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Sierra Rodríguez, Candela; Cebrian, Juli , dir. Post-aspiration in Andalusian Spanish and its effects on voiceless stop production in L2 English. 2022. 58 pag. (1099 Màster Universitari en Estudis Anglesos Avançats / Advanced English Studies)

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Post-aspiration in Andalusian Spanish and its effects on voiceless stop production in L2 English

MA Dissertation

MA in Advanced English Studies

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July 2022



Acknowledgements

First and foremost, I would like to thank my supervisor, Dr. Juli Cebrian for his help and guidance in the completion of my Master's thesis. Thank you for your encouraging words and for giving me the freedom to develop my project. Secondly, I want to thank everyone at the Universidad de Granada for letting me use their facilities, without which I would not have been able to collect the necessary data for this study. Thank you also to all the professors at the Universidad de Granada and the Universitat Autònoma de Barcelona for welcoming me into their classes and helping me find participants.

I am also very thankful to my brother, David, for being an endless source of inspiration and motivation. Without you I would not have been able to finish, or even start, this thesis. Thank you to my family and friends, but especially to Malu and Jose for listening to me talk about aspiration non-stop for months. Many thanks to Kate and Mireia, for sharing the stress of writing a master's thesis and always offering moral support. Last, but not least, I would like to thank the participants. Thank you for taking interest in my study and for being so kind as to share your personal experiences with me. I hope I made it justice.

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Abstract

The production of voiceless stops in Spanish and English has been compared and analyzed in terms of the differences in aspiration and VOT durations. However, the focus has been put on speakers of a more standard or neutral variety of Spanish. In this aspect, other varieties of the language that might share features with English have been disregarded. Andalusian Spanish (AS) is a variety of Spanish in which the so-called phenomenon /s/ aspiration, i.e., the loss or weakening of word-medial and word-final /s/, can result in post-aspiration when it is followed by voiceless stops. The present study aims to examine post-aspiration in AS and to compare it with the production of voiceless stops in English as a second language (L2). Two groups, one with AS subjects and another with Castilian Spanish (CS) speakers, all learners of English, completed a word insertion task and an interview in Spanish and English. Results showed that both groups aspirated more in English than in Spanish, which shows that they make a distinction between the phonetic categories. However, AS speakers were found to aspirate significantly more than CS participants in the two languages. In Spanish, both groups aspirated more after /s/ than after vowel. As for English, the two groups were found to aspirate more when the voiceless stop was preceded by a vowel than /s/. Finally, it can be concluded that post-aspiration in AS shows a positive effect on the production of aspirated voiceless stops in L2 English. Nevertheless, further research is needed to fully understand the effect that L1 dialectal features can have on L2 speech learning.

Keywords: Andalusian Spanish; aspiration; VOT; L2 English; L2 speech learning.

1. Introduction

Spanish and English differentiate two sets of stop consonants by the presence or absence of voicing. Nevertheless, another cue, aspiration, is used in English to distinguish between stops when they are in stressed initial position. Aspiration in stops is measured through VOT (Voice Onset Time), the interval between the release of the stop and the start of voicing. English voiced stops are produced with short lag VOT, whereas Spanish voiced stops are produced with voice-lead. In the case of voiceless stops, they are produced with long lag VOT in English and short lag VOT in Spanish (Lisker and Abramson, 1964). This means that Spanish voiceless stops are considered unaspirated, whereas English voiceless stops are considered aspirated.

In second language acquisition, the research done on Spanish and English production of voiceless stops has focused on comparing these two languages to analyze if L1 speakers of one language can produce L2 stop categories authentically (Flege and Eefting, 1987; Fellbaum, 1996; Gorba and Cebrian, 2021). Nevertheless, in this attempt to compare the two languages, the focus has been put on speakers of a standard or more neutral variety of Spanish. As a consequence, other varieties of Spanish that might share features with English have been overlooked. Such is the case of Andalusian Spanish, the object of study in this paper. In Andalusian Spanish, the phenomenon called /s/ aspiration followed by voiceless stops can result in the post-aspiration of the stops (Torreira, 2007a). This process of post-aspiration has not been reported in any other variety of Spanish and has not been previously compared to English aspiration.

In the following pages, this paper will shed light on the role that L1 dialectal features can have in L2 speech learning. A review of the main literature relevant to the study is presented first. The focus is on voiceless stop consonants in English and Spanish and the features attributed to them, previous studies that have compared the production

of voiceless stops in these two languages, and post-aspiration in Andalusian Spanish. Subsequently, the research questions meant to be addressed in this study are introduced with their respective predictions. Thereafter, the methodology implemented in the experiment is explained and the production task completed by the participants is described. The results obtained in the data collection of this experiment are presented next. Firstly, the within groups comparisons are reported, with separate tests for the AS and the CS groups. This is followed by a short discussion of these results. Secondly, the between groups comparisons are presented and discussed. A general discussion section interprets and explains the results found in the study in terms of the research questions addressed at the beginning and offers concluding remarks to the paper. Finally, the last section is dedicated to discuss the limitations found in the study and to propose further lines of research.

2. Literature review

2.1. Stop consonants and VOT

Stops have been of great interest in cross-linguistic research as they are the only consonants that seem to be present in all natural languages of the world (Ladefoged and Maddieson, 1996). Stops can be classified according to different dimensions. The most common way of categorizing these consonants is by their place of articulation. In the case of English and Spanish, although both seem to have similar phonetic categories for stops, there are some differences between the two. Spanish /d/ and /t/ are dental, whereas English /d/ and /t/ are alveolar. As for /b/ and /p/, they are bilabial in both languages; it is the same for /g/ and /k/, which are considered velar stops in Spanish and English. Stop consonants normally have three phases: onset, when the articulators come closer to each other; closure, when the articulators are touching; and offset or release, when they are moving away from each other (Ladefoged and Maddieson, 1996). When the interval of

closure is marked by glottal vibration, it is said that the stop is voiced, whereas if there is no vibration it is considered that the stop is voiceless (Lisker and Abramson, 1964). This phonetic dimension of voicing, that is, the presence of vibration in the vocal folds, serves as another way of differentiating between stops within and across languages. Both English and Spanish agree in the voicing categorization of their stop consonants: /b, d, g/ are considered voiced in both languages, whilst /p, t, k/ are considered voiceless.

Aspiration is another feature that is used in the categorization of stops in a number of languages, such as Thai, Cantonese, Korean, or Hindi (Lisker and Abramson, 1964; Kessinger and Blumstein, 1996; Ladefoged and Maddieson, 1996). Aspiration is a strong puff of air that occurs after the release of a stop, in which case the consonant would be considered post-aspirated; if this burst of air accompanies the closure of the stop, it is considered that the consonant is pre-aspirated (Ruch and Harrington, 2014; Ladefoged and Maddieson, 1996). Aspiration is most commonly related to voiceless stops due to the fact that voiceless and aspirated stops tend to share tense articulatory force, whereas voiced and unaspirated stops are more likely to be lax (Lisker and Abramson, 1964). Since this paper is concerned with voiceless stops, /p, t, k/ and the features attributed to these consonants will be the focus of discussion in the following pages.

As a way of measuring voicing, Lisker and Abramson (1964) argued that the degree of voicing of a stop can be defined as the time period between the release and the onset of voicing, whether it precedes or follows the release. This is also known as Voice Onset Time (henceforth VOT). Therefore, a difference in voicing would not only differentiate voiced from voiceless stops, but also aspirated from unaspirated stops. They further claim that according to this definition, aspiration is simply a delay in the onset of voicing relative to the stop release. In addition, their study and multiple others (Williams, 1977; Schertz et al., 2015; Zlatin and Koenigsknecht, 1976; Shultz et al., 2012) have

reported the importance of VOT as an acoustic cue used for distinguishing the voicing stop contrast in both production and perception. Lisker and Abramson (1964) established three conditions in relation to where VOT occurs: if voicing begins before release, it is considered that the stop is voiced and unaspirated, also called voicing lead or pre-voiced; if voicing starts right at the release or shortly after (20-40 ms), the stop is considered to be voiceless and unaspirated, with a short voicing lag; finally, when voicing is delayed after the release, the stop is defined as voiceless and aspirated, with long lag VOT. Regarding English and Spanish, their relation to aspiration and VOT will be discussed in following sections.

VOT values have been found to be affected by a number of factors, whether linguistic or social. Perhaps the most studied factor has been the influence of place of articulation in VOT. Several studies have shown that the further back the place of articulation is in a stop, the longer the VOT (Byrd, 1993; Thornburgh and Ryalls, 1998). Therefore, velar stops tend to present higher values followed by alveolars and bilabials, respectively. This has been found true for a number of languages (Cho and Ladefoged, 1999). In fact, Lisker and Abramson (1964) in their cross linguistic study already reported higher values for velar stops in all the languages considered. Another factor that has shown to influence VOT is the height of the vowel that follows the stop. Longer VOT durations have been reported in voiceless stops that precede high vowels, in contrast to when they are followed by mid and low vowels (Klatt, 1975). Furthermore, speech rate has also been proposed as an influential factor (Kessinger and Blumstein, 1996; Schmidt and Flege, 1996; Theodore et al., 2009). Kessinger and Blumstein (1996) reported that the short lag category was not affected by speaking rate and was maintained stable, whereas the long-lag and the pre-voiced stops did suffer changes caused by speaking rate. In addition, it was found that VOT increased when speech rate decreased, whilst VOT

values shortened when speakers spoke faster. Spontaneous or running speech also appears to cause shorter VOT durations (Lisker and Abramson, 1967).

In relation to non-linguistic factors, a number of variables have been found to affect VOT. One of them is age (Ryalls et al., 1997, 2004), with younger speakers producing longer VOT than older speakers. Gender (Whiteside and Irving, 1998; Thornburgh and Ryalls, 1998), which was reported to be significant with male speakers producing shorter VOT than female speakers. Differences in VOT were also found in connection to dialectal background (Syrdal, 1996). Lastly, language experience, as well as age of learning (Flege and Eefting, 1987; Flege, 1991; Flege et al., 1996; Gorba and Cebrian, 2021) have been identified as factors that can influence VOT—positively in the case of speakers who have been learning an L2 longer and who have more experience in it, resulting in more authentic VOT values.

