Constraint Interaction in Spanish /s/-Aspiration: Three Peninsular Varieties

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1. Introduction

Peninsular Spanish presents a diverse array of aspiration types for phonological analysis. In general, aspiration affects coda /s/ at a high rate of frequency throughout southern Spain. Historically, it originates in the southern region of Andalucía (Terrell 1981), from which it has extended northwest into Extremadura, northeast into Murcia, and north into Castilla La Mancha and Madrid (Lipski 1986). Today it has gained at least a tentative foothold throughout the country. Studies of aspiration in Peninsular Spanish usually concur that aspiration is characterized by considerable variation. Despite this variation, however, three clear patterns emerge: simple aspiration, gemination with preaspiration, and gemination. These types will be referred to as types A, B, and C, respectively.[1]

In Variety A, which is probably the most widely attested throughout the Spanish-speaking world, /s/ is realized as [h] in syllable coda before [-voice] and [-sonorant] consonants.[2] This particular version of aspiration is found throughout southern and western Spain, and is typical of Coria, in the western province of Cáceres, in Extremadura. Varieties B and C are typical of Cúllar-Baza, situated in the southern province of Granada, in Andalucía. In this dialect, coda /s/ is commonly realized as a preaspirated geminate in Variety B, and sporadically as an unaspirated geminate in Variety C. Examples of the aspiration pattern before voiceless and sonorant consonants in all three varieties are laid out in figure (1).[3]

(1) Aspiration in Peninsular Spanish (Alvar 1955: 291-293; Salvador 1958: 223-225; Navarro Tomás 1967: 110; Zamora Vicente 1967: 72, 120, 320-322; Cummins 1974: 73-76; Lapesa 1981: 519; Hualde 1989a: 40-42; Hualde 1989b: 184-190; Martínez-Gil 1991: 558-563)

		A	B	C	
__ C[-voice]	*obispo*	obi[h]po	obi[^{h}p]po	obi[p]po	‘bishop’
	susto	su[h]to	su[^{h}t]to	su[t]to	‘fright’
	mosca	mo[h]ca	mo[^{h}k]ca	mo[k]ka	‘fly’
	esfera	e[h]fera	e[^{h}f]fera	e[f]fera	‘sphere’
__ C[+son]	*mismo*	mi[h]mo	mi[^{h}m]mo	mi[m]mo	‘same’
	asno	a[h]no	a[^{h}n]no	a[n]no	‘donkey’
	isla	i[h]la	…….. i[l]la ……		‘island’

2000. *Hispanic Linguistics at the Turn of the Millennium: Papers from the 3rd Hispanic Linguistics Symposium*, ed. by Héctor Campos, Elena Herburger, Alfonso Morales-Front & Thomas J. Walsh. Somerville, MA: Cascadilla.

These data, which represent the most commonly attested pronunciations, clearly reveal the three different aspiration patterns. Note that the form *isla* presents an exception in Variety B; Salvador's definitive study of this dialect identifies only gemination in cases of /s/ before /l/. This exception will be treated as such, and will not receive further mention.

All three varieties converge in their handling of aspiration before a voiced obstruent (i.e. /B, D, G/). Unlike the voiceless stops and sonorants, this series triggers a combination of aspiration, voicing assimilation, and segmental coalescence. Examples of this peculiarity are shown in figure (2).

(2) Varieties A, B, C (Salvador 1958: 222-223; Cummins 1974: 74-75; Penny 1986: 491-492; Hualde 1989a: 41-42; Hualde 1989b: 184-187; 189)

__ C[+voice, -son]	*resbalar*	A: re[ɸ]alar	'bounce'
		B, C: re[f]alar	
	desde	de[θ]e	'since'
	disgusto	di[x]usto	'disgust'

Note that the realization of the sequence /s + B/ in *resbalar* appears most commonly as a voiceless bilabial fricative in Variety A, and as a voiceless labiodental fricative in Varieties B and C, with the bilabial allophone also attested.[4]

In all three Peninsular varieties, aspiration involves the suppression of existing features, yet forbids the insertion of new features. The result is frequently a redistribution of existing features. Fairly common in languages, this phenomenon has not escaped notice. For example, Rose (1996) observes that in languages with tight syllable coda restrictions, laryngeal consonants – i.e. the stop [ʔ] or fricative [h] – are often permitted in syllable coda even if most oral segments are banned. In many of these languages, the coda condition blocks singly linked oral codas. The only possible codas then, are geminates and laryngeals. Indeed, the coda condition may be circumvented by suppressing the oral features of a coda consonant altogether, leaving only the laryngeal ones. This suppression of oral features is called debuccalization.

