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Glottalizing at word junctures: Exploring bidirectional transfer in child and adult Spanish heritage speakers

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Abstract

While research in heritage language phonology has found that transfer from the majority language can lead to divergent attainment in adult heritage language grammars, the extent to which language transfer develops during a heritage speaker's lifespan is understudied. To explore such cross-linguistic transfer, I examine the rate of glottalization between consonant-to-vowel sequences at word junctures produced by child and adult Spanish heritage speakers (i.e., HSs) in both languages. My results show that, in Spanish, child HSs produce greater rates of vowel-initial glottal phonation than their age-matched monolingually-raised Spanish counterparts, suggesting that the Spanish child HSs' grammars are more permeable to transfer than those of the adult HSs. In English, child and adult HSs show similarly low rates of glottal phonation when compared to their age-matched monolingually-raised English speakers' counterparts. The findings for English can be explained by either an account of transfer at the individual level or the community level.

1. Introduction

Heritage speakers (HSs) are early bilinguals who naturalistically acquire a first language that is a minority language in their host country (i.e., heritage language or HL henceforth), either simultaneously or sequentially with the majority language (Valdés, 2000). As HSs gain systematic exposure to this majority language (i.e., ML henceforth) via school teachers, peers, and/or the media, their relative exposure to the HL is reduced and they often shift their language dominance in favor of the dominant language, resulting in unbalanced bilingualism (Polinsky & Scontras, 2020; Stevens, 1992). During adulthood, while HSs maintain language-internal phonological contrasts (Chang, Yao, Haynes, & Rhodes, 2011; Einfeldt, van de Weijer, & Kupisch, 2019; Saadah, 2011), they also present convergence of phonemic categories (Alkhudidi, Stevenson, & Rafat, 2020; Rafat, Mohaghegh, & Stevenson, 2017), underapplication or overapplication of phonological processes (Elias, McKinnon, & Milla-Muñoz, 2017; Rao, 2014; Ronquest, 2013; Strandberg, Gooskens, & Schüppert, 2021; Tse, 2016a, 2016b), divergences in phonetic production (Godson, 2004; Henriksen, 2012; Kim, 2011, 2020; Menke, 2018; Repiso-Puigdelliura & Kim, 2021), and vulnerability in suprasegmental features (Colantoni, Cuza, & Mazzaro, 2016; Kim, 2020; Kim & Repiso-Puigdelliura, 2021; Rao, 2016; Robles-Puente, 2014). Research in HL bilingualism, however, has not yet established how such interactions develop during a speaker's lifespan. In fact, cross-linguistic interaction is not specific to adult heritage bilingualism. Utilizing the framework of early grammar interaction developed by Paradis and Genesee (1996), scholars have shown that the phonological grammars of bilingual speakers during early childhood demonstrate several characteristic features, including transfer (i.e., adoption of a property of language A into language B) (Dickinson, McCabe, Clark–Chiarelli, & Wolf, 2004; Erikson, 2016; Goldstein & Bunta, 2011; Lleó, 2018; Marecka, Wrembel, Otwinowska, Szewczyk, & Banasik-Jemielniak, 2020), deceleration (i.e., lower rate of acquisition when compared to monolinguals; Fabiano-Smith & Barlow, 2010; Kehoe, 2002; Kehoe, Lleó, & Rakow, 2004; Menke, 2018), and, to a lesser extent, acceleration (i.e., faster rate of acquisition when compared to monolinguals; Kehoe, Trujillo, & Lleó, 2001; Tamburelli, Sanoudaki, Jones, & Sowinska, 2015).

Although these studies have led to a better understanding of the heritage language grammar, the development of the HL during primary school remains an understudied topic (Montrul, 2018). This is a crucial period during heritage language acquisition because it constitutes the point at which most HSs gain systematic exposure to the ML and may shift their language dominance to the latter. For instance, Kupisch, Kolb, Rodina, and Urek (2021) found that Russian primary-school-aged HSs (i.e., German–Russian bilinguals) were judged as being more accented than HSs preschoolers. The purpose of the present study is, thus, to examine speech production in primary school-aged-child HSs[1] ranging between 5 to 11 years of age to understand how the HL develops with continued systematic exposure to the ML.

2. Comparing child to adult heritage speakers

To capture language development across a HS's lifespan, recent studies have proposed to compare the HL of child HSs to that of adult HSs (Montrul & Sánchez-Walker, 2013; Polinsky, 2018; Repiso-Puigdelliura & Kim, 2021). These studies are important, as they can help us to determine whether the patterns found in adult HL grammars result from early grammar interaction during language development as bilinguals form categories and processes in their two languages and are sustained until adulthood, or whether such patterns result from a shift in language dominance at some point during childhood or adolescence. However, when comparing child HSs to adult HSs, it is important to consider how the two groups differ along the dimensions of amount of language exposure, and linguistic and cognitive development.

Amount of exposure to the HL is commonly believed to differ between child and adult HSs. When HSs enter the primary school system, their quantity of input in the HL is reduced in favor of the ML, affecting their dominance in the HL (Polinsky & Scontras, 2020; Stevens, 1992). This, in turn, suggests that, as HSs mature and reach young adulthood, their current exposure to the HL decreases. Numerous studies have found that language use and exposure bear a positive relationship with lexical and morphosyntactic proficiency (Bedore, Peña, Griffin, & Hixon, 2016; Cohen, 2016; Correia & Flores, 2017; Paradis, 2010; Place & Hoff, 2011; Ribot & Hoff, 2014; Thordardottir, 2011). In the phonological domain, Ruiz-Felter, Cooperson, Bedore, and Peña (2016) found that while 5;0-to-6;0-year-old-bilinguals with more input-output in English are significantly more accurate in English than in Spanish on late-developing sounds, bilinguals with more input-output in Spanish show greater accuracy in Spanish than in English on early-developing ones, possibly because the onset of schooling results in an increase of accuracy of the English late-developing sounds relative to the Spanish ones (Ruiz-Felter et al., 2016, p. 379). Overall, however, young adults will have had a higher cumulative experience with the HL than young child HSs, and such cumulative exposure can strengthen the HSs' mental representations in the HL. In fact, research shows that, when accounting for current and cumulative experience, the former and the latter can produce different results. For instance, cumulative experience is a better predictor of proficiency than current experience in 5-to-7-year-old child bilinguals (de Cat, 2020).

Aside from cumulative experience, adult HSs have probably been exposed to more speakers than child HSs during their lifetime. When examining quantity of input, therefore, it is also important to describe the type of input to which HSs are exposed. For a linguistic property to be acquired, after all, it is necessary that this linguistic feature is found in the input received by the HSs (Daskalaki, Blom, Chondrogianni, & Paradis, 2020; Kupisch & Rothman, 2018; Mai, Zhao, & Yip, 2022; Otheguy, 2016; Rothman, 2007). Quality of input is mediated by phonetic variation, as speaker variability can lessen the excessive effect that individual characteristics in the input might have during language acquisition (Embick, White, & Tamminga, 2020, p. 21). For instance, Gollan and Ferreira, (2009) found that picture-naming ability in the HL correlated with the number of speakers that participants spoke to as children. Phonetic variation in the input can also be a source of divergence between child HSs and adult HSs. During their lifespans, HSs accumulate exposure to a larger variety of speakers. It follows that adult HSs are likely to have had exposure to a greater number of speakers than child HSs.

As for linguistic development, a crucial difference between child and adult HSs is lexicon size, which is typically smaller for children than for adults (Anglin, Miller, & Wakefield, 1993; Segbers & Schroeder, 2017). In particular, lexical development has an impact on monolingual and bilingual phonological production (Kehoe & Havy, 2018; Viterbori, Zanobini, & Cozzani, 2018). Thus, Kehoe and Havy (2018) found significant correlations between total vocabulary (i.e., vocabulary in the two languages) and percentage of correct consonants, coda presence, and accuracy in the speech production of 40 French–English bilingual preschoolers. Regarding cognitive development, child HSs and adult HSs may diverge in their capacity to inhibit the non-intended language (i.e., bilingual language control) (Abutalebi & Green, 2007, 2016; Branzi, Calabria, Boscarino, & Costa, 2016; Green & Abutalebi, 2013; Luk, Green, Abutalebi, & Grady, 2012; Reverberi et al., 2015). The inhibitory component of the executive function has been found to develop during childhood and adolescence (Leon-Carrion, García-Orza, & Pérez-Santamaría, 2004) and language control appears to be affected by cumulative language experience during childhood (Kubota, Chevalier, & Sorace, 2020). This indicates that adult HSs will probably outperform child HSs in the task of inhibiting the irrelevant language, and thus, suppressing the non-target phonology.

In short, while child HSs may have more constant contact with the HL than adult HSs, the latter have a greater overall rate of cumulative exposure, experience with multiple speakers, larger lexicons, and more mature cognitive skills, all of which are likely to explain between-group differences. Nevertheless, the amount of language exposure and use in the HL will diverge across speakers depending on the frequency at which they have heard and spoken the HL with their family members (i.e., bilingual caregivers, older or younger siblings) and their access to Spanish immersion programs. For this reason, this study will ask whether the amount of exposure to (i.e., input) and use of (i.e., output) the HL predicts rates of language transfer.

3. Connected speech: An area of vulnerability in Spanish heritage grammars

Some areas of the HL are more sensitive to the pressure of the ML than others (Polinsky & Scontras, 2020). Possible areas of vulnerability include those in which processing loads are eased by adopting a structure from the ML (Ivanova-Sullivan, Sekerina, Tofighi, & Polinsky, 2022). In this section, I will argue that, when comparing phonological processes in Spanish and English, connected speech constitutes one such area.

In consonant-to-vowel sequences across word junctures, Spanish phonology shows resyllabification, a process by which the word-final consonant of the first word (i.e., /VC̲#V/ [el.o.xo] 'el ojo' the eye) changes its affiliation from the coda position to the onset position of the subsequent syllable in the second word (e.g., [V#C̲V] [e.lo.xo] 'el ojo' the eye) (Colina, 1997; Harris,

[1]While studies in child bilingualism have not made a distinction between heritage and non-heritage bilingualism, in this study I consider child early bilinguals that acquire a heritage language as HSs.

