

## A sociophonetic account of onset /s/ weakening in Salvadoran Spanish: Instrumental and segmental analyses

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### ABSTRACT

In this study, we identify the linguistic and social predictors that condition onset /s/ weakening in speech data from sociolinguistic interviews with 72 Salvadoran Spanish speakers. In addition, we compare and contrast the explanatory power of instrumental and traditional segmental approaches. We find that the instrumental approach, which identifies flanking segments, stress, and region of origin of the speaker as conditioners of onset /s/ shortening and lowering of center of gravity, does not account for observed social variation in the data. Contrastingly, an ordinal logistic regression based on a combination of instrumental measures and perceived phonetic categories identifies flanking segment, region of origin, sex, and age of the speaker as predictors of onset /s/ weakening. We conclude that an exclusively instrumental analysis examining variation of onset /s/ thus obscures the potential social meaning of onset /s/ weakening in El Salvador.

Sibilant weakening in Spanish is a chief phonological characteristic of dialects such as those of Andalusia, Central America, the Caribbean, and the Southern Cone, and has traditionally been described by researchers within a tripartite system, rendering three perceived allophones for a given phonological /s/: [s], representing retention of the sibilant; [h], representing retention of glottal spreading but elimination of oral constriction; and [Ø], representing full deletion. Because /s/ weakening is most pervasive in syllable-final position, the vast majority of studies focus exclusively on coda weakening. However, this phenomenon also occurs in the syllable onset in some dialects of Spanish. The present study examines onset weakening in the Spanish of El Salvador, a dialect in which this understudied phenomenon is particularly advanced (Lipski, 2000). Furthermore, Salvadoran Spanish proves an excellent vehicle for analysis because of the variation it displays in syllable-onset position beyond a traditional tripartite conception.

In an impressionistic study of eight speakers from the capital, San Salvador, Lipski (1984) found that, while /s/ never deletes entirely in onset position, it is

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most often produced as the aspirate [h] in word-medial position in atonic syllables as in /kasa/ ['ka.ha] 'house', and least often in word-initial position in tonic syllables as in /siglo/ ['sig.lo] 'century'. The prevalence of onset weakening in Salvadoran Spanish has also been alluded to by other authors including Geoffroy Rivas (1975), Hoffman (2001), and Aaron and Hernández (2007).

In addition to the tripartite system of allophones, the use of a voiceless fricative that is perceptually similar<sup>1</sup> (but not articulatorily identical) to interdental [θ] has been observed in the speech of some Salvadorans (Canfield, 1981; Hualde, 2005; Lipski, 1994). Brogan (2018) used acoustic and sociophonetic evidence to argue that this sound is the result of gestural undershoot, which Chitoran, Hualde, and Niculescu (2016:2) described as occurring when "the [articulatory]

that fail to capture important social information associated with segmental categories. We illustrate these issues by first examining how linguistic and social

/s/. File-Muriel and Brown (2011) reported that linguistic factors frequently associated with /s/ lenition significantly affect measures of duration, COG, and percentage of voicelessness, further finding a decrease in all three measures at slower speech rates and in word-final position.

Erker (2010) explicitly compared the efficacy of segmental and instrumental approaches. In his account of /s/ weakening by Dominican Spanish speakers in New York, Erker argued that segmental approaches obscure systematic patterns of lenition for a number of reasons. First, the descriptive adequacy of segmental approaches is diminished by both the presence of within-category variation (e.g., two tokens categorized as [s] may be quite dissimilar acoustically) and the fact that temporal and spectral weakening are not perfectly correlated (e.g., tokens labeled as [s] are significantly shorter when they appear before a following consonant as opposed to a vowel, yet there is no significant difference in COG). Erker ran two types of statistical models on his data, a binary logistic regression following the traditional segmental approach and two linear regression analyses using continuous measures of frication duration and COG as dependent variables, and claimed that the continuous analyses accounted for almost three times more variance than the categorical one when taking identical predictors into account. With these results, Erker argued that the continuous models are a more comprehensive reflection of patterns in the data. Furthermore, as both File-Muriel and Brown (2011) and Erker (2010) discussed, instrumental measures of weakening are not perfectly correlated: different phonological environments may favor or disfavor one dimension of weakening over another, providing information that is “impossible to capture using traditional IPA categories, which collapse all relevant acoustic cues into several categorical labels” (File-Muriel & Brown, 2011:240).

