On glottal stops in Yucatan Spanish: language contact and dialect standardization

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Abstract:
This article examines the impact of linguistic and extra-linguistic factors on the production of glottalization (/ʔ/ and creaky voice) in Yucatan Spanish. The results of this study suggest that glottal insertion before vowel-initial words in Yucatan Spanish is the product of language contact mediated by internal development. It also indicates that glottal insertion, like other traditional features of Yucatan Spanish, is undergoing a process of standardization, whereby younger, more educated speakers employ a less traditional, more ‘standard’ variety of Spanish.

1. Introduction

A growing body of literature has examined the Spanish spoken in the Mexican state of Yucatan, noting the distinctiveness of this regional variety vis-à-vis other dialects of Mexican Spanish (Klee & Lynch, 2009; Michnowicz, 2008, in pressA). This distinctiveness, which extends to other cultural domains as well (Méndez, 2007; Quezada, 2001), stems in large part from the interplay of two related factors. First, until the middle of the 20th century, Yucatan was isolated (physically, culturally and linguistically) from the rest of Mexico (Mosely, 1980). This isolation allowed Yucatan Spanish (YS) to evolve outside of the reach of the pan-Hispanic norms that were developed in more connected regions, such as central Mexico and the Caribbean. Second,
YS has been in contact with an indigenous language, Yucatec Maya (hereafter Maya) for the past five centuries, with close contact between the two languages occurring since the migration of large numbers of Maya speakers to the cities at the end of the 19th century (Mosely, 1980; Lipski, 2004). Contact-induced influence from Maya is often given as one of the main reasons for the distinctiveness of YS, and Yucatan (along with parts of Guatemala) has been cited as one of the three regions of Latin America most likely to exhibit indigenous language influence (along with Paraguay and the Andean region) (Klee, 2009).

Traits that distinguish YS from surrounding varieties include suprasegmental (prenuclear peak alignment (Michnowicz & Barnes, 2013)), and morpho-syntactic features (subject pronoun expression (Michnowicz, in pressB)). The majority of the research on YS, however, has focused on segmental phonetic/phonological variants. Variables studied include the labialization of absolute final nasals – [ˈpam] for pan ‘bread’ (Lope Blanch, 1987; Michnowicz, 2006, 2007, 2009; Yager, 1982, 1989); the use of occlusive [bdg] in contexts that would require an approximant [βðɣ] in standard varieties – [ˈto.do] for todo ‘all’ (Alvar, 1969; Barrera Vásquez, 1937; García Fajardo, 1984; Lope Blanch, 1987; Michnowicz, 2009, 2011, 2012; Yager, 1982); aspirated /ptk/ - [ˈkʰa.sa] for kasa ‘house’ (Alvar, 1969; Barrera Vásquez, 1937; Coupal & Plante, 1977; García Fajardo, 1984; Lope Blanch, 1987; Michnowicz, 2012; Michnowicz & Carpenter, 2013; Nykl, 1938; Suárez, 1979; Yager, 1982); and finally the topic of the present investigation, glottal stop insertion, specifically before vowel initial words – [ˈkwar.to.ʔa.no] for cuarto año ‘fourth year’ (Barrera Vásquez, 1937; García Fajardo, 1984; Lope Blanch, 1987; Michnowicz, 2012; Nykl, 1938; Suárez, 1979; Yager, 1982).

Although /ʔ/ has been widely commented on in previous studies, its use by speakers of YS has rarely been quantified, and has never been analyzed using acoustic means.

The present study seeks to address these shortcomings, providing a clearer picture of the linguistic and social patterning of /ʔ/ in YS through the use of quantitative sociolinguistic methods and acoustic analysis. The rest of the paper is as follows: section 2 reviews previous studies on /ʔ/ insertion, both in other dialects of Spanish as well as in YS, along with the research questions; section 3 presents the methodology, while section
4 reviews the results of the statistical analyses of glottal insertion in YS; and finally sections 5 and 6 present further discussion and conclusions.

2. /ʔ/ across Spanish dialects

Glottal stop insertion is not widely attested in Spanish, and has been presented as a feature that is foreign to most varieties of the language (Bissiri, Lecumberri, Cooke, & Volín, 2011; Valentín-Márquez, 2006). Standard varieties of Spanish generally employ a process of *enlace*, by which a word final consonant resyllabifies into the onset of the following vowel-initial syllable, so that *seis años* ‘six years’ is pronounced as [ˈsej.'sa,ṇos]; likewise, syllable-final and syllable-initial vowels may undergo some level of coalescence or linking, so that *mi otro* ‘my other’ surfaces as [ˈmjo.tro] (Hualde, 2005). Some dialects, including YS, variably show a different process, by which resyllabification/coalescence is blocked by the insertion of a glottal stop, which then occupies the onset of the word-initial syllable. In these varieties, forms such as [ˈsejs.'a,ṇos] or [ˈmi.'ʔo.tro] are possible. This process has most often been presented as a contact feature in previous literature, and in addition to YS, is found in Philippine Spanish (Lipski, 1987) and Guarani Spanish in Paraguay and Argentina (Corrientes) (de Granda, 1982; Thon, 1989). In both of these cases, the existence of /ʔ/ is attributed to contact with substrate or adstrate languages.