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1983; Hualde, 2014).[2] Resyllabification results in a misalignment between the syllabic structure and the boundaries of the prosodic word. These misalignments can weaken the boundaries of the prosodic word, which, in turn, has consequences for word retrieval and word learning. Hence, D'Introno, Ortiz, and Sosa, (1989) report speech errors in the acquisition of Spanish that stem from incorrectly parsing the syllable boundaries (e.g., in 'ojos' eyes production of *[so.xos] for [o.xos]).

Phonetic studies on the production of Spanish resyllabified consonants have examined their acoustic and perceptual correlates (Hualde & Prieto, 2014; Lahoz-Bengoechea & Jiménez-Bravo, 2020; Strycharczuk & Kohlberger, 2016). While some Spanish consonants are capable of undergoing allophonic processes (e.g., /s/→[h] in Chinato Spanish and Buenos Aires Argentinian Spanish [Hualde, 1991; Kaisse, 1996], /r/→[r] [Scarpace, 2017]), most Spanish consonants are not. As such, they have been examined in terms of durational differences with respect to canonical onsets and canonical codas (Hualde, Simonet, & Nadeu, 2011; Strycharczuk & Kohlberger, 2016) or differences in f0 alignment (Torreira, 2007). In addition, resyllabification may not apply to certain consonants in some dialects (e.g., /n/ and /s/ in Quito Spanish [Robinson, 2012], /s/ in Ecuadorian Spanish [Bradley & Delforge, 2006]).

In English, consonant-to-vowel sequences are either produced with an ambisyllabic consonant or with an intervening glottal stop. Ambisyllabicity is the result of a syllabification process by which the coda consonant gains affiliation with the onset of the following syllable but does not detach from the coda position (i.e., sough[t] vs. sough[r]Ed) (Hayes, 2009; Kahn, 1976; Rubach, 1996). Alternatively, English speakers optionally insert a glottal stop before vowel-initial words (e.g., [V#C̲V] [ən ˈʔʌnjən] 'an onion') (Cruttenden, 1994; Garellek, 2014; Scarpace, 2017; Scobbie & Pouplier, 2010). Although the distribution of vowel-initial glottalization is probabilistic in nature, glottal phonation tends to occur in prosodically prominent positions, such as in phrase-medial pitch accented words or at the onset of prosodic phrases (Davidson & Erker, 2014; Dilley, Shattuck-Hufnagel, & Ostendorf, 1996; Garellek, 2012; Redi & Shattuck-Hufnagel, 2001; Scobbie & Pouplier, 2010), and thus can be conceptualized as bearing a prosodic-strengthening function (Garellek, 2014). Hence, reliance on glottal phonation may result in stronger prosodic boundaries, which may, in turn, facilitate lexical access and ease processing costs. A glottalized vowel-initial syllable may be more easily accessible to listeners than an initial syllable that has undergone a syllabic misalignment (i.e., resyllabification).

Although prosodic prominence mediates the production of connected speech in English, Spanish resyllabification does not alternate with other prominence-marking strategies. Thus, English and Spanish use different correlates to produce word-initial strong syllables. English stress is marked with suprasegmental cues, such as duration, pitch, or intensity (Huss, 1978; Lieberman, 1960; Nakatani & Aston, 1978), and segmental information, such as vowel quality (Campbell & Beckman, 1997) or, importantly for this study, glottal phonation when the syllable is word-initial and starts with a vowel[3] (Garellek, 2014). Spanish stress, in contrast, is signaled by suprasegmental cues (i.e., duration, intensity, pitch) (Hualde, 2009) and, crucially for this study, canonically, does not systematically present segmental variation (i.e., vowel-initial glottal phonation, or vowel quality).

Research on the acquisition of connected speech suggests that both Spanish and English-speaking children show an early stage in which rates of glottalization are greater than those of adult speakers. In Spanish, Lleó (2018) showed that two Spanish monolingual children underwent an early stage in which glottal phonation was produced at rates ranging between 40% and 10%, respectively. In English, Newton and Wells (2002) found that, between the ages of 2;7 and 2;9, an English-speaking child mostly used glottal phonation to connect /r/ to vowels (e.g., painter in [peɪntəɹɪn]). This delay could be due to immature articulatory skills, which may postpone the acquisition of consonant-to-vowel sequences (Nittrouer, 1993; Singh & Singh, 2008). Unlike consonant-to-vowel coarticulation, glottal stops do not require movement of the tongue (Esling, Fraser, & Harris, 2005), which could be why children rely more often on glottal stops at the onset of word-to-word production.

By extrapolating from these differences in the production of /C#V/ sequences in Spanish and English, it is possible to outline certain predictions on how each language will behave when in contact with the other. Through cross-linguistic interaction with English, glottal phonation may become available in the HSs' Spanish grammars and could be a resource for HSs to strengthen cross-word prosodic boundaries, thereby facilitating lexical access. In addition, HSs may have glottalization available in their early Spanish grammars, since it is used in /C#V/ sequences before the acquisition resyllabification in early child Spanish monolingual grammars (Lleó, 2018). Unlike monolinguals, HSs may maintain glottalization for a longer time in their grammars because of their exposure to English, a language that consistently uses word-initial glottalization in prosodically prominent positions. In support of this hypothesis, there is evidence of the use of glottal stops in dialects of Spanish that are in contact with other languages containing glottal phonation (Gynan & López Almada, 2020; Michnowicz & Kagan, 2016; Mohamed, González, & Muntendam, 2019; Trawick & Michnowicz, 2019).

Regarding a possible influence of Spanish resyllabification on the HSs' English productions, I predict that the greater rate of modal phonation in the HSs' input when compared to the English monolinguals' input will speed up the acquisition of linked speech in English and, overall, reduce the rate of glottal phonation. These predictions assume that a HSs' input contains few instances of glottal stops in Spanish and a great number of glottal stops in English. However, HSs may hear Spanish input containing glottal stops, as it is probable that they interact with other US-born Spanish speakers (e.g., bilingual siblings, or English-speaking friends), and that their caregivers' Spanish also shows glottal phonation as an instance of language transfer. In English, HSs could be exposed to English spoken by Spanish speakers, which will accordingly contain lower rates of glottal phonation. This means that I cannot completely rule out the possibility that HSs produce glottal stops in Spanish because they are in their Spanish input.

[2]The extent to which the consonant is completely resyllabified has been recently discussed in the phonetics literature, but this debate is outside of the scope of the current study (Hualde & Prieto, 2014; Strycharczuk & Kohlberger, 2016), as both partial and complete resyllabification should result in modal phonation.

[3]Garellek (2014) analyzed degree of EGG contact in both vowels and sonorants and found that an increase in EGG contact was only found in word-initial vowels, but not word-initial sonorants.

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4. Research Questions

In this study, I investigate whether influence from the majority language into the heritage language results in greater rates of language transfer during adulthood than childhood, and whether influence from the heritage language results in greater rates of language transfer in the majority language during childhood than adulthood. To do so, I examine the rate of glottal phonation in Spanish and English /C#V/ sequences. I ask the following questions:

1. Do Spanish HSs present greater rates of glottalization than those of monolingually-raised Spanish speakers in Spanish?
   - If transfer from HSs′ English grammars to HSs′ Spanish grammars occurs, Spanish HSs will present greater rates of glottal phonation than Spanish speakers raised in monolingual environments.
2. Do Spanish HSs present lower rates of glottalization than those of monolingually-raised English speakers in English?
   - If transfer from HSs′ Spanish grammars to HSs′ English grammars occurs, Spanish HSs will present lower rates of glottal phonation than English speakers raised in monolingual environments.
3. What is the role of age in the rate of language transfer?
   3 a. In Spanish, if transfer of glottal phonation from English arises due to weaker mental representations and/ or cognitive control during childhood, child HSs will produce greater rates of glottal phonation than adult HSs. If transfer arises due to prolonged systematic exposure to English, adult HSs will produce greater rates of glottal phonation than child HSs.
   3 b. In English, transfer of modal phonation from Spanish is more likely to occur during childhood than adulthood due to child HSs′ weaker mental representations, weaker cognitive control, and lack of systematic and prolonged exposure to the majority language.
4. Does amount of input and output in Spanish predict rates of glottalization in the Spanish and English of Spanish HS?
   - If the heritage language grammar is vulnerable to language exposure, HSs will show greater rates of glottal phonation with lower exposure to the heritage language. If the majority language grammar is vulnerable to language exposure, HSs will show lower rates of glottal phonation with higher exposure to the heritage language.

5. Methods

5.1 Background questionnaire

The caregivers of the Spanish-speaking child participants completed a language questionnaire eliciting the relative amount of Spanish–English input that the participants heard at home and at school, as well as the relative amount of Spanish–English output that the participants produced at home. To calculate Spanish input scores, the percentage of Spanish use at home (i.e., relative to English) was weighted by the time spent with each family member (i.e., caregiver 1, caregiver 2, older siblings, younger siblings if any) and the time spent at school. For the Spanish output scores, the percentage of relative Spanish–English output was weighted by the time spent with each family member. The Spanish-speaking adult participants filled out a self-reported language questionnaire. This questionnaire elicited the same data elicited by the parental questionnaire, but also included information on input and output for primary school to middle school, high school, and university periods. I used the same methods described above and averaged the data of these three life periods.

5.2 Participants

In total, 184 speakers participated in this study (See Table 1). All the HSs were born in the US, except for 5 participants that arrived in the US before the age of 3 (Mean age of arrival = 25.5 months). All the HSs resided in California and had been exposed to Spanish since birth and to English before the age of 5 (Mean age of exposure younger children = 0.53 years, older children = 0.63 years, adults = 3.3 years). All the HSs had at least one caregiver that emigrated from Mexico (4 participants had one caregiver from El Salvador and one from Mexico, and two participants had a monolingually-raised English caregiver). The participants′ caregivers from Mexico migrated from the following regions: Northern Mexico (N = 12), Central Mexico (N = 63), Chiapas (N = 1), South of Mexico (N = 4), unspecified region (N = 21). The adult HSs were students at the UCLA Spanish and Portuguese department, and the child HSs were recruited through social media using the snowball recruitment method.

All the monolingually-raised Spanish speakers (i.e., SpanMonoSs) were born and raised in Mexico and lived in Northern Mexico (N = 15), Central Mexico (N = 48), Yucatán (N = 1), Golf Coast Mexico City (N = 1) at the time of testing. The SpanMonoSs had not had exposure to any languages other than Spanish at home. They had knowledge of English but were exposed to Spanish at least 70% of the time. None of the participants reported having lived outside of Mexico for more than 6 consecutive weeks. The SpanMonoSs were recruited through social media using snowball recruitment.

