Mapping different L1 dialects to L2 words

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We ask how dialect experience affects the perception of modified L2 words by speakers of different L1 dialects. Colombian Spanish speakers from Barranquilla (s-aspirating dialect) and Bogota (non-s-aspirating dialect) carried out cross-dialect phonological priming experiments in Spanish and L2 English. For Spanish, primes and targets were counterbalanced across dialect features. For English, half the primes and targets exhibited /s/-aspiration of the Barranquilla dialect. Results showed an interaction between trial type and group for the s-aspirated forms; the Barranquilla group showed a significant priming effect in Spanish and also for the nonword /s/-aspirated forms in English. Further analysis revealed that the priming effect for English /s/-aspirated forms was attenuated in Barranquilla listeners with greater English proficiency. These results show that second language listeners transfer abstract native language dialect knowledge to L2 input even when this knowledge is not directly part of the L2 input, providing evidence for the transfer of abstract, socially-indexed knowledge to the processing of L2.

Keywords: Spanish, phonological form priming, second language, variability, dialects

1. Introduction: L1 dialect and L2 acquisition

Learning the sound categories of a new language as an adult is challenging on many different levels. At its essence, the very thing that makes us so good at speaking and perceiving our native language is what leads to problems with a new language. By the time the L2 is acquired, adults have been using their native language for years and have accumulated many stored examples of its sounds and regularities. Since no two languages have exactly the same sound system, the complexity of L2 learning will depend greatly upon how the native and second language representations compare (Best & Tyler, 2007; Flege, 1995). In some cases, L2 learners may need to acquire a whole new set of cues to new categories, or, alternatively, learn to ignore L1 cues that are irrelevant for L2 distinctions. Studies examining

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cross-language lexical processing show that bilinguals have weaker representations of certain contrasts in their non-dominant language (Pallier, Colomé & Sebastián-Gallés, 2012; Sebastián-Gallés, Rodríguez-Fornells, Diego-Balaguer & Díaz, 2006) and exhibit less inhibition than native speakers on priming tasks that involve these contrasts (Broersma, 2012).

This challenge is augmented considerably when we consider that listeners are also speakers and perceivers of particular L1 dialects, which means that perceiving and producing a second language may not always proceed from exactly the same set of 'standard' L1 categories (Escudero & Williams, 2012; Escudero, Boersma, Rauber & Bion, 2009; Shea, 2021). If, as claimed by the dominant L2 perceptual models, contrasts that are similar in the L1 and the L2 are easier to perceive, this should also apply to L2 perception by speakers of different dialects. If a particular contrast aligns more closely with Dialect A than Dialect B, speakers of Dialect A should, in theory, have an easier time processing the contrasts in the L2. In other words, dialect-specific variation should facilitate processing of L2 words that are consistent with it and L2 learners who are native speakers of that particular dialect should perceive and produce the L2 targets with greater accuracy.

It is important to mention, however, that simply determining the way L2 sounds assimilate into dialects is not sufficient. The *amount* and *type* of experience listeners have with specific dialects also affects how the L2 sounds are processed. In a recent study on the perception of /s/-aspiration (e.g., *sie[h]ta* vs. *sie[s]ta*, 'nap') in Spanish by L2 listeners, Schmidt (2018) found that learners who had greater experience with the aspirated variant (through study abroad, native-speaker interactions) classified the aspirated /s/ target more closely to native-speaker norms. Importantly, Schmidt's results highlighted the role of interaction and metalinguistic awareness in the classification of dialect variants such as /s/-aspiration. Research on lexical processing by native speakers has shown that native and standard dialects often have an advantage over unfamiliar and non-standard dialects (Clopper, 2014; Clopper, Tamati & Pierrehumbert, 2016; Floccia, Goslin, Girard, & Konopczynski, 2006) and this advantage carries over to many different languages.

In a study examining native English speaker cross-dialect perception, Sumner and Samuel (2009) investigated the processing of non-rhotic (New York City) and rhotic ('General American') English by listeners with different dialectal experiences. They tested whether words with final <<-er>> could serve as primes for their rhotic and non-rhotic targets (e.g., filt[ɚ] vs filt[ə]). Participants had varying degrees of experience with each variant. Some were exposed to the non-rhotic form in their daily lives and used it in their everyday speech, others who heard it but did not use it in their everyday speech and finally, others who had little prior exposure to the non-rhotic forms and did not use it in their own speech.

The results from a repetition priming task showed that the two groups with more experience with the non-rhotic form were primed by it, while the group with less exposure was not. Sumner and Samuel concluded that listeners with greater experience with both dialects had greater perceptual flexibility and that the processing benefits observed for local and prestigious dialects may be driven by familiarity as well as positive social stereotypes associated with the specific dialect and its features (see also Sumner, Kim, King, & McGowan, 2014).

Larraza, Samuel and Oñederra (2017) combined both the perception and priming of cross-dialectal features in a study with two groups of simultaneous Spanish-Basque early bilinguals who were speakers of Standard Basque or Western Basque. In Standard Basque, there are two voiceless fricatives, the apical /s̺/ and the laminal /s̻/ while in Western Basque, these two sounds have merged into the apical sound only. On an AXB discrimination task comparing the laminal vs. apical fricative, Standard Basque listeners performed significantly better on both accuracy and were significantly faster than the Western Basque speakers. Participants then completed an auditory lexical decision task with two sets of critical words: half with the laminal fricative and half with the apical fricative. These were matched with items in which the fricatives were switched, creating critical nonwords (e.g., [gi.s̻ar.te.a] 'the society'> *[gi.s̺ar.te.a]; [ba.βe.s̺a] 'the protection' > *[ba.βe.s̻a], p. 98). The results showed that Western speakers accepted the laminal nonwords 91% of the time and apical nonwords 51% of the time, more than twice as often as the Standard speakers did. This study shows that phonetic perception difficulties can impede lexical encoding and lead listeners to accept words that contained legal and also unlicensed dialectal variation, resulting in the 'spurious activation of variants with no dialectal basis' (p. 105).

In the present study, we bring together both cross-linguistic and L1 cross-dialect speech perception and examine how experience facilitates the processing of modified L2 words that exhibit L1 dialect variation. The dialect variant used is /s/-aspiration, which is not contrastive in any dialect of Spanish. Participants were native speakers of two varieties of Colombian Spanish, from Barranquilla and Bogota. The Barranquilla, or *costeño* dialect, is more regionally marked and exhibits /s/-aspiration in syllable coda while the Bogota dialect does not.

We begin with L1-L1 cross-dialect priming in order to test the hypothesis that for this variant, regionally-marked dialect speakers will have an advantage when perceiving their own and the 'unmarked' dialect, consistent with the results found above for non-rhotic speakers of English. The advantage of priming (over, say, pure lexical decision) is that it allows us to judge the degree of activation of lexical candidates by particular input, and compare each candidate, or target, against each other by means of reaction times or accuracy scores. Pure lexical decision without priming does not provide information about which candidates were activated by the prime, since we cannot compare activation across different targets. Other priming studies have used semantic decisions (Sumner & Samuel, 2009). Here, we use form priming with lexical decision to determine how primes activate upcoming forms and hypothesize that when the target aligns with these activations, processing will be facilitated.

Participants completed an auditory phonological form priming task in Spanish, in which primes and targets varied across dialects (with or without /s/-aspiration). Participants then completed a second L2-L2 form priming task in their second language, English. Importantly, half the English primes and targets were modified to reflect the /s/-aspiration feature of the Barranquilla dialect. That is, they were pronounced with an aspirated /s/ before a stop (e.g., fa[h]ter 'faster'). For both Spanish and English, the prime-target pairs were of two types: matched and unmatched. The matched prime-target pairs had the same word, same aspiration pattern, e.g., [h]-[h] or [s]-[s] as in the pairs e[h]te-e[h]te *este-este* 'east-east' or pi[s]ta-pi[s]ta *pista-pista* 'path-path', and, due to a technical difficulty, we were obliged to use the same speakers as well. The unmatched pairs had the same word with different speakers and aspiration patterns, e.g., [h]-[s], as in ge[s]to-ge[h]to *gesto-gesto* 'gesture-gesture' or [s]-[h], as in tra[h]te-tra[s]te *traste-traste* 'dish-dish'. Participants had to make a lexical decision on the target.