However, it is important to acknowledge the possible shortcomings of instrumental analyses, including the difficulty of disentangling articulatory mechanisms of speech production—which often have an effect on temporal or spectral characteristics of fricatives—from weakening. Carney and Moll (1971), for instance, found that anticipatory articulation before a following high vowel results in a higher tongue body for /s/, the effects of which can be seen in the acoustic signal. Similarly, in a study of coarticulation effects on fricatives, Tabain (2001) showed that /s/ has a lower spectral peak in the context of rounding by comparing electropalatographic recordings of various consonant-vowel tokens. Tabain’s results are consistent with those of Shadle and Scully (1995), who suggested that [u] has a strong acoustic effect on alveolar fricatives because the lip rounding of [u] causes a whistle-like sound source. Such coarticulatory effects on the acoustic dimensions of /s/ pose problems for the instrumental study of /s/ weakening. While an ins-555.5(s)22.mflectothe.2(an)-542.7(iner)ti

We feel it is important to acknowledge that the line between “phonetic” and “phonological” is not clear cut. Rather, authors such as Campos-Astorkiza (2014) made a compelling case that phonological processes such as assimilation derive from phonetic conditions related to gestural magnitude and timing. Within this framework, it could be argued that coarticulation, that is, increased gestural overlap resulting from shorter and/or less distinct gestures, is in fact a type of weakening. What we are arguing here, in contrast, is that coarticulatory effects may sometimes affect acoustic measures in ways that are not meaningful or informative for phonology. For example, the whistle-like sound produced by a rounded vowel might lower the spectral COG of the /s/ in solo /solo/ ‘only’, leading us to mistakenly conclude that this /s/ is quantitatively “weaker” than the /s/ in sala /sala/ ‘living room’ or silla /si a/ ‘chair’.

Furthermore, while segmental accounts have been criticized for imposing discrete categories on outputs that are inherently continuous, there may be some merit to associating tokens of /s/ with perceptual categories. Previous work has shown that different allophones of [s] have discrete social or indexical meanings for listeners. For instance, Carvalho (2006) demonstrated that coda aspiration is prestigious in a border Uruguayan community, as it is associated with high-status Montevideo speakers. That is, her study showed that naïve speakers and listeners differentiate among allophones of /s/ and assign indexical meaning to these uses. Walker, García, Cortés, and Campbell-Kibler (2014) showed that Puerto Rican and Mexican Spanish listeners rate speakers differently based on the allophone of word-medial coda /s/ used in stimuli, attributing more status to the sibilant [s] variant for both Mexican and Puerto Rican speakers. In other words, segments have social meaning.

Given the pros and cons of segmental and instrumental methods alike, this paper proposes an approach to analyzing /s/ weakening that acknowledges the gradient nature of consonant lenition as well as the importance of both segmental categories and the acoustic measures that define them. Before describing this approach, we briefly review the pertinent literature the linguistic and social factors known to condition /s/ weakening in other dialects.

## LITERATURE REVIEW

### Linguistic constraints on onset /s/ weakening

is also a predictor of weakening, although the effect in the Chihuahua data (Brown & Torres Cacoullos, 2002, 2003) is not statistically significant. As is the case with the preceding segment, a nonhigh vowel following /s/ favors weakening. Taken together, these results suggest that intervocalic position is the most favorable for onset /s/ weakening, particularly when one or both vowels are nonhigh.

Whether /s/ occurs word-initially or word-medially has also been shown to condition rates of /s/ weakening. Brown and Torres Cacoullos (2002, 2003) and















To determine the ordering of the remaining two variants, [h] and [s



Bolker, & Walker, 2015) in R (R Core Team, 2015). All figures were created using the ggplot2 package (Wickham, 2009). Table 2 shows the best fit results of the first linear model, and the p-values shown for each predictor were obtained via likelihood ratio tests.

The only social predictor selected by this model as significant was region, while linguistic predictors of preceding segment, following segment, and tonicity were all included in this model. We used simple effects tests as described in Bretz, Hothorn, and Westfall (2011:108–111) via the glht function in the multcomp

that /i/ and /u/ are also high vowels, facilitating articulatory overlap, this is only true for realizations of /s/ categorized as [s], since neither [h] nor [Ø] require oral constriction. Therefore, it is possible that realizations of [s] are, in fact, shorter after high vowels, but this reality is obscured because /s/ was seldom deleted after /i/ and /u/ in our data. As a result, the overall mean duration of /s/ following /i/ and /u/ is deceptively high.