Additionally, some studies have suggested that /ʔ/ can arise as a variant of /s/ in dialects that show coda /s/ weakening. A glottal stop as a variant of /s/ has been argued for Puerto Rican Spanish, where contact with English may also be a factor (specifically Valentín-Márquez, 2006; see also Terrell, 1977; Tellado González, 2007). Other studies have examined /ʔ/ as a variant of /s/ in non-contact varieties. Cortés Gómez (1979) found cases of /ʔ/ in Badajoz, Spain, primarily preceding voiceless occlusives ([eʔ.'ta.a] *estaca* ‘post’ (p. 29). Chappell (2013), in the most comprehensive study of Spanish glottal stops to date, examined /ʔ/ in Nicaraguan Spanish, another region where language contact is not a factor. Chappell (2013, pp. 2-3) found that /ʔ/ could occur both in the presence of underlying /s/ ([ˈda.'ʔu.ṇa] *das una* ‘you give one’), as well as in contexts where no underlying sibilant was present ([la.'ʔu.βa] *la uva* ‘the grape’). Based on her data, Chappell (2013) concludes that glottal insertion in Nicaraguan Spanish can serve to both
compensate for the loss of underlying /s/, and also as a general strategy to resolve hiatus even in the absence of an elided segment. Specifically, in cases of underlying /s/, Chappell (2013: 104) found 9.4% /ʔ/ across all tasks (sociolinguistic interview, reading sentences, and image identification tasks), with an additional 5.7% realized as creaky voice, for a total of 15.1% glottalized realizations. Rates were much lower in the absence of underlying /s/, with 0.9% /ʔ/ and 2.3% creaky voice, for a total of 3.2% glottalized tokens in intervocalic position (p. 111). Valentín-Márquez (2006, p. 331) found similarly low rates of glottal insertion in Puerto Rico, with /ʔ/ accounting for 9% of all tokens of underlying /s/. In these dialects, glottal insertion is an incipient process, with younger speakers producing higher rates of /ʔ/.

Previous studies have found that /ʔ/ insertion is phonetically conditioned by a variety of factors. These include syllable stress, with glottalized variants more common before stressed vowels (Valentín-Márquez, 2006; Chappell 2013), a finding that is echoed in the literature on YS (Lope Blanch, 1987), and also in studies of other languages with glottalization, such as English (Pierrehumbert, 1995; Dilley, Shattuck-Hufnagel & Ostendorf, 1996; Davidson & Erker, 2014). In Nicaraguan Spanish, the mid vowel /o/ and longer preceding words were also found to favor glottalization (Chappell 2013). Finally, studies have indicated that the grammatical category of word pairings has a significant effect on the production of glottals. In Puerto Rican Spanish, /ʔ/ was more common following the conjunctions pues ‘well’ and entonces ‘then’, and following articles (Valentín-Márquez, 2006, p. 332). Determiner-Noun pairings, followed by Noun-Adjective pairs, also showed the most /ʔ/ in Nicaraguan Spanish (Chappell, 2013, p. 201). Chappell (2013, pp. 201-206) attributes this effect to a combination of frequency and stress, at least in contexts of /s/ weakening.

Specifically with regard to YS, /ʔ/ insertion has been described as one of the most likely candidates for direct Maya influence on the dialect (Lope Blanch, 1987). This claim stems not only from the rarity of glottal segments across varieties of Spanish, but also from the phonotactics of the contact language. In Maya, /ʔ/ is phonemic, and words cannot begin or end with a vowel. Thus vowel-initial words borrowed from Spanish receive an epenthetic /ʔ/, while /h/ is added to vowel-final words, so that amigo ‘friend’ is borrowed into Maya as [ʔáamigóoh] (Frasier, 2009: 23). This suggests that bilingual
Maya speakers may be likely to also produce glottals when speaking Spanish, due to the influence of their L1 phonotactics.