It is hardly a coincidence that the languages which display debuccalization of coda consonants are often precisely the same ones which present geminated codas. Both debuccalization and gemination allow the coda condition to be circumvented, although in different ways. Neither process occurs without a cost, as each involves the omission of place and manner feature information which is important to the effective transmission of the speech signal. On the one hand, debuccalization of coda /s/ involves the suppression of all the oral (supralaryngeal) features. The result is a so-called 'placeless' laryngeal fricative: [h]. On the other hand, gemination of coda /s/ allows supralaryngeal information - although not the underlying information - to be retained. Either way, the phonetic output now satisfies the coda condition for the language, and is therefore an acceptable coda.

Peninsular Spanish aspiration follows this well-attested pattern. Stylistic in nature, it usually occurs in fast or informal registers. Rather than targeting all coda consonants, however, it deals with a subset of coda segments: the class of voiceless continuants. Interestingly, this coda restriction is itself subject to additional restrictions, depending on the variety in question. For example, Variety B [sú^{h}t.to.] presents a combination of debuccalization and gemination. Why should the coda condition be satisfied redundantly in this way? The fact that Variety B [sú^{h}t.to.], with debuccalization and gemination, exists alongside Variety C [sút.to.], with only gemination, suggests that other factors are at work which make redundant satisfaction of the coda condition not only possible, but in some circumstances also desirable.

In this paper, the three main aspiration types for Peninsular Spanish are shown to be the result of competing restrictions on faithfulness and markedness. Aspiration is characterized as an underlying feature whose presence (or absence) in the phonetic implementation is determined by the tension between key constraints, as well as by their ranking relative to other constraints. Such effects as debuccalization, gemination, preaspiration, and coalescence are shown to be the result of pressure from these other constraints (usually low-ranked), and exemplify emergence of the unmarked (McCarthy & Prince 1994).

2. Features and gestural organization

This analysis uses a feature geometry in which the voiced obstruents /B, D, G/ are unspecified for the feature [continuant] (henceforth [cont]) underlyingly. Their voiceless counterparts /p, t, k/, however, are specified underlyingly as [–cont]. This type of analysis, which has been well motivated for Spanish by Mascaró (1984; 1991), Harris (1984; 1985), Hualde (1989a), and many others, allows the data at hand to be handled in a straightforward manner.

The feature [cont], specifically its positive value, plays a principal role in aspiration. So far, all data presented have involved coda /s/. However, in Peninsular Spanish, aspiration may target fricatives other than /s/, such as /θ/, /f/, and /x/, thus *diez* /dieθ/ may surface as die[h], and *reloj* /relox/ may surface as relo[h] (cf. Penny 1986: 496; Hualde 1989a: 38-39; Hualde 1989b: 184).[5] The fact that aspiration targets coda fricatives in general, and not just /s/, provides compelling evidence that aspiration is conditioned by the features which define the voiceless fricatives. The persistence of [h] in this position also suggests that [h] is not a member of this natural class; otherwise, it too would be barred from this position.

