

Spirantization in Spanish

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1. Abstract

This paper will be centered on spirantization in Spanish, an Indo-European language spoken most frequently in North America, South America, and Spain. The purpose of this paper is to understand and record samples of spirantization in Spanish, as well as to develop a phonological model for when spirantization can be expected to occur.

My consultant for this project is [REDACTED]. [REDACTED] speaks Mexican Spanish natively, as well as English beginning from a young age. [REDACTED] states that he learned from various Mexican Spanish speakers, and has minor exposure to Mixe, an indigenous language spoken largely in the Mexican state of Oaxaca. While [REDACTED] notes that the Spanish he speaks does not perfectly resemble what one might hear in an academic or formal setting in the Southwest United States due to that largely resembling Spain-based Spanish, [REDACTED] clarifies that he speaks nearly identically to the standard Spanish of the vast majority of Mexican or US Spanish speakers.

Piñeros lays out a dual approach to explaining the spirantization of voiced obstruents in Spanish: phonetic explanations centering on laziness, and phonological explanations centering on constraint-based analysis of obstruent surface and underlying forms (which this paper will focus most heavily on). Piñeros provides ample Spanish representations to justify the constraint ordering, and this paper will provide experimental evidence including and beyond those samples that have the potential to justify, advance, and/or challenge Piñeros constraint selection and ordering. Ultimately, this paper finds that Piñeros' phonological approach is insufficient, and constructs a different approach, which while not perfect, is a much more accurate predictor of my consultant's spirantization patterns.

Note that, throughout this report, [b, d, g] after undergoing spirantization will be labeled as [B, D, G], representing surface voiced fricatives [β, ð, ɣ] as well as the other varieties that occur due to spirantization (such as close fricatives or approximants).

2. Piñeros (2002)

Before diving into constraints, it's critical to establish an initial premise in Piñeros' analysis: markedness constraints against voicing can either be resolved by devoicing or can be resolved by reducing "the degree of oral constriction" (Piñeros 2002, p 383). This is a constraint on stricture, but for this analysis, it is functional to consider it an alternative to devoicing.

Based on the premise that languages with voiced obstruents always have voiceless obstruents yet voiceless obstruents don't guarantee some voiced counterparts, Piñeros lays out a general restriction on voiced obstruents:

- (1) *[-sonorant, +voice] (Piñeros 2002, p 385)

It's worth noting here that Piñeros doesn't treat voicing as a binary feature, but it is functional for the extent of this analysis to treat voicing as a binary feature. Based on typological analysis similar to the previous example (there are no languages with fricatives and no stop consonants) and an analysis of how learners acquire fricatives, Piñeros also lays out markedness constraints against fricatives:

- (2) *[-sonorant, +continuant] (Piñeros 2002, p 386)

Since a voiced obstruent constraint exists, and Spanish does have voiced obstruents [b, d, g] in surface forms, there must be a faithfulness constraint on voice that outranks the markedness restriction on obstruents: otherwise, there would be no suitable explanation for the surface forms. As mentioned previously, however, Piñeros treats stricture as part of this identity feature. So, changing [b] to B, for example, would incur a violation of 'IDENT[voice]. This unconventional ident will be marked with an accent, as will the later one, indicating that it is being used in a special way in this summary.

- (3) 'IDENT[voice] (Piñeros 2002, p 386)

The issue with the existing constraints is that we have no solid explanation for why there are no voiced fricatives (or a voiced affricate). Richness of the base as a premise means this grammar should be able to handle underlying forms with voiced fricatives, and those would surface faithfully, which doesn't happen in the ranking. So, Piñeros directly penalizes voiced fricatives and affricates.

- (4) *[-sonorant, +continuant, +voice] (Piñeros 2002, p 389)



In general in Spanish, voiced stops undergo spirantization when preceded by a vowel, glides, [h], and liquids (Piñeros 2002, p 382). In essence, the conversion from stops to fricatives happens in Spanish when sounds of a sonority higher than nasals precede them. In some dialects of Spanish, including Panamanian Spanish as referenced in the paper, voiced stops are devoiced when in the syllable-final position. Both of these effectively happen in the coda and not the onset. Piñeros posits that this indicates a preference in the language for faithfulness in the onset, to the point that it is a priority over faithfulness in general.

