that encompasses different levels of lexical knowledge, proficiency, and modes of action (monolingual-bilingual)" (*ibid.*, 34). For the purpose of this paper, our bilingual participants are Argentinean learners of English with a high level of L2 proficiency. In our difficult search for monolinguals, we followed the criteria established in Chang (2012), who suggests that such participants should claim not to be able to communicate orally in any language other than Spanish. This should be the only language used at home or in academic, leisure or work environments.

The 10 bilingual speakers (L1: Spanish; L2: English) were students at the Universidad Nacional de Mar del Plata, a public university in Mar del Plata, Argentina, and were pursuing their major in English Language Teaching. At the time of the data collection, they were taking *Discurso Oral II*, an eight-hour weekly pronunciation course, which aims to develop students' L2 phonetic-phonological awareness. This course is offered in the third semester of the program and is taught along with several other classes in English, which in all add up to a total of 64 hours of instruction in English per semester. The students' ages ranged from 22 to 30 years, and seven of them had started studying English before 10 years of age. Before taking the production tasks, all participants took the *Oxford Online Placement Test*, which indicated that all participants presented a level of proficiency equivalent to C1 or C2 in the Common European Framework<sup>6</sup>. All participants filled in a Language Experience and Self-Evaluation Questionnaire (SCHOLL; FINGER, 2013), in which they were asked to rate their listening and oral skills in English in a scale from 1 (not proficient) to 6 (highly proficient). Self-evaluation on their listening skills averaged 5.1 (S.D.: .99), and self-evaluations of their oral skills tended to present lower scores 4.5 (S.D.: .85)<sup>7</sup>. Table 1 provides more details on the participants and their proficiency levels:

**Table 1.** Information on the participants from the bilingual group

Participant <sup>8</sup>	Age at time of study	Age started learning English	Oxford Online Placement Test Result	Self-evaluation: Listening skills	Self-evaluation: Oral Skills
11	23	9	C1	6	4
12	27	4	C2	6	5
13	23	10	C1	5	4
14	24	11	C2	5	4
15	37	8	C2	6	6
16	22	5	C1	3	4
17	36	10	C2	4	4
18	23	13	C1	5	4
19	20	5	C2	6	6
20	30	18	C1	5	4

<sup>6</sup> According to the Common European Framework of Reference for Languages, proficiency in an additional language can be assessed in six different levels: A1, A2 (which characterize basic users), B1, B2 (describing independent users), and C1 and C2 (proficient users).

<sup>7</sup> This contrasts with the results obtained in the Oxford Online Placement Test, which attested a high level of proficiency to these learners. It should be said, however, that the Oxford Online Placement Test only assesses grammar, reading and listening skills, and can therefore be reflecting the students' proficiency in listening, but not in speaking. It may also be the case that, as language students at college tend to be more aware of their difficulties, participants might have been too demanding at themselves when it comes to speaking skills. These results provide evidence to the dynamic claim that each student carries their unique L2 development history (cf. LOWIE; VERSPOOR, 2015; 2019), and therefore proficiency tests do not necessarily reflect their dynamic trajectories. In this paper, proficiency was measured just for the sake of making sure students presented an advanced level in the L2 which could allow for L1 attrition.

<sup>8</sup> Bilingual participants are numbered from 11 to 20 because participants in the monolingual group are numbered from 1 to 10.

## 2.1 Data collection instruments

The production tasks employed in this study were the same ones employed in Alves; Luchini (2017) and Alves (in press). The students participated in two data collection sessions, one in English and another one in Spanish. The data in Spanish were collected before the productions in English, with an interval of time from five to 10 minutes between each session<sup>9</sup>. The collection instruments consisted of monosyllabic words in English and disyllabic words in Spanish, all of them initiated by the segments /p/, /t/, /k/, followed by the high vowels /i/ or /ɪ/ (as, according to Yavas and Wildermuth 2006, these vowels allow for longer VOT intervals). The words were presented individually in Power Point slides in a .pptx file. The task consisted of three different lexical items for each of the three places of articulation, in addition to the distracting words. Each of the types was presented twice, adding up to 6 tokens for each place of articulation per participant. The lexical items were presented in a random order.

The recordings were carried out in *Audacity - version 2.0.6*, on a laptop computer. The data collection sessions took place individually and were carried out in a quiet environment at the university. The acoustic analysis of the data was carried out with Praat software - version 6.0.40 (BOERSMA; WEENINK, 2018). For the statistical analysis, we used the SPSS Software - Version 21 (IBM Corp, 2012).

## 3 Results and discussion

As mentioned in the Introduction, in order to verify the occurrence of attrition, in this section we aim to carry out three analyses: (i) a comparison of the VOT values in L1 Spanish and L2 English by the bilingual group; (ii) a comparison between the VOT values produced by monolinguals and bilinguals in L1 Spanish; (iii) an analysis of the individual data by each participant in the two groups. By comparing the L1 and L2 of the bilingual group, we aim to verify if the learners' L2 subsystem can be considered different enough from their L1 so that attrition can start taking place. The second comparison aims to provide evidence to the phenomenon of L1 attrition, as it is expected that the VOT values by the bilingual group are significantly higher than those produced by the monolinguals. Finally, as in our third analysis we also aim to verify the variability in each individual's production, we will be able to find further evidence of attrition. This will be possible because a higher variability found among the bilingual productions indicates that their subsystem is more destabilized, and thus more subject to change (cf. DE BOT, 2011; LOWIE; VERSPOOR, 2015; 2019; OPITZ, 2017).