Regarding the patterning of /ʔ/ in YS, Lope Blanch (1987, p. 106) reports that glottal stop insertion occurred “con notable regularidad en el habla española de buen número de yucatecos” in a variety of phonetic contexts, and occurs most often among lower-class speakers, patterning with aspirated /ptk/ (García Fajardo, 1984, pp. 85-86)³. García Fajardo (1984, p. 85) observed that no major differences existed between genders or age groups. Regarding phonetic context, glottals are reported most often in: A) word-initial position before a stressed vowel; and B) between two vowels of different quality (as in ['do.se.'ʔa.nos] doce años ‘twelve years’) (Lope Blanch, 1987, p. 115; see also Yager, 1982). Glottals were also found to occur in other positions, although much less frequently (Lope Blanch, 1987, pp. 115-116): between two stressed vowels ([kom.'ʔe.so] compré eso ‘I bought that’), and in utterance-final position ([’o.tro.'ʔe.ne?] otro nene ‘another child’). Since glottalization is reported to occur most often before vowel-initial words, this study will focus on that position.

Given that glottal insertion in YS has not been systematically analyzed using sociolinguistic or acoustic methodologies, the present study seeks to provide a preliminary account of /ʔ/ in this dialect. Specifically, the study seeks to answer the following research questions:

1. What is the distribution of glottal insertion in phrase medial, vowel-initial words in YS?
2. What are the linguistic and social factors that constrain glottal insertion?
   a. Is there evidence of direct Maya influence?
3. How do glottals pattern with respect to other regional variables in YS?
   a. Are glottals being maintained in YS, or do they follow the pattern of standardization reported for other YS variables (Michnowicz, 2012)?
4. How does glottal insertion in YS compare to previous reports on other varieties of Spanish?

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2 “...with notable regularity in the Spanish of a good number of Yucatecans” (our translation)
3 Yager (1982, 89) briefly mentions that there seems to be a preference for hiatus in YS, observing the possible connection between occlusive /bdg/, glottalization, and other variables. When considered along with aspirated /ptk/, these variables do show very similar linguistic and social distributions. This possible preference for StrongOnset (Baković, 1994) in YS should be explored further.
3. Methodology

In order to offer a preliminary answer to the research questions outlined above, data were collected via sociolinguistic interviews conducted with 18 speakers of YS. All recordings were conducted by the first author, in and around the city of Merida, Yucatan. Both authors coded the interviews for glottalization, and all tokens were checked for consistency by the first author. Speakers are generally balanced for age (older vs. younger), gender, and language background (fluent Maya-Spanish bilinguals vs. Spanish monolinguals), although a perfect balance for each subgroup was not achieved with the present corpus, due primarily to the difficulty of finding young fluent Maya-speakers in Merida. Since previous research has suggested that age is one of the primary social factors constraining /ʔ/ in YS (Michnowicz, 2012), speakers were divided into two age groups: younger speakers (19-25, mean=22) and older speakers (40-75, mean=59). Likewise, since glottalization has frequently been attributed to the influence of Maya language contact, speakers were chosen to reflect only fluent Maya-speakers vs. monolingual Spanish-speakers. Fluency in Maya was determined through a combination of self-reporting, family situation (i.e. a spouse or parent that does not speak Spanish), and other linguistic indicators of L2 Spanish (e.g. the lack of gender agreement; see Michnowicz (2012) for examples of grammatical features of Maya-Spanish bilinguals). Education level was considered in a separate analysis, given the high degree of overlap between education and age/language. Speaker demographic information is found in Table 1.