Since the English words were, in fact nonwords in English, it was possible that listeners might reject these words outright as impossible in English on both a lexical and sublexical, phonotactic level, since [*h.C] and even *[.hC] are phonotactically prohibited in English. However, it is also possible that because these nonwords in English exhibit abstract similarities to the Barranquilla dialect, listeners may perceive them as possible words in English, rather than outright nonwords. In order for this to be the case, however, listeners will necessarily need to transfer L1 dialect features to the novel English words. Given this, the present study tests cross-language and cross-dialect at both the phonetic and phonological (i.e., abstract) levels. Specifically, if the /s/-aspirated form does indeed prime English words that have been modified to include it, the priming effect could be argued to reflect an abstract, dialect-specific generalization taken from the L1. In this sense, the present study tests both phonetic (L1-L1) and priming at a more abstract phonological level (L2-L2 modified forms).

It is also important to note that Spanish and English syllabify [s.C] sequences differently. In Spanish, this sequence is phonotactically illegal while in English it is not. Words such as 'hasta' in Spanish are syllabified as [as.ta] while words such as 'faster' in English are syllabified as [fæ.stəɹ]. Thus, when Spanish speakers hear English input with an aspirated coda they could, arguably, assume this is phonotactically legal in English. However, once they have mastered the phonotactic rules of English, these same learners will know that [h] cannot occur in the coda or as part of a complex onset in that language. For the purpose of the present study, this phonotactic knowledge may be part of what participants develop. However, if this is in fact what is happening and is therefore independent of dialect-specific knowledge, there should be no differences across the two dialect groups in the reaction times to the phonotactically illegal *[.ht] English words. In other words, if dialect does not play a role in accepting or rejecting the *[.ht] English words, the Barranquilla and Bogota groups will show an equivalent lack of priming for these trials.

Given the type of tasks and dialectal variant examined, the present study necessarily considers dialectal variation at various levels of representation, including lexical and phonological. Phonological abstraction allows listeners to create equivalences across different speech events and understand different speakers and novel words. Abstractionist theories of phonology claim that minimal representations are the basis for such generalizations while episodic theories (Goldinger, 1998; Johnson, 2006) argue instead that generalizations emerge through experience with input (both type and token frequency, Hay et al., 2004). The guiding hypothesis that Barranquilla listeners will transfer their dialect-specific abstract structure to English modified forms reflects transfer at the phonological level to new, L2, input. We predict that English primes with /s/-aspiration will facilitate lexical recognition of both /s/-aspirated and non-aspirated lexical targets for Barranquilla listeners and inhibit processing by Bogota listeners. We also predict that since /s/-aspirated forms do not actually exist in English and are indeed 'non-words' in that language, this effect should be attenuated by experience: Barranquilla lower proficiency listeners will be more likely to exhibit priming from L1 dialect-specific representations than listeners of higher proficiency, given their greater experience with the L2. L2 learners at lower proficiency levels approach the acquisition of a second language by transferring their knowledge of how languages work from their first language, which we hypothesize to include dialect-specific phonological patterns. In terms of L1-L1 processing, we hypothesize that Barranquilla listeners will show an advantage for processing both their own dialect and the Bogota dialect, based upon the results obtained by Sumner and Samuel (2009), using a similar methodology. In the next two sections we present more information about /s/-aspiration in Spanish and in particular, its sociolinguistic context in Colombia.

1.1 /s/-aspiration in Spanish

The phonetic realization of aspirated coda /s/ is not limited to the coastal region of Colombia. It occurs throughout coastal regions of Latin America, the Spanish-speaking Caribbean and Andalusia in southern Spain. Indeed, the lenition of coda

[s] to [h] or ø occurs in the speech of approximately half the Spanish-speaking world (Brown & Torres Cacoullos, 2003; Chapelle, 2014) and is one of the most extensively studied sociolinguistic variables of Spanish, from the perspective of phonology (Colina, 1999; Kaisse, 1997) and phonetics (Gerfen, 2002; Torreira, 2007).[1]

The actual phonetic realization of coda /s/-aspiration in preconsonantal position can vary across individual speakers and even words. A fully aspirated segment similar to [h] (e.g., *fuiste* 'you went' /fu̯iste/ → [fu̯ihte]) can be found in South American coastal regions, Chile, Argentina, Uruguay, the Spanish Caribbean as well as Andalusia and the Canary Islands. Preconsonantal coda /s/ can also be realized as a pre-aspirated geminate consonant or a post-aspirated consonant in Andalusian Spanish (Gerfen, 2002; Parrell, 2012), leading to forms such as *pasto* 'grass' /pasto/ → [pahtto] and [pat^{h}o]. Complete elision of the preconsonantal coda /s/ segment is also possible, leading to forms such as *escuela* 'school' /esku̯ela/ → [eku̯ela]. Dialects spoken in the Spanish Caribbean exhibit this elided form and words such as *pasto* 'grass' and *pato* 'duck' can be homophonous.

Phonologically, coda /s/-lenition or aspiration is generally accounted for by the loss of a place specification feature, which results in either [h], the geminate consonant or total elision. As stated, in most radical dialects, speakers alternate between the two forms. Coda /s/-aspiration can occur in word-internal preconsonantal position (e.g., *este* 'this' /este/ → [ehte]), in word-final preconsonantal position (e.g., *las torres* 'the towers' /las#tores/ → [lahtores]) and in pre-pausal position when the following onset is a consonant or in word-final position. In some dialects, word-final aspirated /s/ can be post-lexically re-syllabifed onto the onset of the following word, resulting in phrases such as *las alas* [lah#alah] becoming [la.ha.lah]. While the contexts for coda /s/-aspiration found across dialects can be characterized as a continuum, all dialects that aspirate do so when coda /s/ occurs in word-internal coda position, before an onset consonant.

Variability in the realization of /s/ has been explained by sociolinguistic and speech-related factors. In most of the Spanish-speaking world, /s/-aspiration and deletion has been associated with markers of social class – upper-class speakers tend more towards retention while lower socioeconomic classes favor lenition (Lipski, 1994). In terms of style, /s/-aspiration occurs more frequently in rapid, informal conversation-styles than in more formal, read speech (File-Muriel, 2009). In a study focused specifically on speakers from Barranquilla, File-Muriel

1. While 'aspiration' is not strictly what occurs in many of the dialects that exhibit lenition of /s/ in coda position, it is one of the terms most widely used in the literature examining the phenomenon from a phonological and phonetic perspective.

(2009) examined how lexical frequency effects played out in the patterning of /s/-aspiration. Participants read a list of 100 sentences taken from a Colombian newspaper, all of which contained instances of lexical [s.C], in word-internal position. He examined the role of lexical factors (word frequency, length and phonotactic frequency), phonological factors (stress, vowel context, place/manner of articulation of the consonant following /s/) and gender of the speakers. File-Muriel found that lexical frequency made the greatest contribution (more frequent words were aspirated more often), followed by speaker gender and place/manner of articulation of the following consonant (fricatives favored /s/-aspiration more than any other consonant). Because File-Muriel's speakers were from the same socioeconomic strata, social class was not included as a variable. In another study examining the Cali, Colombia dialect, File-Muriel and Brown (2011) showed that duration, voicing and spectral properties of /s/ were collectively affected by phonological context, speaking rate and lexical stress. Thus, according to these authors, /s/-aspiration should be regarded as a gradient rather than categorical phenomenon (for similar results, see Erker (2010) for Dominican Spanish). We follow File-Muriel and Erker and assume that the Barranquilla listeners in the present study are exposed to a great deal of phonetic variability in the realization of aspirated /s/ in their native Spanish dialect and most likely rely upon a constellation of acoustic cues and sociolinguistically indexed factors that cannot be reduced to one or two invariable phonetic features, beyond regional affiliation with Barranquilla Spanish.