The monolingually-raised English speakers (i.e., EngMonoSs) were born in California, had either basic or no previous knowledge of Spanish, and were neither exposed to Spanish at home nor spoke languages other than English daily. 24 child participants were recruited at the UCLA Primary Lab School, and the rest were recruited through social media. The adult participants were recruited through the UCLA SONA system.

5.4 Experiments

The stimuli for the production task consisted of 24 sequences of function word + vowel-initial content word. Table 2A shows the four Spanish words with initial stress (e.g., ojo ′eye′) and the four Spanish words with non-initial stress (e.g., espejo ′mirror′) were elicited with three function words (i.e., el ′the′, dos ′two′ and un ′a/an′). The most frequent and visually depictable vowel-initial words in compiled corpora from CHILDES database (MacWhinney, 2000) were selected. Words in the stress and the unstressed conditions were approximately matched in frequency. It is important to control for frequency to ensure that children are not disproportionally exposed to words in one of the two conditions (i.e., stressed or unstressed). In addition, to ensure that children have some exposure to the words in linked speech, I summed the frequencies of function word + content word co-occurrence divided by the overall occurrence of the content word (See Table 2).[4]

[4]While the selection resulted in longer words (Mean number of syllables = 3) in the unstressed condition than in the stressed condition (Mean number of syllables = 2), this asymmetry biases against my hypothesis, because longer words (i.e., the unstressed

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Table 1. Profiles of the participants' groups: number of participants, age range, mean Spanish input, and mean Spanish output.

Group	N	Age range	Mean Spanish input	Mean Spanish output
Younger child HSs	18 (9 F, 9 M)	5;2 - 7;7	65.2% (14.2%)	61.8% (28.1%)
Older child HSs	19 (9 F, 10 M),	8;2 - 11;11	60.30% (18.9%)	57.0% (25.6%)
Adult HSs	20 (15 F, 5 M)	18;2 - 26;7	47.2% (14%)	53.3% (20.2%)
Younger child SpanMonoSs	21 (10 F, 11 M)	5;1 -8;0	91.5% (10.3%)	97.9% (4.5%)
Older child SpanMonoSs	23 (11F, 12M)	8- 11;8	91.2% (9.7%)	98.5% (3.6%)
Adult SpanMonoSs	21 (16F, 5M)	18;0- 26;0	87.5% (8.1%)	92.8% (7%)
Younger child EngMonoSs	20 (8F, 12 M)	5;7 to 8;0	NA	NA
Older child EngMonoSs	22 (15 F, 6 M, 1 non-binary)	8;2 - 11;5	NA	NA
Adult EngMonoSs	20 (14 F, 6 M)	18;3–22;5	NA	NA

Table 2A Spanish content words grouped by initial stress or non-initial stress, log frequencies and ratio of content words appearing in front of a consonant in the input (calculated using the CHILDES corpora [MacWhinney. 2000]) and glosses.

Initial stress				Non-initial stress			
Items	Log Freq	Ratio C/V	Gloss	Items	Log Freq		Gloss
ojo	1.79	0.78	eye	animal	1.92	0.71	animal
árbol	1.87	0.84	tree	elefante	1.71	0.78	elephant
hombre	1.69	0.29	man	espejo	1.49	0.90	mirror
ángel	0.73	0.71	angel	avión	1.00	1	plane

In the production task, participants were shown two images side by side in a PowerPoint presentation. A recorded female Mexican voice elicited the sequence of function word and vowel-initial content word (e.g., Experimenter: Aquí hay una boca y aquí hay…. 'There is a mouth here and here there is…' Child: un ojo 'an eye'). A comparable task was designed for English (See Table 2B). The target sequences in English consisted of the function words all, this, an, followed by 4 vowel-initial content words with initial primary stress (i.e., onion) and the 4 vowel-initial content words without initial primary stress (e.g., umbrella). The words in the stressed and unstressed conditions were approximately frequency-matched and the ratio of function word + content word co-occurrence was calculated (See Table 2).[5] An American English female voice produced the sentences to elicit the target sequences (e.g., Experimenter: This is a tomato, and this is…. Child: an onion). To ensure that the content words in Spanish and English had comparable neighborhood frequencies (Nfreq) and neighborhood densities (ND) independent samples t-tests were run. Neither the Nfreq ($t(7) = 1.33$, $p = 0.22$) nor the ND ($t\ (7) = 1.73$, $p = 0.12$) were significantly different across languages.

5.5 Procedures

The SpanMonoSs and EngMonoSs completed one session in either Spanish or English, while the HSs completed one session in Spanish and one session in English on two different days. 24 English-speaking child participants were recorded in a quiet room at the primary school UCLA Lab School using an AKG C520 head-mounted microphone connected to a Zoom H4n handy portable digital recorder with a sampling rate of 44 kHz and a sample size of 16 bits. Due to the Covid-19 pandemic, data collection was disrupted, and the remaining participants completed their experimental sessions on Zoom (Zoom Video Communications Inc., 2019). The participants recorded themselves (or were recorded by their caregivers) using the smartphone recording App ShurePlus MOTIV™ installed on their phones. The phones were held horizontally with the microphone pointing to the participants' mouths at approximately 4 inches.

5.6 Coding and Analysis

The tokens were segmented using Montreal Forced Aligner (McAuliffe, Socolof, Mihuc, & Wagner, & Sonderegger, 2017), manually coded by the author of this study, and classified as containing either glottal or modal phonation (see Table S1). The glottal phonation category consisted of tokens containing either creaky phonation between the consonant and the vowel (i.e., discontinuity in the duration of consecutive pulses, changes in pulse amplitude, widening of pulses or lowered f0) or a complete glottal stop (i.e., visible obstruction in the spectrogram not longer than 150 ms as per Scarpace [2017, p.25]).[6]. The modal

words) would be expected to require higher processing costs and would be, thus, more susceptible to stronger boundaries.

[5]As in Spanish, the fact that words without initial primary stress are shorter (Mean number of syllables = 2.25) than those with initial primary stress (Mean number of syllables = 3.25) biases against my hypothesis.

[6]Glottal stop epenthesis was considered to surface in the grammar if either full glottal stops or creaky voice was visible in the spectrogram. First, Ladefoged and Maddieson (1996) report that glottal stops may be realized without complete closure. Second, Davidson (2021, pp. 6–8) states that, in most studies examining the presence of glottal

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Table 2B English Content words grouped by initial stress or non-initial stress and log frequencies ratio of content words appearing in front of a consonant in the input (calculated using the CHILDES corpora [MacWhinney. 2000]).

Initial stress			Non-initial stress		
Items	Log freq	Ratio C/V	Items	Ratio C/V	Log freq
octopus	1.28	0.32	umbrella	0.36	1.77
island	0.95	0.11	aquarium	0.00	0.60
onion	0.90	0.25	iguana	0.50	0.90
olive	0.48	0.33	avocado	0.00	0.00

phonation category consisted of tokens presenting regular pulses and continuous f0 movement along the /C#V/ sequence.

R statistical software (R Development Core Team, 2020) and the lme4 package (Bates, Mächler, Bolker, & Walker, 2015) were used to conduct generalized linear mixed-effects. I included as fixed effects the theoretically relevant variables: TYPE OF SPEAKER (i.e., monolingually-raised speakers, HSs), age group (i.e., younger children, older children, adults), primary stress position (i.e., initial position vs. non-initial position), and their interactions. To account for the variation introduced by each participant, the consonant of the function word, and vowel of the content word, I allowed these three variables to vary in their intercepts.

6. Results

6.1 Rate of glottal phonation in Spanish

In total, 3106 instances of function + content word sequences were obtained. Among them, 147 tokens were excluded from the analyses due to pauses longer than 150ms between the function word and the content words, deletion of the initial vowel of the content word, creakiness across the complete function and content word sequence, or production of the wrong function word.

Figure 1 demonstrates the percentage of tokens produced with glottal phonation by AGE GROUP, TYPE OF SPEAKER, and PRIMARY STRESS POSITION. My results showed that there was an effect of PRIMARY STRESS POSITION ($\beta = -1.75$, $SE = 0.26$, $z = -6.74$, $p < 0.001$), indicating that glottal phonation was found more often before stressed syllables ($M = 15.83\%$, $SE = 0.96\%$) than before unstressed syllables ($M = 5.38\%$, $SE = 0.58\%$). The model also demonstrated that there was a significant effect of TYPE OF SPEAKER ($\beta = 3.49$, $SE = 0.61$, $z = 5.76$, $p < 0.001$), suggesting that the HSs produced a significantly greater rate of glottal phonation ($M = 20.04\%$, $SE = 1.07\%$) than that produced by the monolingually-raised Spanish speakers ($M = 1.92\%$, $SE = 0.35\%$). PRIMARY STRESS POSITION and TYPE OF SPEAKER interacted ($\beta = -1.18$, $SE = 0.52$, $z = -2.28$, $p = 0.02$). Post-hoc pairwise comparisons showed that the rate of glottal phonation was only significantly different across the two levels of PRIMARY STRESS POSITION in the HSs group ($\beta = 2.34$, $SE = 0.23$, $z = 10.06$, $p < 0.001$). In addition, AGE GROUP (i.e., adults) interacted with TYPE OF SPEAKER ($\beta = -1.18$, $SE = 0.52$, $z = -2.28$, $p = 0.02$). Pairwise comparisons indicated that the younger child HSs produced a significantly greater rate of glottal phonation ($M = 30.86\%$, $SE = 2.23\%$) than the younger child SpanMonoS ($M = 1.59\%$, $SE = 0.56\%$) ($\beta = -5.2$, $SE = 1.05$, $z = -4.95$, $p < 0.001$), and older child HSs produced a significantly higher rate of glottal phonation ($M = 20.12\%$, $SE = 1.83\%$) than older child SpanMonoS ($M = 1.68\%$, $SE = 0.56\%$) ($\beta = -3.68$, $SE = 0.99$, $z = -3.7$, $p = 0.01$). The adult HSs demonstrated a non-significant rate of glottal phonation ($M = 10.23\%$, $SE = 1.39\%$) when compared to the adult SpanMonoSs ($M = 2.48\%$, $SE = 0.68\%$).