<table>
<thead>
<tr>
<th>Speaker Code</th>
<th>Gender</th>
<th>Age</th>
<th>Language</th>
<th>Occupation</th>
<th>Education Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>FM24a</td>
<td>Female</td>
<td>24</td>
<td>Maya-Span</td>
<td>Domestic labor</td>
<td>Primary</td>
</tr>
<tr>
<td>FM24b</td>
<td>Female</td>
<td>24</td>
<td>Maya-Span</td>
<td>Domestic labor</td>
<td>Secondary</td>
</tr>
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<td>Female</td>
<td>40</td>
<td>Maya-Span</td>
<td>Domestic labor</td>
<td>Primary</td>
</tr>
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<td>FM57</td>
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<td>57</td>
<td>Maya-Span</td>
<td>Domestic labor</td>
<td>None</td>
</tr>
<tr>
<td>FM65</td>
<td>Female</td>
<td>65</td>
<td>Maya-Span</td>
<td>Housewife</td>
<td>None</td>
</tr>
<tr>
<td>Code</td>
<td>Gender</td>
<td>Age</td>
<td>Language Group</td>
<td>Occupation</td>
<td>Education</td>
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<td>-------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>MM19</td>
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<td>19</td>
<td>Maya-Span</td>
<td>Domestic labor</td>
<td>Secondary</td>
</tr>
<tr>
<td>MM44</td>
<td>Male</td>
<td>44</td>
<td>Maya-Span</td>
<td>Anthropologist</td>
<td>College</td>
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<tr>
<td>MM50</td>
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<td>50</td>
<td>Maya-Span</td>
<td>Maintenance</td>
<td>Primary</td>
</tr>
<tr>
<td>MM54</td>
<td>Male</td>
<td>54</td>
<td>Maya-Span</td>
<td>Construction</td>
<td>Primary</td>
</tr>
<tr>
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<td>College student</td>
<td>College</td>
</tr>
<tr>
<td>FS22</td>
<td>Female</td>
<td>22</td>
<td>Spanish</td>
<td>College student</td>
<td>College</td>
</tr>
<tr>
<td>FS69</td>
<td>Female</td>
<td>69</td>
<td>Spanish</td>
<td>Housewife</td>
<td>Secondary</td>
</tr>
<tr>
<td>FS72</td>
<td>Female</td>
<td>72</td>
<td>Spanish</td>
<td>Housewife</td>
<td>College</td>
</tr>
<tr>
<td>MS21a</td>
<td>Male</td>
<td>21</td>
<td>Spanish</td>
<td>College student</td>
<td>College</td>
</tr>
<tr>
<td>MS21b</td>
<td>Male</td>
<td>21</td>
<td>Spanish</td>
<td>College student</td>
<td>College</td>
</tr>
<tr>
<td>MS25</td>
<td>Male</td>
<td>25</td>
<td>Spanish</td>
<td>Business</td>
<td>College</td>
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<tr>
<td>MS67</td>
<td>Male</td>
<td>67</td>
<td>Spanish</td>
<td>Business</td>
<td>College</td>
</tr>
<tr>
<td>MS76</td>
<td>Male</td>
<td>76</td>
<td>Spanish</td>
<td>Retired business</td>
<td>Secondary</td>
</tr>
</tbody>
</table>

Table 1. Speaker backgrounds. Codes are their gender (M/F), language group (M/S) and age.

For this study, the envelope of variation was identified as the first 100 phrase-medial, vowel-initial words in each sociolinguistic interview. Tokens were identified and coded in Praat (Boersma & Weenick, 2013), and generally followed the guidelines presented in Chappell (2013, pp. 89-99). Specifically, tokens were identified as one of three possible variants. Full glottal stops were characterized by silence in the spectrogram and a flattened waveform lasting more than 30 milliseconds. An example of /ʔ/ is seen in Figure 1, an older Maya speaker’s (FM65) production of *es ocho* ‘it is eight’.
Creaky voice was considered a glottalized variant (see below), and was identified by separation in the glottal pulses in the spectrogram and of the waveform. Creaky voice can be seen in Figure 2, showing the same speaker’s (FM65) production of \textit{empieza a} ‘s/he begins to’. The vocal creak is evident between the two realizations of /a/ across the word boundary.

Finally, tokens were coded as ‘non-insertion’ if neither of the previous two criteria were apparent, and normative \textit{enlace} was seen to obtain, with no pause or creaky voice visible.
An example of non-insertion, the same speaker’s (FM65) production of *qué otro* ‘what other’, is seen in Figure 3.

![Waveform and spectrogram](image)

Figure 3. Non-insertion (FM65).

Following initial analyses (detailed in section 4), full /ʔ/ and creaky voice were combined as ‘glottal’. This combination is justified both based on the relationship between the two variants, as well as their behavior in the present data.

First, creaky voice and /ʔ/ can be thought of as occurring along the same continuum of glottalization. Ladefoged & Maddieson (1996, p. 75) note that “[g]lottal stops are apt to fall short of complete closure, especially in intervocalic positions. In place of a true stop, a very compressed form of creaky voice…may be superimposed on the vocalic stream”. Importantly, creaky voice and a full stop can be virtually indistinguishable impressionistically. Docherty & Foulkes (2005) found that 70% of audibly glottal tokens in Newcastle English were actually cases of creaky voice. The same pattern holds true for YS – tokens that were impressionistically /ʔ/ were often found to be creaked upon inspection of the waveform and spectrogram.

Second, in order to confirm the validity of combining /ʔ/ and creaky voice in the present analysis, separate statistical analyses were run on each of these variants. Results indicated that both full glottal stop and creaky voice behave virtually identically with respect to the factors examined here, a result that differs from Chappell’s (2013) results for Nicaraguan Spanish. In fact, the only difference in constraint hierarchy in the two analyses was for gender, with women using slightly more creaky voice, compared to
more /ʔ/ for men. Gender was not a significant factor in either analysis, however. Finally, following Davidson & Erker (2014), an additional analysis was run that compared /ʔ/ and creaky voice, excluding non-insertion tokens. No independent variables reached significance in this model, indicating that in the present data, /ʔ/ and creaky voice are statistically equivalent. Therefore, after the initial results showing the frequency of both glottalized variants, creaky voice and /ʔ/ were combined as ‘glottal’ (vs. non-insertion) in the remaining analyses. The entire data set, with the binary dependent variable (glottal vs. non-insertion) was analyzed via a mixed-effects logistic regression in Rbrul (Johnson, 2014), a front end for R (R Core Team, 2014). Speaker and word were included as random factors.