2.2. English and Spanish voiceless stops and L2 acquisition

As aforementioned, English and Spanish both present two phonological stop categories: voiced and voiceless. Nevertheless, the two languages differ phonetically in terms of aspiration and VOT. In English, when /b, d, g/ are present initially after a pause or following a voiceless consonant, they may be produced with little or no vocal fold vibration at all (voicing). In order to differentiate this set of stops from /p, t, k/, aspiration is used as an acoustic cue (Lisker and Abramson, 1964). Hence, aspiration occurs in English only in voiceless stops at the beginning of a stressed syllable. As for Spanish, voicing seems to be sufficient to distinguish between the stop consonants in initial position. For this reason, no aspiration connected to voiceless stops has been reported in the literature (Navarro Tomás, 1990).

Regarding VOT, English /b, d, g/ are produced with short lag VOT and /p, t, k/ with long lag VOT. In contrast, Spanish /b, d, g/ are described as pre-voiced and /p, t, k/

as short lag. This means that there is not an equivalence between the voiceless stops of both languages. VOT values for English voiceless stops in Lisker and Abramson (1964) report an average of 0-40 ms for short lag and greater than 40-60 ms for long lag. Similar values are reported in Klatt (1975). Although short-lag VOT in phonologically voiced stops is more common in initial position, they can also be produced with voice lead. Table 1 presents the VOT values reported in the literature for English voiceless stops. Nonetheless, this seems to change when word-initial voiceless stops are produced embedded in sentences or in running speech. Lisker and Abramson (1967) reported shorter values for words in sentences, with a difference of 25 ms from isolated words. As for Spanish, negative values are reported for voice lead and an average of 0-40 ms for short lag (Lisker and Abramson, 1964). It should be noted that Lisker and Abramson's participants were speakers of Puerto Rican Spanish. Other studies analyzing VOT in Castilian Spanish (Casteñada, 1986; Asensi et al., 1997; Rosner et al., 2000; Martínez-Belda and Padilla, 2021) have found contrasting values (See Table 1 for the VOT values reported for Spanish). With the exception of /k/, the values of the two other stops seem to differ in these studies from those reported by Lisker and Abramson.

		/p/	/t/	/k/
English	Lisker and Abramson (1964)	58	70	80
	Klatt (1975)	47	65	70
Spanish	Lisker and Abramson (1964)	4	9	29
	Casteñada (1986)	6.5	10.4	25.7
	Asensi et al. (1997)	14.7	20.2	35.4
	Rosner et al. (2000)	13.1	14	26.5
	Martínez-Belda and Padilla (2021)	11.79	15.38	28.59

Table 1. Reported VOT means in ms for English and Spanish.

In the field of second language acquisition (SLA), some attention has been paid to the production of voiceless stops by English and Spanish speakers (Flege and Eefting,

1987; Fellbaum, 1996; Magloire and Green, 1999; González López, 2012; Gorba and Cebrian, 2021). The focus has been put on whether it is possible for these speakers to produce L2 stop categories in an authentic manner, that is, achieving values similar to those of native speakers. In order to do so, English speakers would have to suppress aspiration to produce initial Spanish /p, t, k/ and Spanish speakers would have to develop new phonetic categories for aspirated voiceless stops in English. This can be explained by Flege's equivalence classification (1987). Flege establishes a categorization of phones based on how much they differ from the L1, by which identical sounds are those shared by L1 and L2; new L2 phones are those not found in the L1; and similar phones are sounds that share some characteristics in both languages, but are not identical. Thus, English and Spanish voiceless stops would be classified as similar phones, considering that English /p, t, k/ are long lag, whereas Spanish voiceless stops are short lag. Moreover, /t/ is alveolar in English and dental in Spanish.

In the Speech Learning Model (SLM), Flege (1995; and its recently revised version, the SLM-r, Flege and Bohn, 2021) postulates that learners tend to assimilate L2 phones to L1 categories, which results in non-authentic representations and productions that cause accented foreign speech in the L2. Equivalence classification claims that L2 learners are more likely to establish phonetic categories for new L2 phones—as they are not present in their already preexisting phonological inventory—than for similar L2 phones, since they are more likely to be assimilated to L1 categories and, thus, no new target-like category is established. In relation to the interactions between L1 and L2 sounds, the merger hypothesis (Flege, 1987) proposes that L2 learners may end up with a single phonological category for L1 and L2 similar phones. This would affect the production of L2 sounds but also of L1 phones, as they would differ from those of monolingual speakers.

Given the fact that the L1 and L2 phonetic systems exist in a common phonological space, it is inevitable that they will influence one another. In addition, Flege et al. (2003) establish two ways in which L1 and L2 sounds can interact with each other. These are through category assimilation or category dissimilation. Assimilation would occur when an L2 sound is assimilated to an L1 category. A merged category will be created only if the distinctive phonetic properties of the sounds are not differentiated. On the other hand, category dissimilation refers to the instances in which a new category for an L2 sound has been created. Learners will try to maintain the L1-L2 contrast and modify in the process their productions of L1 and L2 sounds with respect to monolinguals' values. According to SLM (Flege, 1995), L2 learners might assimilate similar sounds to the L1 initially, but gaining experience will allow them to distinguish phonetic differences between the two phones, to the point that a new category might be established. The greater the phonetic distance discerned by a learner for two similar phones is, the more likely a new category will be created for the L2 sound.

In fact, both the equivalence classification theory and the merger hypothesis were proven in Flege's study of French and English (1987). English speakers of French with extended language experience were able to produce new L2 sounds with monolingual French values. Regarding similar phones, French /t/, which shares the same features as in Spanish: dental and short lag, was produced by English learners with VOT values closer to the L1 or that approximated French monolinguals' durations. As for the French learners of English, they produced French /t/ with longer VOT than French monolinguals and, even the most experienced French learners of English, produced /t/ with shorter VOT than English monolinguals. Hence, they had a merged category for similar phones. Furthermore, Flege's study (1987) showed that the creation of new phonetic categories

and the modification of preexisting ones for similar L2 phones is available throughout a person's lifespan and not limited to their early years of life.

As for what concerns this study, which is the production of voiceless stops by Spanish speakers learning English as an L2, the outcomes in relation to what has been discussed can be multiple. A number of studies have examined this. For instance, Fellbaum (1996) observed that Spanish speakers were able to reach VOT values that were accepted for English, whereas English speakers produced VOT that was significantly longer than what is accepted for Spanish. Similarly, Flege and Eefting (1986) found that Spanish speakers produced shorter VOT values in English and Spanish. It was concluded that, although Spanish learners had been able to create new phonetic categories for English voiceless stops, they were unable to realize them authentically.

Considering that this study will not compare the VOT of Spanish-English bilinguals to the production of Spanish and English monolinguals, the focus will be on the differences between dialectal speakers of Spanish. Despite the fact that some of the previously mentioned studies used participants that speak different varieties of Spanish, this factor has never been taken into account as to how it might influence the results. For this reason, the role that dialectal features have in L2 speech learning, and how they might affect the production of English voiceless stops, will be examined and analyzed in the following sections.

2.3. Voiceless stops in Andalusian Spanish

Andalusian Spanish (AS) is a variety of Spanish spoken in the southern part of Spain. Two varieties can be observed within this region: Eastern Andalusian Spanish (EAS), which includes the provinces of Almería, Granada, Málaga, and Jaén, and Western Andalusian Spanish (WAS) encompassing Sevilla, Córdoba, Cádiz, and Huelva. These two varieties are part of the same dialectal continuum; they do not differ much from each

other. The main criterion used to differentiate them is whether vowel opening is present following /s/ aspiration. Vowel opening makes reference to the lowering of vowel articulation as a result of the loss of /s/ (e.g., /luθes/ “lights” → [luθe] vs. [luθɛ]). The process of /s/ aspiration can be defined as a loss, debuccalization, or weakening of syllable-final /s/ (Alvar, 1955; Navarro Tomás, 1939). It should be mentioned that aspiration in the context of AS /s/ is not to be understood in the same way as aspiration in English voiceless stops. The term /s/ aspiration is used for any instance in which /s/ is not pronounced. It is one of the main characteristics, as well as the most researched phenomenon in AS, due to the implications that losing coda /s/ can have for the syllable structure and the syntactic functions of the utterance—/s/ is often a mark for plurals and conjugated forms of verbs (Hernández-Campoy and Trudgill, 2002; Gerfen, 2002). The study of /s/ aspiration gained interest when Navarro Tomás (1939) suggested that aspirated /s/ was followed by vowel opening in EAS and claimed that it had given rise to new vowel categories, a topic that is still being discussed to this day (Herrero de Haro, 2017). In WAS, on the other hand, /s/ aspiration does not seem to affect the vowel system and syntactic differences are inferred through context (Alvar, 1955; Salvador, 1977).

Different realizations can be found for the aspiration rule (Rodríguez-Castellano and Palacio, 1948; Alvar, 1955; Salvador, 1957; Romero, 1995). When it happens word-finally, it is normally lost (e.g., /'liβros/ “books” → ['liβro] in WAS; ['liβrɔ] in EAS); when it is word-final, but followed by a vowel, aspiration can be heard (e.g., /'liβros a'θules/ “blue books” → ['liβroh a'θule] in WAS; ['liβroh a'θule] in EAS); when the /s/ is aspirated preceding a consonant, whether in final or word-medial position, it is assimilated in different ways: it can be geminated, which is found most commonly with nasals, laterals, and other fricatives (e.g., /'mismo/ “same” → ['mimmo]; /'isla/ “island” → ['illa]; /es'fera/ “sphere” → [e'ffera]); preceding voiced stops /s/ is aspirated and the

stop is spirantized (e.g., /'rasgo/ “feature” → ['rahyo]). With respect to what concerns us, when aspirated /s/ is followed by voiceless stops, /p, t, k/ can either be pre-, post-, or pre- and post-aspirated (Torreira, 2007a; Ruch and Harrington, 2014; Ruch and Peters, 2016). Therefore, some realizations of this construction would occur word-medially (e.g., /'kasko/ “helmet” → ['ka^hko]/['kak^ho]/['ka^hk^ho]) and even across word boundaries (e.g., /'las 'tartas/ → ['la^h 'tarta]/['la 't^harta]/['la^h t^harta]).