(5) ‘IDENT[voice]_{/Onset} (Piñeros 2002, p 390)

The existing constraints and their necessary orderings are illustrated through the interesting candidate /birtud/, which Piñeros claims surfaces as both [bir.tut] and [bir.tuD] in native speakers. Piñeros collapses the markedness constraints on different categories of voiced obstruents into a single markedness constraint.

(6) *VOICE-OBSTRUENT

Handling certain absurd inputs from a rich base may require untethering the restrictions to show that certain voiced fricatives are more penalized than some voiced obstruents, but that isn't the focus of this analysis.

/birtud/	‘IDENT[VOICE] _{/Onset}	*VOICE-OBSTRUENT	‘IDENT[VOICE]
a. bir.tud		**!	
b.  bir.tut		*	*
c.  bir.tuD		*	*
d. pir.tut	*!		**
e. βir.tuD	*!		**

One critical takeaway from this tableau is that [bir.tuð] only has one violation of our voiced obstruent constraint (on [b]) because the reduction in stricture that came from /d/ → [ð] has a similar effect to devoicing from a markedness perspective. Another takeaway is this necessary ordering relation: we don't see devoicing or spirantization in the onset in surface forms, but we do see it in the coda, so we can conclude that the essence of Piñeros' analysis is:

FAITH-ONSET[VOICE] >> *VOICE-OBSTRUENT >> FAITH[VOICE]

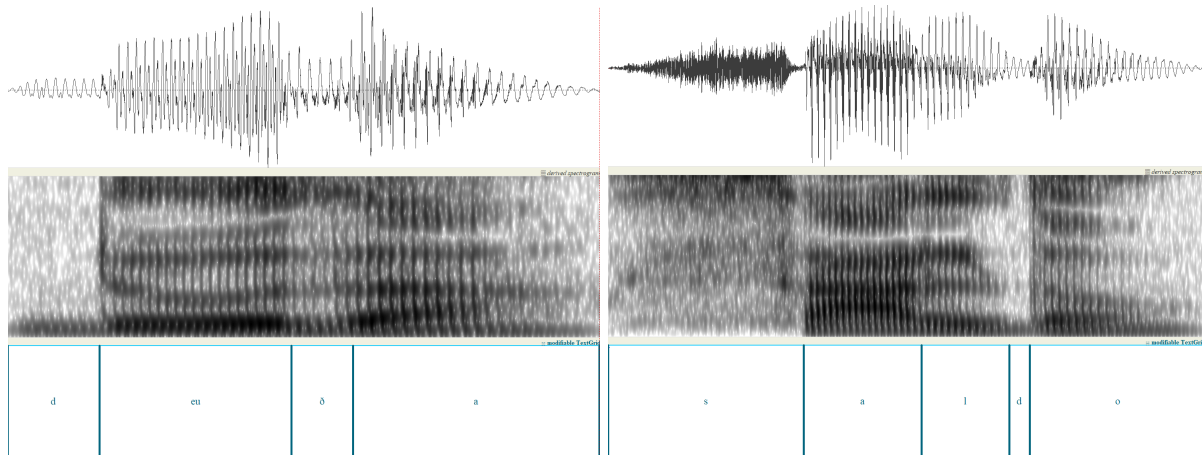
3. Spirantization in a Native Speaker of Mexican Spanish

The first step in eliciting the data involved eliciting the contexts in which spirantization is traditionally expected to occur. This began with checking for spirantization in an intervocalic position.

- | | | | |
|----|---------|--------|--------------------|
| 1. | /kodo/ | ko.Do | elbow |
| 2. | /lago/ | la.Go | lake |
| 3. | /leiba/ | lei.Ba | regional last name |

4. /deuda/ deu.Da debt
5. /traigo/ trai.Go I bring

Spirantization was observed consistently in this context. Compare the leftmost spectrogram for (4.) [deuDa] with that of [saldo] on the right (which will be discussed later). While both [d] and [ð] maintain their voicing bar, it is clear that no complete stop occurs in [deuDa] because the formants (though quieter than in vowels) continue across the fricative, unlike in [d].