Tokens were coded for a variety of linguistic and extra-linguistic factors, based on the findings of previous research on glottalization in Spanish dialects. Independent variables analyzed are outlined in Table 2.

<table>
<thead>
<tr>
<th>Linguistic variables</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preceding word length (in syllables)</td>
<td>1, 2, 3, 4+</td>
</tr>
<tr>
<td>Following vowel stress</td>
<td>Tonic/Atonic</td>
</tr>
<tr>
<td>Following vowel</td>
<td>Collapsed to /a/, /a/, Other</td>
</tr>
<tr>
<td>Preceding segment</td>
<td>Vowel/Consonant</td>
</tr>
<tr>
<td>Word pairs</td>
<td>Adjective-Noun; Other^4</td>
</tr>
<tr>
<td>Sameness of preceding/following vowels (intervocalic tokens only)</td>
<td>Same/Different</td>
</tr>
<tr>
<td>Social factors</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>Younger (19-25); Older 40-76</td>
</tr>
<tr>
<td>Gender</td>
<td>Male/Female</td>
</tr>
<tr>
<td>Language</td>
<td>Maya(bilingual)/Spanish(monolingual)</td>
</tr>
<tr>
<td>Education</td>
<td>Primary or less/Secondary or more</td>
</tr>
</tbody>
</table>

Table 2. Independent variables

4 The recodings for following vowel, word pairs, and preceding segment were checked for significance with the X^2 test feature in Rbrul, and model comparisons showed that the simplified models were not significantly different from the full model.

4 Results

The overall distribution of tokens is seen in Table 3. As can be seen, glottalized tokens occurred in a total of 11% of vowel-initial words. This rate is similar to that found in Puerto Rico (9% - Valentín-Márquez, 2006) and Nicaragua (also 9% averaged across /s/ and V_V contexts - Chappell, 2013). It is also similar to Michnowicz’s (2012, p. 110)
impressionistic case study (13%). Of the 11% glottalized tokens, almost 2/3 are cases of creaky voice, rather than full /ʔ/. As discussed in the methodology, in the remaining analyses creaky voice and glottal stops will be considered together as ‘glottal’.

<table>
<thead>
<tr>
<th>/ʔ/</th>
<th>Creaky Voice</th>
<th>Total Glottal</th>
<th>Non-insertion</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5%</td>
<td>6.5%</td>
<td>11%</td>
<td>89%</td>
<td>100%</td>
</tr>
<tr>
<td>82/1800</td>
<td>118/1800</td>
<td>200/1800</td>
<td>1600/1800</td>
<td>1800/1800</td>
</tr>
</tbody>
</table>

Table 3. Overall distribution of variants

The results of the regression analysis are found in Table 4. With binary variables, Rbrul provides both logodds and Varbrul-type factor weights. Both of these are statistical measures of the variable’s effect on glottal insertion, with positive logodds and factor weights over 0.5 statistically favoring glottalization.
Table 4. Results of regression analyses. *Education was run in a separate model: Deviance 1124.08, df: 12, Intercept -1.359, Grand Mean: 0.111, Input prob 0.204; +Sameness of the preceding and following vowel also run separately, with only intervocalic tokens: Deviance 771.931, df: 3, Intercept -2.289, Grand Mean: 0.111, Input prob 0.092

Table 4 reveals a significant main effect of following vowel stress, age, preceding word length, following vowel, and language. Education was run separately in place of age and language, due to high degrees of overlap among these factors, and was also a significant factor\(^5\). There was also a significant interaction of Age:Stress (p = 0.0158), which will be addressed in the discussion. Word pairings, gender, preceding segment, and sameness of the preceding/following vowels (run separately) failed to reach significance.

The results for linguistic factors largely support the findings of previous studies. Glottalization is favored by a following tonic vowel, longer preceding words, and a following /o/ (see Valentín-Márquez, 2006; Chappell, 2013).

Following vowel stress has been repeatedly found to condition glottalization in a variety of languages, and is attributed to processes of prosodic strengthening that privilege tonic syllables, especially in word-initial position (Dilley et al., 1996; Chappell, 2013; Garellek, 2014; Davidson & Erker, 2014).