Sociolinguistic factors have been found to influence the realization of /s/. Salvador (1957) reported that /s/ deletion and vowel opening was only present in women under 25 years old, although his research was limited to a small demographic in Granada. Peñalver Castillo (2006) found that speakers of a higher socio-cultural status preferred deleting /s/, whereas lower socio-cultural groups aspirated /s/. In fact, for García Marcos (1987) the change to the loss of /s/ originated in lower sociolects. Furthermore, Tejada Giráldez (2012) concluded that the realizations of /s/ are affected by social variables like age, with older speakers having a preference for maintaining or aspirating /s/ over geminating or deleting it.

In previous sections, it has been mentioned that pre-aspirated stops are those in which aspiration precedes the closure of the stop. Although rarely, they can be found in some languages and dialects (Silverman, 2003; Clayton, 2010). Pre-aspiration in English voiceless stops has been found in some varieties of the language (Docherty and Foulkes, 1999; Hejná, 2021; Hejná et al., 2021), but only for word-medial and word-final utterances. As for AS, pre-aspiration has been a well-researched topic in this variety of Spanish (Rodríguez-Castellano and Palacio, 1948; Alvar, 1955), as it has been deemed the most common result of debuccalization of /s/ in /s/ + consonant sequences, what has been previously defined as /s/ aspiration. The phenomenon of /s/ aspiration is not unique to AS. A number of varieties in Spanish present this feature, both in Castilian Spanish

(Monroy and Hernández-Campoy, 2015; Henriksen and Harper, 2016; Momcilovic, 2009, among others) and American Spanish (Canfield, 1981; Lipski, 1994). However, in Spanish, no other dialect but Andalusian Spanish has reported post-aspiration in voiceless stops.

The study of post-aspiration in AS is relatively recent. It was Torreira (2007a) who first theorized that AS, namely WAS, showed post-aspiration in /sp, st, sk/ sequences as a result of debuccalization of /s/. He compared the VOT values of AS speakers to those of Porteño and Puerto Rican Spanish—two Spanish varieties that only present pre-aspiration—and only found post-aspiration in the AS variety. Therefore, if the results found in this study are taken into account, the VOT values reported for Puerto Rican speakers in Lisker and Abramson's study (1964) would not have been influenced in terms of post-aspiration. Torreira reported VOT values for AS that ranged, approximately, from 10-60 ms for /p/, 15-80 ms for /t/, and 35-80 ms for /k/. He concluded that there was a possible sound change on-going in WAS from pre- to post-aspiration (supported in Ruch and Harrington, 2014 and Ruch and Peters, 2016) and hypothesized that post-aspiration is the result of a gestural organization shift from anti-phase to in-phase gestures (claim that was supported in Parrell, 2012). In a later study, Torreira (2007b), compared WAS production of voiceless stops to Northern Peninsular speakers. He found that AS speakers post-aspirated /t/ in /st/ tokens significantly. Moreover, some tokens did not present pre-aspiration at all, whereas others showed pre- and post-aspiration, in which cases VOT was shorter. The co-occurrence of pre- and post-aspiration in a language is an even more uncommon phenomenon (Clayton, 2010; Helgason, 2002).

The theory of a sound change in AS was supported by Ruch and Harrington (2014), who argued that post-aspiration was in the process of becoming a cue for distinguishing /st/ and /t/ sequences. They claimed that it was used as a perceptual cue,

even in varieties that do not present post-aspiration in their voiceless stops, to differentiate between minimal pairs (e.g., *pasta-pata*). In addition, they compared older and younger AS speakers' durations of pre- and post-aspiration in /st/ clusters and found that pre-aspiration was getting shorter, whereas VOT was longer for younger speakers. Younger WAS speakers showed the longest VOT values, whilst older EAS speakers reported the shortest. This gives evidence for a diachronic sound change. In a later study, Ruch and Peters (2016) also provided support for the claim that post-aspiration was used as a perceptual cue. They found that those speakers who produced longer VOT were also more sensitive to post-aspiration as a perceptual cue. Since younger WAS speakers showed longer durations, this could mean that for them post-aspiration in voiceless stops has become phonologized. Furthermore, they analyzed the influence of stop type and duration of aspiration and found results in accordance to previous studies (Cho and Ladefoged, 1999). Velar stops showed the longer VOT values, and bilabials the shortest. Nevertheless, in younger WAS speakers, /t/ in /st/ sequences was produced with longer VOT than /k/ in /sk/ tokens, which deviates from the universal VOT pattern established in Cho and Ladefoged.

In sum, it can be inferred from the studies that have been discussed that post-aspiration in voiceless stops is indeed a feature found in Andalusian Spanish, and no other Spanish varieties. It is caused by the process of /s/ aspiration and, whereas it was originally thought that it only resulted in pre-aspiration, there is evidence that there is an on-going sound change giving way to post-aspiration. Longer VOT values have been reported for younger speakers, specifically in WAS, than for older speakers of the two varieties. It seems that for WAS speakers, post-aspiration has become phonologized, as it is used as a perceptual cue for distinguishing minimal pairs.

Considering how revolutionary and unprecedented it is for Spanish to have a variety that presents post-aspiration in voiceless stops, it seems unfortunate that no attention has been paid to the effect that this could have in speech acquisition of L2 English. To my knowledge, there has only been one piece of research comparing L1 AS to L2 English, and none in relation to their productions of voiceless stops. Jasinnas (2011) set out to examine the interference of AS /s/ aspiration and /n/ velarization in lower-level learners of English. Results showed that these processes were transferred from AS to English, but no correlation was found in regards to the frequency in which they occurred in each language.

3. Goal of the Study and Research Questions

The aim of this paper is to analyze post-aspiration in Andalusian Spanish voiceless stops and to contrast the findings with the production of aspirated voiceless stops in English as a second or foreign language. Specifically, the study aims to explore if Andalusian speakers transfer L1 post-aspiration to English, and if so, whether aspiration is only found in the same contexts as in the L1 (which might or might not coincide with the context of aspiration for English), or whether aspiration is generalized to all initial voiceless stops, following English aspiration rules. The main research questions addressed in the study are the following:

1. Do Andalusian Spanish speakers present post-aspiration in the production of voiceless stops, e.g., in comparison to speakers of other varieties of Castilian Spanish?
2. Is there an influence of phonetic context in which aspiration occurs in Andalusian Spanish, i.e., is aspiration restricted to /s/ + voiceless stops sequences, or is aspiration also found after vowels?

3. Regarding L2 English production, do Andalusian Spanish speakers produce longer aspiration in English voiceless stops than Castilian Spanish speakers, as a result of transfer from the L1?
4. Is there an effect of phonetic context on the production of aspiration in L2 English by AS speakers? In other words, do Andalusian Spanish speakers aspirate more in the same contexts as in the L1, that is, /s/ + voiceless stops, or is aspiration also present in V + voiceless stops sequences?

It is expected that Andalusian Spanish speakers will produce longer VOT in Spanish voiceless stops than the Castilian Spanish speakers, which will support the claim that aspiration is indeed a feature of this linguistic variety. In relation to the context in which aspiration is present, it is more likely that it will be longer in the /s/ + voiceless stop segments, as described in the literature. Nevertheless, instances of V + voiceless stops will also be analyzed and taken into consideration as baseline for comparison.

Regarding English, Andalusian speakers are expected to produce longer aspiration in initial voiceless stops tokens than Castilian Spanish speakers. It is expected that it will be more significant in the /s/ + voiceless stops context. Therefore, this will show that Andalusian Spanish speakers go through a process of phonetic transfer from L1 to L2. Similarly, it is expected that in V + voiceless stops sequences VOT values will be similar to the durations of V + voiceless stops sequences in Spanish, as there will not be any phonetic transfer in this context. Consequently, this will lead to the conclusion that Andalusian Spanish speakers assimilate L2 aspiration to their L1, i.e., that they produce aspiration in English only in the context in which voiceless stops are aspirated in the L1. In contrast, speakers of other varieties of Castilian Spanish are predicted to produce shorter aspiration for both conditions in Spanish and English. The study involves learners of low proficiency levels in English (see the methodology section for more details).

4. Methodology

4.1. Participants

A total of 25 Spanish learners of English took part in the study. The experimental group was made of 18 Andalusian Spanish (AS) speakers, 11 females and seven males, with a mean age of 24.7 (ranging from 18 to 38 years old). At the time of recruiting, they were either undergraduate, master's, or PhD students at the Universidad de Granada. The choice of participants was made on the basis that they had been born in Andalusia or that they had lived there for most part of their lives. Thirteen of the participants were from Eastern Andalusia (EA)—nine from Granada, two from Jaén, one from Almería, and one from Málaga—and the five remaining were from Western Andalusia (WA)—three from Córdoba and two from Cádiz. Regarding the control group, it consisted of seven Castilian Spanish (CS) speakers who were undergraduate and master's students at the Universitat Autònoma de Barcelona. Their ages ranged from 18 to 22, with a mean age of 20 years old. In the case of this group, it was a requisite that they were speakers of a variety of Castilian Spanish that did not present any kind of /s/ aspiration, that is, that they did not lose final or word-medial /s/ preceding a consonant. All of them, with one exception, were from Catalonia.

Since the focus of the study is on beginner and intermediate learners of English, only students with no relation to English linguistics, or English studies in general, were considered for the experiment. This was done to ensure that participants had no extended knowledge of English pronunciation that could alter in any way their production of aspiration in voiceless stops. Prior to the experiment, participants were asked to fill out a questionnaire (See Appendix A) on their linguistic background, as well as on their linguistic use. The majority of students reported making either little or no use of English at home or in their social lives. On the other hand, half of the students reported making

moderate use of English for their studies. All participants had started learning English in primary or secondary school, and only six reported having no official certification in English; as for the rest, 12 of them had a B1 and seven a B2, according to the Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFRL, Council of Europe, 2001). Moreover, none of the participants in both groups had lived in an English-speaking country longer than two weeks.

