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Spanish /s/

A different story from beginning (initial) to end (final)*

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1. Introduction

Syllable final /s/ is perhaps the most studied phonological variable in Hispanic linguistics. The most frequent consonant in Spanish (Alarcos Llorach 1961:13), /s/ participates in many widely discussed phonological processes and its patterns of variation have been used to distinguish geographic, social, and stylistic varieties, synchronically and diachronically, in countless studies. The overwhelming focus on syllable final /s/ is not surprising since phonetic reduction in this position is prevalent in many varieties and, word finally, intersects with morphology. In sharp contrast to the plethora of studies on /s/ in final position, there is a dearth of empirical studies on initial /s/, although syllable initial aspiration, as in *nohotros*, is mentioned anecdotally for parts of Spain, Colombia, northern New Mexico, and various other points between these geographic extremes (e.g. Espinosa 1930; Flórez 1951; Lipski 1984, 1994; Cotton & Sharp 1988; García & Tallon 1995). Syllable initial /s/ variation has been neglected as an object of study, not only because of the supposition that its occurrence is relatively limited, but more importantly we think, because of the prevailing assumption that it is a predictable extension of processes occurring in syllable final position and therefore merits little theoretical interest.

Typologically the change [s] > [h] is implemented along two main pathways, labeled by Ferguson (1990) the Greek type and the Spanish type. The Greek type begins in intervocalic position and proceeds to word initial and then to preconsonantal positions. The Spanish type starts in syllable final positions, first word medially and then word finally before a consonant. Aspiration extends "last, if at all, to word initial position" (Ferguson 1990:64).

i. Word medial and word final, syllable final: preconsonantal
s > h / Vs$C ex.: [lah mohkas] *las moscas*
ii. Word final: prepausal
s > h / Vs## ex.: [lah mohkah] *las moscas*
iii. Word final: prevocalic
s > h / Vs##V ex.: [lah alah] *las alas*
iv. Word medial, syllable initial: prevocalic
s > h / VsV ex.: [ke paha] *¿qué pasa?*
v. Word initial: prevocalic
s > h / ##sV ex.: [hi heñor] *Sí señor*

Figure 1. Diffusion pattern for /s/ aspiration (adapted from Méndez Dosuna 1996)

The syllable-final to initial pathway for Spanish has been explicitly articulated in the framework of Natural Phonology by Méndez Dosuna (1996), who argues that the phonetic change is a progression of the diachronic process illustrated in Figure 1.

According to this model, the development of /s/ aspiration and deletion begins syllable finally before a consonant (stage i: *las moscas*), and, generalizing from there, may extend its phonetic context to absolute final (stage ii: *las moscas*). It may proceed from there to word final prevocalic position (stage iii: *las alas*), thence to syllable initial position word internally (stage iv: *qué pasa*), and lastly to word and utterance initial position (stage v: *sí senor*). Although he has not studied this empirically, Méndez Dosuna suggests that this is, indeed, the diachronic route for the s > h change and adds, "Stages iv and v occur only in most casual speech styles in most radical aspirating dialects (e.g. Andalusian, Extremeño, Caribbean Spanish) ... " (1996:98). The reduction of /s/ in syllable initial position is thus hypothesized to be the last step in a diachronic weakening process that would be found in dialects where /s/ is pronounced overall the least. It is striking, in our view, therefore, that the aspiration and loss of syllable initial /s/ is documented in varieties of Mexican Spanish, a dialect typically characterized for its retention and articulation of consonants.

In this paper we compare aspiration and deletion in syllable final and syllable initial positions in Spanish data from Chihuahua, Mexico. Contrary to the prevailing assumption that /s/ reduction diffuses from syllable final to syllable initial position, we find a higher frequency of aspiration/deletion word medially in syllable initial position (*ese*) than in syllable final position (*este*). In striking contrast to the familiar pattern in aspirating Caribbean, South American, and Andalusian dialects, in the Chihuahua data we find that the frequency of aspiration and deletion word finally is higher before a pause or a vowel than before a consonant. Given this nonconforming pattern, we compare constraint hierarchies for /s/ reduction syllable finally and initially and show that following phonological environment makes

the greatest contribution syllable finally, while preceding environment is the most important linguistic constraint syllable initially. This pair of results, higher /s/ reduction prevocalically than preconsonantally and different phonetic conditioning for /s/ reduction syllable finally and initially, provides evidence against the model in Figure 1 and more generally, against a unitary process of aspiration extending from syllable final to syllable initial position in Spanish.