Spirantization is the viable repair insofar as Piñeros' analysis is concerned, and this aligns with the observed surface forms. However, if we add a few more constraints to make the analysis slightly more robust, and to account for output candidates involving deletion, a concerning reality emerges. Using the IDENT features to penalize unfaithful surface candidates in a more traditional manner that doesn't rely on notions of stricture, Piñeros fails to generate the correct surface form.


(7) MAX-C

(8) IDENT[cont]

/lago/	MAX-C	IDENT[VOICE] _{Onset}	*VOICE-OBSTRU ENT	IDENT[VOICE]	IDENT[CONT]
a. 💣 la.go			*		
b. ☹️ la.Go			*		*!
c. la.ko		*!		*	
d. la.o	*!				

While Piñeros' does motivate spirantization in the onset through phonetic constraints (Piñeros 2002, p 400), and Piñeros does define voicing and stricture in ways that could potentially coerce the correct surface form, with the current phonological constraints we only accurately capture the occurrence of spirantization in the coda, which, already, we can observe is not the sole place in which it can occur. I propose the repair to be a new constraint, V-OB-AGREE[cont], which penalizes any voiced obstruent that doesn't have the same feature for continuation as the segment in front of it, and is based on Martínez-Gil's effectively identical constraint (Martínez-Gil 2019, p 57). Repeating the analysis with the addition of this constraint outranking IDENT[cont] generates the correct surface candidate for my speaker.

(9) V-OB-AGREE[cont] (Martínez-Gil 2019, p 57)

/lago/	MAX-C	IDENT[VOIC E]/Onset	V-OB-AGREE[cont]	*VOICE-OBST RUENT	IDENT[VOI CE]	IDENT[CON T]
a. la.go			*!	*		
b.  la.Go				*		*
c. la.ko		*!			*	
d. la.o	*!					

The next context to be checked for spirantization is voiced stops immediately following an [h], which is likely an underlying /s/ in Spanish. However, it is relevant to note here that my consultant did not pronounce these forms with a surface [h] or [s], but rather with a surface [z]. This is likely a dialect-dependent process, and my speaker seems to voice the /s/. However, the important conclusion to draw here is that spirantization is consistently observable in a [+cont -syll]_ context, cementing that we are interested in the continuant feature as opposed to this being a process that only engages with vowels.

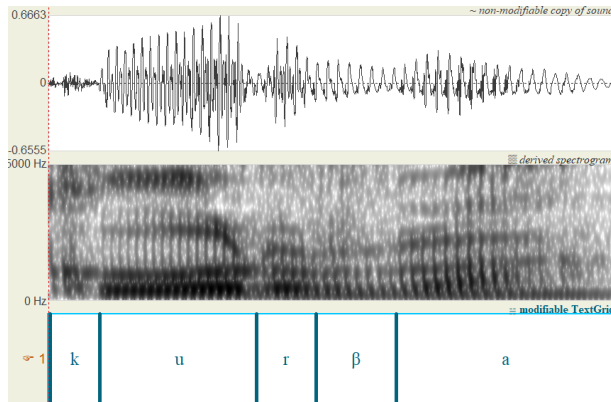
- | | | | |
|----|-----------|-----------|---------|
| 6. | /esbelto/ | ez.Bel.to | slender |
| 7. | /desde/ | dez.De | from |
| 8. | /musgo/ | muz.Go | moss |

Next is voiced stops after the trill [r], where the pattern holds

- | | | | |
|-----|---------|--------|-------|
| 9. | /kurba/ | kur.Ba | curve |
| 10. | /berde/ | ber.De | green |