In a series of instrumental studies on aspiration in Spanish, Widdison (1995a, 1995b, 1997) observes that the perceptual cue for alveolar [s] is physically present in alveolar [s] as well as in laryngeal [h]. In instances of phonetic [s], this segment is characterized by glottal widening. In cases of aspirate [h], the glottal widening is preserved in absence of the alveolar constriction. According to Widdison, glottal widening is a gestural

subcomponent of [s] which becomes acoustically prominent only when the alveolar constriction is removed by debuccalization.[6]

In phonology, the distinctive feature associated with the glottal widening identified by Widdison and others is generally held to be the laryngeal feature [spread] (henceforth [spr]) (cf. Halle & Stevens 1971; Iverson 1983; Clements 1985; Sagey 1986; Widdison 1995b; Clements & Hume 1995). It is generally accepted that the feature [spr] characterizes all voiceless fricatives (cf. Zamora Munné & Guitart 1982: 110; Ladefoged 1993: 139; Widdison 1995b: 332).[7] The present analysis follows Clements (1987), Selkirk (1991), Palmada (1997), and others in maintaining that the feature [cont] is a dependent of the supralaryngeal cavity node, rather than of the root node. Many motivations for this analysis of the feature [cont] are available; perhaps the most compelling is Kenstowicz's (1994: 489) observation that the laryngeal fricative [h] and the laryngeal stop [ʔ] generally do not pattern with their supralaryngeal counterparts cross-linguistically, therefore making their inclusion in the natural classes of [+cont] and [–cont] segments (respectively) problematic. This inconsistency is avoided if [h] is left unmarked for the feature [cont], and thereby disassociated from the other voiceless fricatives. The feature structure used in this analysis is summarized in (4).

(4) Feature values for key distinctive features

Underlying	[cont]	[spr]	[voice]
/s, f, θ, x/	+	YES	-
/p, t, k/	-		-
/B, D, G/			+
Surface			
[h]		YES	-

In Peninsular Spanish, debuccalization is triggered by the presence of the feature [+cont] in syllable coda. Because [h] is not [+cont], it is an allowable coda. However, [h] is a member of the natural class of [spr] segments, an affiliation it shares with the voiceless oral fricatives. The exclusion of [h] from the class of [+cont] segments and its inclusion in the class of [spr] segments has significant consequences for aspiration, as the analysis will now show.

3. An Optimality Analysis

The constraints used in this analysis are summarized in figure (5). Two positional markedness constraints are used: *C/[spr] and *C/[+cont]. These constraints are responsible for banning their respective features from syllable coda. Their ranking with respect to their corresponding identity constraints

IDENT [spr] and IDENT [+cont] determines the type of coda condition which is active in the dialect. Note that, as they are defined, the identity constraints are violated only if a change is made to an underlying value. Acquisition of a feature by a segment not specified for it underlyingly does not incur violation of the relevant identity constraint. It does, however, violate DEP-LINK, which bans nonunderlying structural association lines. The identity constraints are satisfied as long as the underlying feature is retained without change. Importantly, such satisfaction includes retention of the feature on another segment, for example if the original segment is deleted.

Note that the feature [cont] is monitored by two identity constraints, IDENT [+cont] and IDENT [-cont], which are ranked independently. This division is motivated by asymmetry in the input-ouput correspondence of continuants and stops; specifically, changes from a positive value to a negative value of this feature are admitted, but changes from a negative to a positive value are blocked.

(5) Constraints involved in aspiration

a. *markedness constraints*

*C/[spr][8]	No coda [spr] segments.
*C/[+cont]	No coda [+cont] segments.
HAVE-PLACE	No placeless segments (cf. Padgett 1996).

b. *faithfulness constraints*

MAX-IO	No segmental deletion.
IDENT [spr]	The feature [spr] in the input is retained in the output.
IDENT [+cont]	The value of the feature [+cont] in the input does not change in the output.
IDENT [-cont]	The value of the feature [-cont] in the input does not change in the output.
DEP-LINK	No insertion of nonunderlying structural associations. (cf. Itô, Mester & Padgett's (1995) FILL-LINK.)
UNIFORMITY	No segmental coalescence. (cf. McCarthy & Prince 1995: 371)

In careful style cross-dialectally, IDENT [spr] is ranked above *C/[spr] and IDENT [+cont] is ranked above *C/[+cont]. The result is faithful realization of /s/ as [s]. For ease of exposition in the following tableaux, inactive constraints are not shown (see tableau 6).