1.2 Colombian Spanish: *Costeños* vs. *cachacos*

Using phonological characteristics, Lipski (1994) groups Colombian Spanish into four main dialectal regions. Of those regions, Bogota, the capital, is in the Central highlands and Barranquilla is on the Caribbean coast. In Colombia, Bogotanos are called *cachacos* and are typically described as being very formal and more reserved than their Barranquilla counterparts, who are commonly known as *costeños*, and often identified as speaking more rapidly and in a much more 'animated' manner (Escamilla-Morales, 1993; Garrido, 2007). According to Lipski (1994), the sociolinguistic prestige of the capital dialect is considerable and it is generally held as the model for all educated Colombians. This is partially a consequence of how Colombia was settled during colonial times, by elite governors from northern Spain (Lipski, 1994). This led to the establishment of certain phonological and phonetic characteristics of Bogotano Spanish, among which is the full retention of the /s/ in coda position and more limited consonant lenition. Currently, most of Colombia's elite live in Bogota, cementing its position as the dialect of power and prestige.

The Caribbean coast, on the other hand, was settled primarily by Spaniards from southern Spain who used slave labor to work their agricultural holdings; together, these two groups have heavily influenced the Spanish spoken in this region. The *costeño* dialect is considered by many Colombians as 'defective', reflecting an informal, uneducated manner of speaking (Escamillo-Morales, 1993). Nonetheless, there is a certain degree of covert prestige held by *costeño* dialect speakers, accompanied by a strong sense of regionalism that today has translated to a recognition of the prestige held by the capital variety but at the same time certain pride in their *costeño* speech variety, even if the *costeños* themselves overtly recognize Bogotano as the prestige variety spoken in Colombia (Garrido, 2007).

In the present study, we use a form-priming task with lexical decision to determine whether speakers of these two Colombian dialects are primed differently by aspirated /s/, present predominantly in the costeño dialect and, subsequently, whether the costeño group transfers their the /s/-aspiration feature to words in English. In the next section we describe the experimental methods used to address these questions.

2. Method

Participants completed four tasks, counterbalanced across participants and counterbalanced for language: two auditory phonological form priming tasks with lexical decision (in English and Spanish, about 15 minutes), a monologue task (in English and Spanish, about ten minutes each), a vocabulary evaluation (in English only, about 15 minutes) and an autobiographical questionnaire regarding experience with English and other dialects (about ten minutes). The entire experiment took about 1.5 hours. Participants completed all the tasks in one language first (about 3–5 minute break between tasks) and were granted about 5 minutes between the shift to the other language. The experiments were carried out in a quiet room at their respective university, in Bogota or Barranquilla. We did not recruit individuals from Barranquilla living in Bogota or vice versa.

2.1 Stimuli for the form-priming task

For the form priming with lexical decision task, 60 lexical items with word-internal coda [s.C] structure were selected from each language to serve as experimental prime-target pairs. Given inherent limitations in the lexicons of Spanish and English, items with voiceless plosives, bilabial nasal consonants and labiodental fricatives in the following syllable onset position were selected.

Three types of prime-target pairs were created for each language (see Table 1 below): trials with the variants of experimental interest, control trials and filler/nonword trials. The trials with the variants of interest included ten pairs in which the prime and target were the same word and had /s/ in internal coda position (no aspiration). These were the *matched [s]* items (e.g., *a[s]ko-a[s]ko*, 'disgust'). A second set included ten prime-target pairs with the same word and [h] in internal coda position (e.g., *rie[h]go-rie[h]go*, 'risk'). These were the *matched [h]* items. Due to a methodological problem, as stated above, the matched items were produced with the same voice. This is further addressed in the results and analysis section below. A third set of ten pairs included the same lexical items but different realization of the target segment across the prime and target (e.g., *ca[s]ko-ca[h]ko* 'helmet' or *vi[h]to-vi[s]to* 'seen'). Five of these trials had the [s] internal coda for the prime and [h] for the target. The other five had [h] internal coda for the prime and coda [s] for the target. These were the *unmatched* trials, produced with different voices. Originally, we planned to analyze the ten unmatched trials together, without considering the prime variant (i.e., grouping [s] and [h] primes together). Once the data was collected and analyzed, however, the decision was made to separate them, resulting in a total of five trials for each prime type. Nonetheless, the total number of unmatched trials was ten. Together, there were 30 matched and unmatched trials.

The second type of prime-target trials consisted of 30 pairs of control trials. They included prime-target pairs for which the words were different but the aspiration feature was the same (*control matched trials* e.g., *pue[h]to-re[h]to* 'put-leftover'). There were ten prime-target pairs for which the words were different and the aspiration features were also different (*control unmatched items* e.g., *ga[h]to-li[s]to*, 'spend-ready'). The aspiration (aspirated/non-aspirated) feature was counterbalanced across prime target pairs. Together, there were 30 matched and unmatched control trials. The purpose of the control trials was to serve as a baseline for evaluating the priming effect. We hypothesized that the matched and unmatched trials with the same words would exhibit greater priming than the control items, which had different words. As explained below, the difference in priming served as the dependent variable for the regression models.

The third type of trials included 33 nonword-nonword pairs, 33 filler-filler pairs (e.g., *casa-parque*) and 33 each of nonword-filler (*mesu-coche* 'car') and filler-nonword pairs (*plato* 'plate' – *caminu*). This gave a total of 132 filler and nonword trials.

In order to minimize possible effects for item, two different lists were created. Items that were recorded by the Barranquilla dialect speaker were replaced by the same item read by the Bogota speaker. Thus, the items with coda /s/-aspiration that were primes on List 1 were non-aspirated targets for List 2. For example, the unmatched pair *busca-busca* bu[h]ka-bu[s]ka 'looks' for List 1 would appear as bu[s]ka-bu[h]ka for List 2. And the matched pair with non-aspirated coda /s/ appeared as *vista* bi[s]t̪a-bi[s]t̪a 'seen' on List 1 and with the aspirated coda /s/ as bi[h]t̪a-bi[h]t̪a on List 2. Each word from the related and unrelated pairs appeared once as a prime and once as a target, appearing one time on each list. The order for the non-word and filler items was also switched across the two lists.

In total, the form priming with lexical decision task included 30 trials with related words, 30 trials with unrelated words and 132 trials with fillers and non-word combinations. This gave a total of 192 trials per language, or 384 trials in total from each participant, across English and Spanish. Table 1 shows the prime-target pairs used in the experiment:

Table 1. Trials

<table>
<tr><th></th><th colspan="2">Spanish</th><th colspan="2">English</th></tr>
<tr><th>Condition</th><th colspan="2">Prime – Target</th><th colspan="2">Prime – Target</th></tr>
<tr><td>matched [s]</td><td>ba[s]ta
'enough'</td><td>ba[s]ta</td><td>a[s]king
'asking'</td><td>a[s]king</td></tr>
<tr><td>matched [h]</td><td>fui[h]te
'went'</td><td>fui[h]te</td><td>ma[h]ter
'master'</td><td>ma[h]ter</td></tr>
<tr><td>unmatched</td><td>ha[s]/[h]ta
'until'</td><td>ha[h]/[s|ta</td><td>di[s]/[h]play
'display'</td><td>di[h]/[s]play</td></tr>
<tr><td>control matched</td><td>mue[s]tra
'sample'</td><td>tra[s]te
'dish'</td><td>exi[s]t
'exist'</td><td>fa[s]ter
'faster'</td></tr>
<tr><td>control unmatched</td><td>fra[h]/[s]co
'bottle'</td><td>di[s]/[h]co
'disk'</td><td>we[h]/[s]tern
'western'</td><td>di[s]/[h]trict
'district'</td></tr>
<tr><td>fillers</td><td>casa
'house'</td><td>árbol
'tree'</td><td>table</td><td>pencil</td></tr>
<tr><td>nonwords</td><td>mesu</td><td>lapin</td><td>roon</td><td>flowi</td></tr>
<tr><td>filler-nonword</td><td>silla
'chair'</td><td>caju</td><td>window</td><td>rinning</td></tr>
</table>

Items for both languages were selected using the NIM search engine (Guasch et al., 2013), based upon the Léxico Informatizado del Español corpus (LEXESP; Sebastián-Gallés, Martí, Carreiras, & Cuetos, 2000). The corpus is based on 5,629,279 Spanish word tokens and 166,494 word types. All items were matched for frequency and length. The average length of the Spanish target words was 7.5 letters (range: 5–10) and the average log frequency was 1.73 (range: 1.33–2.6). For the English lexical items, the average number of letters was 7.9 (range: 6–10) and the average log frequency was 1.63. Items included verbs, nouns and adjectives. A paired samples t-test was used to compare the frequency of occurrence for each item in the prime-target pair across trials. For no pairs did frequency differences reach significance. None of the target words were obvious cognates.