In addition, students also had to complete two vocabulary tests: LexTale (Lemhöfer and Broersma, 2012) and V_YesNo v1.0 (Meara and Miralpeix, 2015). Both were lexical decision tasks: in the first one subjects had to indicate whether the given word was a real English word or not, whilst in the second one, they had to indicate whether they knew the meaning of the word or not. Two tests were used to get a better assessment of their proficiency level, as Meara and Miralpeix's is of a greater degree of difficulty than LexTale. These tasks were used because a number of studies (Meara and Jones, 1988; Harrington, 2006; Lemhöfer and Broersma, 2012; Koizumi and In'nami, 2013; Roche and Harrington, 2013) have claimed that vocabulary size and knowledge can be predictors of proficiency level in L2 learners. Participants in the current study reported a mean score of 67% (ranging from 45% to 78,75%) in the first test and a mean of 5100 out of 10000 (ranging from 2700 to 6936) in the second one. These scores, interpreted accordingly, indicate that students are generally considered intermediate-level learners.

4.2. Stimuli

In order to elicit the production of aspirated voiceless stops, a total of 48 words (24 for each language) were chosen for the experiment. Following the methodology of prior studies (Flege and Eefting, 1987; Fellbaum, 1996; Torreira, 2007a; Gorba and Cebrian, 2021), and taking into account that lexical stress has been found to affect

aspiration (Keating, 1984; Kessinger and Blumstein, 1997), only disyllabic words stressed in the first syllable were considered for the two languages. Both in Spanish and English, 18 of the tokens included initial /p, t, k/ (See Tables 2 and 3), with the remaining six being filler words (See Appendix C).

/p/	/t/	/k/
Pera ‘pear’	Taza ‘mug’	Caja ‘box’
Pulpo ‘octopus’	Torre ‘tower’	Casa ‘house’
Perro ‘dog’	Tumba ‘tomb’	Queso ‘cheese’
Pato ‘duck’	Tarta ‘pie’	Coche ‘car’
Pollo ‘chicken’	Toro ‘bull’	Cubo ‘bucket’
Piña ‘pineapple’	Tigre ‘tiger’	Casco ‘helmet’

Table 2. List of words used in the Spanish production task organized by initial consonant.

/p/	/t/	/k/
Panda	Table	Camera
Pizza	Ticket	Carrot
Peanut	Toilet	Kilo
Poster	Taco	Candy
Parrot	Turkey	Kettle
Pillow	Towel	Kiwi

Table 3. List of words used in the English production task organized by initial consonant.

The stimuli consisted of common words, all of them nouns, so that they could be picturable and, in the case of English, so that they were known to learners and would not cause difficulty for less proficient speakers when recognizing and articulating them. Since participants also had to repeat the words in the plural form, a decision was made to choose nouns that were countable and had regular plurals to avoid mistakes or diverting the attention from the actual task of the experiment.

4.3. Tasks and procedure

In order to examine the production of voiceless stops, participants completed two tasks, a word insertion task and an interview. Both tasks were completed in their L1 and L2.

4.3.1. Production task

The main task that was used to elicit production was a word insertion task that students were asked to complete in Spanish and English. After the tokens had been chosen, they were randomized—with a fixed order for all participants—making sure that no two of the same stops were immediately one after the other. Subsequently, pictures for each of the words were found from a copyright free photo bank and arranged into a Power Point presentation. Carrier sentences in which the target words were to be embedded were chosen for both English and Spanish. This resulted in a production task that involved a mix of picture naming and sentence repetition.

The reason why the picture naming element was included, in lieu of simply a word reading task, had to do with wanting to redirect focus. Instead of putting emphasis on the written sentence, students were forced to focus their attention on the images and, thus, orthographic influence could be avoided. Speakers of dialectal varieties—as the AS subjects were—tend to use a more neutral or standard accent when reading aloud, as it is considered a more “formal” activity. Although participants were informed that the study was concerned with the Andalusian accent and its relation to English, and they were asked to speak as naturally as they would if they were with friends or family, it was expected that in some cases they would resort to using more standard forms, that is, non-aspirating /s/. The intended goal with these pictures was to avoid this switch in accent as much as possible. In any case, out of the 18 AS subjects, seven of them continuously pronounced full sibilants during the word insertion task. Due to time constraints to find more

participants, these instances were kept in the study and will be discussed accordingly in following sections of this paper.

As for the task itself, participants were first provided with instructions in the given language, as a way to control for the activation of the target language mode (Grosjean, 2001). Following this, they had a practice session to fully understand what they had to do. They would see a slide with a speech balloon showing the corresponding word that would disappear after two seconds. Thereafter, the next slide would show a picture of said word (but not the written word itself) with a carrier sentence that they had to repeat (See Figure 1 for an illustration of the task). In the case of Spanish, it was '*Veo XXX aquí*' (I see XXX here), which they had to complete with '*un/una*' and the target word (e.g., '*Veo una caja aquí*' 'I see a box here'). Once they had repeated this same sentence twice, the next slide would show the same picture duplicated and the same phrase as in the previous one. This time, participants had to complete it with the plural form of the word, that is, '*dos*' and the target word (e.g., '*Veo dos cajas aquí*' 'I see two boxes here'). Again, the sentence had to be repeated twice. It was the plural sentences the ones that elicited the desired /s/ + voiceless stop sequences that the study is concerned with. Regarding English, the same design and structures were used (See Figure 2 for an illustration of the task). In this case, they had to repeat the first sentence with '*this*' and the second with '*two*' (e.g., '*I see this table here*' and '*I see two tables here*') to compare the context in which voiceless stops were produced in both languages, i.e., preceded by a vowel or /s/.

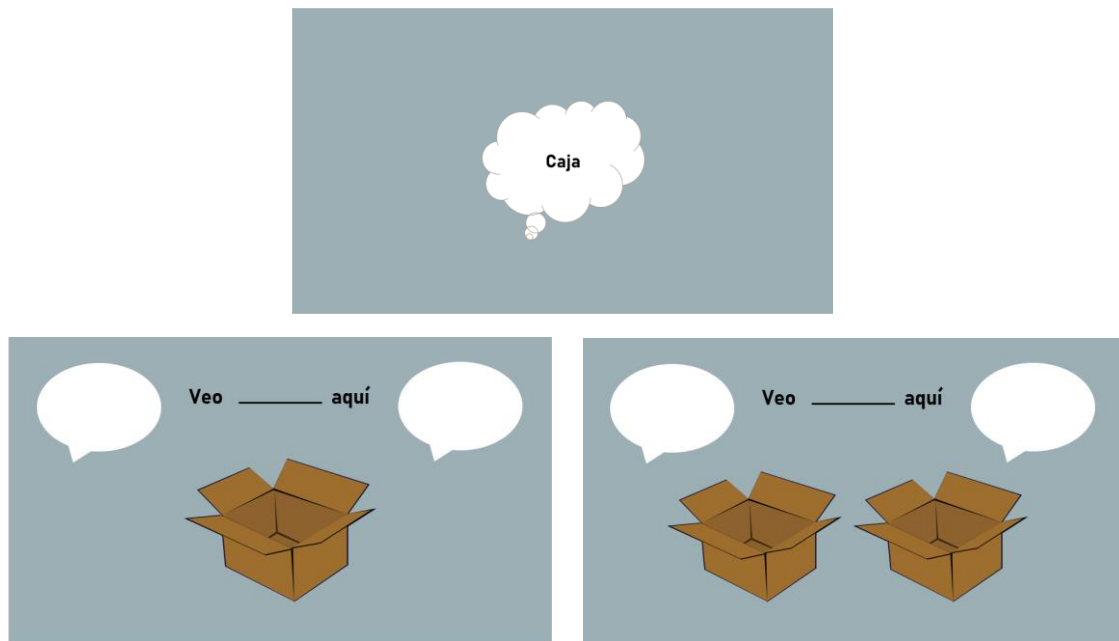


Figure 1. Screenshot of the Spanish production task.

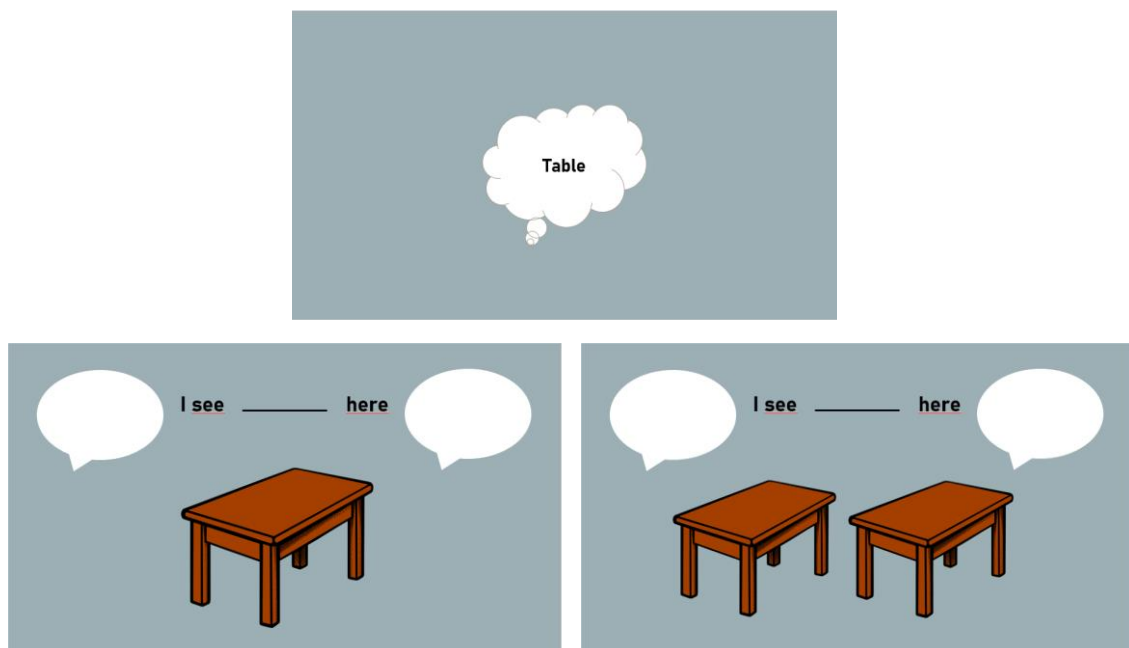


Figure 2. Screenshot of the English production task.