The variances introduced by the random terms for PARTICIPANT ($var = 5.88$ $SD = 2.42$, LRT $p < 0.001$ and CONSONANT ($var = 0.38$, $SD = 0.62$, LRT $p < 0.001$) are not likely to have occurred by chance, whereas the variance of the random term for VOWEL was likely to be produced by chance ($var = 0$, $SD = 0$, LRT $p = 1$).

6.2 Effects of Spanish input and output on the rate of glottal phonation in Spanish

To examine the effects of Spanish input and output only the tokens of the HSs were selected ($N = 1392$). The model[7] for Spanish showed that the relationships between SPANISH INPUT and rate of glottal phonation ($\beta = -2.536$, $SE = 2.58$, $z = -0.98$, $p = 0.326$) and SPANISH OUTPUT and rate of glottal phonation were not statistically significant ($\beta = -1.965$, $SE = 1.61$, $z = -1.22$, $p = 0.221$). The model demonstrated an effect of AGE between the group of adult HSs ($M = 10.23\%$, $SE = 1.39\%$) and that of younger child HSs ($M = 30.86\%$, $SE = 2.23\%$) ($\beta = -3.46$, $SE = 1.05$, $z = -3.28$, $p < 0.001$). No significant differences were found between the group of younger child HSs and the group of older child HSs ($M = 20.12\%$, $SE = 1.83\%$). After releveling the age group variable (i.e., older child HSs), an effect was also found for TYPE OF SPEAKER between the adult HSs and the older child HSs ($\beta = -1.35$, $SE = 0.95$, $z = -1.43$, $p = 0.152$). In addition, the model also revealed that the content words with initial primary stress were glottalized more often ($M = 29.88\%$, $SE = 1.75\%$) than those without initial primary stress ($M = 10.48\%$, $SE = 1.15\%$) ($\beta = 2.18$, $SE = 0.39$, $z = 5.6$, $p < 0.001$). No interaction was found between AGE GROUP and PRIMARY STRESS POSITION.

6.3 Rate of glottal phonation in English

A total of 2847 instances of function + content word sequences were obtained in the English production task. As with the Spanish results, 262 tokens were excluded from the logistic regressions due to pauses, deletions, creakiness, and errors.

Figure 2 illustrates the percentage of tokens produced with glottal phonation by AGE GROUP, TYPE OF SPEAKER, and PRIMARY STRESS POSITION. My findings demonstrated that there was an effect of the variable PRIMARY STRESS POSITION ($\beta = -3.26$, $SE = 0.14$, $z = -22.91$, $p < 0.001$), indicating that the content words with initial stress were produced more often with glottal phonation ($M = 78.22\%$, $SE = 1.17\%$) than the content words without primary stress ($M = 29.63\%$, $SE = 1.25\%$). The model also showed that there was a significant effect of TYPE OF SPEAKER ($\beta = -1$, $SE = 0.3$, $z = -3.3$, $p < 0.001$), indicating that the HSs produced a

stops, such consonants are more often realized as periods of creaky phonation than as complete glottal stops (Dilley et al., 1996; Garellek, 2013; Kohler, 1994)

[7]Model collinearity was tested with the R package performance (Lüdecke, Ben-Shachar, Patil, Waggoner, & Makowski, 2021). Spanish input and Spanish output showed a low correlation with a VIF of 2.69 [CI: 2.46, 2.95] and 2.39 [CI" 2.20, 2.62] respectively.

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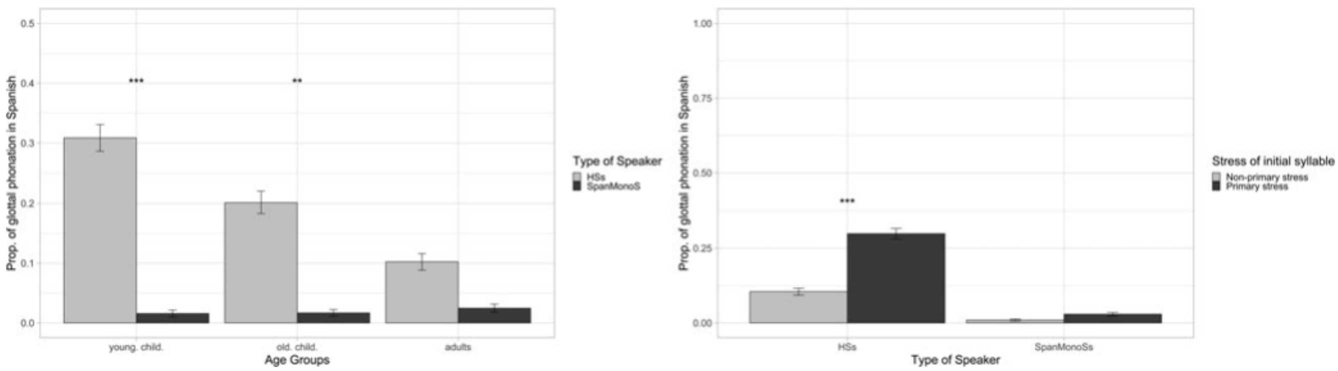

Fig. 1. Rate of glottal phonation in Spanish by type of speaker and age group (left), and type of speaker and stress (right).

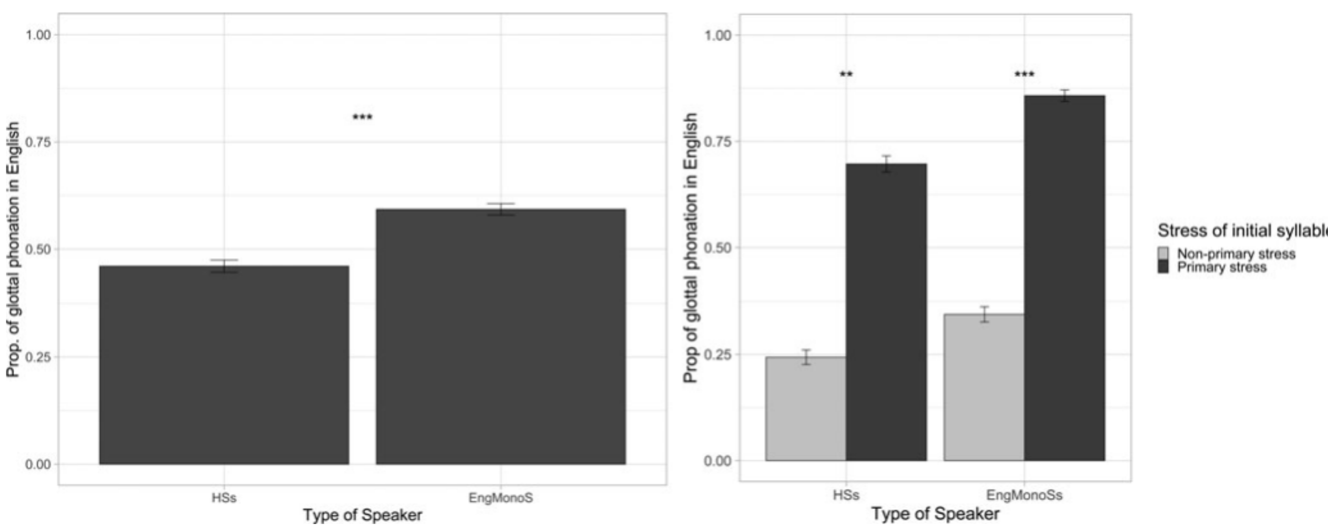

Fig. 2. Rate of glottal phonation in English by type of speaker (left), and type of speaker and stress (right).

lower rate of glottal phonation (M = 46.03%, SE = 1.43%) than that of the monolingually-raised English speakers (M = 59.28%, SE = 1.33%).

A statistically significant interaction was found between the variables of PRIMARY STRESS POSITION and TYPE OF SPEAKER ($\beta = 0.71$, $SE = 0.26$, $z = 2.79$, $p = 0.01$). Pairwise comparisons revealed that the difference in the rate of glottal phonation across the two levels of primary stress position was significantly different in the EngMonoSs ($\beta = 3.61$, $SE = 0.2$, $z = 17.89$, $p < 0.001$), but not significantly different in the group of HSs ($\beta = 2.9$, $SE = 0.18$, $z = 16.16$, $p < 0.001$).

The variances introduced by the random terms for PARTICIPANT ($var = 2.32$, $SD = 1.52$, LRT $p < 0.001$ and consonant ($var = 0.69$, $SD = 0.83$, LRT $p < 0.001$) are not likely to be produced by chance, while the variance introduced by VOWEL was likely to have occurred by chance ($var = 0$, $SD = 0$, LRT $p = 1$).

6.4 Effects of Spanish input and output on the rate of glottal phonation in English

To investigate the relationship between amount of input and output in the HL and the rate of glottal phonation, the tokens of the HSs (N = 1222) were submitted to a generalized mixed effects logistic regression. The model[8] demonstrated that neither SPANISH INPUT ($\beta = -2.45$, $SE = 2.11$, $z = -1.16$, $p = 0.246$) nor SPANISH OUTPUT ($\beta = 0.69$, $SE = 1.38$, $z = 0.5$, $p = 0.617$) was a significant predictor of the rate of glottal phonation. Moreover, the model revealed that content words with initial primary stress were glottalized more often than those without initial primary stress ($\beta = 3.04$, $SE = 0.2$, $z = 15.32$, $p < 0.001$). No significant effect of AGE GROUP, nor interaction with AGE GROUP and STRESS was found.

7. Discussion

7.1 Glottal phonation in the Spanish and English baseline grammars

To determine the extent to which glottal phonation occurs in non-contact varieties of Spanish and English, I will first discuss the results for the Spanish and English speakers raised in monolingual environments.

The SpanMonoSs show a high overall rate of modal phonation in both words with initial primary stress (i.e., prosodically

[8]Model collinearity was tested with the R package performance (Lüdecke et al., 2021). Spanish input and Spanish output showed a low correlation with a VIF of 1.68 [CI: 1.57, 1.82] and 1.46 [CI: 1.37, 1.57] respectively.

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prominent syllables) (M = 97.06%) and words without initial primary stress (M = 99.02%). This suggests, predictably, that glottal phonation is not prevalent in the Spanish grammars and that Spanish speakers produce linked speech (i.e., modal phonation) between the coda consonant and the following vowel. As for dialectal variation, most of the Spanish HSs had exposure to the same dialects (i.e., Northern, Central Mexico) as those of the Spanish speakers raised in monolingual environments (N = 37 / 57). It is also worth noting that the use of glottal phonation in Mexican Spanish has only been reported in Yucatan Spanish as a result of contact with Yucatec Maya (Michnowicz & Kagan, 2016), and the HSs in this study did not report having contact with languages other than Spanish[9].