In Nicaraguan Spanish, Chappell (2013) relates the effect for preceding word length to /s/ weakening in that dialect. Studies have found that longer words show higher rates of /s/ weakening (Terrell, 1979), a result that File-Muriel (2007) relates to perception and processing – the longer the word, the less important the word-final segments become, since each preceding segment narrows down the possible interpretations of the word. Given that glottal insertion seems to function primarily as a variant of underlying /s/ in Nicaraguan Spanish, Chappell concludes that the increased glottalization following longer words is tied to the increased weakening that occurs word-finally. The present results for YS, however, complicate the picture, since there is no underlying segment to be weakened. It appears then that glottal insertion in YS is

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\(^5\) A series of Conditional Inference Trees (see Tagliamonte, 2012) including the social variables age, education and language found that age continues to be the primary factor in glottalization, with education taking on a secondary role. Language was no longer significant when analyzed with education. When education was excluded, age was still the primary split, while language groups patterned similarly to education groups, due to high degrees of overlap.
responding to a desire to delimit word boundaries, a tendency that may be increased among bilingual speakers. This possibility will be further explored in the discussion.

Regarding following vowel, as in Chappell (2013), a following /o/ was found to significantly favor glottal insertion. Chappell argues that this is primarily an effect of stress – in her Nicaraguan data, a majority of following /o/ occurs within stressed syllables. Stress also plays a role in the present data, with two-thirds of the word-initial /o/ tokens in stressed syllables, compared to around one-fourth for the other vowels. In the present analysis, however, inclusion of “word” as a random factor in the regression analyses makes it clear that this effect is not due to a few lexical items skewing the data (Johnson, 2009). Additionally, a comparison of only tonic syllables shows that tonic /o/ has the highest rate of glottal insertion (33%), compared to much lower rates for the other vowels (21% /a/, 12% Other). Thus the effect for /o/ remains even when we only compare stressed syllables.

Three of the social factors were significant predictors of glottal insertion. Age was the strongest social predictor, and ranked second only to following vowel stress in the analysis. Older speakers produced significantly more glottal insertions than did younger speakers. The result of fewer glottal insertions for younger speakers is consistent across both language groups, as seen in Table 5. Separate analyses for each language group show that the reduction in glottal insertion for younger speakers is significant for speakers of both linguistic backgrounds (Maya bilinguals p = 0.0101; Spanish monolinguals p = 0.00849). This change in apparent time will be further addressed in the discussion.

<table>
<thead>
<tr>
<th>Language background</th>
<th>Older</th>
<th>Younger</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maya bilinguals</td>
<td>18.7%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Spanish only</td>
<td>11.8%</td>
<td>3.6%</td>
</tr>
</tbody>
</table>

Table 5. Cross-tabulation of language and age.

Language background was also a significant predictor, with Maya-Spanish bilinguals producing significantly more glottal insertions than monolingual Spanish-speakers. As already seen in Table 5, the effect of language is independent of age, with Maya-speakers in both age groups having higher rates of glottalization. Finally,

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Note that age was also significant when run as a continuous variable, rather than grouped into older vs. younger: Age +1 logodds 0.025, p = 0.00983. For ease of discussion, we will continue to refer to the binary variable.
education level, run in a separate model in place of age and language, also showed significant differences, with more educated speakers showing lower rates of glottalization.

5. Discussion
Based on the results outlined above, we now return to the research questions outlined in section 2, regarding the distribution of glottals in YS, maintenance vs. standardization of /ʔ/, and the possible role of Maya-Spanish contact.

First, results show that glottal insertion occurred in 11% of vowel-initial words, a rate slightly lower than Michnowicz’s (2012) impressionistic case studies (13% overall glottal insertion). In the present study, more than half of the glottal tokens (6.5%) were realized as creaky voice, rather than as full glottal closure. Frequencies of glottalization for individual speakers ranges from 1% to 29%, generally supporting Lope Blanch’s (1987, p. 106) observation that glottal insertion occurs “with notable regularity” for “a good number of Yucatecans”. In the present data, most speakers show cases of glottal insertion, but some – specifically older speakers and Maya speakers – show much higher rates. Recall also that García Fajardo (1984) did not observe important differences across age groups, further suggesting that standardization of this feature is a recent process in YS, as also found by studies of other traditional variables in YS (Michnowicz, 2011, 2012; Michnowicz & Carpenter, 2013).

A comparison of glottal insertion with other phonetic variables observed in the literature on YS is found in Figure 4. It is evident that glottal insertion follows the same pattern as aspirated /ptk/ (data adapted from Michnowicz & Carpenter, 2013) and occlusive /bdg/ (data adapted from Michnowicz, 2011). Younger speakers use all of these ‘traditional’ regional forms less than older speakers. This pattern led Michnowicz (2012) to conclude that traditional YS is a moribund dialect, at least as spoken in major urban centers like Merida. Younger speakers are speaking a much more ‘standard’ variety of Spanish with regard to the phonetic variables seen here. This development in YS matches trends away from traditional variants perceived to be of indigenous origin in contact varieties across Latin America (Klee, 2009; Klee & Lynch, 2009). As seen in Table 4, this process of standardizing glottal insertion is consistent across language groups.
Younger speakers – both Spanish monolinguals and Maya bilinguals – use significantly fewer glottals than do their older counterparts.