4.3.2. Interview

The interview was conducted with the only purpose of obtaining spontaneous speech data. This was considered important taking into account that it was expected some of the AS participants would switch to a more neutral, formal, or “correct” accent when

repeating the sentences in the Spanish production task. The interview was a way of ensuring that the production of the words, and mostly the plurals, was in line with their everyday speech practices. In the Spanish interview, the first few questions had to do with the academic background of the students, whereas the last part was concerned with aspects related to accents, dialects, and their personal experiences (See Appendix C for the interview transcripts). This offered a sociolinguistic perspective on the topic that was considered relevant for the study. As for English, the first part of the interview asked the participants about the video that they had been shown to transition from Spanish to English. The second part was dedicated to asking about their linguistic background and their experience with learning English and other languages. In the same way, interviews also served as another way to assess their proficiency level in English.

4.3.3. Procedure

Once participants had completed the production task in Spanish followed by the interview, they were shown a short video in English to activate this language mode. They were then given instructions in English to complete the production task, which was once again followed by the interview. Each word for each condition (singular or plural) was repeated twice. A total of 4800 words (25 participants x 2 languages x 24 stimuli x 4 repetitions) were elicited for both languages. Removing the filler words, which were not analyzed, left us with 3600 tokens.

The production data were collected in individual sessions. The recordings for both groups of participants took place in sound-treated rooms at the respective universities of the students. Participants at the Universidad de Granada were recorded with a Yeti Stereo microphone, as well as a high-quality Sony PCM-D50 recorder. As for the speakers at the Universitat Autònoma de Barcelona, they were only recorded using the Sony PCM-D50 recorder. The recordings were analyzed using the Praat software (Boersma and Weenink,

2022). VOT was measured from the release of the stop to the first glottal pulse shown on the spectrogram. In the cases in which either the burst—due to voicing—or the onset of voicing were not clear, adjustments were made to measure VOT—or it was automatically considered 0.

5. Results

The VOT for all voiceless stops tokens was measured from the release of the stop to the start of voicing in both languages using the software Praat (Boersma and Weenink, 2022). The average of VOT duration for each place of articulation, each condition (after /s/ or after vowel), and each group was calculated. The within-groups comparisons will be presented first, with descriptives and statistical analyses for each group, followed by between groups comparisons and their respective statistical tests.

5.1. Within-groups comparisons

In order to compare the production of voiceless stops in Spanish and English for each group, a number of tests were carried out. First, the results for the AS group will be presented, followed by the CS group results.

5.1.1. Andalusian Spanish group

The mean VOT and the standard deviation for the AS group in English and Spanish are presented in Table 4. It is organized by condition, that is, whether the voiceless stops were preceded by /s/ or by a vowel (V).

	Mean	St. Deviation
English	37	22
after /s/	33	21
after V	41	23
Spanish	24	13
after /s/	26	13
after V	21	12
Total	30	19

Table 4. Mean VOT in ms and standard deviation by condition (after /s/ and after a vowel) produced by the Andalusian Spanish group.

The mean VOT and standard deviation organized by segment (/p/, /t/, and /k/) and condition are presented separately for each language: Table 5 shows the Spanish results and Table 6 the English averages. Figures 3 and 4 illustrate the means of /p, t, k/ productions by condition in Spanish and English.

		Mean	St. Deviation
/p/	after /s/	19	10
	after V	15	8
	Total	17	9
/t/	after /s/	27	12
	after V	21	10
	Total	24	12
/k/	after /s/	33	12
	after V	28	13
	Total	31	13

Table 5. VOT in ms and standard deviation for the Andalusian Spanish group organized by segment and condition in Spanish.

		Mean	St. Deviation
/p/	after /s/	17	11
	after V	21	13
	Total	19	12
/t/	after /s/	37	18
	after V	52	21
	Total	44	21
/k/	after /s/	46	20
	after V	49	19
	Total	48	20

Table 6. VOT in ms and standard deviation for the Andalusian Spanish group organized by segment and condition in English.

Examining Tables 4, 5 and 6 and looking at Figures 3 and 4, it seems that AS participants produced longer VOT in English than in Spanish for all voiceless stops (19 ms vs. 17 for /p/, 44 ms vs. 24 for /t/, 48 ms vs. 31 for /k/). A wider range of values is found in the English production task ($SD=22$) compared to the Spanish results ($SD=13$). In Spanish all voiceless stops were produced with longer aspiration when they were preceded by /s/ than by a vowel, which is what was expected for this group. Moreover, there seems to be an effect of place of articulation, /k/ showed the longer values in both conditions, followed by /t/ and /p/, respectively. This is in line with phonetic universals related to VOT durations and place of articulation (Cho and Ladefoged, 1999). Nevertheless, in English, AS speakers produced /t/ in the vowel context with longer VOT than /k/ in any of the conditions. In addition, the values for all voiceless stops were shorter in the /s/ condition than when preceded by a vowel, which contradicts what they were expected to produce in the English task.

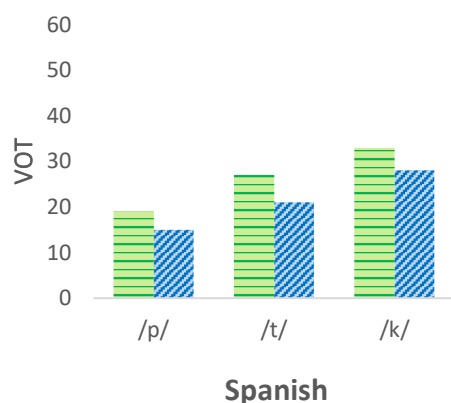


Figure 3. VOT in ms for the AS group by segment and condition in Spanish.

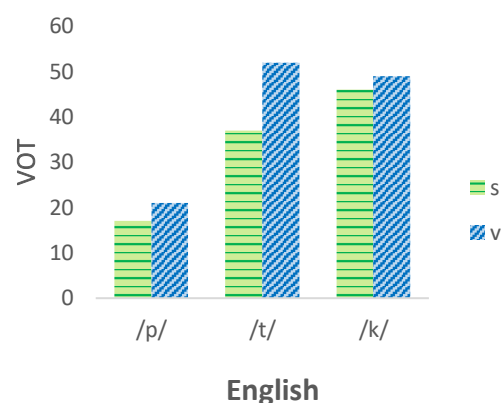


Figure 4. VOT in ms for the AS group by segment and condition in English.

In order to assess the effects of language and condition in the Andalusian Spanish production of voiceless stops, a two-way ANOVA was conducted with VOT as the dependent variable and language (English, Spanish) and condition (s, V) as independent variables. The main effect of language reached significance ($F(1, 2588) = 345.87, p < 0.01$). AS speakers produced greater aspiration in English (37 ms) than in Spanish (24 ms). However, no significant difference was found between the two conditions ($F(1, 2588) = 2.98, p > 0.05$). AS subjects produced a similar amount of aspiration in both contexts, 30 ms in the /s/ condition and 31 ms in the vowel condition. A significant interaction between language and condition was found ($F(1, 2588) = 75.51, p < 0.01$). Figure 5 illustrates this interaction effect.

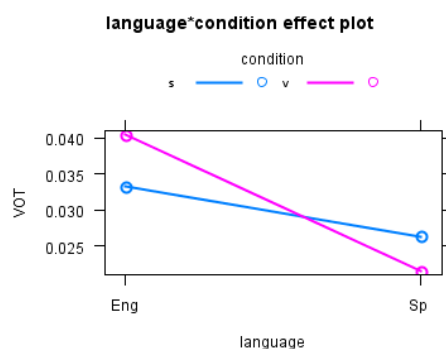


Figure 5. Interaction between language and condition in the AS group.

This interaction means that the effect of condition depends on the language. Greater aspiration after vowel is produced in English, whereas it is the opposite for Spanish, that is, more aspiration is found in the /s/ condition.

5.1.2. Castilian Spanish group

Table 7 shows the VOT mean and standard deviation by condition of CS participants. Subsequently, Tables 8 and 9 show these averages organized by segment and condition. Table 8 for the Spanish values and Table 9 for the English results.

	Mean	St. Deviation
English	25	14
after /s/	23	13
after V	27	15
Spanish	18	9
after /s/	19	9
after V	18	9
Total	22	12

Table 7. Mean VOT in ms and standard deviation by condition produced by the Castilian Spanish group.

		Mean	St. Deviation
/p/	/s/	14	6
	V	14	6
	Total	14	6
/t/	/s/	18	6
	V	15	5
	Total	16	6
/k/	/s/	26	9
	V	24	11
	Total	25	10

Table 8. VOT in ms and standard deviation for the Castilian Spanish group organized by segment and condition in Spanish.

		Mean	St. Deviation
/p/	/s/	14	7
	V	16	7
	Total	15	7
/t/	/s/	23	11
	V	30	16
	Total	26	14
/k/	/s/	33	14
	V	34	14
	Total	33	14

Table 9. VOT in ms and standard deviation for the Castilian Spanish group organized by segment and condition in English.

Looking at Tables 7, 8, and 9 and Figures 6 and 7, it seems that the Castilian Spanish group produced slightly longer aspiration in English than in Spanish (25 ms vs. 18 ms). Similar to the AS group, there was a wider range of VOT in English ($SD=14$) than in Spanish ($SD=9$). An effect of place of articulation can be observed for both languages; /k/ showed the longest aspiration (33 ms in English vs. 25 ms in Spanish) followed by /t/ (26 ms in English and 16 ms in Spanish) and /p/ (15 ms in English and 14 ms in Spanish). As for the phonetic context condition, aspiration was longer in Spanish when the voiceless stop was preceded by /s/, even if there is no post-aspiration after /s/ in this variety of Spanish. In contrast, the opposite was found for English, where aspiration was longer in the vowel condition.

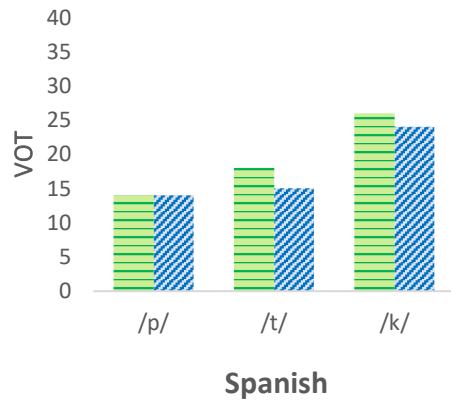


Figure 6. VOT in ms by segment and condition in Spanish for the CS group.