The Spanish trials were created using naturalistic stimuli read by one female native speaker of the Bogota dialect and a second female native speaker of the Cartegena dialect (same Colombian Caribbean dialect region as Barranquilla). Stimuli were recorded in a soundproof booth using a Marantz PM 670 solid state recorder and a Sennheiser e835 microphone, sampled at 44.1 kHz. Speakers read each word in the carrier phrase '*Yo digo* _____ *dos veces*' ('I say _____ two times') at a comfortable pace. The speakers were informed about the purpose of the study and encouraged to read the words using their native dialects. Due to difficulties finding appropriate recording conditions, it was not possible to record more than one speaker for each dialect to create the Spanish stimuli. To maintain consistency across languages, two speakers were also used for the English stimuli. Two different tokens were selected for the trials where the prime and target were identical (in English as well) in order to avoid complete repetition of the same token. For the mismatching trials, different speakers were used.

The aspirated /s/ segments varied between 74 ms and 182 ms, with an average length of 109 ms. The average length of the [s] segments was 91 ms and the range was 68 ms–100 ms.[2] An independent samples t-test with equal variance was run on the duration of the [s] vs. [h] tokens for Spanish. The results showed a significant difference between the duration of the two token types ($t(28) = 2.3$, $p = .031$).Phonetically, all [s] tokens were sibilants and exhibited high-frequency aperiodic noise, observable in a spectrogram. The [h] tokens, on the other hand, did not exhibit any aperiodic noise and no sibilance. While the term 'aspirated coda /s/' is used to characterize these tokens, it should be noted that not all tokens were aspirated. Some tokens exhibited an elongation of the preceding vowel without aspiration. Care was taken to match primes and targets with similar phonetic realization of the aspiration variant, whenever possible. Native speakers of each dialect (distinct from those who recorded the stimuli) selected the final tokens for inclusion.

The English tokens were also created from naturalistic stimuli, read by two female native speakers of Midwest American English. The speakers read the tokens out loud in a soundproof booth using the same equipment as above. The items were placed in the carrier phrase '*I said* _______ *two times*'. The English

2. Gerfen and Hall (2001) examined the duration of /s/ in Andalusian Spanish (also an /s/-aspirating variety) and found that the duration of the aspirated segment was between 30–80 ms, shorter than the tokens used here.

tokens selected to reflect the Barranquilla aspiration feature were produced by a speaker who is a trained Spanish linguist and was aware of the dialect feature under study. She was asked to imitate a Spanish Caribbean dialect when reading the words. The word-list was read three times and the most representative tokens were selected for inclusion in the experiment by the author and a Spanish linguistics colleague. As with the Spanish tokens, two different tokens were selected for the matched trials and different speakers were used for the unmatched trials. The average length for the aspirated tokens was 119 ms (range: 79–172 ms). For the [s] tokens, the average length was 89 ms (range: 52–98 ms). An independent samples t-test with equal variance revealed a significant difference between the revealed the two sets of tokens ($t(28) = 2.65$, $p = .013$). To avoid possible biases against accepting the /s/-aspirated English forms as real words, we piloted the tasks with Colombian speakers of both dialects ($n = 4$) Mexican Spanish speakers (from Mexico City, a non-aspirating dialect, $n = 3$) who confirmed that while the aspirated forms sounded different, they were recognizable as real words.

The filler items had the same frequency range as the target items. They also ranged from 5–10 letters in length. None of the filler items had the target sequence [s.C] in word-medial or word-final positions. The non-word items were created by switching the penultimate or ultimate vowel in a real word. For example, instead of the word *mesa* 'table', the nonword became *mesu*, a word that does not exist in Spanish. An example from English is *munt,* which is similar but not exactly the same as the English word 'mint' or 'month'.

2.2 Procedure

All tasks were completed fully for one language at a time, counterbalanced for each individual across languages, lists and task order. Communication was conducted in both English and Spanish, depending upon the language of the task.

2.2.1 *Form priming task*

The form priming task was carried out using SuperLab 5.0 experimental software on a MacBook Pro computer. Participants indicated their decision regarding the lexicality of the target by pressing a key on the RB-844 USB response pad. A typical trial proceeded as follows: participants were presented with pairs of utterances over Sennheiser PXC 480 noise-cancelling headphones and were asked to make a lexical decision to the second item in each pair. They were told to answer as quickly and accurately as possible. For each trial, an auditory prime was presented first, followed by a 500 ms ISI, followed by an auditory target. Participants had three seconds to respond, after which the experiment program presented the next pair. Responses were measured from the offset of the target word and once a response was registered, a new trial began after 1500 ms. Reaction times were registered upon the release of the response key. Reaction time and accuracy were recorded.

2.2.2 *English vocabulary task*

Participants completed a standardized productive and receptive vocabulary task (R/EOWPVT-4, Brownell, 2012) in English. Participants were presented with a series of images and had to name them (productive) or select the picture named by the tester (receptive). To continue with the study, participants had to reach a minimum vocabulary score (less than 2.5 standard deviations below the mean) and be able to produce at least 30 seconds of fluent (grammatically coherent) speech. Three participants from the Barranquilla group were eliminated based upon their failure to reach these thresholds.

2.2.3 *Spanish and English monologue tasks*

Participants also completed a monologue in Spanish and in English that involved telling a story related to a time they had felt a particular emotion, selected from amongst three listed on a power point slide ('surprise', 'sadness' and 'happiness'). In addition to proficiency verification, the English monologue task also served to verify whether participants produced the /s/-aspirated form in their English speech. The results from the English monologue task showed that only two participants did so, both male Barranquilla speakers. These tokens represented 2.4% of words with the obligatory contexts (three words out of 120, across both groups).[3] The goal of the Spanish version of the monologue task was to determine if the participants in fact used the expected dialect variant in their own speech. For the Bogota group, all the participants produced 100% of their coda /s/ as alveolar fricatives. For the Barranquilla group, individual percentages for within-word and word-final coda /s/- aspiration (or elimination) ranged from 88% to 98%. The average across speakers was 95%. There was slightly more variability in the production of the /s/-aspiration feature in the Barranquilla group, which may mirror the variability of this dialect feature overall in production (File-Muriel, 2007) or reflect overall speech variability independent of the specific feature involved.

3. Other phonological processes did transfer from Spanish (e.g., nasal neutralization, epenthetic schwa in [sC] onsets). This raises an interesting question as to why /s/-aspiration did not. It may be due to the sociolinguistic indexing of /s/-aspiration as a marked feature of *costeño* speech that is consciously not reproduced in L2 English. For perception, on the other hand, the process is more implicit and therefore beyond conscious control, which means activation by English stimuli is possible. This remains to be tested in future research.

2.2.4 *Language and dialect experience questionnaire*

Participants completed a background questionnaire in Spanish that included questions about where they had lived, where their families were from and how long their families had lived in each region. Information gleaned from the background questionnaire led to the elimination of four participants from each group, in spite of their dialect-consistent productions during the monologue task.