Similarly, duration of /s/ is affected by the following segment. Specifically, a following low or mid vowel (as in *casa* /kasa/ 'house' or *son* /son/ 'they are') is associated with a significant shortening of an onset /s/ as compared to an /s/ before a high vowel or a consonant (as in *casi* /kasi/ 'almost', or *suelo* /swelo/ 'floor').

Interestingly, the onset /s/ of a tonic syllable and of a posttonic syllable do not significantly differ in duration, but both are significantly longer than  $j/F2ocn7(/s/)-322.6(of)23$





between a tonic /s/ and a posttonic /s/, the onset /s/ in *hicimos /isimos/* 'we did' is shown to have a significantly higher center of gravity than both the /s/ in *interesa /inte esa/* 'interests' and the /s/ in *presidente /p esidente/* 'president'.

Finally, as in the duration model, speakers in the San Miguel region are significantly more likely to produce onset /s/ with a lower center of gravity than speakers in both other regions. Additionally, as in the duration model, the random effect of participant was found to be a significant conditioner of variance across participants via an analysis of random effects ( $\chi^2(1) = 1281, p < .001$ ).



dichotomous comparisons. In other words, an ordinal regression with four levels of the outcome variable can be interpreted as a grouping of three comparisons:

- (1) Level 0 as compared to levels 1, 2, and 3  
Levels 0 and 1 compared to levels 2 and 3  
Levels 0, 1, and 2 compared to level 3

categorical variable to another), the odds of weakening are the exponentiated coefficient, or the proportional odds ratio. For instance, the model shows a coefficient for the predictor age:Young to be  $-1.20$ . The negative coefficient tells us that young speakers are more likely to produce /s/ as lower on the scale, or as more constricted, than older speakers. Calculating  $e^b$ , or exponentiating  $-1.20$  using the `exp()` code in R, returns a value of .3. Therefore, a young person

Providing further evidence that this may be a change from above, speakers from the region of San Miguel are nearly 4.5 times more likely to reduce their onset /s/ than are speakers from the more prestigious Santa Ana and San Salvador regions ( $p < .001$ ). This effect can be visualized in [Figure 10](#).

In other words, onset /s/ reduction is indexed with lower social status. According to Brogan (2018), onset /s/ reduction in the stigmatized San Miguel region is unsurprising given that speakers throughout the San Miguel region are considered by themselves and by the other participants to be uneducated and low class.

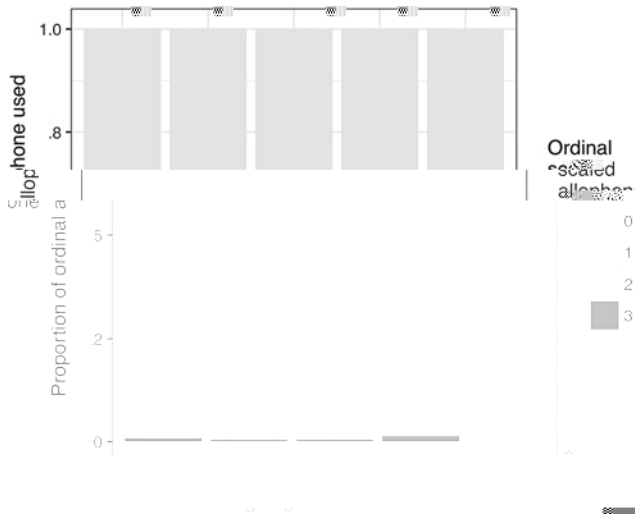
Unlike previous studies of changes in progress in which young women typically lead the change (cf. Labov, 2001:261–293), in this study we find that women are about 30% more likely to weaken onset /s/ than men are ( $p < .001$ ). In other changes from above (cf. Labov, 2001:261–293), women have been found to use the more standard variant, but here, it is men using the more prestigious sibilant [s] variant, exemplifying fewer instances of onset /s/ weakening. We posit that this is due to the increased movement of men as compared to women between El Salvador and the United States, as attested throughout the sociolinguistic

dialectal changes might permeate particular speech communities in the home country.