2. Data and method

For this study we analyze the realizations of both initial and final /s/ in data from Ascención, Chihuahua, in northern Mexico. Given the limited number of speakers and hours of speech in our data, we do not make claims about the representativeness of the findings. Speakers were recorded in conversations or sociolinguistic interviews conducted as part of research on an unrelated topic (Torres Cacoullos 2000). Although we do not discuss extralinguistic factors here, the speakers, four males ranging in age from 30 to 80 years, show significant differences in rates of aspiration and deletion; stylistic factors are also important (Brown 2000). 3839 occurrences of /s/ were extracted from approximately 150 minutes of transcribed material.

The locus of variation, or variable context, is occurrences of standard Spanish orthographic *s, z, c* (before *e* or *i*), and *x* in words like *experiencia.* In delimiting the variable context we included sequences of orthographic *s, z, c* across word boundaries, because in the data this is an eligible context for variation, as in *buenas tardes señora*, realized *tarde*[s] [h]*eñora*. We coded a little over 1,000 tokens each of /s/ in word initial (*señor*), word medial – syllable initial (*ese*), and word final (*vamos*) position. For word medial – syllable final position (*este*) the total is substantially smaller, at a little over 500. We note that word medial syllable final /s/ is a context of considerably lower frequency than word final /s/ (occurring between 3.5 and 4 times less frequently).[1]

Since we are interested in s > h > Ø as a process of phonetic reduction (lenition, weakening) in this study, we contrast sibilant realizations of /s/ with any reduced variants. Sibilant realizations include the voiced allophone [z], while considered together as reduced variants are aspirated and deleted tokens. With respect to aspiration, we did not distinguish phonetically between syllable initial and syllable final realizations, although acoustic (e.g. Mann & Soli 1991) and perceptual (e.g. Widdison 1991) studies suggest that /s/ has two very distinct sets of characteristics in onset versus coda position.[2]

With respect to deletion, we counted word final tokens in disambiguating contexts but excluded unclear cases, where we could not tell whether or not a plural

was intended. For example, in *lo[Ø] dia[s] festivo[s] si lo[s] trabajas, tienen que pagártelo[Ø] doble[s], y si, si no lo[Ø] trabajas, te lo[Ø] tienen que pagar sencillo*, we coded the first two zeroes as plurals (*los días* and *pagártelos dobles*) but did not count the last two (*lo trabajas te lo tienen que pagar*, or *los trabajas te los tienen que pagar*). We recognize that these might well be cases of what Labov (1994:561–566) calls "missing zeroes", which give the appearance of lower reduction rates.

Particularly apt for evaluating the proposed syllable final to syllable initial reduction model outlined above in Figure 1 is variable rule analysis. Variable rule analysis is a type of multivariate analysis that considers different environmental factors simultaneously and measures their effects on the choice of variants (Rand & Sankoff 1990), in this case, reduced versus sibilant realizations. Factor groups considered in this study are phonological context, stress, and lexical frequency. Variable rule analyses provide evidence on (1) statistical significance of effect (i.e., the regularities observed are not due to random fluctuation, at the .05 level); (2) magnitude of effect (i.e., which conditioning factor group is most responsible for reduction); and (3) hierarchy of constraints (i.e., ordering of factor weights within a group, e.g., following voiced consonants are more favorable than voiceless stops to /s/ reduction) (Poplack & Tagliamonte 2001:92–93). The hierarchy of constraints yields "the detailed structure of the relationship between variant and context, or the "grammar" [or phonology] underlying the variable surface manifestations (Poplack & Tagliamonte 2001:94). The comparison of constraint hierarchies across positions allows us to examine the claim that Spanish /s/ reduction is a unitary process extending predictably from syllable final to syllable initial positions.

3. Does the final to initial continuum hold?

As a first step in evaluating the hypothesis that syllable initial reduction is an extension of syllable final processes, we compared /s/ reduction in four positions: word initially (*señor*), word medially/syllable initially (*dicen*), word medially/syllable finally (*mismo*), and word finally (*una vez*). The frequency of reduced variants, combining aspiration and deletion, is summarized in Table 1. The prediction consistent with the hypothesis of a unitary syllable-final-to-syllable-initial reduction process is that reduction will be higher in syllable final than syllable initial positions. The right and left extremes of the table show the predicted result, with 21% and 45% for word initial and word final position respectively. Matters are complicated in the middle two columns, however, since in medial position reduction is higher in syllable initial (prevocalic) than syllable final (preconsonantal) position, with 34% and 22%.