2.3 Participants

After eliminating those who did not pass the three screening tasks (vocabulary, monologue and questionnaire), there were a total of 32 participants from Bogota (23 female) and 31 from Barranquilla (18 female). The average age was 24.5 years (range: 19–27) and all were undergraduate students majoring in something other than English or another foreign language. None of the participants had spent more than three consecutive weeks in an English-speaking country and none spoke English on a regular basis outside of their weekly or bi-weekly English classes.[4] The average age of English acquisition was 16 years (range: 13–21 years of age). None had attended a bilingual school. As part of the language background questionnaire, participants indicated if they had ever lived in another region of Colombia. Participants who had lived outside of their dialect region for longer than 6 months after the age of six (the start of school) were eliminated, which led to the exclusion of a participant from Barranquilla, who had also failed to reach the vocabulary threshold. In terms of socioeconomic status, the two groups were drawn from different strata of Colombian society. Specifically, participants from Barranquilla were attending a large public institution in that city while the Bogota participants were studying at a private university that enrolled students primarily from the upper and upper-middle socioeconomic classes. They were recruited through professors at their respective universities, from low-Intermediate or Intermediate-level English classes and received $ 20.00 for their participation.

4. In terms of classroom exposure, both groups had studied English with Colombian native Spanish-speaker teachers, native to their respective regions. After the experiment was completed and participants were informed about its goals, we asked them about whether their English teachers used the /s/-aspirated forms in the classroom. According to their responses (and anecdotal evidence from English teachers in the region), none of the participants reported hearing [s]-aspiration in the speech of their teachers.

3. Results

We present the results in three different sections. We first report the results for accuracy, followed by the difference scores, calculated as the difference in reaction time between the matched/unmatched trials and their respective control trials (e.g., the difference between the reaction time for the control pair *ha[s]ta-vi[h]ta* and the unmatched pair *ba[s]ta-ba[h]ta)*. Finally, we present the results from a correlation analysis testing the hypothesis that proficiency in English will affect the degree of priming for the English /s/-aspirated and non-aspirated forms. For all statistical models we combined the data from Spanish and English, to permit direct cross-language comparisons.

3.1 Accuracy

Mean accuracy rates and raw reaction time values are presented in Table 2, by dialect group, trial type and language. For the English trials, errors were counted as a rejection of the aspirated forms and overall, higher error rates were observed for the English trials than for the Spanish trials, of which the English nonword trials were the highest (Bogota = 7.1%, Barranquilla = 7.21%), followed by the filler-nonword trials (Bogota = 6.88%, Barranquilla = 7.07%). For Spanish, the Bogota group had a higher error rate for the [h] matched trials (1.88%) than the Barranquilla group (.91%) while the opposite held for the [s]-matched trials (Bogota = 1.08%, Barranquilla = 1.12%).

The high error rates for the nonword trials reflect the nature of the items – the base for all nonwords was a real word, with one vowel or consonant switched to make it a nonword. All errors were excluded from the statistical analysis. Table 2 presents the error rates across groups and conditions.

Figure 1 presents the error rates for Spanish and Figure 2 presents the error rates for English.

We analyzed the error rates with a mixed-effects logistic regression (*lmer*) analysis (Baayen et al., 2008) using the lme4 package (Bates et al., 2013) in R (V.3.3.1, R Core Team, 2016). The full random effects structure included intercepts for participant and item and random slopes for language and trial type for both subject and item. The full fixed effect structure included interactions among dialect group, language and target. The syntax is as follows:

Response (correct vs. incorrect) ~ Group * Language * Target +(1|Participant) + (1|Item)

We used dummy coding for all factors. The backward model selection procedure was used for both random and fixed effects. Model comparison was performed

Table 2. Error rates across all trials for Spanish and English

	Spanish	*English*	*Spanish*	*English*
	Matched [h]		*Control Matched [h]*	
Bogota	1.88%	2.7%	2.63%	3.9%
Barranquilla	.91%	1.95%	2.70%	3.1%
	Matched [s]		*Control Matched [s]*	
Bogota	1.08%	2.18%	2.17%	2.01%
Barranquilla	1.12%	2.84%	3.1%	3.1%
	Unmatched [h]-[s]		*Control Unmatched [h]-[s]*	
Bogota	2.01%	3.1%	4.2%	4.5%
Barranquilla	1.77%	2%	3.2%	4.13%
	Unmatched [s]-[h]		*Control Unmatched [s]-[h]*	
Bogota	2%	3.1%	3.8%	5.2%
Barranquilla	1.77%	2.3%	3.4%	4.3%
	Filler-Filler		*Nonword-Nonword*	
Bogota	3.9%	4.1%	6.89%	7.11%
Barranquilla	3.66%	4.52%	5.88%	7.9%
	Nonword-Filler		*Filler-Nonword*	
Bogota	4.88%	5.22%	5.59%	6.88%
Barranquilla	3.88%	4.98%	5.42%	7.07%

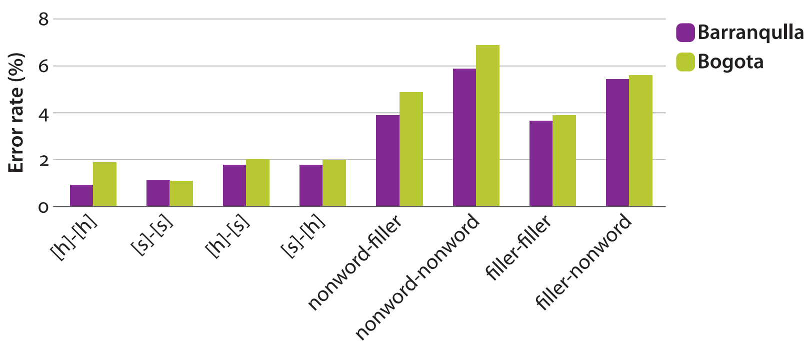


Figure 1. Error rates across all trials for Spanish

using chi-squared log-likelihood ratio tests with maximum likelihood. The random slopes improved fit ($X^2(12) = 311.2$, $p < .001$) and were included in the model.

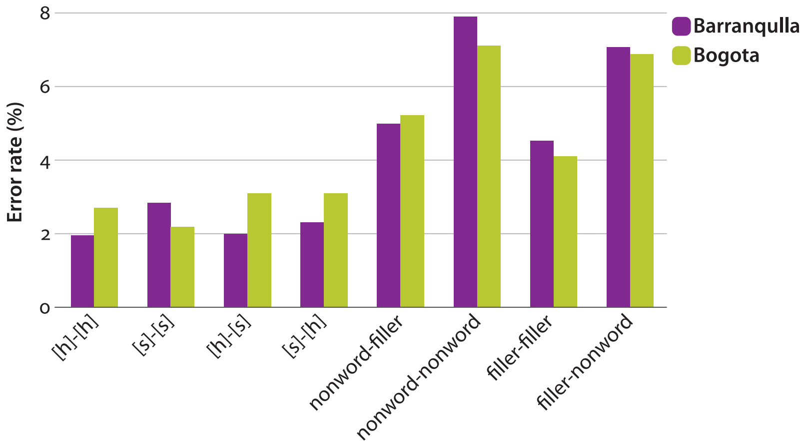


Figure 2. Error rates across all trials for English

For the fixed effects, all English trials yielded significantly more errors than Spanish trials ($z = -1.536$, $p = 0.0012$), which was the case for all trial types (all $p > 0.05$). The nonword-nonword trials yielded significantly more errors than all other trial types (all $p < 0.05$). There were no significant interactions. For the statistical analyses that follow, only correct responses were included.

3.2 Difference score results

In this section, we discuss the results from the model that used difference scores as the dependent variable. The difference scores were calculated by subtracting the reaction time for a target matched or unmatched trial from the control condition average. Recall that the matched trials had the same phonetic variant and the unmatched trials had different phonetic variants. Both had the same lexical item. As stated above, due to methodological issues, the matched trials used the same voice for the prime and the target while the unmatched trials used different voices. While this was not ideal, it is important to note that greater priming for the matched trials was predicted to occur overall. When listeners hear the same word with the same features, priming should be at its maximum. The fact that the same speaker was used meant that the repetition priming effect was potentially larger than if two voices had been used and would be the same across dialects and for both groups of speakers. Importantly, the direction of the hypotheses driving this study are not affected by the use of the same voices.