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<sup>9</sup> We consider this fact to be a limitation of our study, as we recognize the importance of carrying out each data collection session in different days and times (cf. KUPSKE, 2016). This, however, was not possible due to our time limitations. In order to overcome this limitation, we provided at least five minutes of rest between each task. Before each data collection, participants were always addressed by the researchers in the language of the task (English or Spanish).



### 3.1 Productions by the Monolingual Groups

In Table 2, we present the average VOT values produced by the bilinguals in Spanish (L1) and English (L2).

**Table 2.** VOT productions by the bilingual group.

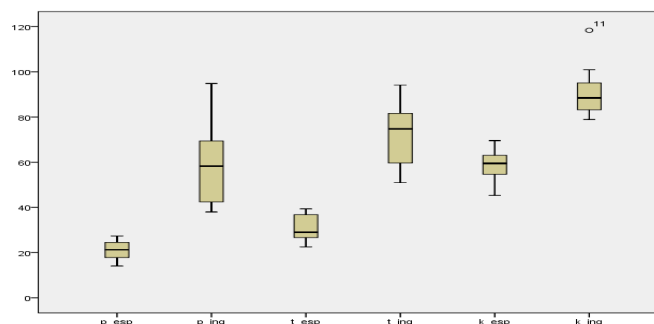
<i>Consonant</i>	<b>Spanish (L1)</b>		<b>English (L2)</b>	
	<i>Tokens</i>	<i>Mean (SD)</i>	<i>Tokens</i>	<i>Mean (SD)</i>
/ p /	60	<b>21.49</b> (4.33)	60	<b>58.92</b> (17.42)
/ t /	60	<b>31.11</b> (6.07)	60	<b>72.31</b> (14.38)
/ k /	60	<b>58.32</b> (6.98)	60	<b>91.37</b> (11.68)

As can be seen in the mean values shown in Table 2, the target plosives in English were produced with a much longer VOT than in Spanish. Paired-sample T-Tests indicated significant differences between the VOT values in the two languages<sup>10</sup>, in each one of the three places of articulation (/p/:  $t(9)=-5.73$ ,  $p=.00$ ; /t/:  $t(9)=-9.93$ ,  $p=.00$ ; /k/:  $t(9)=-10.52$ ,  $p=.00$ ).

The VOT values in English shown in Table 2 are not only significantly higher than in Spanish, but they are also equivalent to the VOT values produced by native speakers of English. With regard to native speakers of North American English, Lisker and Abramson (1964) report VOT values of 58ms, 70ms and 80ms for /p/, /t/ and /k/ respectively. As for speakers of the Standard Southern British English variety, Kupske (2016) reports means of 56.95ms for /p/, 77.31ms for /t/ and 82.55ms for /k/. Although the data collection instrument in our experiment are particularly different from the ones used in those two studies (especially considering the fact that all of our plosives were followed by the high vowels /i/ or /I/), we can assume that our group of bilinguals has already reached the target VOT values in English.

The Standard Deviation values found on Table 2 also indicate a higher rate of variability in the productions in English than in Spanish. Figure 1 presents the box plots of the bilingual productions for each one of the languages and places of articulation, providing more information on the group medians, interquartile ranges and highest-lowest means.

**Figure 1.** Productions of /p/, /t/ and /k/ by the bilingual group (VOT values in the y-axis in ms)<sup>11</sup>.



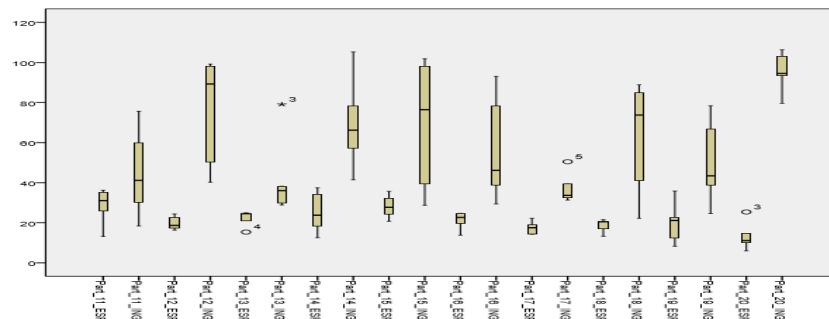
<sup>10</sup> Parametric tests were run because the normality tests of Kolomogorov-Smirnov and Shapiro-Wilk indicated that the tested variables presented a normal distribution ( $p > .05$ ).

<sup>11</sup> In the x axis, 'ESP' stands for 'Spanish' and 'ING' stands for 'English'.

Figure 1 indicates that not only are the medians higher in English than in Spanish, but also that the value ranges are much higher in the L2. Although it is evident that this higher rate of variability may be a consequence of the higher VOT values produced in the L2 (which by themselves would allow for more variation), we assume that this greater variability is a signal of the developmental process itself, as variability is an indicative of learning (LOWIE;VERSPOOR, 2015) and attrition (OPITZ, 2017). It should be noticed that, for the three places of articulation, the highest VOT value in Spanish is still lower than the lowest VOT value for that same place of articulation in English. Figure 1 also shows that only one learner (Participant 11) presents an outlier value in the production of the velar stop. More about this participant's behavior will be discussed in this section.