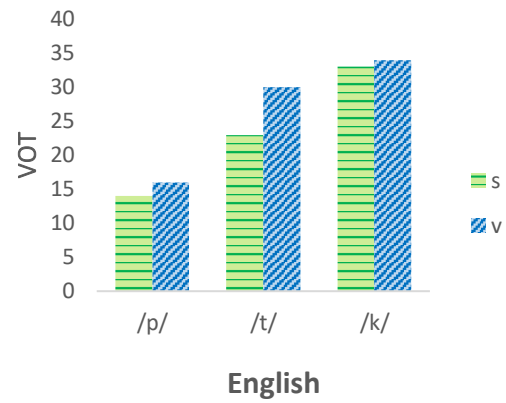


Figure 7. VOT in ms by segment and condition in English for the CS group.

In the same way as was done for the AS group, a two-way ANOVA was conducted for the CS group in order to assess the effects of language and condition on VOT production. The effect of language was found to be significant ($F(1, 1004) = 72.79$, $p < 0.01$), which means that the CS group aspirated more in English (25 ms) than in Spanish (18 ms). Similar to the AS group, the condition effect did not reach significance ($F(1, 1004) = 2.03$, $p > 0.05$). The /s/ condition reported shorter aspiration (21 ms) than the vowel condition (22 ms). Once again, the interaction between language and condition turned out to be significant ($F(1, 1004) = 12.87$, $p < 0.01$). Figure 8 illustrates the effect of the interaction.

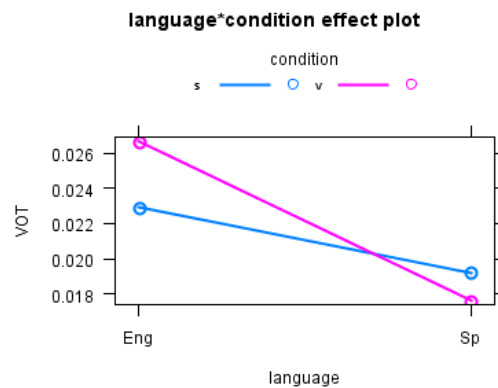


Figure 8. Interaction between language and condition in the CS group.

This interaction reflects that the effect of condition is dependent on language. Therefore, the /s/ condition only produces longer aspiration in Spanish, whilst the vowel condition reports higher values in English.

5.1.3. Summary of results and interim discussion

In sum, from the within-groups comparisons, it can be observed that both the AS and the CS groups produced longer aspiration in English than in Spanish. This was true for all voiceless stops. In Spanish both groups produced more aspiration when /p, t, k/ were preceded by /s/ than when they were in the vowel condition. This was expected for the AS group, as they present /s/ aspiration in their variety of Spanish, but it was not necessarily predicted for CS speakers. Regarding English, the vowel condition was found to elicit longer aspiration than the /s/ context in both groups. It was not expected that this would happen. As for place of articulation, AS and CS subjects reported higher values for velars than for alveolars/dentals and bilabials in Spanish and English, with the exception of /t/ in English produced by the AS group, which showed longer VOT than the rest of the stops. But, overall, the results for place of articulation were in line with the expected tendency. The language effect and the interaction between language and condition proved significant for AS and CS speakers. This means that condition depends on language, that is, the /s/ condition reports greater values only in Spanish and the vowel condition shows more aspiration in English. In contrast, there was no significant difference in the duration of aspiration following /s/ and following a vowel. This was predicted for CS speakers, but not for AS, where the prediction was that they would aspirate voiceless stops more when they were following /s/. In Spanish this was expected considering that post-aspiration is found after the loss of /s/, and in English it was hypothesized that they would transfer the process and aspirate in the same phonetic

context. These results are discussed further in the general discussion in relation to the research questions of the study.

5.2. Between groups comparisons

First, to assess the effects of group and language, a two-way ANOVA was conducted with VOT as the dependent variable and group (AS, CS) and language (English, Spanish) as independent variables. The main effect of language proved to be significant ($F(1, 3596) = 406.97, p < 0.01$). In general, both groups aspirated more in English (33 ms) than in Spanish (22 ms). Similarly, the effect of group also reached significance ($F(1, 3596) = 204.83, p < 0.01$). The AS group aspirated significantly more (30 ms) than the CS speakers (22 ms). The interaction between language and group was significant ($F(1, 3596) = 28.71, p < 0.01$). The difference between the two languages is greater for AS speakers (24 ms in Spanish vs. 37 ms in English) than for the CS group (18 ms in Spanish vs. 25 ms in English). Figures 9 and 10 show the distribution of VOT values produced by both groups for each language.

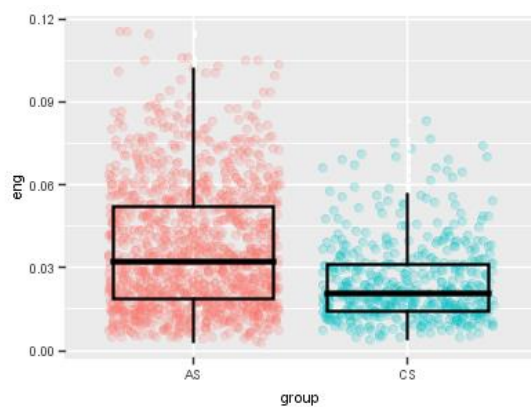


Figure 9. Boxplot of the distribution of VOT in ms produced in English by the AS (in red) and CS (in blue) groups.

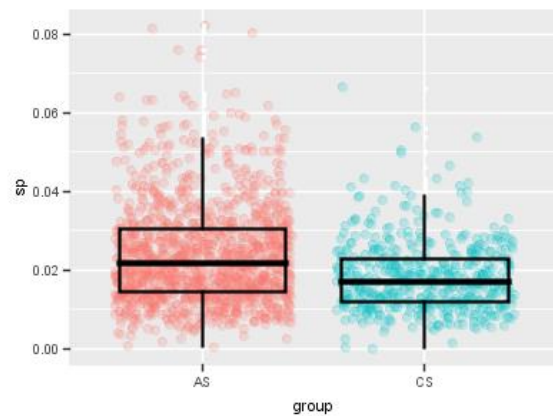


Figure 10. Boxplot of the distribution of VOT in ms produced in Spanish by the AS (in red) and CS (in blue) groups.

In order to examine the effects of group and phonetic condition, a two-way ANOVA was conducted with VOT as the dependent variable and group (AS, CS) and

condition (s, V) as independent variables. It showed that group effect ($F(1, 3596) = 182.89, p < 0.01$) and condition ($F(1, 3596) = 3.84, p = 0.05$) were both significant. However, the mean value for /s/ (27 ms) does not seem to differ much from the vowel condition (28 ms). Moreover, the interaction between the two factors did not yield significance ($F(1, 3596) = 0.007, p > 0.05$). The distribution of VOT values for each condition and groups is shown in Figures 11 and 12.

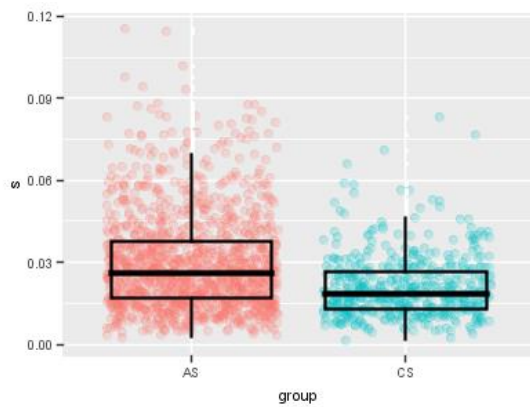


Figure 11. Boxplot of the distribution of VOT in ms for the /s/ condition in the AS (in red) and CS (in blue) groups.

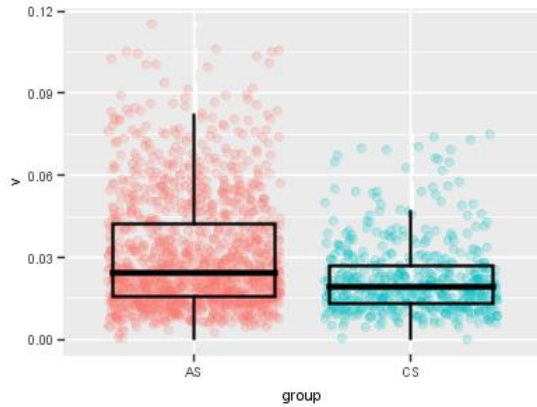


Figure 12. Boxplot of the distribution of VOT in ms for the vowel condition in the AS (in red) and CS (in blue) groups.

Individual two-way ANOVAs for each language with group and condition as independent variables were also conducted. For English, the effects of group ($F(1, 1796) = 131.59, p < 0.01$) and condition ($F(1, 1796) = 43.57, p < 0.01$) were found significant. The AS group averaged longer aspiration (37 ms) than the CS group (25 ms). As for condition, the vowel condition reported higher VOT (37 ms) than the /s/ condition (30 ms). No significant interaction between group and condition was found ($F(1, 1796) = 2.70, p > 0.05$). Figures 13 and 14 show the English values produced by the two groups for each condition.

For Spanish, the main effect of group proved significant ($F(1, 1796) = 83.87, p < 0.01$). The AS subjects reported means of 24 ms, whereas the CS participants reported 18 ms. Similarly, the effect of condition was also significant ($F(1, 1796) = 53.83,$

$p < 0.01$). The aspiration was longer in the /s/ context (24 ms) than in the vowel condition (20 ms). In contrast to the English ANOVA, for Spanish, the interaction between group and condition did reach significance ($F(1, 1796) = 7.30, p < 0.01$). This is due to the fact that the difference between the two contexts is greater for AS (30 ms for the /s/ condition vs. 31 ms for the vowel condition) than for CS (21 ms for the /s/ condition vs. 22 ms for the vowel condition). The Spanish VOT values obtained for both groups for each condition are presented in Figures 15 and 16.