The difference scores represent the amount of priming that occurred by measuring the difference in reaction time between the target trials (same lexical items across prime and target) and the control trials (different lexical items across prime and target, different speakers). By using a baseline with different words but the same variant combination, it was possible to see the effect of the form repetition on reaction times. That is, whether the listeners were in fact processing the prime and target as the same word. If they were processing them as different words, then the reaction times would be closer to the controls.

Reaction times were checked for outliers and all values ±2.5SD away from the individual's mean for that condition (2.1% of all responses) were removed. The English reaction time values were greater than those for Spanish and the matched /s/ trials were the fastest for both dialect groups. This was expected, given that unaspirated forms occur in the dominant dialect and also in English. Of the target trials, the longest latencies were observed with the unmatched [s]-[h] trials in English. Table 3 provides the Log-transformed reaction times and difference scores for each dialect group across trial type and language.

Table 3. Average LogRT and difference score results across languages, groups and trial types

	LogRT				**Difference Score (ms)**			
	[h]-[h]	**[h]-[s]**	**[s]-[s]**	**[s]-[h]**	**[h]-[h]**	**[h]-[s]**	**[s]-[s]**	**[s]-[h]**
English	2.92	2.94	2.87	2.97	327.41	262.08	360.73	233.40
Barranquilla	2.89	2.93	2.89	2.90	284.99	282.08	366.85	222.89
Bogota	2.94	2.95	2.85	3.03	367.93	182.17	354.07	202.38
Spanish	2.78	2.78	2.73	2.83	274.27	290.85	305.83	274.76
Barranquilla	2.74	2.78	2.73	2.89	327.47	312.38	301.84	188.09
Bogota	2.82	2.79	2.73	2.77	218.00	269.60	311.83	362.60

Difference scores were analyzed using a linear mixed effects model in R with the lme4 package. We verified that there were no violations of homogeneity of variance by using the *plot()* function in R, which allows an examination of the fitted vs. residual values. The data was tested for normality using the Shapiro-Wilk test ($W = 0.812$, $p = 0.631$, no violation of normality). The predictors were analyzed for collinearity by computing the variance inflation factor (vif) using *mer.utils.R* (downloaded from github.com/aufrank). The variance inflation factor value was 2.3, indicating low collinearity.

The random effects structure was maximally specified with random intercepts for item and participant, with random slopes for the within variables of group for item and language for participant (see Barr, 2013). Backward selection was used first to specify the random effects structure. Model comparison was performed using chi-squared log-likelihood ratio tests with maximum likelihood. The model with random slopes for both participant and item was significantly better than the model with random intercepts only ($X^2(2) = 73.5$, $p < .001$). The fixed effects structure was maximally specified with interactions among trial type, group and language. The syntax for the final model is the following:

Difference scores ~ Group * Language * Target + (1|Participant) + (1|Item)

The default treatment coding in R was used (reference for group was Barranquilla, language was English and trial type was [h]-[h] trials). Using the *MuMIn* package (Bartón, 1.15.6) in R, we calculated the marginal and conditional coefficients of determination for the model. The Marginal R^2 represents the variance explained by fixed factors. Its value was $R^2m = .5322$. The Conditional R^2 represents the variance explained by both fixed and random factors for the entire model. The R^2c value was .5911.

Given the way in which the difference scores were calculated (RT control trials – RT target trials), lower difference scores mean less priming. Figure 3 presents these results graphically:

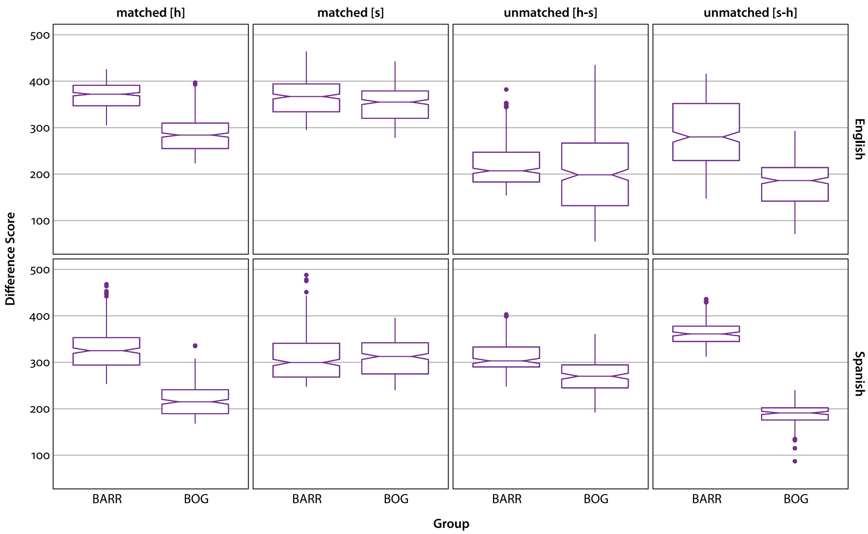


Figure 3. Difference scores (RT control – RT matched/unmatched trials) by trial-type, group and language

Table 4 provides the results from the difference score model. Values are in ms.

We first discuss the between groups results for Spanish. There was a significant difference between the groups for the [h]-[h] trials. The Barranquilla group showed a significantly greater priming effect than the Bogota group ($\beta = 140$,

Table 4. Linear mixed model results for difference scores (Difference score values are in ms)

	Variance			
Item (Intercept)	70.3			
Group	83			
Participant (Intercept)	199			
Language	221			
Residual	1052			
Fixed effects	**β**	**S.E.**	**t**	**P**
Between groups				
Spanish				
[h]-[h]: Barranquilla vs. Bogota	140	4.7	30.1	<.0001***
[s]-[s]: Barranquilla vs. Bogota	−11	5.6	−1.48	.132 n.s.
English				
[h]-[h]: Barranquilla vs. Bogota	33	3.4	9.79	<.0001***
[s]-[s]: Barranquilla vs. Bogota	−7	4.1	−1.82	.09 n.s.
Spanish				
[h]-[s]: Barranquilla vs. Bogota	62	5.9	10.4	<.0001***
[s]-[h]: Barranquilla vs. Bogota	−120	4.3	−27.7	<.0001***
English				
[h]-[s]: Barranquilla vs. Bogota	197	5.9	33.2	<.0001***
[s]-[h]: Barranquilla vs. Bogota	212	6.4	18.1	<.0001***
Within groups				
Spanish				
Barranquilla: [h]-[h] vs. [s]-[s]	14.1	4.1	3.5	.005**
Bogota: [h]-[h] vs. [s]-[s]	−115.4	4.4	−26.1	<.0001***
English				
Barranquilla: [h]-[h] vs. [s]-[s]	16.8	3.4	4.9	<.0001***
Bogota: [h]-[h] vs. [s]-[s]	−44	3.7	−11.8	<.0001***
Spanish				
Barranquilla: [h]-[s] vs. [s]-[h]	52	6.7	7.8	<.0001***
Bogota: [h]-[s] vs. [s]-[h]	−64	6	−10.9	<.0001***
English				
Barranquilla: [h]-[s] vs. [s]-[h]	47.4	4	11.9	<.0001***
Bogota: [h]-[s] vs. [s]-[h]	−131.4	4.1	−32.5	<.0001***

$t = 30.1$, $p < .001$). For the [s]-[s] trials, however, the difference across the groups did not reach significance ($\beta = -11$, $t = -1.5$, $p = .132$). For the unmatched trials, the Barranquilla group showed significantly greater priming for the [h]-[s] unmatched primes ([h]-[s]: $\beta = 62$, $t = 10.4$, $p < .0001$) but significantly less for the [s]-[h] unmatched primes ($\beta = -120$, $t = -27.7$, $p < .0001$) compared to the Bogota listeners.