11. /largo/ lar.Go long

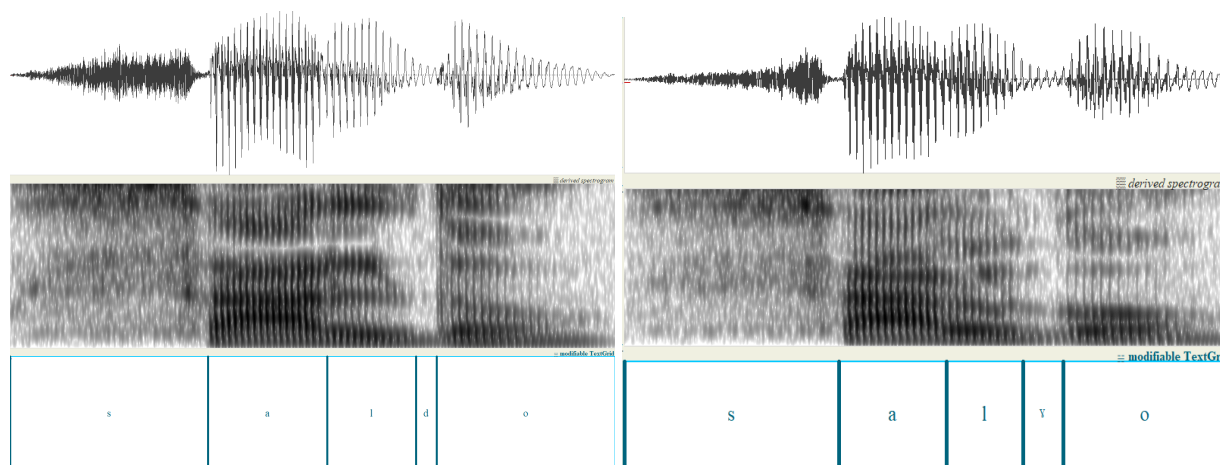
This spectrogram for [kurBa] makes it visually clear that no complete blockage of the vocal tract occurs, so spirantization likely occurs in this context. No clear release of a stop happens between B and [a], indicating that we are indeed observing a fricative.



Next still is spirantization following the lateral [l]. (This is the data which the prior [sal_ldo] spectrogram was referencing)

12. /selba/ sel.Ba jungle
 13. /sal_ldo/ sal_ldo balance
 14. /salgo/ sal.Go I leave

Seemingly, spirantization applies to /b/ and /g/ in the context of [l], but does not apply to /d/. This aligns with Piñeros' prediction (Piñeros 2002, p 382). Comparing the minimal pair /saldo/ and /salgo/, we observe much more clearly that /g/ has become a fricative, because we do not see the release after it (as in [d]). The formants continuing through indicate that the vocal tract was not blocked to the same extent as in [saldo].



For other cases where a voiced stop is in the onset and the preceding phoneme is [-cont], no interesting behavior outside of what is predicted emerges. Spirantization doesn't occur, because the voiced obstruents already agree with the prior continuant feature. The case in which the preceding phoneme is a voiced obstruent itself is discussed later. Also, the "Post-Stop" case where a devoiced obstruent is before a voiced one requires compound words, which should be noted as it could potentially have an effect, but regardless the results here are standard.

Post-Nasals:

- | | | | |
|-----|----------|---------|--------|
| 15. | /sombra/ | som.bra | shadow |
| 16. | /oŋða/ | oŋ.ða | wave |
| 17. | /saŋgre/ | saŋ.gre | blood |

Post-Stops:

- | | | | |
|-----|---------------|----------------|------------|
| 18. | /fuṭbol/ | fuṭ.bol | football |
| 19. | /edaṭdeoro/ | e.daṭ.de.o.ro | golden age |
| 20. | /pareṭgrande/ | pa.reṭ.gran.de | big wall |

Word Initial:

- | | | | |
|-----|--------|------|--------|
| 21. | /bien/ | bien | good |
| 22. | /ḍose/ | ḍose | twelve |
| 23. | /gano/ | gano | I win |