Table 1. Distribution of reduced /s/ in all positions (N = 3839)

Word initial	Medial(syl.init.)	Medial(syl.fin.)	Word final
218/1044 = 21%	380/1110 = 34%	125/569 = 22%	504/1116 = 45%
Hí, heñor	*dihen*	*lo mihmo*	*una veh*

The ordering of positions in Table 1 goes against the suggested diachronic path of development outlined by Méndez Dosuna (1996). If the Chihuahua data were a reflection of the hierarchy for /s/ reduction drawn in Figure 1, which we think fair to say is assumed by most linguists, there should have been a higher occurrence of reduced variants in word medial/syllable final position than in either of the syllable initial positions. What we find instead is that the rate of reduction is virtually the same in word initial and word medial/syllable final position (Chi-square = .259968, p = .6101). Moreover, reduction rates are significantly higher word medially in syllable initial (e.g., *ese*) than syllable final (e.g., *este*) position (Chi-square = 26.91058, p = .0000).

It is notable that word final position shows higher reduction rates than word medial/syllable final position, since the former constitutes an alternating environment, where changes have been found to be retarded (Timberlake 1978; Bybee 2001:145–148). Several linguists explicitly place word internal preconsonantal ahead of word final preconsonantal position in the Spanish s > h pathway (e.g., Ferguson 1990:64). In word medial/syllable final position, following (and preceding) phonological environment for /s/ is constant in a given word, e.g. word medial /s/ in any token of *estar* is followed by /t/. Word finally, in contrast, following phonological context is in theory as variable as the number of different phonemes with which the following word types may begin. In the present corpus, following consonants make up 59%, pauses 21%, and vowels 20%, of the word final data. Thus, not only is word final an alternating environment, but this word final alternating environment includes following vowels and pauses, which presumably are less favorable to reduction than consonants. The higher frequency of reduction in word final than word medial/syllable final position, which is always a preconsonantal context, points to a pattern of phonetic conditioning for aspiration and deletion that is different from those of other well-studied varieties of Spanish.

Table 2 compares syllable final /s/ reduction in the Chihuahua data and two extensively studied regions, Cuba and Argentina, in four phonetic contexts: word internal preconsonantal, word final preconsonantal, word final prevocalic, and word final before a pause. The data in the columns labeled Cuba and Argentina, summarized from Terrell (1977, 1978, 1979), show a good fit with the generally accepted hierarchy for /s/ reduction (Figure 1). That is, in Cuba and Argentina, reduction rates are highest before a consonant, word medially or finally (stage i, Figure 1). The Argentina data, in fact, exactly fit Méndez Dosuna's (1996) proposed model of

Table 2. Comparison syllable final /s/ reduction in Chihuahua vs. Cuba, Argentina*

Phonetic context	Chihuahua, Mexico	Cuba	Argentina
___C	22% (569)	97% (1714)	88% (4150)
___##C	42% (656)	98% (3265)	89% (5475)
___##V	47% (221)	82% (1500)	12% (2649)
___//	54% (230)	39% (1776)	22% (2407)

*Cuba, Argentina data taken from Terrell (1977, 1978, 1979); as summarized in Bybee (2001:140)

the reduction process, with reduction rates following the order preconsonantal > prepausal > prevocalic position (in the Cuban data prevocalic and prepausal are reversed).

Chihuahua syllable final /s/ reduction differs strikingly from Cuban and Argentine patterns. The environments with the most reduction in Cuba and Argentina (before a consonant word medially and finally), are those precisely in which we find the least reduction in the Chihuahua data, at 22% and 42%. Conversely, where the sibilant is most retained in other dialects (before a vowel or pause), it tends to be reduced in this corpus, at rates of 47% and 54%. The Chihuahua data are more similar to those reported by Brown (1993) for Sahuaripa, Sonora, also in northern Mexico. Higher reduction rates before a pause (29%) than before a consonant (14.5%) are similarly found here (1993: 173–174, Tables 7 & 10). The Sonoran Spanish also shows syllable initial /s/ aspiration and deletion, at a combined rate of 12% between vowels word medially and at word boundary (1993: 167, Table 4).

Since the northern Mexican varieties that in fact aspirate initial /s/ do not seem to conform to either the proposed syllable-final to syllable-initial pathway (Figure 1), or the reduction pattern found in the Caribbean and South America, we need to take a more detailed look at regularities and tendencies in the Chihuahua data. What environmental factors condition /s/ reduction and how?