Having pointed out that the highest group means were found in English, what remains to be explored now is whether group tendencies can be found among all participants. Therefore, we investigate whether all participants in the bilingual group present (i) higher VOT values in English than in Spanish; (ii) higher rates of variability rates in the L2 than in the L1; (iii) target-like VOT values. Figures 2, 3 and 4 present individual data, both in Spanish and in English, of each one of the places of articulation.

**Figure 2.** Individual productions of /p/ by the bilinguals (VOT values in the y-axis in ms)<sup>12</sup>.

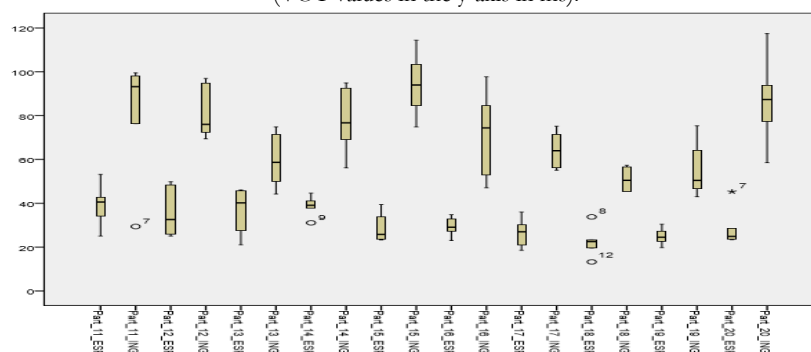


As can be seen in Figure 2, all participants produced higher VOT values in English than in Spanish. The box plots show that, among all participants, the token with the largest VOT in Spanish produced by each participant did not reach the median value of the very same participant when producing words in English. Indeed, the tokens with highest VOT values produced by participants 12, 13, 14, 16, 17, 18 and 20 in Spanish did not reach the lowest VOT value produced in the L2. All participants also showed larger box plots in English than in Spanish, as their range of VOT values in English was much larger than in their L1. This variability made it clear that not all tokens were produced with target-like values, although all but participant 17 produced at least one token above the target-like values in English. In turn, participant 20 was the only one to produce target-like VOT values in all his productions of /p/. Participants 11, 13, 17 and 19 presented a median value lower than the target-like means described in the literature (cf. LISKER;

<sup>12</sup> In all the box plots of individual participants presented in this article, the numbers presented next to the outliers correspond to the order of appearance of the lexical item in the reading task.

ABRAMSON, 1964; KUPSKE, 2016). All in all, participants can be considered to be developing the L2 VOT patterns, showing variable productions that already prove much higher than the L1 values<sup>13</sup>.

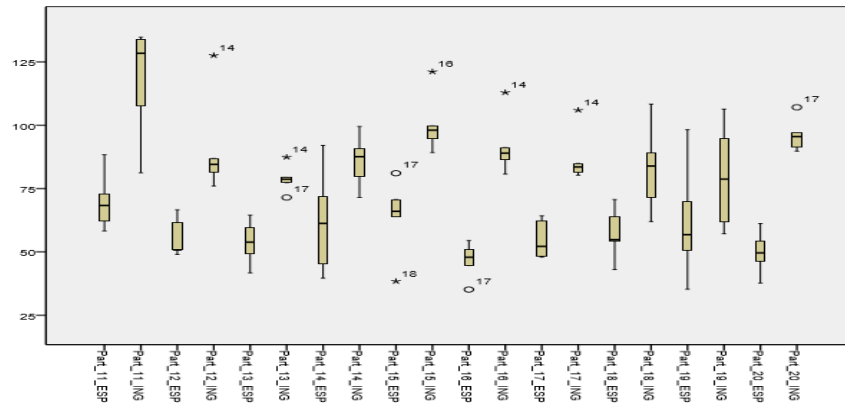
**Figure 3.** Individual productions of /t/ by the bilinguals (VOT values in the y-axis in ms).



In a similar fashion to /p/, all participants produced higher VOT values for /t/ in English than in Spanish. Once again, for all participants, the token with the largest VOT in Spanish did not reach the median value of the very same participant when producing words in English. With the exception of participants 11 and 13, the highest VOT values produced by all participants in Spanish did not reach the lowest VOT value in English. Except for Participant 18, all participants also showed larger box plots in English than in Spanish, as their range of VOT values in English was much larger than in their L1. Therefore, not all tokens were produced with target-like values, although all but participant 18 produced at least one token above the target-like values. In turn, participant 15 was the only one to produce target-like VOT values in all his productions of /t/. Participants 13, 17, 18 and 19 presented a median value lower than the target-like values described in the literature (70ms, LISKER; ABRAMSON, 1964). On the other hand, participants 15 and 20 produced some tokens with VOT values above 100ms. In other words, just as we concluded with regard to the labial plosive, participants seem to be developing the L2 VOT patterns, showing variable productions beyond the L1 values.