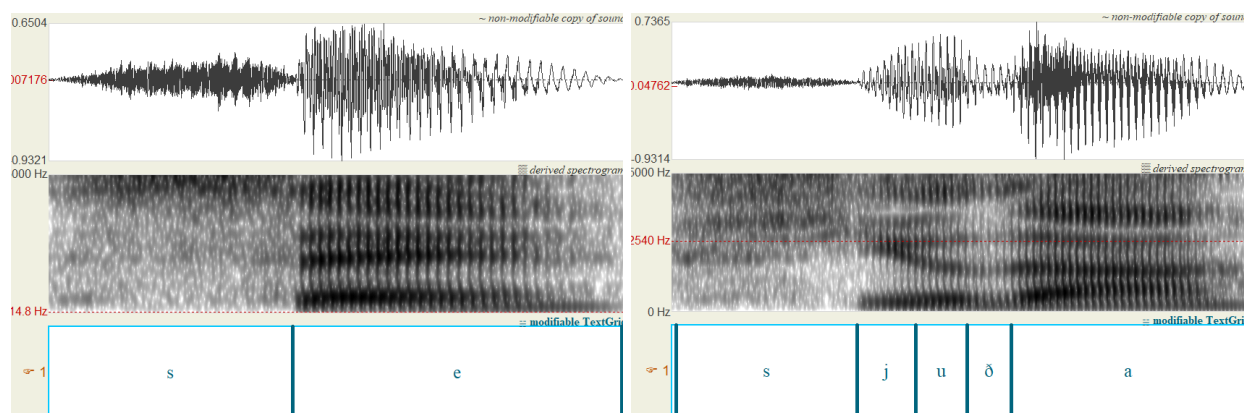
With the broad categories established, the next topic of interest was voiced stops in the coda. Spanish has a process by which voiced stops in the coda are devoiced. This process would

presumably bleed spirantization, which only applies to voiced stops. Relevant segments for analysis are underlined.

24.	/a <u>bs</u> welto/	a <u>B</u> .swel.to	absolved
25.	/sub <u>ma</u> ri <u>no</u> /	sub <u>ma</u> .ri.no	submarine
26.	/o <u>b</u> tener/	o <u>b</u> .te.ner	to obtain
27.	/bi <u>r</u> tud/	bi <u>r</u> .tu <u>d</u>	virtue
28.	/s <u>ju</u> da <u>d</u> /	s <u>ju</u> .Da <u> </u>	city
29.	/s <u>e</u> d/	se <u> </u>	thirst
30.	/do <u>g</u> ma/	do <u>g</u> .ma	dogma
31.	/pu <u>g</u> na/	pu <u>g</u> .na	fight
32.	/si <u>g</u> no/	si <u>g</u> .no	sign
33.	/a <u>bs</u> urdo/	a <u>bs</u> .sur.Do	absurd
34.	/e <u>Da</u> d/	e <u>Da</u> <u> </u>	age
35.	/ma <u>g</u> dalena/	ma <u>G</u> .da.le.na	proper name

Piñeros' analysis that the forms can surface either devoiced or spirantized seems to have merit in so far as spirantization doesn't consistently apply in the coda, but seems to fall short as my speaker does not appear to ever devoice the coda, which is likely a consequence of dialectal differences. This motivates the removal of the voicing constraints for the remainder of the analysis since at best they penalize output candidates that my consultant never expresses.

This data is partially complicated by the fact that my speaker seems to delete some dental stops in coda position. For instance, in the left spectrogram for [se] 'sed' and the right spectrogram for [sjuDa] 'ciudad' it's unclear that there is any phoneme after the final vowels. This is even further complicated by the fact that [birtud] 'virtud' does not delete the coda stop. However, this deletion appears to be an optional process, as my consultant informed me that deletion is typical but not necessary. The lack of the final [d] (or any final obstruent) can be seen in the following spectrograms, where the vowels fade in volume but no final segments can emerge.