Turning now to linguistic predictors, this model finds that onset /s/ is most likely to be strongest in utterance-initial position, shown in [Figure 11](#). This aligns with the findings of the continuous models presented in this paper. However, the linear models also showed that there were no significant differences in either duration or COG between a preceding pause and a preceding high vowel. In this ordinal model, however, we do not find the same effect. Rather, an utterance-initial /s/ is most likely to be strong, whereas a preceding high vowel and a preceding consonant occasion onset /s/ weakening at about twice the rate of a preceding pause, while an onset /s/ following low or mid vowels is most likely to weaken. This demonstrates that the apparent strengthening effect of a preceding high vowel observed in the linear models may be overstated.

The results of the following segment predictor align perfectly with those of the two linear models. That is, an onset /s/ is more likely to be retained when followed by a consonant or a high vowel and significantly more likely to weaken when followed by a low or mid vowel as seen in [Figure 12](#).

Unlike the linear models, the ordinal model did not select tonicity to be a



FIGURE

posit that a standardization is taking place, led by young men residing in regions outside of San Miguel.

The most evident shortfall of the ordinal logistic regression (and indeed, any analysis that categorizes this segment) is the a priori segmentation and categorization of the allophones of /s/. However, as discussed, listeners have been shown to be sensitive to this allophonic variation.

Additionally, this type of model more closely adheres to the phonological weakening process: there is a weakening scale between the strongest, most



complex segment, and the weakest, least complex segment, or, in this case, phonetic zero. Crucially, while the levels must be ranked in some natural order, the distance between each level is not clearly defined in an ordinal regression. This configuration closely mirrors the theoretical characteristics of /s/ weakening: while a given phonetic realization can be defined as weaker or stronger than another, the “distance” between the two outcomes is difficult to quantify. In other words, is it the case that the distance between [s] and [s<sup>0</sup>] is the same as that between [s<sup>0</sup>] and [h]? Additional studies using articulatory imaging technology would be required to further investigate this line of inquiry, though interspeaker and intra-allophone variation may render this an impossible question to answer. This theoretical consideration is extremely important. While it would be possible to convert the ordinal variable into an interval variable and simply run the analysis as a linear regression or mixed model, which is easier to interpret, this model would assume equal distance between each level on the 0 to 3 scale.

Additionally, the levels of the dependent variable were assigned by taking into consideration both theoretical conceptions of weakening as well as acoustic correlates that may reflect this phonological process: reduction in duration and lowering of COG. Future studies of sibilant weakening may benefit from this procedure, particularly for researchers of gradient phenomena that tend to cluster in more than two allophonic groups, as is the case for /s/ weakening in Spanish. That is, the ordinal logistic regression enables us to account for the importance of multiple perceptual categories.

## CONCLUSION

In this paper, we have contributed new information regarding the social and linguistic conditioners of /s/ weakening in both an understudied dialect of Spanish and an understudied prosodic position. Furthermore, this paper has proposed an approach to /s/ weakening that is both theoretically and practically sound. An ordinal approach treats weakening as a gradient process in which a given output is “weaker” or “stronger” relative to another. Additionally, the procedure used to determine the ordering of allophones from 0 to 3 in the ordinal model acknowledges the importance of acoustic parameters in constructing a speaker/hearer’s notion of what a segment is without relying on them exclusively. Perhaps most importantly, this approach is equipped to capture important social distinctions in onset /s/ production that may be obscured by linear models. This method is particularly well equipped to analyze weakening of Salvadoran y19(ening)]TJ(se?im21Tf1-392R1T11.811(intbscur)157ng)]TJT\*[(ling)-1.6(

with a recognition of the importance of social indices, presents a potential approach for analyzing other gradient phonological phenomena.

#### NOTES

1. Penny (2000:118) describes this sound as a dental fricative with “fronting of the tongue body so that the sound acquires some of the acoustic qualities of interdental /θ/.”
2. There is debate as to the relationship between the processes of onset and coda /s/ weakening. While some scholars have proposed that the former is an extension of the latter (e.g., Méndez Dosuna, 1985), others have argued that that syllable-initial weakening begins in onset position and should be treated as a separate process (e.g., Brown, 2005; Brown & Brown, 2012; Brown & Torres Cacoullos, 2002, 2003). However, because the pertinent sociolinguistic theory can be applied generally to situations of standard versus nonstandard variation, it is reasonable to assume that onset and coda weakening of /s/ will be conditioned by similar, if not identical, social factors.
3. El Salvador is divided into 14 departments, which are then grouped into the three regions.

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