<sup>13</sup> Given this high degree of variability among participants, in an exploratory fashion, we ran Pearson (parametric) and Spearman (non-parametric) correlations between the VOT values for each place of articulation and the variables of 'age of learning', 'self-assessment of oral skills' and 'self-assessment of listening skills', described in Table 1 and obtained from the language experience questionnaire applied to the bilingual participants. The results of these statistic tests found no significant correlations between these variables and the VOT values found. We also ran correlations between the VOT values in Spanish and English for each one of the consonants, again with no significance found. As this non-significance may be explained by the low number of participants in the study, we cannot deny that, according to a complex view of language (LARSEN-FREEMAN; CAMERON, 2008; DE BOT; LOWIE; VERSPOOR, 2007, 2011; DE BOT; LOWIE; VERSPOOR, 2013; BECKNER *et al.*, 2009; DE BOT, 2017, among others), learning is a non-linear process. In this sense, it is very likely that these few variables cannot linearly express the learners' growth in their L2, as a multitude of factors should be in action in order to explain each individual student's trajectory.

**Figure 4.** Individual productions of /k/ by the bilinguals (VOT values in the y-axis in ms).



As for the velar plosive, once again, all participants produced higher VOT values in English than in Spanish. However, it is quite visible that the L1 productions of the velar plosives tend to exhibit not only higher VOT values than those found for /p/ and /t/, but also a much larger range of variation. As previously discussed, even among monolingual speakers, the velar /k/ in L1 Spanish tends to present higher average values, and can be considered to be semi-aspirated (as in the term proposed by M. Alves, 2015). This might be the reason why participants 14 and 19 present larger box plots in Spanish than in English. Indeed, participants 11, 14, 15 and 19 present some tokens in Spanish whose VOT values are equivalent to those found in target-like English. These higher values might be both the result of the semi-aspiration found among monolinguals or the result of L1 attrition. This last possibility is very likely, as the literature on L1 attrition in Brazilian Portuguese (KUPSKE, 2016; SCHERESCHEWSKY; ALVES; KUPSKE, 2017; SCHERESCHEWSKY, 2018) shows that the velar stop is the first place of articulation to show signs of attrition, as the L2 values in /k/ are the first ones to be reached in English as a result of the semi-aspiration that also occurs in Brazilian Portuguese /k/. In the next sections, when we compare the productions of Spanish bilinguals and monolinguals, we will be able to discuss whether the high variability found in L1 /k/ is indicative of language attrition. For now, it remains to be said that the medians in L2 English are always higher than those found in L1 Spanish in this group, which indicates participants are developing the English pattern.

In summary, when producing their L2, the bilingual participants in our study produced VOT values similar to those found among native speakers of English. Also, their production in English presented more variability than in their L1. These results deserve special consideration, as they might provide further evidence for the occurrence of attrition. In fact, since target language values have been reached, we have evidence that these learners indeed present a higher level of proficiency and are likely to present signs of L1 attrition.

### 3.2 L1 productions by monolinguals and bilinguals

In this section, we present the VOT productions in L1 Spanish by the monolingual and the bilingual groups. As seen in the previous section, the

bilingual participants already present large VOTs in L2 English, which may contribute to making their Spanish VOT longer as well, as evidence that the L2 may also have effects on the L1. Table 3 presents the mean and standard deviation values in L1 Spanish by both groups.

**Table 3.** VOT productions in Spanish by monolinguals and bilinguals.

<i>Consonant</i>	<b>Monolinguals</b>		<b>Bilinguals</b>	
	<i>Token</i>	<i>Mean (SD)</i>	<i>Token</i>	<i>Mean (SD)</i>
/ p /	60	<b>16.39</b> (3.38)	60	<b>21.49</b> (4,33)
/ t /	60	<b>26.91</b> (4.97)	60	<b>31.11</b> (6,07)
/ k /	60	<b>46.61</b> (4.53)	60	<b>58.32</b> (6,98)

As shown in Table 3, in the three places of articulation, the means of the bilinguals are higher than those produced by the monolinguals. The Standard Deviation values are also larger among the bilinguals, which shows that VOT values tend to vary more (being, therefore, less stabilized) in this group. We ran independent samples T Tests which showed significant differences between the two groups for /p/ ( $t(18)=-2.93$ ,  $p=.01$ ) and /k/ ( $t(18)=-4.45$ ,  $p=.00$ ), but not for /t/ ( $t(18)=-1.69$ ,  $p=.11$ ), even though Table 3 shows higher mean and standard deviation values in the Spanish produced by the bilinguals. Similar results were reported in Schereschewsky, Alves and Kupske (2017), who investigated language attrition in the VOT in Brazilian Portuguese produced by Brazilian learners of English. In that study, significant differences between the L1 productions of monolinguals and bilinguals were also found for /k/. The data in Schereschewsky; Alves; Kupske (2017) led the authors to suggest that /k/ was the first consonant to show signs of attrition, very likely due to the fact that /k/ is semi-aspirated in Brazilian Portuguese. In the present study, semi-aspiration was also found in the /k/ produced by the Argentinean monolinguals, as the mean VOT value by this group was 46.61ms. These production data by the bilinguals, therefore, provide additional evidence to the early status of attrition in the velar plosive. Furthermore, these results also lead us to suggest that the bilabial stop, rather the alveolar, should be the second one to present significant differences between monolingual and bilingual productions. This might be due to the intermediary position of /t/ in the vocal tract, as it exhibits intermediate values between the bilabial and velar extreme values, which contributes to affecting both perception and production<sup>14</sup>. Once again, it is important to highlight that, although no significant differences have been found for /t/, the mean and SD values concerning the bilingual productions are higher than the monolinguals', which might suggest that the L1 is already being affected.