In the following tables we show the results of four independent variable rule analyses, one for each of the four positions into which we classified occurrences of /s/: word final and word medial/syllable final, depicted in Table 3, and word initial and word medial/syllable initial, depicted in Table 5. Separate analyses were done because the positions involve different possible phonetic environments. Each analysis opposes reduced variants [h] and [Ø] to sibilant realizations. The analysis includes the following five factor groups: following and preceding phonological environment, relationship to stress in the word, word frequency, morphemic status (for word final /s/), and speaker differences.[3] Within each factor group, individual factors are listed in descending order of factor weights; the higher weights are more favorable to /s/ reduction, while lower weights disfavor. The magnitude of the effect is measured by the range, the difference between the highest and lowest weight. The

greater the range, the greater the contribution of the factor group to the probability of /s/ reduction.

4. Final /s/ reduction: Following phonological environment and frequency/lexical effects

We begin with syllable final /s/ (Table 3). As a first observation, following phonological environment is the most important constraint on /s/ aspiration and deletion, with a range of 46 word finally and 66 word medially. The direction of effect is the same for both positions, with reduction most favored by a following liquid, as in *Israel* and *es lo*, a nasal, as in *mismo*, and by other voiced consonants, as in *vamos de*.[4] A following /s/ is least favorable, though aspiration does occur, for example, *e[h] cierto*. It is notable that voiceless stops disfavor reduction, since their conserving effect helps explain the lower rates of reduction word medially/syllable finally. On the other hand, word finally aspiration and deletion are favored by a following /a/, pause, and other vowels.

The ordering of factors in preceding phonological environment is different in each position, with preceding /a/ most favorable to reduction word finally and preceding /e/ most favorable word medially. We note, though, that the word medial syllable final environment is heavily skewed. /e/ is the preceding phonological environment in 71% of our sample cases, while voiceless stops, overwhelmingly /t/, make up 94% of the following contexts. It turns out that half of the medial syllable final data is from two word types with the /est/ sequence, *estar* and *este/a/o*, a point to which we return shortly. Stress also shows differences between the two positions, with word final reduction favored in unstressed syllables, as in the articles *los, las* and object clitic *nos*, and post-tonic syllables, as in *entonces, Juárez, todos.* Word medially, reduction is favored in pre-tonic syllables, as in *está.*

For word final /s/, we also considered morphemic status. The relationship of rates of reduction, deletion in particular, to the status of /s/ as a plural marker has been much debated, with consensus yet to be reached. (See Labov 1994:556–568 for a summary of functional and counterfunctional accounts.) In the present data, the plural marker makes up 45% of the word final data and shows a reduction rate of 44%. This compares with 45% reduction for non-morphemic final /s/. On the other hand, the 2nd person singular marker apparently favors reduction more than either plural or non-morphemic /s/. We do not, however, interpret these results as evidence for morphemic status as a predictor of final /s/ behavior, since verbal /s/ makes up a scarce 4% of the data. Furthermore, 42% of the reduced variants come from the verb or discourse marker *ves, verás* 'you see', which aspirates or deletes in all but one occurrence.

Table 3. Variable rule analysis of the contribution of phonological and lexical factors to the probability of syllable-final /s/ reduction, in word-final and word medial position (factors selected as significant within enclosed column)

	Word-final				Word-medial		
Input:	.44				.16		
Total N:	1116				569		
	%	Factor Weight	% data		%	Factor Weight	% data
Following phonological environment							
Liquid	63	.71	6	/r/	75	.98	1
/f,x,y/	52	.63	4				
nasal	54	.61	9	nasal	53	.97	3
/a/	53	.60	9				
pause	54	.57	21				
vd. consonants	50	.55	11	vd. consonants	33	.84	1
other vowels	44	.53	10				
other	37	.36	2				
voiceless stops	28	.31	23	voiceless stops	21	.47	94
/s/	22	.25	4	/s/, /l/	9	.32	2
	Range 46				*Range 66*		
Preceding phonological environment							
/a/	57	.64	24	/e/	25	.56	71
/o/	45	.49	43	/a/	12	.52	9
/e/	36	.41	31	/i/	34	.45	6
/u,i,ei/	46	.36	1	/u,o,n/	9	.25	14
	Range 28				*Range 31*		
Morphemic status							
verbal (2nd sg)	58	.67	4				
non-morphemic	45	.54	52				
plural marker	44	.44	45				
	Range 23						
Stress							
unstressed	53	.59	20	pre-tonic	27	.63	61
post-tonic	46	.53	49	stressed	13	.33	31
stressed	38	.39	31	unstressed	13	.22	8
	Range 20				*Range 41*		
Word frequency							
High (>2 tokens)	47	.52	82	high	23	.51	88
Low (1–2 tokens)	37	.42	18	low	12	.43	12
	Range 10						

Word-final: Chi-square/cell = 1.2169, Log likelihood = –670.235, p = .000; Word-medial: Chi-square/cell = .7448, Log likelihood = –252.349, p = .008. Also selected: speaker differences.