In monolingual English, speakers show a higher overall rate of glottal phonation in syllables bearing primary stress (M = 85.76%, SE = 1.36%) than in syllables not bearing primary stress (M = 34.42%, SE = 1.79%). Hence, the preferred strategy (i.e., more than 50%) in stressed positions is glottal phonation, and modal phonation is preferred whenever the syllable does not have primary stress. My results here are in line with findings highlighting the prosodic nature of glottal phonation (Dilley et al., 1996; Garellek, 2012; Redi & Shattuck-Hufnagel, 2001; Scobbie & Pouplier, 2010).

My findings confirm that Spanish and English speakers raised monolingually demonstrate asymmetrical preferences when producing /C#V/, in that Spanish speakers prefer modal phonation over glottal phonation and English speakers prefer glottal phonation over modal phonation in prosodically prominent syllables.

7.2 Discussing English-to-Spanish crosslinguistic transfer

To determine whether language transfer occurs in the connected speech of HSs, I asked whether Spanish HSs demonstrate greater rates of glottal phonation in /C#V/ sequences than age-matched Spanish speakers raised in monolingual environments and whether this difference is moderated by age and prosodic prominence (i.e., stress).

My results for the Spanish production task demonstrate that child HSs (younger child HSs; M = 30.86%, SE = 2.23%, older child HSs; M = 20.12%, SE = 1.83%) produce a greater rate of glottal phonation than their age-matched controls (younger child SpanMonoSs; M = 1.59%, SE = 0.56%, older child SpanMonoSs; M = 1.68%, SE = 0.56%). Adult HSs, however, present a low rate of glottal phonation similar to their SpanMonoSs' counterparts (HSs; M = 10.23%, SE = 1.39%, adult SpanMonoSs; M = 2.48%, SE = 0.68%). This indicates that child HSs transfer phonological processes of connected speech from the ML into the HL, and that their grammars are more permeable to such transfer than adult heritage grammars.

Moreover, the use of glottal phonation is mediated by prosodic prominence in the HSs (syllables with primary stress: M = 29.88%, SE = 1.75%, syllables without primary stress: M = 10.48%, SE = 1.15%), but not in the SpanMonoSs (syllables with primary stress: M = 2.94%, SE = 0.62%, syllables without primary stress: M = 0.98%, SE = 0.34%). Thus, HSs are more likely to produce glottal phonation in stressed-initial syllables than in unstressed-initial syllables. This shows that glottal phonation in the group of HSs follows patterns of English, in which glottal phonation strengthens prosodically prominent positions (Dilley et al., 1996; Garellek, 2014; Mitterer, Kim, & Cho, 2021; Redi & Shattuck-Hufnagel, 2001). Employing an account of prominence-based glottalization, Garellek (2014, p.112) suggests that, cross-linguistically, languages with word-initial glottal phonation will be those with word-initial prominence and will tend to assign prominence an important role. It is possible that, because of grammar interaction, HSs assign a greater weight to prosodic prominence and, in turn, to acoustic cues to signal prominence, such as glottalization. This aligns with findings showing that HSs use prosodic prominence cues to express phrasal focus (Kim, 2019).

My findings suggest that glottal phonation in the HL is unlikely to be due to a shift in language dominance from the HL into the HL arising between the primary school years and adulthood but is instead a result of early grammar interaction extending into adulthood. When exploring the reasons why grammar interaction may be stronger during childhood than adulthood – therefore, it is important to examine my results in light of the differences between children and adults reported in section 2. First, since children are still developing several key cognitive skills, the greater rates of language transfer in child HSs' speech production may reflect their weaker language-inhibitory skills. This explanation foregrounds the role of general cognitive processes on language transfer, suggesting that still-maturing cognitive architectures will benefit from a strategy that adopts the majority language grammar whenever this reduces processing costs and eases lexical access. Second, adult HSs may have greater cumulative exposure to the HL, and their acquaintance with higher levels of phonetic variability can result in more robust representations of resyllabified consonants (i.e., linked speech). This, in turn, may render such representations less likely to be influenced by glottal phonation. A third possibility stems from the observation that child HSs tend to have smaller lexicons than those of adult HSs (Anglin et al., 1993; Segbers & Schroeder, 2017), a characteristic that may cause some child HSs to resort to glottal phonation to ease lexical access. As previously discussed, after all, glottal phonation may aid word retrieval by strengthening the boundaries between the two prosodic words, while the smaller and less robust lexicons of children may require clearer acoustic properties at word boundaries for word access. A limitation of this study is the absence of measures of lexical development and cognitive abilities to determine whether language transfer is more likely to be explained through a developing lexicon or through maturing cognitive skills. When explaining my results, at least two hypotheses compete with that of crosslinguistic transfer. First, it is possible that these findings represent delayed development due to articulatory complexity, a proposal that assumes an initial stage in monolingual Spanish grammars in which children rely on glottal phonation due to articulatory complexity. Under this hypothesis, Spanish HSs show a longer period of glottal phonation than their age-matched monolingual counterparts due to their simultaneous exposure to English, a language that presents lower rates of closed junctures (i.e., ambisyllabicity or resyllabification). Vowel-initial glottal phonation in the child HS, however, is unlikely to be related to articulatory maturity, as the high rates of modal phonation in the unstressed syllables of the (younger child HSs M = 83.19%, older child HSs M = 88.84%) suggest that they have acquired consonant-to-vowel articulation. Instead, the child HSs' grammars appear to be sensitive to prosodic prominence, a phonological factor that also conditions the alternation between modal and glottal phonation in the English grammars. Thus, I assume that it is more

[9]Additionally, out of the HSs that reported their caregivers' place of origin, none of them reported having caregivers that migrated from Yucatan. Region of origin for 21 caregivers is missing.

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likely that the rates of glottal phonation in the child HSs arise from phonological transfer than from delayed development due to articulatory complexity.

A second possibility is that my results are best explained by the fact that HSs are exposed to an input containing glottalization. For this hypothesis to be tenable, however, we must make a case for the greater influence of language input during childhood than during adulthood. A priori, child and adult HSs may be exposed to similar rates of Spanish input containing glottal phonation, given that both groups are likely to hear the Spanish of the Spanish-speaking community in California. However, adult HSs' greater cumulative exposure with more phonetic variation may make them less sensitive to glottalization in the Spanish input. In addition, adult HSs and child HSs may behave differently with regard to the perception of the type of input to which they are exposed. That is, adult HSs may be more likely to consider speech productions from non-heritage Mexican speakers as more target-like than child HSs, which would result in more sensitivity for an input with less glottal phonation during adulthood than childhood. Future research should explore whether child HSs and adult HSs differ in their perceptions of the type of input to which they are exposed.

7.3 Discussing Spanish-to-English language transfer

Regarding the ML, I asked whether the HSs' English grammars demonstrate effects of language transfer from the HL. Examining the majority language of the HSs can help build complete models of cross-linguistic interaction of the HSs' two grammars. In this section I examine the extent to which cross-linguistic transfer between the HSs' two grammars is bidirectional.

My results for the production task in English demonstrate that the HSs produce a lower rate of glottal phonation ($M = 46.03\%$, $SE = 1.43$) than that of EngMonoSs ($M = 59.28\%$, $SE = 1.33$). An interaction between TYPE OF SPEAKER and PRIMARY STRESS POSITION suggests that the difference in the rate of glottal phonation between the two levels of stress is greater in the EngMonoSs (Δ51.34%) than in the HSs (Δ45.36%). That is, prosodic prominence has a stronger impact on the EngMonoSs' grammars than on those of the HSs. Contact with Spanish can account for this interaction, as HSs may transfer Spanish-like probabilities of producing linked speech from their Spanish into their English grammars.

Regarding the effects of AGE GROUP, I predicted that, in English, transfer of modal phonation from Spanish would be more likely to occur during childhood than adulthood given child HSs' lack of systematic and prolonged exposure to the ML. However, unlike my results for Spanish, AGE GROUP was not a predictor of the rate of glottal phonation in English. It is possible, therefore, that the lower rates of glottal phonation in the HSs' group (which appear to be unaffected by language development) do not result from individual transfer, but from language change at the community level (i.e., lower rates of glottal phonation in the English of the Spanish-speaking community). This possibility is supported by the fact that dialects in contact with Spanish in California, such as Chicano English, have influences of a Mexican Spanish substrate (e.g., Spanish-like place of articulation of stops, such as apico-dental production of alveolar stops, monophthonguization of vowels, lesser vowel reduction) (Fought, 2003; Otto & Bayley, 2008). To further explore this hypothesis, future studies should examine the speech production of English speakers raised in Spanish-speaking communities with little knowledge of Spanish, to better understand whether the lower rate of glottal phonation arises at the community or at the individual level.

7.4 Examining variation

7.4.1 The effects of amounts of Spanish input and output in grammars of HSs

Rate of glottal phonation was not found to be predicted by either quantity of Spanish input or quantity of Spanish. Finding null results might indicate that, either the null hypothesis is correct, or the data are inconclusive. If the former is true, my results indicate that the total frequency of input and output does not moderate cross-linguistic influence between languages in connected speech. Instead, the type of input, the vocabulary size, and the number of speakers with whom HSs interact daily (i.e., phonetic variability) should be investigated in future studies. It is also possible, however, that my study did not have enough statistical power to prove the presence of an otherwise real effect at the population level. Further research should consider smaller effect sizes for input-output measures and recruit a greater number of participants. A limitation of this study is the fact that the input–output measures are self-reported for the adults and caregiver-reported for the children. This slight methodological difference might have led to discrepancies in the perception and reporting of amounts of Spanish input and output.

7.4.2 Discussing individual variation

While Spanish input and output did not explain individual patterns in my data, individual participants introduced a significant amount of variance in my models for Spanish and English. Figure S2 illustrates the distribution of the mean rates of glottal phonation by participants. The data of the SpanMonoSs demonstrate a right-skewed distribution ($SD = 3.86\%$), with most of the speakers producing glottal phonation at rates ranging between 0% and 10% (95.24% of the younger child SpanMonoSs, 95.45% of the older child SpanMonoSs, and 95.24% of the adult SpanMonoSs). A smaller amount of the speakers (i.e., 4.76% of the younger child SpanMonoSs, 4.55% of the older child SpanMonoSs, and 4.76% of the adult SpanMonoSs) produced glottal phonation at rates between 10% and 20%.