(6) All Varieties: /susto/ → [sús.to.] (careful style)

candidates	MAX-IO	IDENT [-cnt]	IDENT [spr]	IDENT [+cnt]	*C/ [+cnt]	*C/ [spr]
☞ a. sús.to.					*	*
b. súh.to.				*!		*
c. súh.θo.		*!				*
d. sú^{h}t.to.				*!		*
e. súθ.θo.		*!			*	*
f. sút.to.			*!	*		
g. súð.ðo.		*!	*		*	
h. sú<s>.to.	*!					

3.1 Analysis: Variety A

As shown in the original data set, Variety A aspiration is characterized by the segmental coalescence of /s/ with the voiced obstruents /B, D, G/; in all other cases, /s/ is typically realized as [h]. These realizations are achieved by the ranking of *C/[+cont] above IDENT [+cont]. At the same time, IDENT [spr] dominates *C/[spr]. As a result, [s] is banned from syllable coda, but [h] is permitted. For ease of exposition, top-ranked MAX-IO is henceforth omitted (see tableau 7).

(7) Variety A: /susto/ → [súh.to.]

candidates	IDENT [-cnt]	IDENT [spr]	*C/ [spr]	*C/ [+cnt]	IDENT [+cnt]	DEP-LINK
a. sús.to.			*	*!		
☞ b. súh.to.			*		*	
c. súh.θo.	*!		*			*
d. sú^{h}t.to.			*		*	*!
e. súθ.θo.	*!		*	*		*
f. súð.ðo.	*!	*		*		
f. sút.to.		*!			*	*

Note that candidates (7b) and (7d), both with coda [h], would be tied were it not for the intervention of DEP-LINK, which bans the insertion of association lines, and therefore also the spreading of features and structural nodes.

In Variety A, the sequences /sB/, /sD/, and /sG/ all undergo a combination of structural and segmental coalescence. Because the voiced obstruents /B, D,

G/ are not specified underlyingly for [cont], they do not violate IDENT [cont] when they are implemented as fricatives [β, ð, ɤ]. Again, the IDENT constraint prohibits changes to the input value of the feature. It does not, however, prohibit the acquisition of this feature by a segment not initially specified for it. The realization of /B, D, G/ as a stop *or* a fricative inevitably requires the acquisition of a [cont] feature, and therefore incurs a violation of DEP-LINK without exception.

The reduction of the sequences /sB, sD, sG/ to single voiceless fricatives [ɸ, θ, x] may appear problematic, as it seems to require the deletion of a segment. Such deletion would fatally violate MAX-IO. However, the process at hand is not segmental deletion, but rather segmental coalescence. If the output segment is a coalescence of two input segments, then segmental correspondence is preserved. The coalesced segment does violate UNIFORMITY, the constraint on multiple input correspondence. Ranked low in Variety A, UNIFORMITY is violable, and segmental coalescence is therefore allowed. Tableau (8) shows evaluation of /desDe/, with segmental coalescence emerging as the optimal solution.

(8) Variety A: /desDe/ → [dé.θe.]

candidates	IDENT [-cnt]	IDENT [spr]	*C/ [+cnt]	IDENT [+cnt]	DEP-LINK	UNIF
a. dés.de.			*!		*	
b. déh.de.				*!	*	
c. déh.ðe.					*!	
d. dé^{h}d.de.				*!	*	
e. déð.ðe.		*!	*		*	
f. déθ.θe.			*!		*	
☞ g. dé.θe.						*
h. dé.ðe.		*!				*

As tableau (8) shows, coalescence does not introduce any nonunderlying structural associations, so DEP-LINK is satisfied. The obstruent /D/ is unspecified for [cont], and therefore its realization as interdental fricative [θ] in optimal candidate (8g) [dé.θe.] violates neither IDENT [+cont] nor IDENT [–cont].

As would be desired, this ranking also accommodates the input /susto/, which unlike /desDe/ resists coalescence in favor of simple aspiration. Because /t/ is specified underlyingly as [–cont], the correspondence between /t/ and [θ] (or any other fricative) fatally violates IDENT [–cont] (see 9).