We hypothesized that lexical frequency would be an important factor in the reduction of /s/, both syllable initially and finally. In the usage-based model of phonology developed by Bybee (2001), high frequency lexical items tend to undergo articulatorily motivated reductive changes at faster rates than low frequency words. Sound change occurs in real time as language is used, and the instances of use are registered in memory. Words or phrases that are more frequently used have more of an opportunity to be altered, having the effect of accelerating the phonological reduction. Such is the case in studies of English schwa-deletion (Hooper 1976), historical sound changes (Phillips 1984), and t/d deletion (Bybee 2000). We find a small but significant frequency effect for word final /s/, in the direction predicted. Higher token frequency words favor aspiration or deletion more than lower frequency words. Although not selected as statistically significant, the direction of effect word medially is the same.[5]

The word medial data is highly skewed lexically. The six most frequent word types make up 69% of the data and 87% of reduced tokens. However, they do not behave uniformly. *Estar* ['to be (located)'] alone makes up 39% of all the medial data and 61% – close to two-thirds – of all reduced tokens. Forms of *estar* have an overall reduction rate of 34%. In contrast, tokens of *este/-a/-o*, which is the second most frequent word type with 12% of the data and has the same /est/ sequence, show only 11% reduction. This may be because /s/ invariably occurs in a stressed syllable in this word. On the other hand, in an earlier variable rule analysis including individual word types, high frequency words *mismo* ['same'] and *después* ['after'] highly favored reduction, with rates of 80% and 46% respectively, while *hasta* ['until, including'] and *usted* ['you'] were less favorable, with 18% and 13%. Here stress does not provide an obvious explanation for the differences in reduction rates, since both *mismo* and *hasta* have a tonic /s/, while *después* and *usted* are pretonic, which should favor reduction (Table 3). What low reducers *hasta*, *usted*, and *este* have in common is a following /t/. Note, though, that despite the following /t/, *estar* has a relatively high reduction rate, in accord with its exceptionally high token frequency.

In summary, we have seen that final /s/ reduction is not conditioned the same way in the present Chihuahua data as in the Caribbean and other well-studied dialects. Voiceless stops are the least favorable following phonological environment (excepting following /s/). Following pauses and vowels, as well as sonorants and voiced obstruents, favor aspiration and deletion in word final position. Reduction is less frequent overall word medially, and is also lexically restricted.[6]

5. Initial /s/ reduction: Preceding phonological environment, frequency/lexical effects and productivity

Let us now turn to syllable initial /s/. Table 4 summarizes the distribution of the three variants, sibilant, aspirated, and zero, between word initial and word medial positions. The distribution of variants is similar in both positions. Nevertheless, reduction rates are higher word medially (Chi-square = 47.83179, p = .0000). This contrasts with syllable final /s/, where medial position showed restricted reduction rates.

Table 5 shows the results of separate variable rule analyses for word initial and word medial syllable initial /s/. The linguistic factor group with the greatest effect on initial /s/ variation in both positions is the preceding phonological environment. This contrasts with syllable final /s/, where following phonological environment showed the greatest range. Following phonological environment was not selected as significant for word initial /s/, and shows a relatively smaller range for medials than preceding environment. It appears that syllable initial /s/ looks more to its preceding phonological environment, whereas syllable final /s/ looks to the following. The former is looking back, as it were, and the latter is looking forward.

The direction of effect in all factor groups is similar, both word initially and medially. Preceding low and mid vowels are more favorable to aspiration and deletion than high vowels, though /a/ is ordered above /e/ in word initial position. For following environment, reduction is more favored by following /o/ and /e/ than following /a/ and /i/. In the stress factor group, unstressed and pre-tonic syllables are more favorable than stressed syllables, and also post-tonic ones in word medial position. With respect to lexical frequency, higher frequency words show higher reduction rates than low frequency items. Nevertheless, this factor group has the smallest range in word medial position and was not selected for word initial /s/ (but see Note 5).