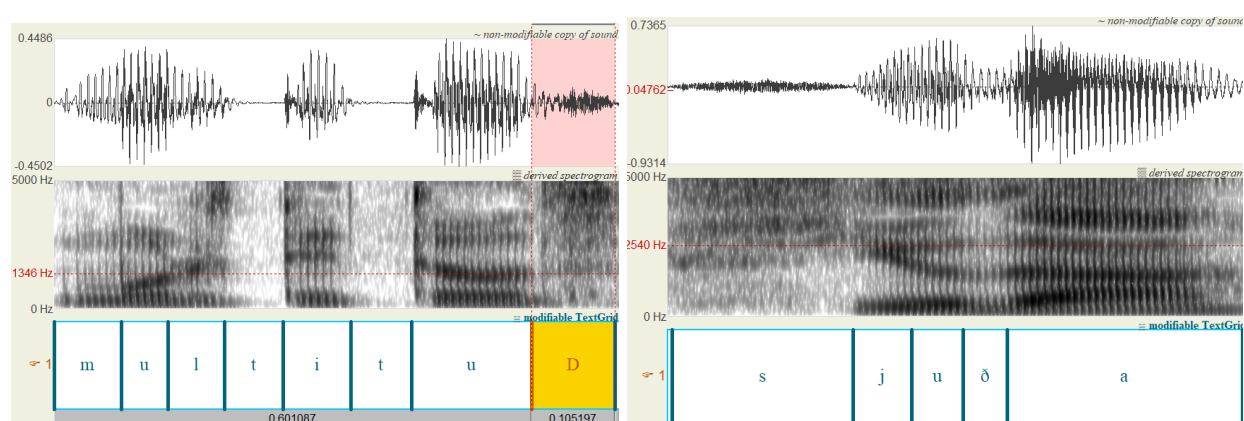


I specifically prompted my consultant to produce the final sound, and was able to elicit additional data points, with a representative one being:

36. /multitud/

mul.ti.tuD

multitude



The contrast between [D] and Ø in the final obstruent position is clear, as in [multitud] we can see the formants indicative of spirantization carrying through, but we also see a distinct change in the spectrogram that indicates a word-final consonant is present. So, we can conclude that spirantization in the word-final position is possible, and in my consultant's opinion preferable to ending with a voiced obstruent (though deletion is still preferable to both options). It should be noted that constraints that reflect this capacity could be chosen (simply by restricting MAX-C to not value word-final voiced obstruents) but this is not relevant to the current analysis.

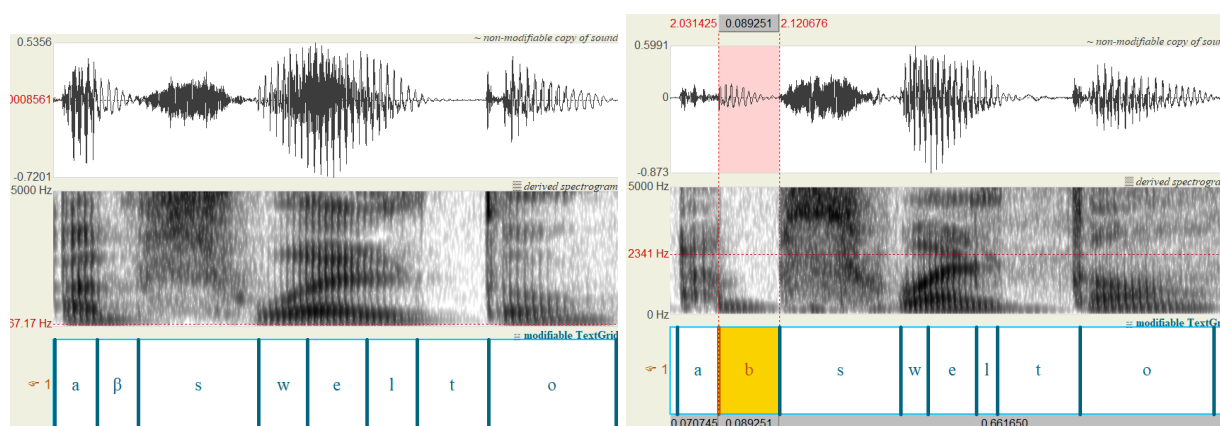
Another odd difference is present: [aB.swel.to] underwent spirantization, and [ab.sur.Do] did not, despite the voiced obstruents both being in identical contexts of [a]_[s]. We would expect the continuant feature to spread per the current analysis, yet in [ab.sur.Do] the voiced obstruent remains in the coda. Either spirantization seems to be an optional process in the coda,

is motivated by other factors such as speaking cadence or phonetic factors in line with what Piñeros proposes (Piñeros 2002, p 400), or it has something to do with the [w] vs the [u] segment that comes immediately after the [s]. Digging into this, I elicited a few more samples in this context and tested some of these hypotheses.