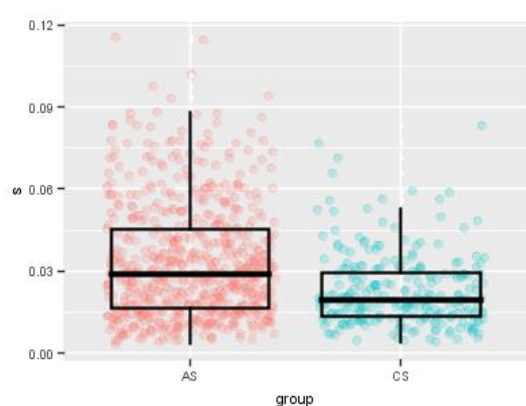


Figure 13. Boxplot of the distribution of English VOT in ms for the /s/ condition in the AS (in red) and CS (in blue) groups.

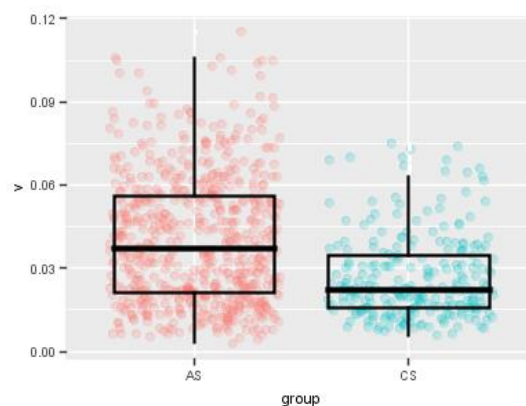


Figure 14. Boxplot of the distribution of English VOT in ms for the V condition in the AS (in red) and CS (in blue) groups.

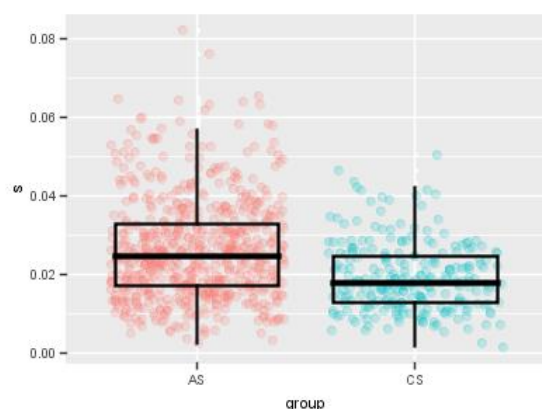


Figure 15. Boxplot of the distribution of Spanish VOT in ms for the /s/ condition in the AS (in red) and CS (in blue) groups.

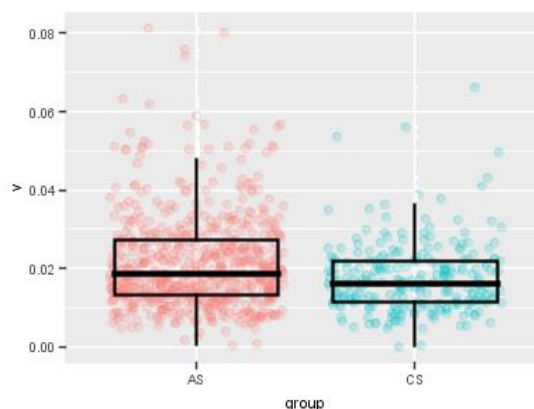


Figure 16. Boxplot of the distribution of Spanish VOT in ms for the V condition in the AS (in red) and CS (in blue) groups.

A series of Spearman correlations were also conducted. However, no correlation was found between the VOT values in English and Spanish for the AS group ($r(18) = 0.095, p > 0.05$). The CS group yielded similar results, showing no correlation in the VOT durations of the two languages ($r(7) = 0.222, p > 0.05$). By contrast, correlations were found between the two phonetic context conditions in AS speakers ($r(18) = 0.606, p < 0.01$), as well as in the CS group ($r(7) = 0.863, p < 0.01$). This shows that those speakers who aspirated more in Spanish were not necessarily the same who aspirated more in English. As for the condition, it seems that those who aspirated more in the vowel condition also showed longer aspiration in the /s/ condition.

5.2.1. Summary of results and interim discussion

The series of statistical tests conducted for between groups comparisons yielded numerous results. AS participants reported higher VOT values than CS speakers in both languages and conditions. This was expected as a result of /s/ aspiration in AS and of phonetic transfer to English. Nevertheless, the difference between the two conditions across groups, despite statistically significant, is numerically small. Generally, in both languages, the two groups aspirated more after vowel (28 ms) than after /s/ (27 ms). This is somehow expected, considering that AS speakers were predicted to aspirate more after /s/, but CS participants were expected to report somewhat longer values after vowel. In addition, the interaction between language and group proved significant, whereas the interaction between group and condition did not. This means that the VOT values reported for language depend on group—therefore the AS group aspirated more than CS speakers in both languages—but that condition is independent of group.

As for each language, both group and condition reached significance for the two languages, with the AS group always obtaining higher VOT values. However, the interaction between group and condition for English was not significant, in contrast to

Spanish in which the interaction proved significant. In Spanish, the /s/ condition reported longer aspiration in both groups compared to the vowel condition. Correlations were also carried out to establish relationships between the different variables. Nonetheless, no correlation was found between English and Spanish VOT for either of the groups. Conversely, phonetic condition was proved to be correlated for both the AS group and the CS speakers. This means that those participants who aspirated more in Spanish were not necessarily related to those who aspirated more in English. On the other hand, those who aspirated more after /s/ seem to be the ones who aspirated more after vowel, as well.

6. General discussion and conclusions

The purpose of the present study was to analyze the production of voiceless stops in L1 Andalusian Spanish and compare the results with the production of L2 English stops. Two groups of speakers of different Spanish varieties were compared in their production of Spanish and English voiceless stops. They completed a word insertion task and an interview for each language. In this section, the main results will be discussed in terms of the research questions presented at the beginning of the paper.

In regards to the first research question addressed in this study, which asked if AS speakers present post-aspiration in Spanish voiceless stops compared to other varieties of Spanish, positive results were found. AS participants produced longer VOT values in Spanish for all voiceless stops in comparison to CS speakers. These results show support for the on-going sound change from pre- to post-aspiration in AS voiceless stops that has been reported in the literature (Torreira, 2007a; Ruch and Harrington, 2014; Ruch and Peters, 2016). Nevertheless, the values shown in this experiment are lower in terms of post-aspiration than those found in other studies. Furthermore, the difference between AS and CS VOT is smaller than expected (mean of 24 ms for AS vs. 18 ms for CS).

There are several reasons that might explain this outcome. Firstly, although in the interview all participants aspirated /s/, seven out of the 18 AS subjects repeatedly produced full sibilants in the Spanish word insertion task. This undoubtedly affected their post-aspiration durations, that is, those participants who pronounced the /s/ produced shorter aspiration in the following voiceless stop than those who did not pronounce the /s/. The main reason that is believed to have caused this switch in accent is related to linguistic insecurity (Labov, 1966). Participants might have associated the experiment with a formal situation and chose to switch to a linguistic variety of higher social prestige in which /s/ is not aspirated. In addition, post-aspiration has been reported as a more developed process in Western Andalusian Spanish compared to Eastern Andalusian Spanish (Ruch and Harrington, 2014; Ruch and Peters, 2016). In this study, there were only three participants from Western provinces, and the rest were from Eastern provinces in which post-aspiration is not as present. Therefore, the reported shorter values might be related to the variety of AS that the participants spoke. It might also have been caused by orthographical influence of the production task. Even though this was controlled for by representing target words with pictures and using less orthography, it could be the case that it still affected their production.

The second research question was concerned with the influence of phonetic context in AS aspiration, that is, whether aspiration is only found in /s/ + voiceless stops sequences or also after vowels. In this aspect, all voiceless stops reported longer values in the /s/ condition (26 ms) than in the vowel condition (21 ms). This was expected for this group as a result of aspirating /s/ and producing post-aspirated voiceless stops. Again, the difference between the two conditions did not differ much from each other, and were lower than predicted, due to the pronunciation of /s/ in the word insertion task. As for the CS speakers, they also produced longer aspiration in the /s/ condition. However, the

difference between values was minimal (mean of 19 ms for /s/ vs. 18 ms for the vowel condition). Positive correlations were found between conditions for AS and for CS speakers, which means that those speakers who produced longer aspiration in the /s/ condition were also the ones that aspirated more in the vowel condition.

Concerning the third research question, which looked at L2 English production, the results appear to support the prediction that AS speakers produce longer aspiration in English than the CS group. AS subjects reported significantly higher VOT values for English than the CS participants (37 ms vs. 25 ms). In fact, both groups produced longer durations in English aspiration than in Spanish. However, if the results of English aspiration are compared to the values reported in the literature produced by English native speakers (Lisker and Abramson, 1964), they are still much shorter. Learners seem to make a distinction between categories, but they would need to be compared to monolinguals speakers in the same experimental context to examine if they have created new categories to differentiate between the phones. Nevertheless, since the AS group showed longer VOT, it can be inferred that post-aspirating in L1 Spanish has an effect on the production of aspiration in L2 English. This can be explained by a process of phonetic transfer, in which L2 aspiration is assimilated to the L1 category. This transfer occurs when AS speakers aspirate /s/ and the following voiceless stop is post-aspirated. In addition, no correlation was found for the AS and CS groups between the VOT values in English and Spanish. Participants who aspirated the most in Spanish were not necessarily those that aspirated the most in English. This shows that the use of aspiration is independent in one or the other language.

As for the last research question addressed in this paper, which was related to the effect of phonetic condition in English aspiration, unexpected results were found. Both groups aspirated initial voiceless stops more when preceded by vowel than by /s/. This

was not predicted for either of the groups, but especially for the AS group, the hypothesis that AS speakers would aspirate in English in the same condition as in Spanish is proven wrong. The reason as to what might cause this is unclear. In the case of the AS subjects, it can be that the same effect of linguistic insecurity in the L1 might have extended to their L2. Since they are extremely self-aware of their /s/ aspiration in Spanish, it might be that they try not to transfer this phenomenon to their L2. In addition, although in general place of articulation showed the expected results, the AS group showed longer VOT for /t/ in the vowel condition. This goes against phonetic universals established in relation to VOT values and place of articulation, in which /k/ would have to show the longest duration (Cho and Ladefoged, 1999). Ruch and Peters (2016) report in their study longer values for /t/ than for the other two stops, although these results are for Spanish production of voiceless stops. Despite not having found similar results in the present study, maybe if fewer participants had pronounced /s/ in Spanish, comparable results could be observed in the AS production of voiceless stops. Therefore, if this were the case, it might be that they are transferring the L1 aspiration rule, in which /t/ has longer VOT values than the other voiceless stops, to the L2. Nevertheless, this does not explain why it is found in the vowel condition instead of /s/, where it is reported in Spanish.