The box plots in Figure 5 provide additional information on the productions in L1 Spanish by both groups, as they indicate the highest and lowest values produced by each group, besides the median values and the range of variability in each place of articulation.

<sup>14</sup> It is important to mention that the production of the coronal plosive /t/ was not investigated in Schereschewsky; Alves; Kupske (2017), as this consonant tends to be palatalized before [j] in the dialect of Brazilian Portuguese of the participants in that study. It should be said, however, that in Alves (in press), who also investigated language attrition in L1 Spanish, attrition in /t/ seemed to occur first than in /p/. Further studies are therefore necessary in order to verify if there is indeed an order of occurrence of attrition between these two places of articulation.

**Figure 5.** Productions of Spanish /p/, /t/ and /k/ by monolinguals and bilinguals (VOT values in the y-axis in ms; In the x-axis, '1' stands for 'monolinguals' and '2', 'bilinguals').

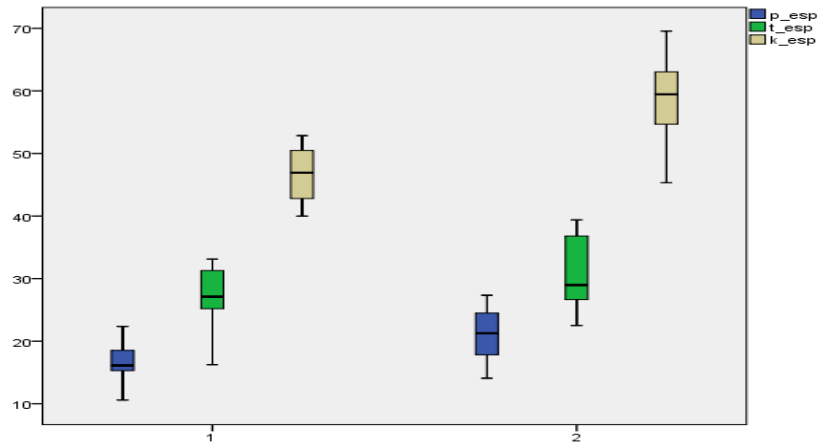


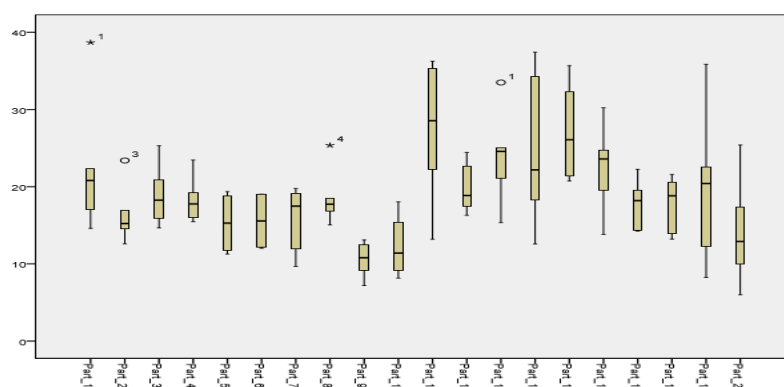
Figure 5 suggests that /k/ is the most altered consonant in the bilingual productions, as the participant with the highest VOT values in the monolingual group did not reach the median value of the bilinguals. It should also be mentioned that the box plot of the bilinguals seems to cover a much larger range of VOT values than that of the monolinguals'. As for the bilabial plosive, signs of attrition can also be found, but not as clearly as in /k/: as expected, the median in the bilingual group is higher, and both lower and upper whiskers in the bilingual group are higher than the monolinguals', with an interquartile range much higher among the bilinguals. However, the range between maximum and minimum values are almost the same for the two groups (monolinguals: 22.36ms – 10.58ms = 11.78ms; bilinguals: 27.33ms – 14.09ms = 13.24ms), showing that the bilinguals do not present a higher range of variation than the monolinguals. Finally, as for /t/, the median in the monolingual group (27.11ms) almost reaches the bilinguals' (28.99ms). Although the interquartile range is much higher among the bilinguals, the difference between maximum and minimum values is just the same (monolinguals: 33.12ms-16.25ms= 16.87ms; bilinguals: 39.38ms – 22.51ms = 16.87ms). It might be the case that this similar range might have contributed to the non-significant values found in the inferential test. In other words, this is the consonant that presents the weakest evidence of attrition.

Considering a dynamic view of language (LARSEN-FREEMAN; CAMERON, 2008; DE BOT; LOWIE; VERSPOOR, 2007, 2011; DE BOT; LOWIE; VERSPOOR, 2013; BECKNER *et al.*, 2009; DE BOT, 2017, among others), as data variability is one of the main sources of evidence of development (and consequently of L1 attrition, since the L1 and L2 subsystems are seen as interconnected), it is important to analyze if the higher variability found in the group can be found among all participants. Following Lima Jr. (2016a, b), Pereyron (2017) and Lowie; Verspoor (2019), in this paper we aim to integrate and combine the descriptions of groups and their individual participants, as already done in the previous section, which concerned the development of L2 English.

In order to provide more descriptive information on medians, lowest and highest values and interquartile ranges, Figures 6, 7 and 8 present the

individual production box plots for each one of the places of articulation. The data in this table will not only clarify the range of individual variation by each participant, but also indicate whether all participants in the bilingual groups already show the signs of attrition previously found in the group analysis.