(9) Variety A: /susto/ → [súh.to.] (final)

candidates	IDENT [-cnt]	IDENT [spr]	*C/ [+cnt]	IDENT [+cnt]	DEP-LINK	UNIF
a. sús.to.			*!			
☞ b. súh.to.				*		
c. súh.θo.	*!				*	
d. sú^{h}t.to.				*	*!	
e. súθ.θo.	*!		*		*	
f. sút.to.		*!		*	*	
g. súð.ðo.	*!	*	*		*	
h. sú.θo.	*!					*
i. sú.ðo.	*!	*				*
j. sú.to.		*!		*		*

3.2 Analysis: Variety B

In Variety A, it was shown that DEP-LINK is decisive in rejecting candidates which – all else equal – introduce nonunderlying association lines. Such associations include the assimilation of place and manner features associated with Variety B, as illustrated by candidate (9d). In Variety B, DEP-LINK is deactivated by its demotion below HAVE-PLACE, which is in turn activated. HAVE-PLACE bans placeless segments, specifically [h]. Ranked above DEP-LINK, it causes a preaspirated geminate to be chosen as optimal. Other rankings remain the same (see tableau 10).

(10) Variety B: /susto/ → [sú^{h}t.to.]

candidates	IDENT [–cnt]	IDENT [spr]	*C/ [+cnt]	IDENT [+cnt]	HAVE-PLACE	DEP-LINK
a. sús.to.			*!			
b. súh.to.				*	*!	
c. súh.θo.	*!				*	*
☞ d. sú^{h}t.to.				*		*
e. súθ.θo.	*!		*			*
f. sút.to.		*!		*		*
g. súð.ðo.	*!	*	*			*
h. sú.θo.	*!					
i. sú.ðo.	*!	*				
j. sú.to.		*!		*		

Recall that Variety B handles the sequences /sB/, /sD/, and /sG/ in the same manner as Variety A. Again, these sequences may be handled without revising the constraint ranking, as shown for /desDe/ in tableau (11).

(11) Variety B: /desDe/ → [dé.θe.]

candidates	IDENT [spr]	*C/ [+cnt]	IDENT [+cnt]	HAVE-PLACE	DEP-LINK	UNIF
a. dés.de.		*!			*	
b. déh.de.			*!	*	*	
c. déh.ðe.				*!	*	
d. dé^{h}d.de.			*!		*	
e. déð.ðe.	*!				*	
f. déθ.θe.		*!			*	
☞ g. dé.θe.						*
h. dé.ðe.	*!					*

3.3 Analysis: Variety C

So far we have seen that Varieties A and B require the ranking of IDENT [spr] above *C/[spr]; the latter constraint has so far been inactive. In Variety C, *C/[spr] is promoted above IDENT [spr], with the effect of tightening the coda condition by imposing an additional ban on the feature [spr]. The coda condition now targets *all* the voiceless fricatives, *including* [h]. Any coda

feature [spread] is rejected, and the phonetic shape of the new coda segment is determined by the intervention of lower-ranked constraints. If DEP-LINK is also demoted one step so that it is below UNIFORMITY, then the geminated variant [sút.to.], without preaspiration, emerges as optimal, as shown in tableau (12).

(12) Variety C: /susto/ → [sút.to.]

candidates	IDENT [-cnt]	*C/ [spr]	IDENT [spr]	IDENT [+cnt]	UNIF	DEP-LINK
a. sús.to.		*!				
b. súh.to.		*!		*		
c. súh.θo.	*!	*				*
d. sú^{h}t.to.		*!		*		*
☞ e. sút.to.			*	*		*
f. súð.ðo.	*!		*			*
g. súθ.θo.	*!	*				*
h. sú.θo.	*!				*	
i. sú.ðo.	*!		*		*	
j. sú.to.			*	*	*!	

This ranking still permits the realization of /sB, sD, sG/ as single voiceless fricatives (see 13).

(13) Variety C: /desDe/ → [dé.θe.]

candidates	IDENT [-cnt]	*C/ [spr]	IDENT [spr]	IDENT [+cnt]	UNIF	DEP-LINK
a. dés.de.		*!				*
b. déh.de.		*!		*		*
c. déh.ðe.		*!				*
d. dé^{h}d.de.		*!		*		*
e. déð.ðe.			*!			*
f. déθ.θe.		*!				*
☞ g. dé.θe.					*	
h. dé.ðe.			*!		*	

4. Conclusion

Any analysis seeking to account for Peninsular Spanish aspiration must be able to accommodate the range of variation observed within the three varietal themes. As table (14) shows, Peninsular Spanish aspiration offers anything but a unified set of data. The most common attestations are shown in bold.