![Age comparison for regional variants in YS](image)

Figure 4. Age comparison for regional variants in YS. /ptk/ data adapted from Michnowicz & Carpenter (2013); /bdg/ data adapted from Michnowicz (2011). Education data (educación media-superior) from INEGI (2005).

Arguably the primary driver of this standardization process is increased access to education in Yucatan. The far right of Figure 4 compares rates of educación media superior (~high school) in the Municipality of Mérida. Education rate presents a mirror image to the patterns of language use to the left. As younger speakers become more educated, the rate of traditional dialect forms decreases. The importance of education in change away from non-standard forms (whether contact induced or not) has been frequently noted (Klee, 2009; Díaz-Campos, Fafulas & Gradoville, 2011), and has previously been cited as an important factor in standardization in YS (Michnowicz, 2011, 2012; Michnowicz & Carpenter, 2013).

In fact, education is such a strong influence on traditional forms like glottal insertion that the increased exposure to standard varieties that accompanies more schooling can even enable speakers to override their family background. Some anecdotal evidence of this is seen in the situation of speaker MS21a (‘José’) in the present study. José was a college student at the time of the interview, from a lower-class Maya-speaking family. José, however, speaks almost no Maya, and his sociolinguistic interview is
characterized by completely standard Spanish, without any of the grammatical L2 features that persist among fluent Maya-speakers. Because of this José was grouped with the Spanish-speakers in the present analysis. A comparison between José and his father and uncle, both included in the present analysis, sheds light on the subject. His father (MM54) and uncle (MM50) produced some of the highest glottalization rates in the study (22% and 29% respectively), and show numerous instances of L2 interference in their Spanish. José, in contrast, shows the lowest rate of glottal insertion in the study (1%). These participants live in the same house, and communicate on a daily basis, yet the younger speaker, attending a local college, shows almost no glottalization in his speech, at least in the context of the sociolinguistic interview.

As noted in the results, there was a significant interaction between Age:Tonicity, and separate regression analyses on each age group indicate that younger speakers are losing some of the constraints on glottal insertion, specifically on tonicity and following vowel. The only significant factor for younger speakers is preceding word length, possibility retained for the processing reasons outlined below. As discussed, glottal insertion is clearly in retreat in YS, and the loss of significant constraints for younger speakers is likely a case of grammatical simplification, as the grammar of younger speakers, instantiated in the constraint hierarchy in the statistical analysis (Tagliamonte, 2012), shows fewer conditioning factors than that of older speakers. Such simplificatory processes have been shown to accompany language attrition (cf. Silva-Corvalán, 1991), and the present results suggest that similar processes may be at work in cases of dialect attrition.

There are several pieces of evidence that support claims of direct Maya influence on glottal insertion in YS. First, Maya speakers significantly favored glottals in the mixed effects regression model. Although language background was secondary to age and education among social factors, the three factors are not completely unrelated in Yucatan.

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7 As two anonymous reviewers correctly point out, the result of increased education and exposure to more ‘standard’ varieties of Spanish may not actually be the complete elimination of traditional, presumably Maya-influenced features, but rather the ability to code-switch between ‘standard’ and more traditional varieties of Yucatan Spanish. It is possible, even likely, that José might speak a much more traditional YS outside of the interview context. The fact that José successfully suppresses the traits common to his family members’ speech in the recording speaks to both the role of education in the standardization of YS, as well as the stigmatization of these regional features associated with Maya-influenced Spanish.
Census data indicate that Maya is spoken less frequently among younger speakers (INEGI, 2005), as evident in Figure 5.\footnote{Note that the census data is reported as “indigenous language”, which is then broken down as part of a separate question. Of the 538,355 people that report speaking an indigenous language in Merida, 527,107 (98%) of them report speaking Maya (INEGI, 2005).}