**Figure 6.** Individual productions of /p/ by monolinguals and bilinguals (VOT values in the y-axis in ms).



As for the production of the bilabial plosive, Figure 6 shows that the ranges of values tend to be much larger among bilinguals than monolinguals. One exception among the monolinguals is Participant 1, who shows an outlier value which makes its range (of 24.10 ms) much higher than those found among many monolinguals. The second highest range value (10.79ms) in this group, that of Participant 2 (who also shows an outlier value), is outnumbered by the range values of seven out of the 10 participants in the bilingual group (with the exception of participants 12, 17 and 18, who show ranges of 8.15ms, 8.01ms and 8.37ms, respectively). Among the participants in the bilingual group, participants 11, 14 and 19 show ranges above 20ms (23.07ms, 24.85ms and 27.62ms, respectively). Once again, these higher ranges of variability may indicate that the learners' L1 might be presenting some sort of unstable behavior, in which L2 influence might be playing a role.

The median values also show higher VOT durations among bilinguals. Among the bilinguals, Participant 20 is the one who presents the lowest median, although his range of 19.40ms (lowest value: 8.23ms; maximum value: 35.85ms) suggests that this learner's L1 is destabilized, presenting some tokens that resemble those of attrited /p/. Among the monolingual participants, Participant 1 once again shows a unique pattern, resembling the participants from the bilingual group, with a median of 20.79ms. The second highest median among the monolinguals is found in Participant 3, whose median of 18.26ms, which should be seen as high in this group, outnumbers the medians of only two participants in the bilingual group (Participant 17: 18.19ms; Participant 20: 12.90ms). Therefore, it suffices to say that, in general, the bilinguals tend to present a higher median than the monolinguals, suggesting once again the occurrence of language attrition.

Finally, a word should be said about the highest VOT tokens produced by each participant in the two groups. Among all participants, Participant 1, from the monolingual group, presents the highest (outlier) value. Further

studies on this participant trying to trace the conditions which contribute to this outlier pattern in this group are worth carrying out<sup>15</sup>. Still in the monolingual group, only Participants 3 and 8 presented higher values above 25ms (25.31ms and 25.35ms, respectively). In the bilingual group, three participants presented their highest token with a VOT lower than 25ms: Participant 12 (24.43ms), Participant 17 (22.25ms), and Participant 18 (21.58 ms). Participant 20 was the only one in the bilingual group who presented a highest value between the range of 25ms and 30ms (25.40ms), as all other participants produced at least one token with VOT length higher than 30ms, indicating that at least one of their productions could be considered to be attrited. It is interesting to mention that Participants 12, 17, 18 and 20 are those that exhibited not only lower values of higher VOT, but also lower medians. Indeed, when we consider their production of English in Figure 6, we see that Participant 17 was the one who presented the lowest median in the target language, while Participants 12 and 18 presented very larger ranges between their highest and lowest VOT values. These facts contribute to showing that maybe Participant 17 is still in a lower stage of development to what concerns VOT, while the other two participants are still presenting a more destabilized L2 subsystem in comparison to the other learners, who seem to have mastered the L2 target pattern. When considering the individual data presented in Figure 6, it is also important to mention some of these learners peculiarities: Participant 20, followed by Participant 18, started learning English at older ages (18 and 13, respectively), while Participant 12 was the one among all participants who started learning English at the youngest age (4 years). Besides, Participant 17 rated herself with the lowest grades (4 in both oral and listening skills) in the self-evaluation questionnaire (SCHOLL; FINGER, 2013)<sup>16</sup>, besides being older than the rest of the group. These factors seem to work as additional evidence of the strong connections between the learners' L1 and L2 subsystems, besides reinforcing that a large number of individual variables might be at play when defining attainment in the L2, as predicted by a view of language from a CDS perspective (LARSEN-FREEMAN; CAMERON, 2018; DE BOT; LOWIE; VERSPOOR, 2007, 2011; DE BOT; LOWIE; VERSPOOR, 2013; BECKNER *et al.*, 2009; DE BOT, 2017, among others).

In summary, the individual analysis seems to suggest that at least six out of 10 participants show clear signs of attrition, while the remaining ones seem to be a bit behind in what concerns their development of the L2 (and thus still exhibit fewer changes in their L1). These data reinforce the importance of individual participant analyses, showing many differences that tend to be masked in an overall group description.

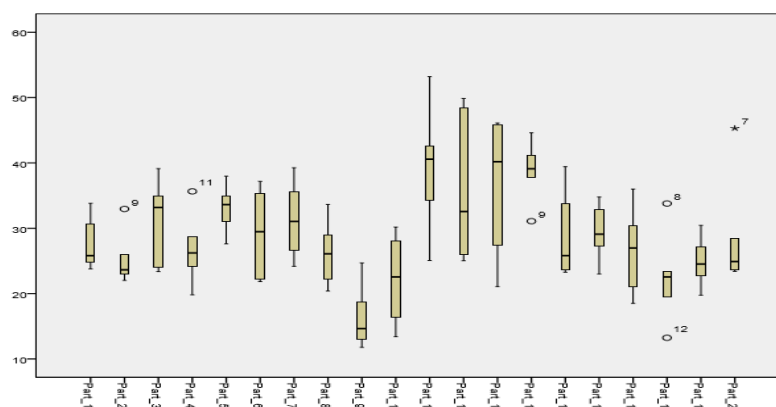
<sup>15</sup> It might also be the case this participant did not come clean when referring himself as a monolingual speaker. A further qualitative analysis on this participant, which includes further interviews on language experience, would prove necessary in order to rule out this possibility.