37. /abswelto/ ab.swel.to absolved
38. /subswelo/ sub.swelo subsoil

My consultant did not spirantize in [subswelo], which allows us to rule out the hypothesis that the [w] phoneme was a condition for the spirantization

Additionally, while my consultant noted a preference for spirantizing the [b] in “absuelto”, my consultant did produce [abswelto] when prompted, and both of these productions are seen as valid by my consultant.





Note how in the left production above the formants are visible through the B, yet in the right production, a full stop of everything save voicing is present, then a release into the [s]. This variation which was never present in the onset is acceptable in the coda, which could motivate restricting many of our constraints to only apply to the onset position, for instance:

(10) V-OB-AGREE[cont]_{/Onset}

(11) IDENT[cont]_{/Onset}




/abswelto/	MAX-C	V-OB-AGREE [cont] _{/Onset}	*VOICE-OBSTRUENT	IDENT[CONT] _{/Onset}
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a.  ab.swel.to			*	
b.  aB.swel.to			*	
c. a.swel.to	*!			

Clearly, this analysis would generate both surface forms that my consultant considers valid, but this approach is somewhat flawed in that it now says almost nothing meaningful about when and why spirantization occurs in the coda. A more robust, compelling approach to explain this alternation can be constructed from an explanation of my consultant's preferences. Notably, while a degree of free variation may seem to be acceptable, this variation is only valid when the following segment is [+cont].

For instance, [ab.swel.to] ~ [aB.swel.to] are both valid, yet both in the data and in my consultant's judgment [sub.ma.ri.no] is the only valid surface form, and *[suB.ma.ri.no] would be mildly incorrect. Introducing a new constraint that incurs one violation for each onset consonant with a phoneme before it that doesn't agree in [cont] should resolve this.


(12) AGREE[cont]_{/Onset}

/abswelto/	MAX -C	V-OB-AGREE [cont] _{/Onset}	*VOICE -OBSTRUENT	IDENT[CONT] _{/Onset}	AGREE[cont] _{/Onset}
a.  ab.swel.to			*		
b.  aB.swel.to			*		
/submarino/					
a.  sub.ma.ri.no			*		*
b. suB.ma.ri.no			*		**!
c. suB.Ma.ri.no			*	*!	*

First, let [M] represent [m][+cont], which does not exist in Spanish, and could not surface here. It is included to demonstrate why, with this new constraint ranking, we will never repair a violation by making sounds besides voiced obstruents into continuants. The critical ranking that motivates this is:

$$\text{V-OB-AGREE[cont]}_{/Onset} \gg \gg \text{IDENT[cont]}_{/Onset} \gg \gg \text{AGREE[cont]}_{/Onset}$$

This ranking essentially ensures that spirantization occurs in the onset because the markedness constraint outranks the faithfulness constraint. Additionally, it also behaves correctly insofar as it doesn't motivate [+cont] being added in odd places, such as in the [M] output candidate above, because for all phonemes besides voiced obstruents, faithfulness outranks markedness. Finally, it also captures the restriction on spirantizing in the coda if the next sound is a [-cont] onset, because that would incur a violation of AGREE[cont]_{/Onset}. These constraints still accurately handle earlier data points, such as /traigo/.

/traigo/	MAX -C	V-OB-AGREE [cont] _{/Onset}	*VOICE -OBSTRUENT	IDENT[CONT] _{/Onset}	AGREE[cont] _{/Onset}
a. trai.go		*!	*		*
b.  trai.Go			*	*	**
c. rai.Go	*!		*	*	
d. tai.Go	*!		*	*	*
e. Ørai.Go			*	**!	

It may seem perilous that our general AGREE[cont]_{/Onset} constraint can affect even environments without voiced obstruents, but this example makes it clear that this isn't a problem since any repairs to the [trai] syllable can't surface because they either involve deletion or violating IDENT.