As already seen in the discussion on education, these younger speakers of both language backgrounds are highly likely to be more educated – and therefore more exposed to normative varieties of Spanish – than older speakers. Still, as seen in Table 5, Maya-speakers used more glottal insertion than monolingual Spanish-speakers, regardless of age. Likewise, the effect for language group is robust in the analysis of glottal insertion. Some other variables that are also attributed to (indirect) Maya influence do not show significant differences between bilingual and monolingual speakers. For example, Michnowicz & Carpenter (2013) did not find significant differences in aspirated /ptk/ between language groups, although they still attribute increased levels of aspiration to indirect contact via L2 features that are passed on to the monolingual population through processes of increased dialect contact and koineization (Kerswill, 2002; see also Thomason & Kaufman, 1988, pp. 38-42; Thomason, 2001, pp. 66-76). Here the significant result for language group suggests a more direct transfer from Maya to Spanish, in agreement with Lope Blanch (1987; p. 123).
Glottal insertion in YS certainly meets most of the criteria to establish possible language contact features, as outlined by Thomason (2001, pp. 93-95): YS displays multiple cases of possible contact-induced change (see Section 1, Michnowicz, (in pressB) for an overview); the source language is obvious and still co-existent with Spanish; /ʔ/ exists in Maya in the exact contexts in which it is found in YS (but not in most varieties of Spanish); and when vowel-initial words are borrowed into Maya, they occur with an epenthetic /ʔ/ (Frazier, 2009). It is reasonable to assume that shifting Maya-speakers would, at least initially, apply their L1 phonotactics to their L2 (Spanish).

The one question that remains from Thomason’s (2001) criteria is the possibility of glottal insertion as a language-internal development in YS, a scenario that cannot be discarded a priori, given the existence of the process in a few non-contact varieties. While previous research suggests that language contact may be the most common route by which glottal insertion enters Spanish, glottal insertion behaves in much the same way across both contact and non-contact varieties of Spanish. For example, glottal insertion in YS follows the same set of constraints as Puerto Rican and/or Nicaraguan Spanish with regard to following vowel stress, following vowel quality, and preceding word length. This suggests that the existence of glottal insertion in YS cannot be solely due to language contact, and that language internal factors also play a role in the distribution of glottals, most likely related to cross-linguistic tendencies to maximize word boundaries and strengthen syllable onsets (Dilley et al., 1996). Of course, the choice between contact-induced vs. internal development is really a false dichotomy in most cases (Dorian, 1993; Romaine, 2012), and these results suggest that glottal insertion in YS is a product of multiple causality – the combination of both contact-induced change and internal development. It is important to observe that the Maya phonotactic rule is not transferred ‘as is’ into YS, given that even dominant Maya-speakers allow vowel-initial words in Spanish at least 70% of the time. Instead, there is a variable tendency of glottal insertion that arises among bilingual speakers, and with increased contact between the two languages (Mosely, 1980; Lipski, 2004), this pattern can be passed on to further generations of bilingual or monolingual speakers. Once passed on to subsequent generations, /ʔ/ ceases to be a contact feature indicative of L2 Spanish, and now ‘belongs’ to Spanish, following a set of constraints that is largely consistent across varieties. In
other words, the trigger for /ʔ/ may differ across glottalizing dialects of Spanish: contact with a language whose phonotactics favor glottal insertion (YS, Guaraní Spanish, and Philippine Spanish), or the recovery of a weakened segment (Puerto Rico, Nicaragua, Badajoz). Once triggered, however, language-internal constraints are remarkably consistent across dialects (and languages, see Pierrehumbert (1995), among others). Regardless of the origin of /ʔ/, glottal insertion serves the same function of marking word boundaries in contexts where they may not be clear (following longer words, V_V word boundaries), thereby decreasing the processing load for the listener (Dilley et al. 1996; Bissiri et al., 2011). This enhancement of word boundaries in running speech is likely to be even more important in contexts of second language acquisition/bilingualism, such as YS. For example, Altenberg (2005) found that /ʔ/ insertion was one of the strongest cues attended to by Spanish L2 speakers of English in delimiting word boundaries. Likewise, glottal insertion in YS may help lower the processing load of bilingual Maya speakers, enabling speakers to better recognize word boundaries via the blocking of *enlace* in running speech.

6. Conclusions

In sum, this study has shown that glottal insertion in YS is governed by both linguistic and extra-linguistic factors, is almost certainly a contact-feature in this dialect, and is quickly disappearing from the speech of younger speakers of both Spanish and Maya backgrounds. Increased access to formal education was identified as one of the primary factors driving this move to a more ‘standard’ variety of Spanish, as has also been documented for other features of YS (Michnowicz, 2011; Michnowicz & Carpenter, 2013). Future study should examine this feature in the speech of children and adolescents in order to shed further light on the role of education and dialect contact in the overall standardization of Yucatan Spanish. Likewise, YS, one of the primary indigenous-influenced dialects in Latin America (Klee & Lynch, 2009), provides an ideal laboratory for the study of language and dialect contact, and provides further evidence in support of theories of multiple causality in situations of language contact. While the origin of many traditional YS features, like glottal insertion, may be direct or indirect (via L2 features)

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9 A similar need to mark word boundaries in the presences of a deleted segment (such as /s/) may be at play in non-contact varieties, such as Nicaraguan Spanish.
contact with Maya, once passed on to the monolingual population, language internal 
factors take over, making the distribution of these linguistic variables remarkably 
consistent across dialects, regardless of their origin in a particular variety.

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