Frequency effects may be related to the productivity of phonological processes. If initial /s/ aspiration were a non-productive, entirely lexicalized phenomenon, we might not expect to see a frequency effect. Indeed, reading the limited bibliography on initial /s/ aspiration, one cannot help but notice that certain examples are repeated: *nohotros, heñor, hí.* Is Chihuahua initial /s/ aspiration a non-productive phenomenon applying to a small, closed set of words?

Table 4. Distribution of syllable-initial /s/ variants by word position (N = 2154)

	s	H	0	Totals
Initial	79%	19%	2%	48%
Medial	66%	28%	6%	52%
Totals	72%	24%	4%	

Table 5. Variable rule analyses of the contribution of phonological and lexical factors to the probability of syllable-initial (s) reduction, in word-initial and word-medial position (factors selected as significant within enclosed column)

	Word-initial				Word-medial		
Input:	.15				.28		
Total N:	1044				1110		
	%	Factor Weight	% data		%	Factor Weight	% data
Preceding phonological environment							
/a/	34	**.70**	10	diphthong	57	**.89**	1
pause	30	**.65**	33	/e/	41	**.58**	31
/e/	25	**.60**	11	/a/	39	**.56**	32
/o/	14	**.43**	20	/o/	40	**.54**	9
/i/	11	**.36**	8	/i/	25	**.39**	8
/u/	K.O.	(100%)	0	/u/	19	**.27**	3
diphthongs	K.O.	(100%)	0				
/s/	10	**.32**	8				
liquid	8	**.25**	5				
nasal	3	**.16**	3	nasal	19	**.34**	12
other	3	**.09**	3	non-nasal cons.	4	**.17**	4
	Range 61				*Range 72*		
Following phonological environment							
/o/	20	.63	4	/o/,/u/	42	**.57**	19
/e/	20	.52	36	/e/	34	**.55**	29
/i/	25	.52	39	/a/	35	**.49**	21
/a/	23	.50	12	/i/	34	**.45**	22
/u/, diphthong	6	.29	10	/ie/	15	**.34**	8
					Range 23		
Stress							
pre-tonic	27	**.72**	16	unstressed	38	.57	2
unstressed	20	**.60**	28	pre-tonic	33	.56	5
stressed	19	**.39**	56	stressed	35	.51	38
	Range 33			post-tonic	34	.49	55
Word frequency							
High (>2 tokens)	22	.51	95	high	37	**.52**	87
Low (1–2 tokens)	9	.28	5	low	15	**.36**	13
					Range 16		

Word-initial: Chi-square/cell = 1.1760, Log likelihood = –442.321, p = .000; Word-medial: Chi-square/cell = 1.0334, Log likelihood = –532.590, p = .045. Also selected: speaker differences.

Table 6. Productivity of syllable initial variants by word position (Number and proportion of all word types appearing with variant; total types = 258)

	s	h	0	Total types
Initial	69 (88%)	22 (28%)	6 (8%)	78
Medial	148 (90%)	43 (26%)	18 (11%)	165

To measure the productivity of syllable initial /s/ aspiration and deletion, we counted the number of different word types that occurred at least once with a reduced variant. If reduction applied only to words such as *no*[h]*otros* and [h]*eñor*, the type frequency of the reduced variants would be a small proportion of the total number of word types in the corpus. However, as shown in Table 6, aspiration occurs in over 25% and deletion in about 10% of the types, in both words with an initial /s/ and words with a medial /s/. This spread suggests that aspiration of initial /s/ is not restricted to just a handful of words and is, at least partially, a productive variant, occurring in roughly one fourth of all word types.

The relationship between lexical frequency and initial /s/ aspiration is not completely straightforward. In looking more closely at rates of aspiration in individual word types, we find evidence that the regular mention of *nohotros* in the literature is no accident. In the Chihuahua data, /s/ was aspirated in 81% of the occurrences of this word, the highest aspiration rate for a single lexical type in the data.[7] Yet *nosotros* does not figure among the words with the highest token frequency.

Table 7 lists in descending order the 13 word types with the highest token frequency in the combined word initial and word medial/syllable initial /s/ data. Also listed in Table 7 are the 13 word types with the highest aspiration rates, including verbs *pasar* ['to pass'], *conocer* ['to know'], *decir* ['say'], and *sacar* ['to take out']; nouns *veces* ['times'] and *señor* ['mister, man']; distal demonstrative *ese*; and adverb *casi* ['nearly']. There is some overlap between the two lists, for example, *hacer* ['to do'] is a high aspirating word and a highly frequent verb, as well. Nevertheless, there is not a one to one correspondence between token frequency and rate of aspiration. *Sí* ['yes'], the single most frequent word, is last on the list of aspirating words. At least half of the most highly aspirating words are not even on the list of the most frequently used words.