Comparisons within groups for Spanish showed a significantly greater priming effect for the [h]-[h] vs. [s]-[s] trials for the Barranquilla group ($\beta = 14.1$, $t = 3.5$, $p = .005$). The Bogota group showed the opposite effect, whereby the [h]-[h] trials exhibited significantly less priming than the [s]-[s] trials ($\beta = -115.4$, $t = -26.1$, $p < .001$). For the unmatched trials, the Barranquilla group showed greater priming effects for the [h]-[s] trials than for the [s]-h] trials ($\beta = 52$, $t = 7.8$, $p < .001$) while the Bogota group showed significantly less priming for the [h]-[s] trials ($\beta = -64$, $t = -10.9$, $p < .001$).

The across-group comparisons for English trials showed significantly greater priming for the Barranquilla group on the [h]-[h] trials than for the Bogota group ($\beta = 33$, $t = 9.79$, $p < .001$) while for the [s]-[s] trials, the difference between groups was non-significant ($\beta = -7$, $t = -1.82$, $p = .09$). For the English unmatched items, the Barranquilla group exhibited significantly greater difference scores than the Bogota group for both trial types ([h]-[s]: $\beta = 197$, $t = 33.2$, $p < .001$; [s]-[h]: $\beta = 212$, $t = 18.1$, $p < .001$).

The within-group matched English items showed a similar pattern to that of Spanish, whereby the Barranquilla listeners showed significantly greater difference scores for the [h]-[h] vs. [s]-[s] trials ($\beta = 16.8$, $t = 4.9$, $p < .001$). The Bogota group showed the opposite effect ($\beta = -44$, $t = -11.8$, $p < .001$). The within-group unmatched English trials for the Barranquilla group revealed significantly greater difference scores for the [h]-[s] vs. [s]-[h] trials ($\beta = 47.4$, $t = 11.9$, $p < .001$) while the Bogota group showed the opposite effect, with significantly lower difference scores for the [h]-[s] trials ($\beta = -131.4$, $t = -32.5$, $p < .001$).

3.3 Discussion: Difference scores

The results from the Spanish difference score model show interesting priming patterns across and within groups. For the matched non-aspirated variants, no significant difference emerged across groups for Spanish or for English. For the aspirated variants, on the other hand, the Barranquilla listeners exhibited greater difference scores for the matched aspirated trials in both English and Spanish when compared to the Bogota group. For the within-group trials, each group showed significantly greater difference scores for their respective dialect variant. That is, the Barranquilla listeners showed a larger priming effect for the aspirated variants and the Bogota listeners showed a larger effect for the non-aspirated variants. This is consistent with the predictions guiding the study.

For the unmatched trials, based upon previous work, we expected to find that the Barranquilla group would demonstrate greater priming for both unmatched trials than the Bogota group, across English and Spanish. This was confirmed for English but not for Spanish. For Spanish, across-group difference score comparisons revealed greater priming effects for the Barranquilla listeners on [h]-[s] trials while the Bogota listeners showed significantly greater priming for [s]-[h] trials. Thus, for Spanish, cross-group comparisons revealed that listeners were primed more by the /s/-aspiration variant that was consistent with their dialect. It is important to note that there were fewer trials for the unmatched items than for the matched items, which may have led to greater cross-group differences. For English, the pattern was different. The Baranquilla group showed greater priming for both unmatched trial types. For the within-group unmatched English trials, the two groups showed opposite priming effects, similar to those observed for Spanish. Specifically, the trials with the dialect-consistent variant was primed more than the non-dialect-consistent variant.

How can we account for these differences across groups for the Spanish and English unmatched primes? For the Spanish trials, since both words are plausible items in Spanish, there may be a difference across the strength of encoding for each, reflecting the native dialect of the listener. The variant that is specific to the listener's dialect is more strongly encoded and thus primes the target to a greater extent than the non-dialect variant. For the English trials with /s/-aspiration (both as prime and target) there are no specific lexical targets that can be activated. For the Barranquilla listeners, however, the /s/-aspiration feature is consistent with an *abstract representation* of their dialect variant, which may serve to activate forms they have never encountered in English. For the Bogota listeners, the /s/-aspirated forms are not encoded as strongly and therefore do not serve as abstract activation for the English items.

Since these forms are effectively nonwords in English, it is also possible that activation of abstract phonological knowledge regarding /s/-aspiration is modulated by experience with English. Specifically, as listeners gain experience with English, the transfer of /s/-aspiration phonological patterns will diminish and participants with higher L2 proficiency will exhibit less activation of [h] items than lower-proficiency participants. We explore this possibility in the next section.

3.4 Proficiency results

If proficiency interacts with lexical processing of the aspirated English forms, Barranquilla listeners with *higher* English proficiency (as measured by a vocabulary test) will exhibit less activation of aspirated primes in English than lower-proficiency listeners. In order to test this hypothesis, random effects coefficients were extracted using the *ranef*() function in the package *lme4* (Bates et al., 2015).

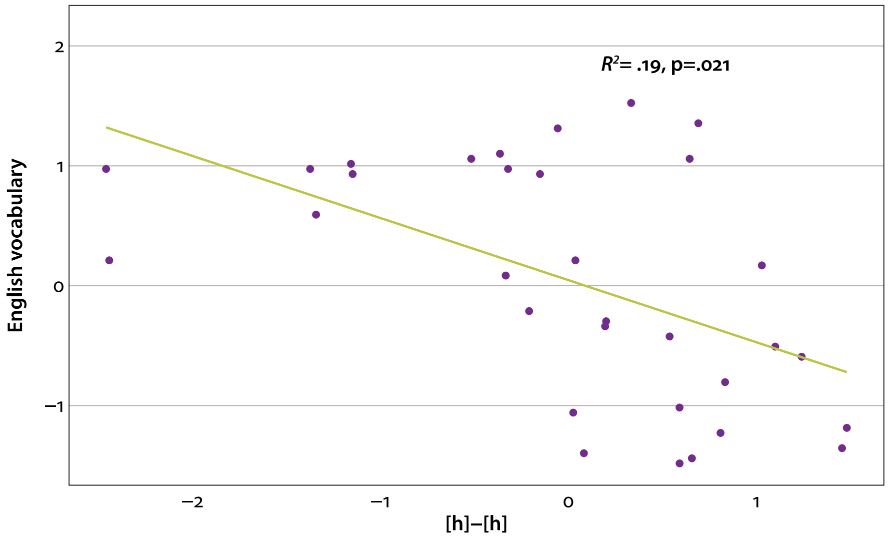
As is well recognized, one of the advantages of using mixed models is that they allow researchers to estimate the amount of variation in the average reaction time across individuals. The random effects coefficients (also known as best linear unbiased predictors, or BLUPs) represent the difference from the mean intercept for each individual intercept. While BLUPs are not formally parameters of the model, they provide an estimate of how each participant (or item) systematically varies from group level estimates (Baayen et al., 2008). To test the hypothesis that Barranquilla listeners with lower proficiency in English were more likely to accept the aspirated forms as primes, we extracted the individual BLUPs for the [h]-[h] and [h]-[s] trials from the difference score model presented above. Subsequently, we correlated the BLUP values with each participant's vocabulary score for English (vocabulary in Spanish is not expected to have an effect on difference scores). All values were normalized to a mean of zero. Higher BLUPs indicate difference scores that were above the mean for that condition while lower BLUPs indicate scores that were below the mean. Participants who exhibited greater priming for the trials with [h] primes in English (higher BLUP scores) are predicted to have lower English proficiency.