(14) Range of variation in Peninsular aspiration (cf. Cummins 1974: 74-75; Alvar 1955: 292; Salvador 1957: 223-224; Martínez-Gil 1991: 558)

Variety	/sB/	/sD/	/sG/	/sp/	/st/	/sk/	/sm/
Coria *(Variety A)*	**[ɸ]** [ʰβ]	**[θ]** [ʰð]	**[x]** [h]	**[ʰp]** [ɸ]	**[ʰt]** [θ]	**[ʰk]** [x]	**[ʰm]**
Cúllar-Baza *(Varieties B&C)*	**[f]** [ɸ] [ʰb] [ʰβ] [ʰv] [ʰɸ] [ᵇb] [ᵛv]	**[θ]** [ʰd] [ʰð]	**[x]** [ʰg] [ᵍg] [ˣx]	**[ʰᵖp]** [ᵖp] [ʰp]	**[ʰᵗt]** [ᵗt] [ʰt]	**[ʰᵏk]** [ᵏk] [ʰk]	**[ʰᵐm]** [ʰm] [ᵐm] [m] [m̥]

Despite the observed intravarietal variation, however, the patterning of aspiration into three basic types remains consistent. Indeed, no variant reflects more than a minor deviation from any of the three types supported by this analysis. For example, Cummins (1974) notes for Variety A that although the most common realization of /s/ before a voiceless stop is [h], segmental coalescence of the type observed with the voiced series is also possible. Thus the word *distinto*, most commonly realized as di[h]tinto with aspirated /s/ and no other changes, appears sporadically as di[θ]into, in which the /s/ and /t/ are coalesced (cf. also *las curvas* → la[x]urvas). This result is achieved by a minor adjustment to the Variety A ranking: IDENT [–cont] is demoted below IDENT [+cont], as tableau (15) shows.

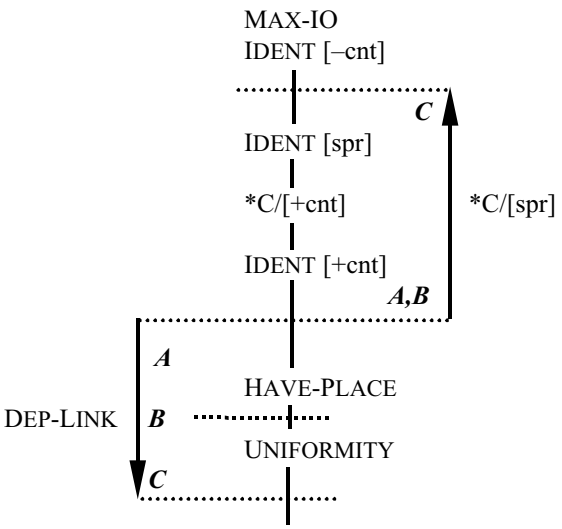
(15) Variety A: /distinto/ → [di̤ ín.to.] (as variant of [dih.tín.to.])

candidates	IDENT [spr]	*C/ [+cont]	IDENT [+cont]	IDENT [–cont]
a. dis.tín.to.		*!		
b. dih.tín.to.			*!	
c. di^{h}t.tín.to.			*!	
d. dit.tín.to.	*!		*	
e. diθ.θín.to.		*!		*
☞ f. di.θín.to.				*
g. di.ðín.to.	*!			*

In this analysis, three varieties of Peninsular Spanish aspiration are explained using ranked constraints which monitor the classes of [+cont], [–cont], and [spr] segments. Secondary effects such as preaspiration, gemination, and coalescence are shown to be the outfall of faithfulness and markedness considerations, and represent emergence of the unmarked.