<sup>16</sup> We restate that, in an exploratory fashion, correlation tests had been run between the learners' English VOT values and the independent variables presented in Table 1, with no significant difference found. In the same fashion, in this part of the study we correlated the values of the same independent variables and the bilinguals' VOT values in Spanish. Once again, no significance was found. We reinforce that these results might be considered as evidence of a non-linear relation between the variables taken isolatedly and the participants' performances. As stated by Lowie; Verspoor (2015, 2019), individual trajectories are built based on the combined action of a series of learner characteristics.



The next Figure presents the box plots on the productions of /t/ by each one of the participants.

**Figure 7.** Individual productions of /t/ by monolinguals and bilinguals (VOT values in the y-axis in ms).



As stated previously, the results of the independent samples T-Tests showed no significant differences between the means of monolinguals and bilinguals. Therefore, the analysis of the performances of each one of the individuals assumes a central role when it comes to this consonant, as it might be the case that, despite the lack of significance in the inferential test, one or more participants might already show some signs of L1 attrition.

This really seems to be the case. As seen in the labial plosive, variability seems to be much larger among bilinguals than monolinguals. In the monolingual group, Participant 10 presents the highest range of values (16.77ms). This highest range is still lower than the ranges produced by six participants from the bilingual group (Participants 11, 12, 13, 17, 18, 20), as only Participants 14, 15 and 19 present ranges lower than 15ms (13.53ms, 11.79ms and 10.68ms, respectively). In the bilingual group, Participants 11 and 13 are the ones who present the largest ranges of values (28.14ms and 25.05ms, respectively). This larger variability in the L1 productions by the bilinguals might be considered to be a sign of a more unstable and dynamic system, which seems to be more subject to change in view of the contact with the L2 subsystem.

As for the median values, except for bilingual Participants 11, 13 and 14, who present median values of 40.57ms, 40.19ms and 39.11ms respectively, a visual inspection of Figure 7 does not tend to show many differences between bilinguals and monolinguals. This lack of differences, which could also be noticed in the means of each group, might have resulted in the non-significant results found for this consonant. However, as far as individuals are considered, we can easily see that the three aforementioned participants seem to be presenting a different pattern.

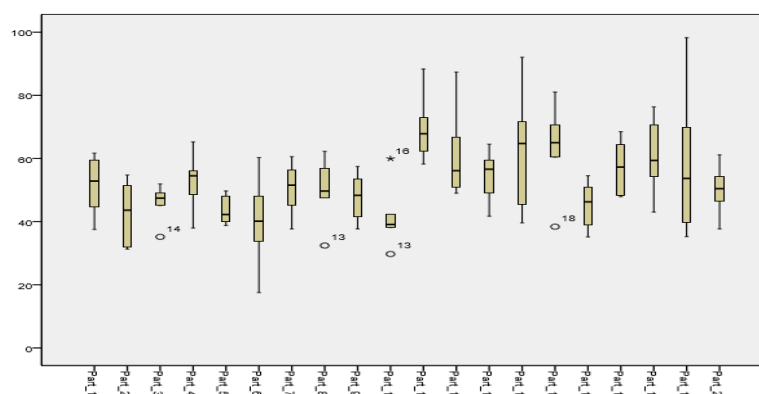
These differences can also be found as we consider the highest production values produced by each participant. Whereas the token with the highest VOT does not reach 40 ms in the monolingual group (Participant 7 – 39.25 ms), six of the 10 bilingual participants (Participants 11, 12, 13, 14, 15, 20) reached higher VOT values. Participants 11, 12 and 13 produced the tokens

with the highest VOTs (53.21ms, 49.87ms and 46.12ms, respectively), whereas Participants 16, 17, 18 and 19 produced the lowest highest values in this group (34.79ms, 36ms, 33.79ms and 30.44ms, respectively).

All in all, our verification of Figure 7 confirms that even though no significant differences have been found in the inferential test, there seem to be participants who already show signs of language attrition in their productions of Spanish /t/. This is clearly the case of Participants 11 and 13, who show a great deal of variability as well as higher median and highest VOT values. Participants 12, 14 and 20 also seem to be showing some signs of attrition, although not as evidently as the aforementioned participants. On the other hand, as in the labial stops, we can see that those participants who are still a bit behind in their development of the English VOT pattern seem to present a more similar performance to that found among the monolinguals.

In what follows, we present Figure 8, which describes the individual L1 productions of the velar plosive.