The results support this prediction and show a negative correlation between the Barranquilla group's English vocabulary scores ($M = .035$) and the [h]-[h] BLUP values ($M = .089$, $r(29) = -.53$, $p = .0024$) and [h]-[s] BLUP values ($M = .13$, $r(29) = -.431$, $p = .024$). Figure 4 plots the correlation between BLUP values and English vocabulary scores for the Barranquilla participants:

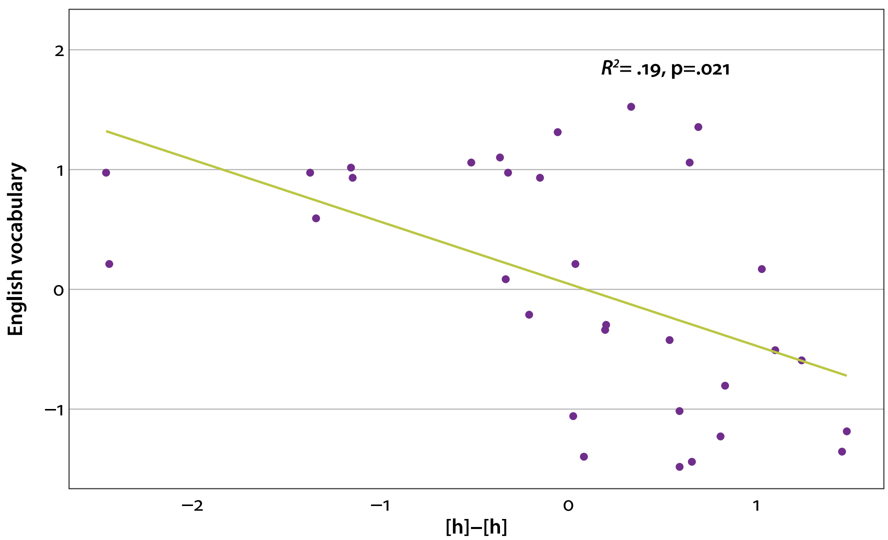
To summarize, the results show a moderate negative correlation between the BLUP coefficients and English vocabulary for both trials with [h] primes. This outcome confirms the prediction that as English proficiency (operationalized as vocabulary knowledge) increases, the amount of priming observed for the [h]-[h] and [h]-[s] trials decreases.

4. Discussion and conclusions

In this study we examined cross-dialect priming and confirmed that experience plays a key role in processing dialect variants. Participants were from Barranquilla, speakers of the *costeño* dialect in which /s/-aspiration is common, and from Bogota, speakers of highland Colombian Spanish in which /s/-aspiration rarely occurs. Cross-dialect phonological form priming in Spanish revealed that across groups, there were no significant priming differences for the [s]-[s]



(a)



(b)

Figure 4. Correlation between BLUP values and English vocabulary scores for Barranquilla group

matched trials. For the [h]-[h] matched trials, however, the Barranquilla group showed significantly more priming than the Bogota group. Due to methodological issues, the same voice was used for the matched trials, which may have inadvertently led to greater priming effects for this condition than if different voices had been used but, as stated above, this effect does not negatively impact the hypotheses of the study. These results follow those found previously in the literature showing a standard dialect advantage in cross-dialect lexical recognition and priming (Sumner & Samuel, 2009). For unmatched items, dialect-specific activation effects emerged whereby each group showed a larger priming effect in for primes that matched their dialect-specific feature. That is, the Barranquilla group was faster when the prime was [h] and the target [s] while the opposite held for the Bogota listeners.

We then considered how the native dialect serves to process modified second language input. The same groups of listeners were exposed to nonwords in English that had been modified from real English words to include an aspirated /s/ that resembled the aspirated /s/ variants of Barranquilla Spanish. The Barranquilla listeners were significantly faster and showed greater priming effects for the matched trials with aspiration than the Bogota listeners and were also faster than the Bogota listeners on the unmatched trials overall, a result that contrasted with that obtained for Spanish. The within-group results showed similar dialect-specific results for the matched trials and, as for Spanish, unmatched trials also revealed a similar pattern to Spanish.

Episodic views of the lexicon can account for a part of these results. According to these models (e.g., Goldinger, 1998), as listeners are exposed to speech variants, they store each in a detailed lexical representation. In the present case, that means that both the /s/-aspirated form and the unaspirated are represented in speakers' memories and frequency of exposure would determine how quickly each is accessed in recognition and production (Bürki et al., 2018; Pitt, Dilley, & Tat, 2011; Ranbom & Connine, 2007). While episodic models can account for the priming advantage exhibited by the Barranquilla group for their dialect, it is less obvious how these models might explain the fact that both groups exhibited equal priming for the unaspirated matched trials. According to the frequency-based argument, we would not expect to see this, since each group was tested in their native dialect regions and all participants were native to those regions as well. While the Barranquilla group is exposed to the Bogota dialect in the media (news and politicians), we could also potentially say the same for the Bogota listeners, who are certainly aware of the *costeño* speech and readily identify it as particular to that region. Thus, it is difficult to argue that frequency of exposure (or even word frequency with particular dialect-specific forms) is the driving factor behind the results observed here. Moreover, as noted in the introduction, /s/-aspiration occurs widely throughout the Spanish-speaking world, not just in Barranquilla, Colombia. Thus, the aspirated variant may in fact be heard quite often by speakers of both dialects, once media, music and other possible input sources are taken into account.

Another way of accounting for these results is by means of hybrid models of speech processing in which word-form knowledge and sociophonetic knowledge are simultaneously mapped to linguistic and social representations (Sumner et al., 2014). This type of model could account for the priming effect observed for the unaspirated forms across both groups in Spanish, if we argue that the Bogota dialect is more prestigious and therefore receives greater attentional resources at encoding and activation – independent of frequency – leading to the equivalent degree of priming between the two dialect groups. One difficulty with this explanation, however, is the finding that dialect-specific priming was observed for the unmatched trials as well. If the Barranquilla group is giving greater socially-encoded weight to the unaspirated forms, it should hold for the unmatched forms as well and lead to a greater priming effect across the unmatched trials as well.

For the L2 results, the Barranquilla group showed significantly more priming for the matched modified English words with /s/-aspiration but, consistent with the Spanish results, no significant difference emerged across the two groups for the /s/-unaspirated forms. However, the Barranquilla listeners did show more priming for *both* unmatched trial types in English than the Bogota group, distinct from the Spanish results described above. Neither episodic nor hybrid models with social-weighting can fully account for the data, mainly because the aspirated forms are nonwords in English.

Instead, we argue that Barranquilla listeners have extensive L1 experience that they use to infer what acceptable forms linguistic input can take (Pajak et al., 2016; Shea, 2021). As shown from the priming results in Spanish, participants encoded dialect-specific information in their Spanish lexical representations and the Barranquilla listeners exhibited priming for both their own and the Bogota dialects. For English, modified L2 'words' with /s/-aspiration also successfully primed each other for the Barranquilla listeners, suggesting that L2 learners can abstract dialect-specific information from their first language and apply it to L2 forms. This, we argue, implies a role for implicit transfer of abstract L1 dialect features to novel L2 input (again, these are nonwords in English) in the development of L2 representations. For second language learners, experience at the early stages with the L2 builds from generalizations across the L1, since L2 categories are still sparse and limited. Therefore, it is logical (and indeed rational) for the listeners from Barranquilla to continue relying upon both dialects when processing English. As shown in this study and others (see the introduction), listeners can use their native dialect and non-native dialect to process their L1, so it is logical for them to do so when processing the L2 as well, even when the forms are nonwords in that language. This is key to explaining why /s/-aspiration may serve as a basis for processing new input and extend to input that is not really part of the L2. As experience accumulates, L2 representations become more robustly encoded and the L1 generalizations that do not align with the L2 input no longer serve as the basis for processing (Clopper, Tamati & Pierrehumbert, 2016; Pierrehumbert, 2001). Experience will fine-tune the use of this knowledge and diminish the activation of lexical items with the incorrect abstractions.[5]

In conclusion, the results from this study provide a novel perspective on the role of experience in L2 phonetic and phonological acquisition, broadening it to include abstraction across socially-indexed L1 dialectal representations to L2 input. These results provide evidence in favor of L2 lexical representations that are sensitive to L1 dialect information, even in situations where this information is not strictly supported by the L2 input itself.

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5. An anonymous reviewer pointed out that it is also possible that the observed proficiency effects could be due to the acquisition of abstract phonotactic properties of English, specifically, the fact that *[h.C]/[s.C] and *[.hC] are illegal syllabification structures in that language and this knowledge is what diminishes the priming effect for the English nonword aspirated forms for the more advanced listeners. While this may indeed play a role in the results obtained here, abstract syllabification restrictions cannot account for the gradiency observed in the results of this study and the fact that both groups showed a significant difference between the aspirated and non-aspirated forms for the unmatched trials, a difference that aligned with the variant found in their native dialect.

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