Figure (16) contains a ranking summary of the three aspiration types examined. Constraints shown marginally are those which rank variably across types. The three types model the diachronic progression of aspiration from simple aspiration to aspiration with gemination and finally to gemination (cf. Terrell 1981; Penny 1991; Widdison 1995a) , with this progression determined by constraint promotions and demotions, indicated by the arrows. This progression is achieved by the simultaneous tightening of the coda condition and loosening of the restriction on structural reassociation. These movements represent a tendency toward a state of affairs in which positional markedness is maximally satisfied with minimal loss of feature faithfulness.

(16) Ranking summary



In the three varieties considered, the constraint-based analysis enables a key generalization about Peninsular Spanish aspiration to be straightforwardly expressed; namely, that it involves the suppression or redistribution of existing features, but not the introduction of new features. The dialects are therefore free to play variations on these aspiration themes, but only as long as they maintain balance between positional markedness and feature faithfulness, and defer, when necessary, to the unmarked.

Notes

* I would like to thank the audience at the 3rd Hispanic Linguistics Symposium at Georgetown University (October 1999) and two anonymous reviewers for helpful discussion and comments. All errors remain my own.

1. Total segmental deletion would count as a fourth alternative. Because deletion does not involve any retention of underlying featural or segmental material, it is not actually a form of aspiration and will not be considered in this analysis. It is important to note, however, that coda /s/ deletion in Peninsular Spanish is quite frequent, especially in the dialect types examined here. Salvador (1958: 224) and Hualde (1989b: 189) concur that in Variety B (Cúllar-Baza), the most common realization of coda /s/ which is also utterance-final is a phonetic zero (cf. also Lipski 1986).

2. Zamora Munné & Guitart (1982: 31), a definitive study of Spanish dialectology, offers the following characterization of Variety A-style aspiration:

La aspiración, simbolizada [h], es una fricción audible causada por el paso de aire espirado a través de la glotis. La fricción se origina al ser la abertura glotal mucho más reducida que en la espiración callada, pero las cuerdas en sí no vibran.

3. Alvar's (1955) Southern Peninsular Spanish data refer primarily to the phonetic realization of /s/ which is not only syllable-final but also word-final. Salvador (1958: 224) observes that the pattern of aspiration at word boundaries is different from that within a word (cf. Lipski 1986). The present study focuses primarily on aspiration which is word-internal.

4. The alternation [ɸ~f] may be the result of any number of variably-ranked constraints; one possibility is a constraint on the feature [strident] in syllable coda – [f] is [strident] but [ɸ] is not. This same constraint would also suppress [s] in the same context, as [s] is also [strident]. This issue will not be taken up here.

5. Contrast, however, the pattern found in the Peninsular dialect of Chinato, which is also native to the province of Cáceres (Extremadura). This dialect has no underlying /s/; instead, it has only /θ/ (spelled with 's', 'c', or 'z'). In syllable coda, /θ/ is realized as [h] following the expected pattern. Between vowels, however, /θ/ voices and emerges as [ð]; e.g. *las cosas* → [lah.kó.ðah.], *las alas* → [la.ðá.lah.] (Hualde 1991: 62-63).

6. Acoustic analysis conducted by Klatt, Stevens & Mead (1968: 46) reveals that [h] has the highest volume-per-second profile of any fricative, and therefore the lowest articulatory impedance of any fricative. For example, the syllable [hah] uttered by a male English speaker delivered 525 mL of air, compared to only 210 mL for [θaθ] and 175 mL for [sas]. Air volume of all voiceless fricatives excluding [h] ranged from 175 to 325 mL.

7. According to Manrique & Massone (1981: 1152), the acoustic correlate of [spr] is a wide noise band with two or sometimes three spectral peaks. In absence of data to compel a natural class of [–spr] segments (i.e. the natural class of vowels, sonorants, voiced and unvoiced stops, and voiced fricatives), it will be maintained in that in Spanish the feature [spr] is monovalent (cf. Lombardi's (1994) feature [aspirate], also monovalent).

8. Boersma (1998: 259) develops the articulatory constraint *GESTURE (spread glottis) to ban the occurrence of aspiration; his constraint, however, is nonpositional. My constraint *C/[spr] is positional in nature.

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