While frequency effects appear to apply to /s/ reduction, as indicated by the direction of effect in all four variable rule analyses (Tables 3 and 5), when words are taken individually it is not the case that the highest frequency words show the highest reduction rates (Table 7). Thus, the aggregate frequency result may be due to the skewing effects of certain lexical items. These findings may be related to those of Poplack (2001) in her study of variation in the irrealis domain of French, which suggest a highly correlated relationship between frequency and lexical identity (and morphological irregularity) in the determination of productivity. On the

Table 7. Syllable-initial /s/: Most frequent word types and word types with highest aspiration rates

13 most frequent words	Tokens	13 highest aspiration rates		Tokens
sí	306	*nosotros*	81%	27
se	227	suffix *-cito*	73%	15
ese, esa, esos, esas	141	***pasar***	58%	43
hacer*	102	*casi*	56%	10
sea	77	*veces*	52%	21
así	72	***hacer***	40%	102
entonces	53	*conocer*	39%	18
si	45	*señor*	38%	26
decir*	44	*empezar*	36%	14
pasar*	43	***ese/a(s)***	34%	141
casa(s)	43	***decir***	34%	44
*salir**	35	*sacar*	30%	27
*ser**	30	***sí***	29%	306

*Types with different inflected forms; bolded words are common to both lists.

other hand, a complicating facet in evaluating lexical frequency-based explanations is that not all word types are of a single form. This is especially the case for verbs, in which the phonetic environment for medial /s/ may not be uniform. For example, *pasar* has /aso/, /asa/, and /ase/ sequences as well as stress in different places in different conjugated forms. Thus, disentangling general frequency and particular lexical effects in initial /s/ aspiration is an issue for further study.

Finally, the present data suggest another promising avenue of inquiry, looking beyond syllable and word boundaries to explore the effects of phonotactic patterns. A close examination of the weights for preceding phonological environment in Tables 3 and 5 reveals that, in all four positions, we have a common preceding vowel hierarchy, with low and central vowels more favorable to reduction than high vowels. Combining preceding and following phonological environment could yield illuminating results.

Table 8 shows reduction rates in the /asa/ sequence in three positions. This phonotactic sequence occurs word medially in words like ***casa*** ['house'] and ***pasar*** ['to pass']; word finally in frequent phrases such as ***gracias a*** ['thanks to'] and ***vas a*** ['you're going to']; and word initially in combinations such as ***ya sabía*** ['he already knew'] and ***había sacado*** ['he had already removed']. We find that aspiration and deletion occur at higher rates between two /a/'s than average for the respective positions.

In a usage based phonology it makes sense to analyze the data in larger units. While the majority of studies on Spanish /s/, including this one, specify the locus of weakening through a discussion of strictly defined syllable position, phonotactic

Table 8. Phonotactic factor: /s/ reduction in /a/_–_/a/ context

	N	% aspiration/ deletion	Average aspiration/ deletion
Word initial (e.g. *ya sabía, había sacado*)	17	59%	21%
Word-medial, syllable initial (e.g., *pasar, casa*)	80	46%	34%
Word final (e.g., *gracias a, vas a ver*)	20	60%	45%

sequences may provide insights not obtainable when separating the data by syllable position and word boundary (cf. Lipski 1994:271–272). As Bybee (2001) convincingly argues, the basic unit of mental storage and the domain of application for sound change is the word and frequent constructions or phrases. The /s/ of *vamos*, for example, is usually categorized as syllable final. But if in actual linguistic usage *vamos* is frequently followed by *a* in the phrase *vamos a* 'we're going to, let's', we may not be justified in viewing this /s/ as syllable final. Similarly, certain frequent article – noun combinations (*una/la señora* 'a /the lady, woman') and routinized expressions (*Bendito sea Dios*) are likely stored in the lexicon as single chunks. Frequent collocations such as these may lead to the emergence of phonotactic patterns that may be favorable to /s/ reduction.[8]

6. Conclusion

In summary, in comparing syllable final and syllable initial /s/ reduction in data from Chihuahua, Mexico, variable rule analyses reveal that following phonological environment makes the greatest contribution to final /s/ variation, while syllable initial /s/ looks backward to the preceding phonological environment. On the other hand, lexical frequency effects appear to apply to /s/ reduction in any position, with higher frequency words favoring aspiration and deletion. Nevertheless, words with the highest initial /s/ aspiration rates are not all among the words with the highest token frequency. We find that while initial /s/ reduction is, at least partially, productive, lexical factors are clearly involved. Another question inviting further research is the role of frequent phonotactic patterns (such as the /asa/ sequence) in /s/ reduction.