In sum, there appears to be a positive effect of L1 post-aspiration on the production of voiceless stops in L2 English. Overall, the Andalusian Spanish group reported longer VOT values in Spanish and English compared to the Castilian Spanish group. This shows that post-aspiration is a feature of AS voiceless stops, as a result of /s/ aspiration. Indeed, longer durations were found in Spanish for the /s/ condition than for the vowel condition. Moreover, the results of the AS group in the Spanish task show support for the theory of a sound change in AS, in which pre-aspiration is giving way to post-aspiration. This is in line with Torreira's (2007a) conclusions. The reason for obtaining shorter values than

expected, and that those reported in previous studies, was attributed to sociolinguistic factors related to linguistic insecurity (Labov, 1966). As for the CS group, longer VOT was reported in the /s/ condition, although the difference with the vowel condition was very small. Regarding English, both groups showed more aspiration in English than in Spanish. It seems that they are making a distinction between the stops in the two languages, although they may not yet produce English stops accurately. Nonetheless, AS speakers still produced longer aspiration than CS participants, which proves the influence of AS post-aspiration in the production of English aspirated voiceless stops. In contrast, unpredicted results were reported for the condition effect in English. Both groups reported more aspiration in the vowel condition than in the /s/ condition. No definitive explanation has been provided for this, but in the case of AS speakers, it seems that it might be related to a transfer of linguistic insecurity to the L2. All in all, it can be concluded that post-aspiration in Andalusian Spanish affects the aspiration of L2 English.

7. Limitations of the study and lines for further research

The greatest limitation found in the study was in connection to non-aspiration of /s/ in the Andalusian Spanish group. There was no way to control for this switch in accent, as it was impossible to predict if participants were going to aspirate /s/ or not in the Spanish task. Therefore, ways to control for this effect need to be taken into account for future studies, whether that is by revising the methodology, or using new materials altogether. The ideal situation would have been to remove the productions for those tokens in which subjects did not aspirate /s/, but then the sample size for the AS group would have been reduced to almost half of it. In any case, the reliability of the results was compromised and VOT durations were much shorter than what they could have been if only those who aspirated /s/ would have been measured. Thus, further studies need to control for this factor and analyze only those instances in which /s/ is indeed aspirated.

Since participants seem to consider experimental tasks as more formal, other types of experiments that are not controlled need to be taken into account. Maybe in further studies more natural spontaneous speech can be collected and analyzed to examine if there is also an effect of linguistic insecurity or if the switch in accent can be avoided. In fact, in this study spontaneous speech data was collected in the interviews. However, this data was used to gather sociolinguistic information, and due to time constraints, it was not analyzed acoustically. It would be interesting to do so in future research.

In regards to participants, the effect of Western Andalusian Spanish on post-aspirated voiceless stops in AS could not be analyzed due to the small sample of subjects from Western provinces. The results provided in this study might only be representative of the Eastern Andalusian variety, as most of the participants were from Eastern provinces. Moreover, it is highly likely that if more WAS speakers had been recorded, higher VOT values for AS would have been reported. This is why it is necessary that more studies are conducted with considerable representation from both varieties. Similarly, the sample size for the control group was relatively small. It would have been better if both groups of participants had been equally distributed.

All in all, further research is needed to analyze the effect of post-aspiration in Andalusian Spanish on the production of English aspiration. In order to compare the productions of AS speakers in Spanish and English, it would be interesting to analyze Andalusian Spanish and English monolinguals as well. This would allow to observe if there is any effect of L2 acquisition and if aspiration values are indeed produced authentically.

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Appendix A. Questionnaire.

Estudio lingüístico

Información personal

- Nombre:
- Edad:
- Género:
- Ocupación:
- Lugar de nacimiento:
- Lugar de residencia:
- Lugar de Nacimiento de tus padres (especifica la ciudad de donde es cada uno/a):
- Lugares donde has residido más de un mes (especifica cuándo y durante cuánto tiempo):

Lenguaje y usos del lenguaje

- Lengua materna:
- Lenguas maternas de tus padres (especifica la de cada uno/a):
- ¿Hablas otras lenguas fluidamente a parte del castellano? Indica cuáles:
- Indica el porcentaje de uso del castellano en cada caso:

0-25% 25-50% 50-75% 75-100% 100%

Trabajo/estudios

En casa

Vida social

- ¿Hablas inglés? Si es el caso, ¿cuántos años has estudiado inglés y dónde?
- Indica el porcentaje de uso del inglés en cada caso:

0-25% 25-50% 50-75% 75-100% 100%

Trabajo/estudios

En casa

Vida social

- ¿Tienes alguna certificación oficial en lengua inglesa? Indica el nivel:
- ¿Dónde y con quién hablas inglés habitualmente (amigos, pareja, en la universidad, profesores, nunca, etc.)?:
- ¿Has hecho algún curso de pronunciación general o inglesa?:
- En caso afirmativo, indica cuál (puedes incluir asignaturas del grado):
- ¿Sueles ver películas o series en versión original en inglés?:
- En caso afirmativo, indica la frecuencia:

Nunca Algunas veces A menudo Casi siempre Siempre

- ¿Has hecho alguna estancia en países de habla inglesa?:
- En caso afirmativo, indica dónde, cuándo y la duración:
- Comentarios (opcional):

Appendix B. Carrier sentences in the production task.

Spanish

Veo una mesa aquí/ Veo dos mesas aquí
Veo una caja aquí/ Veo dos cajas aquí
Veo una pera aquí/ Veo dos peras aquí
Veo una taza aquí/ Veo dos tazas aquí
Veo un gato aquí/ Veo dos gatos aquí
Veo una casa aquí/ Veo dos casas aquí
Veo una torre aquí/ Veo dos torres aquí
Veo un pulpo aquí/ Veo dos pulpos aquí
Veo un queso aquí/ Veo dos quesos aquí
Veo una silla aquí/ Veo dos sillas aquí
Veo una tumba aquí/ Veo dos tumbas aquí
Veo un perro aquí/ Veo dos perros aquí
Veo un vaso aquí/ Veo dos vasos aquí
Veo un coche aquí/ Veo dos coches aquí
Veo una tarta aquí/ Veo dos tartas aquí
Veo un pato aquí/ Veo dos patos aquí
Veo un banco aquí/ Veo dos bancos aquí
Veo un cubo aquí/ Veo dos cubos aquí
Veo un pollo aquí/ Veo dos pollos aquí
Veo un toro aquí/ Veo dos toros aquí
Veo una rosa aquí/ Veo dos rosas aquí
Veo un casco aquí/ Veo dos cascos aquí
Veo una piña aquí/ Veo dos piñas aquí
Veo un tigre aquí/ Veo dos tigres aquí

English

I see this flower here/ I see two flowers here
I see this camera here/ I see two cameras here
I see this panda here/ I see two pandas here
I see this table here/ I see two tables here
I see this apple here/ I see two apples here
I see this carrot here/ I see two carrots here
I see this ticket here/ I see two tickets here
I see this pizza here/ I see two pizzas here
I see this kilo here/ I see two kilos here
I see this chicken here/ I see two chickens here
I see this toilet here/ I see two toilets here
I see this peanut here/ I see two peanuts here
I see this mirror here/ I see two mirrors here
I see this candy here/ I see two candies here
I see this turkey here/ I see two turkeys here
I see this poster here/ I see two posters here
I see this bottle here/ I see two bottles here
I see this kettle here/ I see two kettles here
I see this parrot here/ I see two parrots here
I see this taco here/ I see two tacos here

I see this letter here/ I see two letters here
I see this kiwi here/ I see two kiwis here
I see this pillow here/ I see two pillows here
I see this towel here/ I see two towels here

Appendix C. Interview transcripts.

Spanish

For Andalusian Spanish speakers:

- ¿De dónde eres?
- ¿Cuánto tiempo llevas en Granada?
- ¿A qué te dedicas? ¿Qué estudias?
- ¿Por qué decidiste estudiarlo aquí?
- ¿Cómo encuentras el grado/máster/doctorado? ¿Está a la altura de tus expectativas?
- ¿Te gustaría seguir estudiando cuando termines? ¿Máster, doctorado?
- ¿Crees que es difícil sacar adelante un doctorado? ¿Escribir una tesis?

Sobre acentos

- ¿Crees que vivir en Granada ha afectado a tu acento?
- ¿Modificas tu acento dependiendo de la situación en la que estés? ¿En qué situaciones?
- ¿Cómo crees que se considera el acento andaluz en el resto de España? ¿Y en Andalucía?

For Castilian Spanish speakers:

- ¿De dónde eres?
- ¿A qué te dedicas? ¿Qué estudias?
- ¿Por qué decidiste estudiarlo aquí?
- ¿Cómo encuentras el grado/máster? ¿Está a la altura de tus expectativas?
- ¿Te gustaría seguir estudiando cuando termines? ¿Máster, doctorado?
- ¿Crees que es difícil sacar adelante un doctorado? ¿Escribir una tesis?

Sobre acentos

- ¿Crees que tienes un acento marcado o definido?
- ¿Modificas tu acento dependiendo de la situación en la que estés?
- ¿Crees que hay acentos en España que están mejor vistos y otros que tienen connotaciones negativas? ¿Cuáles?
- ¿A qué crees que se debe esto? ¿Estás de acuerdo?

English

- What did you think about the video I showed you earlier?
- Do you think it is important to take care of nature? Why?
- What kind of catastrophes do you think are happening in nature?
- What do you think could happen if we don't do something about the environmental crisis?

Questions about language

- Do you like learning languages?
- Do you like studying English?

- Do you think it is important to learn English nowadays? Why?
- Do you speak any other languages? Since when?
- Would you like to learn any other languages in the future?