The HSs show a greater spread in the overall group distribution ($SD = 25.55\%$) than that of the SpanMonoSs. Interestingly, however, a non-negligible percentage of the HSs shows a proportion of glottal phonation in the ranges of 0% to 10% (41.18% of the younger child HSs, 47.37% of the older child HSs, and 70% of the adult HSs). 33.93% of the HSs fall within the ranges of 10% and 50% (47.06% of the younger child HSs, 31.58% of the older child HSs, and 25% of the adult HSs). Glottal phonation is produced by 20.34% of the HSs with ranges above 50% (23.53% of the younger child HSs, 36.84% of the older child HSs, and 5% of the adult HSs). This indicates that HSs are a heterogeneous group with some speakers falling within the ranges of the SpanMonoSs (0%-10%), and less than half of the speakers diverging from the SpanMonoSs by more than 10%, which, in turn, indicates that the degree of cross-linguistic influence varies at an individual level.

The mean rates of glottal phonation for each participant in English (Figure S3), overall, show dispersed distributions (EngMonoSs $SD = 20.72\%$; HSs $SD = 25.55\%$). The child EngMonoSs' two groups show a slightly left-skewed distribution with a small peak between 80% and 90% for the younger child EngMonoSs (5% of the speakers) and a low peak between 70%

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and 80% for the older child EngMonoSs (4.55% of the speakers). When compared to the child EngMonoSs, the adult EngMonoSs show a peak at a lower range in the distribution around 40% and 60% of (30% of the speakers). This indicates that, while I did not find a significant difference in the three groups, the data show a displacement in the peaks when comparing the results for children and adults, suggesting that, after the age of 5 and until the age of 11 some speakers could still be adapting rates of glottal phonation to adult-like patterns.

HSs demonstrate an almost uniform distribution along the scale of glottal phonation. That is, HSs do not show the same tendency towards higher glottal phonation values during childhood as those of the EngMonoSs, except for three speakers in the older child HSs' group, whose values range between 80% and 90%. Moreover, most of the speakers' glottal phonation rates oscillate around 20% and 60% on the scale (58.82% of the younger child HSs, 68.42% of the older child HSs, and 65% of the adult HSs). This means that, while some EngMonoSs are still adjusting to adult-like rates of glottal phonation, the group of HSs more uniformly presents adult-like rates of glottal phonation during childhood. Contact with Spanish could have accelerated the acquisition process in those child HSs that would have been at the right end of the distribution otherwise. Alternatively, since out of the three speakers in the older child HSs' group showing higher values of glottal phonation, two of them presented higher input and output scores than the mean group values (CH_HS_29 input: 68.67%, output: 80%, CH_HS_55 input: 93.64% output: 95.98%), this fact suggests the possibility that reduced exposure and use of English could also lead to slower acquisition rates.

7.4.3 Discussing variation introduced by type of consonant

My models suggest that type of coda consonant introduced significant variation to the results for Spanish and English. Overall, HSs produced higher rates of glottal phonation after /s/ (M = 28%, SE = 2%), followed by /n/ (M = 19%, SE = 2%), and /l/ (M = 13%, SE = 2%). The difference between /s/ and /n/ (9%) was greater than that between /l/ and /n/ (6%). These differences in the rates of glottal phonation between consonants are found across all age groups, suggesting that such differences are not conditioned by language development. Instead, I argue that these differential rates of glottal phonation are related to the type of function word. In the Spanish function words, the numeral 'dos' (two) is semantically richer than the indefinite article 'un' (an)[10] and the definite article 'el' (the). Spanish HSs may, hence, resort to glottal phonation more often in 'dos' (two) than in the other function words in order to clearly mark the boundaries between the function and the content word. Garellek (2012), for instance, puts forth that glottal phonation can serve the function of impeding proclitization of the function word to the content word (Garellek, 2012).

In English, the consonant that shows the highest rate of glottal phonation is /l/ ('all') (EngMonoSs M = 57%, SE = 2%, HSs M = 66%, SE = 2%), followed by /s/ ('this') (EngMonoSs M = 53%, SE = 2%, HSs M = 65%, SE = 2%), and /n/ ('an') (EngMonoSs M = 28%, SE = 2%, HSs M = 46%, SE = 2%). Following a similar explanation to that of Spanish, the quantifier 'all' and the demonstrative 'this' are, in order, more semantically richer than the indefinite article 'an'. As in the case of Spanish, English speakers may choose to strengthen the boundaries between semantically rich function words and content words to avoid the former to cliticize. This means that, aside from the effect of prosodic prominence of the content word, a possible influence of the previous word should be taken into account when considering the gradient nature of glottal phonation in vowel-initial words[11].

8. Conclusions

To understand the development of connected speech during the HSs' lifespan, I examined glottal phonation in the production of /C#V/ sequences in Spanish and English by Spanish child and adult HSs and I compared their outcomes to those of approximately age-matched Spanish and English speakers raised in monolingual environments. I found that the child HSs demonstrate greater rates of glottal phonation in Spanish than their age-matched monolingually raised Spanish speakers' counterparts. In English /C#V/ sequences, the child and adult HSs show lower rates of glottal phonation than the monolingually-raised English speakers. My findings offer support for majority-to-heritage language transfer and partial support for heritage-to-majority language transfer and suggest that child HL grammars may be more permeable to language transfer than adult HL grammars.

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Supplementary Material. For supplementary material accompanying this paper, visit https://doi.org/10.1017/S1366728923000160

Table S1 (Word Document, 3.33MB) Soundwaves and spectrograms of the categories in the data (i.e., modal phonation and glottal phonation). Glottal phonation is further divided into creaky phonation and complete glottal stop.

Figure S2. Distribution of the individual speakers along a scale showing proportion of glottal phonation in Spanish per group of speakers.

Figure S3. Distribution of the individual speakers along a scale showing proportion of glottal phonation in English per group of speakers.

Data availability statement. The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research supporting data is not available.

References

Abutalebi J and Green DW (2007) Bilingual language production: The neurocognition of language representation and control. Journal of Neurolinguistics 20, 242–275. https://doi.org/10.1016/j.jneuroling.2006.10.003

Abutalebi J and Green DW (2016) Neuroimaging of language control in bilinguals: Neural adaptation and reserve. Bilingualism: Language and Cognition 19, 689–698. https://doi.org/10.1017/S1366728916000225

Alkhudidi A, Stevenson R and Rafat Y (2020) Geminate Attrition in the Speech of Arabic–English Bilinguals Living in Canada. Heritage Language Journal 17(1). https://doi.org/10.46538/hlj.17.1.1

Anglin JM, Miller GA and Wakefield PC (1993) Vocabulary Development: A Morphological Analysis. Monographs of the Society for Research in Child Development 58(10). https://doi.org/10.2307/1166112

Barbiers S (2007) Indefinite numerals one and many and the cause of ordinal suppletion. Lingua 117, 859–880. https://doi.org/10.1016/J.LINGUA.2006.03.003

[10]The function word un, traditionally has been analyzed as an indefinite article and as a numeral. However, more recently, scholars have posited that un is only an indefinite article (Barbiers, 2007; Kayne, 2009; Mateu & Hyams, 2016).

[11]Alternatively, /l/ in coda position can be vocalized, while in ambisyllabic position /l/ is velarized but not vocalized (Hayes, 2009). It is possible, then, that this allophony renders the consonant more resistant to resyllabification than /n/ and /s/.

Bates D, Mächler M, Bolker BM and Walker SC (2015) Fitting linear mixed-effects models using lme4. Journal of Statistical Software 67(1). https://doi.org/10.18637/jss.v067.i01

Bedore LM, Peña ED, Griffin ZM and Hixon JG (2016) Effects of Age of English Exposure, Current Input/Output, and grade on bilingual language performance. Journal of Child Language 43(3). https://doi.org/10.1017/S0305000915000811

Bradley TG and Delforge AM (2006) Systemic Contrast and the Diachrony of Spanish Sibilant Voicing. https://doi.org/10.1075/cilt.274.04bra

Branzi FM, Calabria M, Boscarino ML and Costa A (2016) On the overlap between bilingual language control and domain-general executive control. Acta Psychologica 166. https://doi.org/10.1016/j.actpsy.2016.03.001

Campbell N and Beckman ME (1997) Stress, Prominence, and Spectral Tilt. Intonation: Theory, Models and Applications, September.

Chang CB, Yao Y, Haynes EF and Rhodes R (2011) Production of phonetic and phonological contrast by heritage speakers of Mandarin. The Journal of the Acoustical Society of America 129, 3964–3980. https://doi.org/10.1121/1.3569736

Cohen C (2016) Relating input factors and dual language proficiency in French–English bilingual children. International Journal of Bilingual Education and Bilingualism 19, 296–313. https://doi.org/10.1080/13670050.2014.982506

Colantoni L, Cuza A and Mazzaro N (2016) Task-related effects in the prosody of Spanish heritage speakers and long-term immigrants. In M. del M. V. Meghan E Armstrong, Nicholas Henriksen (Ed.), Intonational gram-mar in Ibero-Romance: Approaches across linguistic subfields (6,3). John Benjamins, pp. 1–24. https://doi.org/10.1075/ihll.6.01col

Colina S (1997) Identity constraints and Spanish resyllabification. Lingua 103, 1–23. https://doi.org/10.1016/S0024-3841(97)00011-9

Correia L and Flores C (2017) The Role of Input Factors in the Lexical Development of European Portuguese as a Heritage Language in Portuguese–German Bilingual Speakers. Languages 2, 30. https://doi.org/10.3390/languages2040030

Cruttenden A (1994) Gimson's pronunciation of English. Arnold.