4. Further Research and Open Questions



Though the following forms were solicited early in the elicitation, their results are particularly difficult to understand without the prior rankings. These may provide the strongest evidence that my analysis, which attributes functionally all spirantization to be a consequence of onset-based constraints, may be inaccurate. Here, spirantization is checked for after a spirant, which is done in this case via samples with two consecutive voiced stops. The interesting question here is whether two consecutive underlying stops become [+cont].

Piñeros predicts that they will be of the form [X.x] (Piñeros 2002, p 382), with the first undergoing spirantization (because its input has a continuant segment to the left) and the second not. This implicitly relies on a certain type of I/O theory which is not present in my analysis.

More concerningly, the elicited forms show that my analysis is nearly capable of deriving them, but Piñeros analysis is the one that correctly predicts [aB.dikar] surfacing.

39. /adberso/ aD.Ber.so adverse
 40. /abɖikar/ aB.ɖi.kar abdicate
 41. /edgar/ ed.gar proper name

My analysis, in contrast, correctly predicts [edgar], but not [aDBerso].

/adberso/	MAX -C	V-OB-AGREE [cont]/Onset	*VOICE -OBSTRUENT	IDENT[CONT]/Onset	AGREE[cont]/Onset
a.  ad.ber.so			**		*
b. ad.Ber.so		*!	**	*	**
c. aD.ber.so		*!	**		
d.  aD.Ber.so			**	*!	*

The insufficiency of both my and Piñeros' system of phonological analysis to explain these forms means significant unanswered questions remain in the context of sequential voiced obstruents. I do believe this opens room for future experimentation regarding my analysis, as my consultant said that [edgar], [abdikar], and [adberso] would all be correct but did not have a strong intuition on preferability. So my analysis does still correctly generate an acceptable surface form, but the robust capability to generate all valid outputs is lost on this data.

5. Conclusion

V-OB-AGREE[cont]/Onset >>> IDENT[cont]/Onset >>> AGREE[cont]/Onset

This ranking is proposed as one that correctly generates spirantized outputs in my consultant's dialect of Mexican Spanish. Its strength certainly relies upon its simplicity, as well as the nuanced point that it is capable of correctly generating forms such as [a_b.swel.to] and [a_B.swel.to], which my consultant considers valid, but cannot generate forms such as *[su_B.ma.ri.no]. While this relies on Piñeros' and Martínez-Gil's general ideas regarding some sort of AGREE constraint which effectively spreads a continuant feature from left to right, it is a massively more robust predictor of when spirantization may occur in my participant's specific dialect and manages to encapsulate a degree of free variation in an OT-analysis, which is nontrivial.

My ranking falls short of 3 experimental data points: [aDBerso], [aB.ɸikar], and [saɫ.ɸo]. The [saldo] candidate is not of particular concern, as this irregularity is the source of Piñeros (Piñeros 2002, p 400) proposing a phonetic OT system to capture spirantization, but, as explained in Section 4, the sequences of voiced obstruents do seem to be the primary flaw with my analysis. Additionally, as a whole, my analysis is somewhat contrived to validate both surface forms that undergo and those that don't. This has the side effect of not sufficiently explaining some behavior in the coda, since it somewhat opens the door to a variety of repairs in the coda which may not be valid in Spanish. This could be resolved by simply selecting a mildly more restrictive constraint ordering that validates my consultant's preferred outcomes, which would always predict spirantization in the coda, but then the capture of the free variation would be lost.

As a whole, Piñeros' phonological account of spirantization seems to fall short even of general cases, putting aside my speaker's particular dialect, as the emphasis on faithfulness in the onset seems to prohibit forms such as /lago/ from correctly surfacing as /laGo/.

References

Martínez-Gil, Fernando. “Spirantization and the Phonology of Spanish Voiced Obstruents.” *The Routledge Handbook of Spanish Phonology*, Routledge, 2019, pp. 69–71.

Piñeros, Carlos-Eduardo. 2002. Markedness and laziness in Spanish obstruents. *Lingua* Volume 112, Issue 5. 379-413.