**Figure 8.** Individual productions of /k/ by monolinguals and bilinguals (VOT values in the y-axis in ms).



VOT values tend to be higher in the production of /k/. As already said, the velar stop seems to present higher VOT values even among Spanish monolinguals, being considered to be 'semi-aspirated' (cf. M. Alves, 2015). Despite this fact, figure 8 also shows that variability can be more easily found in the L1 productions by bilinguals. In the monolingual groups, an exceptional case is Participant 6, whose lowest token is responsible for a higher variability, presenting a range of 42.75ms. All of the other participants in this group presented a range below 30.20ms. As for the bilinguals, six out of 10 participants (Participant 11, 12, 14, 15, 18 and 19) presented a value range larger than 30 ms. Participant 19 presents the highest range, as he produced the token with the highest VOT (98.27ms). As for the median values, only three participants in the bilingual group (Participants 16, 19 and 20) presented values below 55ms, whereas the highest median found among the monolinguals was 54.51ms (Participant 4). Also, the token with the highest VOT value found among the monolinguals (65.26ms – Participant 4) outnumbered the highest value of only 03 bilinguals (Participant 13: 64.50ms; Participant 16: 54.51ms; Participant 20: 61.17ms). In this latter group, six participants presented tokens with a VOT higher than 75ms (Participant 11: 88.36ms; Participant 12:

87.35ms; Participant 14: 92.04ms; Participant 15: 81.05ms; Participant 18: 76.35ms; Participant 19: 98.27ms). As in the previous places of articulation, participants 17 and 20 are the ones who most resemble monolinguals in their L1 VOT productions.

In sum, the analysis of individual productions proves to be really useful in that it provides additional information to the inferential results. As for /p/ and /k/, in which significant differences in the L1 productions of monolinguals and bilinguals were found, we see that not all participants are following the same pace, as some seem to be showing more signs of attrition than others. Our individual analysis has also suggested that those bilinguals that show more altered values are the ones who have reached an advanced performance in L2 English VOT. As for /t/, as shown in the inferential tests in which no signs of attrition were displayed, we were able to find some participants that show clear signs of an altered L1. These learners also show to have had a successful trajectory in the learning of English aspiration.

#### 4. Final considerations

In this paper, we investigated the occurrence of L1 attrition among Argentinean learners of English living in the city of Mar del Plata-Argentina, an L1-dominant environment. Following Kupske (2016), who sees attrition as a natural process of change in language, and grounded on a dynamic view of language (LARSEN-FREEMAN; CAMERON, 2008; DE BOT; LOWIE; VERSPOOR, 2007, 2011; DE BOT; LOWIE; VERSPOOR, 2013; BECKNER *et al.*, 2009; DE BOT, 2017, among others), which sees language change in time as the key factor in development, we assumed that the L1 may also be subject to change due to the development of additional languages. Departing from this assumption, we investigated the production of word-initial Voice Onset Time in word-initial position both in L1 Spanish and L2 English.

Our results showed that the bilingual students produced different VOT patterns in Spanish and English, since they proved able to aspirate word-initial voiceless plosives in the L2. As for the verification of their VOT in the L1, inferential analyses showed significant differences between the averages of monolinguals and bilinguals in their productions of /p/ and /k/, which suggests the occurrence of language attrition. These results are in accordance with previous studies on language attrition in L1-dominant environments (SCHERESCHEWSKY; ALVES; KUPSKE, 2017; ALVES, in press), which also suggest higher VOT values in the L1 productions of learners of English as an L2. The present results also provide additional evidence to the claim that attrition seems to be occurring first in the velar stop. This seems to be the case considering both Brazilian Portuguese (SCHERESCHEWSKY; ALVES; KUPSKE, 2017) and Spanish (ALVES, in press) as L1, as in these two languages /k/ is produced as 'semi-aspirated' (cf. ALVES, 2015). This facilitates L2 development, which in turn accelerates the changes in the L1 itself.

Besides the inferential analyses, we also carried out an analysis of the VOT patterns produced by each one of the participants of the two groups. In these individual analyses, we not only considered the means and medians of the VOT produced by each participant, but also their individual variability in the production of VOT. Following a dynamic account of language, variation can be

considered to be a sign of development (LOWIE; VERSPOOR, 2015) and also of attrition (OPITZ, 2017). In the case of our study, this analysis proved particularly important, as it revealed that some of the participants already showed signs of attrition in their production of L1 /t/, despite the non-significant results of the inferential analysis. The analysis of each participant also revealed that not all participants showed signs of attrition in their productions of /p/ and /k/, even though the inferential analysis had indicated a significant difference between monolinguals and bilinguals. Furthermore, the individual analysis also suggested that those who tended not to show signs of L1 attrition were those whose learning of the L2 pattern could be found in an earlier developmental stage, which provides additional evidence to the interconnectedness of the L1 and the L2 subsystems. In sum, the individual analyses provide further evidence to the claims by De Bot (2011), Lowie; Verspoor (2015, 2019) and Opitz (2017) on the importance of investigating the data of each participant individually.

The results presented in this paper open new avenues for future research, especially in what concerns new investigation goals on language attrition. It must be considered that, although we have grounded our research on the assumption that language is dynamic and that change over time is what accounts for L1 attrition, one limitation of this study is that it has relied on results of a transversal analysis. In our future studies, we aim to investigate learners longitudinally, so that the changes in both the L1 and L2 systems can be accompanied over time. We believe that a combination of group and individual analyses over time will be able to provide a clearer picture not only of L2 development, but also of the longitudinal changes that arise in the L1 in view of the contact between two or more language systems. Having provided empirical evidence which sustains this claim, we believe to have given the first steps towards this long-term goal.

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*Recebido em abril de 2019.  
Aprovado em junho de 2019.  
Publicado em junho de 2019.*

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