Daskalaki E, Blom E, Chondrogianni V and Paradis J (2020) Effects of parental input quality in child heritage language acquisition. Journal of Child Language 47(4). https://doi.org/10.1017/S0305000919000850

Davidson L (2021) The versatility of creaky phonation: Segmental, prosodic, and sociolinguistic uses in the world's languages. Wiley Interdisciplinary Reviews: Cognitive Science 12, e1547. https://doi.org/10.1002/WCS.1547

Davidson L and Erker D (2014) Hiatus resolution in American English: The case against glide insertion. Language 90, 482–514. https://doi.org/10.1353/lan.2014.0028

de Cat C (2020) Predicting language proficiency in bilingual children. Studies in Second Language Acquisition, 279–325. https://doi.org/10.1017/S0272263119000597

Dickinson DK, McCabe A, Clark–Chiarelli N and Wolf A (2004) Cross-language transfer of phonological awareness in low-income Spanish and English bilingual preschool children. Applied Psycholinguistics 25, 323–347. https://doi.org/10.1017/S0142716404001158

Dilley LC, Shattuck-Hufnagel S and Ostendorf M (1996) Glottalization of word-initial vowels as a function of prosodic structure. Journal of Phonetics 24, 423–444. https://doi.org/10.1006/jpho.1996.0023

D'Introno F, Ortiz J and Sosa J (1989) On resyllabification in Spanish. Studies in Romance Linguistics, 97–114.

Einfeldt M, van de Weijer J and Kupisch T (2019) The production of geminates in Italian-dominant bilinguals and heritage speakers of Italian. Language, Interaction and Acquisition 10, 177–203. https://doi.org/10.1075/lia.18015.ein

Elias V, McKinnon S and Milla-Muñoz Á. (2017) The effects of code-switching and lexical stress on vowel quality and duration of heritage speakers of Spanish. Languages 2, 29. https://doi.org/10.3390/languages2040029

Embick D, White Y and Tamminga M (2020) Heritage languages and variation: Identifying shared factors. In Bilingualism (Vol. 23, Issue 1). https://doi.org/10.1017/S1366728919000476

Erikson J (2016) Phonological transfer during word learning: Evidence from bilingual school-age Spanish–English-speaking children. In ProQuest Dissertations and Theses.

Esling JH, Fraser KE and Harris JG (2005) Glottal stop, glottalized resonants, and pharyngeals: A reinterpretation with evidence from a laryngoscopic study of Nuuchahnulth (Nootka). Journal of Phonetics 33, 383–410. https://doi.org/10.1016/j.wocn.2005.01.003

Fabiano-Smith L and Barlow J (2010) Interaction in bilingual phonological acquisition: evidence from phonetic inventories. International Journal of Bilingual Education and Bilingualism 13, 81–97. https://www.tandfonline.com/doi/pdf/10.1080/13670050902783528

Fought C (2003) Chicano English in Context. In Chicano English in Context. https://doi.org/10.1057/9780230510012

Garellek M (2012) Glottal stops before word-initial vowels in American English: distribution and acoustic characteristics. UCLA Working Papers in Phonetics 110, 1–23. http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Glottal+stops+before+word-initial+vowels+in+American+English+:+distribution+and+acoustic+characteristics#0

Garellek M (2013) Production and perception of glottal stops (Doctoral dissertation, UCLA).

Garellek M (2014) Voice quality strengthening and glottalization. Journal of Phonetics 45, 106–113. https://doi.org/10.1016/j.wocn.2014.04.001

Godson L (2004) Vowel production in the speech of Western Armenian heritage speakers. Heritage Language Journal 2, 44–69.

Goldstein B and Bunta F (2011) Positive and negative transfer in the phonological systems of bilingual speakers. International Journal of Bilingualism 16, 388–401. https://journals.sagepub.com/doi/pdf/10.1177/1367006911425817

Gollan TH and Ferreira VS (2009) Should I Stay or Should I Switch? A Cost-Benefit Analysis of Voluntary Language Switching in Young and Aging Bilinguals. Journal of Experimental Psychology: Learning Memory and Cognition 35(3). https://doi.org/10.1037/a0014981

Green DW and Abutalebi J (2013) Language control in bilinguals: The adaptive control hypothesis. Journal of Cognitive Psychology 25(5). https://doi.org/10.1080/20445911.2013.796377

Gynan SN and López Almada EL (2020) The glottal stop in Guaraní and Paraguayan Spanish. In R Rao (Ed.), Spanish Phonetics and Phonology in Contact: Studies from Africa, the Americas and Spain. John Benjamins Publishing, pp. 227–262. https://doi.org/10.1075/ihll.28.09gyn

Harris J (1983) Syllable structure and stress in Spanish. a non-linear analysis. In Linguistic Inquiry Monographs (Vol. 8). MIT Press.

Hayes B (2009) Syllabification in English. Introductory Phonology 20.

Henriksen N (2012) Chicagoland heritage and native Mexican Spanish intonation: Three contact phenomena. Current Approaches to Spanish and Portuguese Second Language Phonology. Current Approaches to Spanish and Portuguese Second Language Phonology.

Hualde JI (2009) Unstressed words in Spanish. Language Sciences 31, 199–212. https://doi.org/10.1016/j.langsci.2008.12.003

Hualde J (1991) On Spanish syllabification. In H Campos and F Martínez-Gil (Eds.), Current Studies in Spanish Linguistics. Washington D.C.: Georgetown University Press.

Hualde JI (2014) Los sonidos del español. Cambridge University Press.

Hualde JI and Prieto P (2014) Lenition of intervocalic alveolar fricatives in Catalan and Spanish. Phonetica 71, 109–127. https://doi.org/10.1159/000368197

Hualde JI, Simonet M and Nadeu M (2011) Consonant lenition and phonological recategorization. JLP 2, 301–329. https://doi.org/10.1515/LABPHON.2011.011

Huss V (1978) English word stress in the post-nuclear position. Phonetica 35 (2). https://doi.org/10.1159/000259924

Ivanova-Sullivan T, Sekerina IA, Tofighi D and Polinsky M (2022) Language-Internal Reanalysis of Clitic Placement in Heritage Grammars Reduces the Cost of Computation: Evidence from Bulgarian. Languages 7 (1). https://doi.org/10.3390/languages7010024

Kahn D (1976) Syllable-based generalizations in English phonology [Massachusetts Institute of Technology]. https://doi.org/10.4324/9781315688121

Kaisse EM (1996) Resyllabification Precedes all Segmental Rules (LAR Jean-Marc Authier, Barbara E. Bullock, Ed.; p. 197). https://doi.org/10.1075/cilt.185.15kai

Kayne RS (2009) More articles than meet the eye. In Talk handout.

Kehoe M (2002) Developing vowel systems as a window to bilingual phonology. International Journal of Bilingualism 6, 315–334. https://doi.org/10.1177/13670069020060030601

Kehoe M and Havy M (2018) Bilingual phonological acquisition: the influence of language-internal, language-external, and lexical factors. Journal of Child Language 46, 292–333. https://doi.org/10.1017/S0305000918000478

Kehoe M, Lleó C and Rakow M (2004) Voice onset time in bilingual German-Spanish children. Bilingualism: Language and Cognition 7, 71–88. https://doi.org/10.1017/S1366728904001282

Kehoe M, Trujillo C and Lleó C (2001) Bilingual phonological acquisition: An analysis of syllable structure and VOT. In KF Cantone and M.-O. Hinzelin (Eds.), Proceedings of the colloquium on structure, acquisi-tion and change of grammars: Phonological and syntactic aspects. Arbeiten zur Mehrsprachigkeit, pp. 38–54.

Kim JY (2011) L1-L2 phonetic interference in the production of Spanish heritage speakers in the US. The Korean Journal of Hispanic Studies 4, 1–28. https://doi.org/10.18855/lisoko.2010.35.1.003

Kim JY (2019) Heritage speakers' use of prosodic strategies in focus marking in Spanish. International Journal of Bilingualism 23, 986–1004. https://doi.org/10.1177/1367006918763139

Kim JY (2020) Discrepancy between heritage speakers' use of suprasegmental cues in the perception and production of Spanish lexical stress. Bilingualism 23, 233–250. https://doi.org/10.1017/S1366728918001220

Kim JY and Repiso-Puigdelliura G (2021) Keeping a critical eye on majority language influence: the case of uptalk in heritage Spanish. Languages 6, 1–27. https://doi.org/10.3390/languages6010013

Kohler KJ (1994) Glottal Stops and Glottalization in German. Phonetica 51 (1–3). https://doi.org/10.1159/000261957

Kubota M, Chevalier N and Sorace A (2020) How bilingual experience and executive control influence development in language control among bilingual children. Developmental Science 23(1). https://doi.org/10.1111/desc.12865

Kupisch T and Rothman J (2018) Terminology matters! Why difference is not incompleteness and how early child bilinguals are heritage speakers Article. International Journal of Bilingualism 22, 564–582. https://doi.org/10.1177/1367006916654355

Kupisch T, Kolb N, Rodina Y and Urek O (2021) Foreign Accent in Pre- and Primary School Heritage Bilinguals. Languages, 6, 96. https://doi.org/10.3390/languages6020096

Ladefoged P and Maddieson I (1996) The Sounds of World's Languages. Blackwell.

Lahoz-Bengoechea J and Jiménez-Bravo M (2020) Spoken word boundary detection in ambiguous resyllabification contexts in Spanish. Laboratory Phonology, 1–33.

Leon-Carrion J, García-Orza J and Pérez-Santamaría FJ (2004) Development of the inhibitory component of the executive functions in children and adolescents. International Journal of Neuroscience 114(10). https://doi.org/10.1080/00207450490476066

Lieberman P (1960) Some Acoustic Correlates of Word Stress in American English. Journal of the Acoustical Society of America 32(4). https://doi.org/10.1121/1.1908095

Lleó C (2018) Aspects of the phonology of Spanish as a heritage language: From incomplete acquisition to transfer. Bilingualism: Language and Cognition 21, 734–747. https://doi.org/10.1017/S1366728917000165

Lüdecke D, Ben-Shachar MS, Patil I, Waggoner P and Makowski D (2021) performance: An R Package for Assessment, Comparison and Testing of Statistical Models. Journal of Open Source Software 6, 3139.