We conclude that the Chihuahua data provide evidence that the proposed continuum from syllable final to syllable initial position in /s/ reduction does not hold. Against the assumption that /s/ reduction diffuses from syllable final to syllable ini-

tial position, we find a higher frequency of aspiration and deletion word medially in syllable initial position (for example, *ese* with 34%) than in syllable final position (*este* with 11%). The Chihuahua data show a different ordering of favorable contexts for final /s/ reduction than the familiar Caribbean pattern, as the frequency of aspiration and deletion is higher before a pause or a vowel than before a consonant word finally, and higher word finally overall than word medially before a consonant. Furthermore, overall rates of syllable final and word final reduction are relatively low.

Recall Méndez Dosuna's (1996:98) prediction that initial /s/ aspiration will appear as an extension of final /s/ reduction in the "most radical aspirating dialects." The Chihuahua data (and other northern Mexican patterns), however, suggest a different generalization. We propose the following two-part hypothesis, which can be empirically tested in dialects in which word and syllable initial aspiration have been noted, including Colombia, El Salvador, and Honduras.

> Syllable initial /s/ reduction will occur in Spanish varieties where:
> (1) word final /s/ reduction is greater before a pause and a vowel than before a consonant, and
> (2) overall final /s/ reduction rates are relatively low.

This prediction is a generalization from patterns observed in the Chihuahua data and indications from Latin American dialect studies that initial /s/-aspirating Spanish varieties show syllable final aspiration rates that are either lower than in highly reducing Caribbean and coastal Central/South American dialects, or nil. The first appears to be the case in El Salvador and Honduras, the second in the highland regions of Colombia (cf. Lipski 1994:209, 258, 271–272; Zamora & Guitart 1982:119–120).

Beyond generalization from the available data, independent motivation for this prediction is the affinity of the Chihuahua patterns with the Greek type of s > h change, in which the "crucial phonetic condition is the presence of a following vowel" (Ferguson 1990:72). Since word medial syllable final /s/ is always preconsonantal, in the "Greek type" of Spanish varieties this will be the position with the lowest reduction rate. And since word final /s/ is preconsonantal about half the time, reduction rates in this position will be lower in these varieties than in classic Spanish type dialects.[9] We thus predict that it is Spanish varieties with word final reduction rates higher in prepausal and prevocalic than preconsonantal contexts, and also relatively low overall syllable final reduction rates, that will manifest syllable initial reduction. In sum, the data and analyses presented here suggest a different story for Spanish /s/ reduction, one that is different from beginning (initial) to end (final).

Notes

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1. The 569 word medial syllable final tokens correspond to more recorded material than the other /s/ positions.

2. The distribution of reduced variants is different syllable finally versus initially. In syllable final position, both word finally (*vamos*) and word medially (*este*), the deletions and aspirations are roughly equal. In syllable initial position, in contrast, aspiration predominates over deletion with 92% of reduced tokens word initially (*señor*) and 82% word medially (*ese*).

3. Speaker differences showed a range of 36 in word final, 49 in word medial /syllable final, 47 in word initial, and 65 in word medial /syllable initial position. However, the ordering of the speakers by reduction rates was the same in all positions.

4. In Table 3, following /l/ appears to disfavor reduction word internally. Most occurrences in this data base were in tokens of *trasladar*, where /s/ was mostly maintained.

5. In this study we classified as high frequency those words with more than two tokens in the corpus; different cut-off points may well yield stronger frequency effects.

6. We do not know if lexical effects on word medial/syllable final /s/ reduction such as those found here have been studied in the Caribbean or other varieties.

7. It is not at all evident that aspiration in *nosotros* is due to morphological analysis (*nos* + *otros*). In an expanded data base, we found lower reduction rates for *nos* overall (72%) [including in prevocalic contexts (82%)] than for *nosotros* (89%). Perhaps more telling, if we separate out deletion, aspiration rates are 36% *nos* overall, 59% *nos* prevocalically, and 79% *nosotros*.

8. The effect of frequent phonotactic patterns could be measured by combining preceding and following phonological environment as a single conditioning factor in the variable rule analysis.

9. In a count of 141,295 word final /s/ tokens in an oral corpus of over one million words (Marcos Marín 1992), we found 52% followed by a word beginning with a consonant, and 24% each followed by a pause and a vowel.

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