Luk G, Green DW, Abutalebi J and Grady C (2012) Cognitive control for language switching in bilinguals: A quantitative meta-analysis of functional neuroimaging studies. Language and Cognitive Processes 27(10). https://doi.org/10.1080/01690965.2011.613209

MacWhinney B (2000) The CHILDES project: Tools for analyzing talk. In Lawrence Erlbaum Associates. (Ed.), Child Language Teaching and Therapy (3rd ed.). https://doi.org/10.1177/026565909200800211

Mai Z, Zhao L and Yip V (2022) The Mandarin ba -construction in school-age heritage speakers and their parental input. Linguistic Approaches to Bilingualism 12(3). https://doi.org/10.1075/lab.18025.mai

Marecka M, Wrembel M, Otwinowska A, Szewczyk J and Banasik-Jemielniak N (2020) Bilingual children's phonology shows evidence of transfer, but not deceleration in their L1. Studies in Second Language Acquisition 42, 16. https://doi.org/10.1017/S0272263119000408

Mateu V and Hyams N (2016) One is the loneliest number: The Acquisition of Spanish Indefinite "un." In L Perkins, R Dudley, J Gerard and K Hitczenko (Eds.), Proceedings of the 6th Conference on Generative Approaches to Language Acquisition North America (GALANA 2015) (pp. 73–80). Cascadilla Proceedings Project.

McAuliffe M, Socolof M, Mihuc S, Wagner M and Sonderegger M (2017) Montreal Forced Aligner: trainable text-speech alignment using Kaldi. Proceedings of the 18th Conference of the International Speech Communication Association, 498-502, doi: 10.21437/Interspeech.2017-1386

Menke MR (2018) Development of Spanish rhotics in Spanish–English bilingual children in the United States. Journal of Child Language 45, 788–806. https://doi.org/10.1017/S0305000917000460

Michnowicz J and Kagan L (2016) On glottal stops in Yucatan Spanish. In S Sessarego and F Tejedo-Herrero (Eds.), Spanish Language and Sociolinguistic Analysis. John Benjamins Publishing Company, pp. 217–240. https://doi.org/10.1075/ihll.8.09mic

Mitterer H, Kim S and Cho T (2021) Glottal stops do not constrain lexical access as do oral stops. PLoS ONE, 16(11 November). https://doi.org/10.1371/journal.pone.0259573

Mohamed S, González C and Muntendam A (2019) Arabic-Spanish language contact in Puerto Rico: A case of glottal stop epenthesis. Languages 4, 93.

Montrul S (2018) Heritage language development: Connecting the dots. International Journal of Bilingualism 22, 530–546. https://doi.org/10.1177/1367006916654368

Montrul S and Sánchez-Walker N (2013) Differential Object Marking in Child and Adult Spanish Heritage Speakers. Language Acquisition 20, 109–132. https://doi.org/10.1080/10489223.2013.766741

Nakatani LH and Aston CH (1978) Perceiving the stress pattern of words in sentences. The Journal of the Acoustical Society of America 63. https://doi.org/10.1121/1.2016717

Newton C and Wells B (2002) Between-word junctures in early multi-word speech. Journal of Child Language 29, 275–299. https://doi.org/10.1017/S0305000902005044

Nittrouer S (1993) The emergence of mature gestural patterns is not uniform: Evidence from an acoustic study. Journal of Speech and Hearing Research 36, 959–972. https://doi.org/10.1044/jshr.3605.959

Otheguy R (2016) The linguistic competence of second-generation bilinguals. In C Tortora, den DM, IL Montoya, and T. O'Neil (Eds.), Romance Linguistics 2013: Selected papers from the 43rd Linguistic Symposium (p. 301). John Benjamins Publishing Company.

Otto SA and Bayley R (2008) Chicano English: Phonology. In A Handbook of Varieties of English (Vol. 1). https://doi.org/10.1515/9783110208405.1.219, pp. 417–434.

Paradis J (2010) Bilingual Children's Acquisition of English Verb Morphology: Effects of Language Exposure, Structure Complexity, and Task Type. Language Learning 60, 651–680. https://doi.org/10.1111/J.1467-9922.2010.00567.X

Paradis J and Genesee F (1996) Syntactic acquisition in bilingual children: Autonomous or interdependent? Studies in Second Language Acquisition 18, 1–25. https://doi.org/10.1017/S0272263100014662

Place S and Hoff E (2011) Properties of Dual Language Exposure That Influence 2-Year-Olds' Bilingual Proficiency. Child Development 82, 1834–1849. https://doi.org/10.1111/j.1467-8624.2011.01660.x

Polinsky M (2018) Bilingual children and adult heritage speakers: The range of comparison. International Journal of Bilingualism 22, 547–563. https://doi.org/10.1177/1367006916656048

Polinsky M and Scontras G (2020) Understanding heritage languages. Bilingualism: Language and Cognition 23, 4–20. https://doi.org/10.1017/S1366728919000245

Rafat Y, Mohaghegh M and Stevenson R (2017) Geminate attrition across three generations of Farsi-English bilinguals living in Canada: An acoustic study. Ilha Do Desterro 70, 151–168. https://doi.org/10.5007/2175-8026.2017v70n3p151

Rao R (2014) On the status of the phoneme /b/ in heritage speakers of Spanish. Sintagma 26, 37–54. https://www.raco.cat/index.php/Sintagma/article/view/293002

Rao R (2016) On the nuclear intonational phonology of heritage speakers of Spanish. In Diego Pascual y Cabo (Ed.), Advances in Spanish as a heritage language. John Benjamins Publishing Company, pp. 51–80. https://doi.org/10.1075/sibil.49.04rao

R Development Core Team. (2020) R: a language and environment for statistical computing. In R: A Language and Environmental for Estatistical Computing. https://www.r-project.org/

Redi L and Shattuck-Hufnagel S (2001) Variation in the realization of glottalization in normal speakers. Journal of Phonetics 29, 407–429. https://doi.org/10.1006/jpho.2001.0145

Repiso-Puigdelliura G and Kim JY (2021) The missing link in Spanish heritage trill production. Bilingualism 24, 454–466. https://doi.org/10.1017/S1366728920000668

Reverberi C, Kuhlen A, Abutalebi J, Greulich RS, Costa A, Seyed-Allaei S and Haynes JD (2015) Language control in bilinguals: Intention to speak vs. execution of speech. Brain and Language 144. https://doi.org/10.1016/j.bandl.2015.03.004

Ribot KM and Hoff E (2014) "¿Cómo estas?" "i'm good." Conversational code-switching is related to profiles of expressive and receptive proficiency in Spanish–English bilingual toddlers. International Journal of Behavioral Development 38(4). https://doi.org/10.1177/0165025414533225

Robinson K (2012) The Dialectology of Syllabification: A Review of Variation in the Ecuadorian Highlands. Romance Philology 66, 115–145. https://doi.org/10.1484/J.RPH.5.100801

Robles-Puente S (2014) Prosody in contact: Spanish in Los Angeles. In ProQuest Dissertations and Theses. University of Southern California.

Ronquest R (2013). An Acoustic Examination of Unstressed Vowel Reduction in Heritage Spanish. In C Howe, S Blackwell and M Lubbers Quesada (Eds.), Selected Proceedings of the 15th Hispanic Linguistics Symposium. Cascadilla Proceedings Project, pp. 151–171.

Rothman J (2007) Heritage speaker competence differences, language change, and input type: Inflected infinitives in Heritage Brazilian Portuguese. International Journal of Bilingualism 11, 359–389. https://doi.org/10.1177/13670069070110040201

Rubach J (1996) Shortening and ambisyllabicity in English. Phonology 13, 197–237. https://doi.org/10.1017/S0952675700002104

Ruiz-Felter R, Cooperson SJ, Bedore LM and Peña ED (2016) Influence of current input-output and age of first exposure on phonological acquisition in early bilingual Spanish–English-speaking kindergarteners. International Journal of Language & Communication Disorders 51, 368–383. https://doi.org/10.1111/1460-6984.12214

Saadah E (2011) The production of Arabic vowels by English L2 learners and heritage speakers of Arabic. University of Illinois at Urbana-Champaign.

Scarpace D (2017) The Acquisition of Resyllabification in Spanish by English Speakers. University of Illinois at Urbana-Champaign.

Scobbie JM and Pouplier M (2010) The role of syllable structure in external sandhi: An EPG study of vocalisation and retraction in word-final English /l/. Journal of Phonetics 38, 240–259. https://doi.org/10.1016/j.wocn.2009.10.005

Segbers J and Schroeder S (2017) How many words do children know? A corpus-based estimation of children's total vocabulary size. Language Testing 34(3). https://doi.org/10.1177/0265532216641152

Singh L and Singh NC (2008) The development of articulatory signatures in children. Developmental Science 11, 467–473.

Stevens G (1992) The social and demographic context of language use in the United States. American Sociological Review 57, 171–185.

Strandberg JAE, Gooskens C and Schüppert A (2021) Simultaneous bilingualism and speech style as predictors of variation in allophone production: Evidence from Finland-Swedish. Journal of Phonetics 88. https://doi.org/10.1016/j.wocn.2021.101095

Strycharczuk P and Kohlberger M (2016) Resyllabification Reconsidered: On the Durational Properties of Word-Final /s/ in Spanish. Laboratory Phonology: Journal of the Association for Laboratory Phonology 7, 1–24. https://doi.org/10.5334/labphon.5

Tamburelli M, Sanoudaki E, Jones G and Sowinska M (2015) Acceleration in the bilingual acquisition of phonological structure: Evidence from Polish–English bilingual children. Bilingualism: Language and Cognition 18, 713–725. https://doi.org/10.1017/S1366728914000716

Thordardottir E (2011) The relationship between bilingual exposure and vocabulary development. International Journal of Bilingualism 15, 426–445. https://doi.org/10.1177/1367006911403202

Torreira F (2007) Tonal realization of syllabic affiliation in Spanish. Journal of Phonetics 35, 473–500. www.icphs2007.de

Trawick S and Michnowicz J (2019) Glottal Insertion before Vowel-Initial Words in the Spanish of Asunción, Paraguay.

Tse H (2016a) Contact-induced splits in Toronto Heritage Cantonese mid-vowels. Linguistica Atlantica 35, 133–155. http://projects.chass.utoronto.ca/ngn/HLVC/0_0_home.php

Tse H (2016b) Variation and change in Toronto heritage Cantonese. Asia-Pacific Language Variation 2(2). https://doi.org/10.1075/aplv.2.2.02tse

Valdés G (2000) Introduction. In Spanish for native speakers (Vol. 1). Harcourt College., pp. 1–32.

Viterbori P, Zanobini M and Cozzani F (2018) Phonological development in children with different lexical skills. First Language 38(5). https://doi.org/10.1177/0142723718784369

Zoom Video Communications Inc. (2019) Zoom meetings & Chat.