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Intervocalic Fricative Voicing in the Spanish of Barcelona: Considerations for Contact-Induced Sociophonetic Innovation

This investigation constitutes a quantitative variationist approach toward Spanish in contact with Catalan in Barcelona, Spain. It seeks to empirically measure concrete usage patterns of a single phonetic variant, intervocalic [z], in the Spanish of Catalan-Spanish bilinguals, and establish the extent to which this variant is conditioned by both linguistic factors and language exposure and use. The careful Spanish speech of 20 Barcelonan females (ages 18-27) was elicited through a word-reading task. Goldvarb binomial logistic regression analyses revealed that sensitivity to linguistic factors varied according to exposure to and use of Catalan. Results with respect to the frequency of intervocalic [z] as well as linguistic constraints on [z] production are discussed in reference to those found for non-contact varieties of Spanish so as to assess the extent to which this phenomenon reflects contact-induced innovation and/or language-internal effects of lenition.

1. Introduction

The present study examines patterns of language use with respect to a phonetic feature of Spanish in contact with Catalan, that is, the Spanish spoken by the diverse community of bilingual speakers of Catalan and Spanish in Barcelona, Spain. Spanish in contact with Catalan, henceforth referred to as Catalan Contact Spanish (CCS), can be described as a Catalanized variety of Spanish in that it exhibits features of Catalan syntax, morphology, lexicon, and phonetics.¹ We focus on usage patterns of a CCS phonetic phenomenon traditionally ascribed to first language (L1) transfer from Catalan: the voicing of the intervocalic voiceless alveolar fricative [s] to voiced [z] (e.g. *los años* ‘the years’ [lo.sá.ɲos] realized in CCS as [lo.zá.ɲos]). The selection of this phonetic feature is motivated by its frequent presence in previous, more impressionistic treatments of Catalan-Spanish interference (also understood as *language transfer*; cf. Odlin 1989) in the speech of bilinguals in Barcelona (cf. Sinner 2002; Vann 2001; Wesch 1997). By examining [z] usage in a select group of Barcelonan CCS-speakers, this study seeks to establish, as conditioned by Catalan usage and exposure, both: (1) the degree to which [z] is present in formal CCS production and (2) which linguistic (or language-internal) factors condition its production. The results of this study will be discussed in the context of language-internal and language-external contributions to linguistic innovation, and contribute to an only recently growing body of research regarding the effects of Catalan on the Spanish of Catalonia, as traditional language contact research in Catalonia has focused primarily on the effects of Spanish on Catalan (Galindo Solé 2003, 18).

2. Review of Intervocalic Fricative Voicing Phenomena in the Spanish of Barcelona

2.1. Language Contact in Barcelona

Previous research on CCS has often focused on the variety of Spanish present in the city of Barcelona due to the particularly high contact between L1 speakers of Catalan and L1 speakers of Spanish (accompanied increasingly more by balanced bilinguals that speak both languages natively). The substantial presence of L1 speakers of Spanish in Barcelona has been attributed to mass immigrations to industrial regions of Spain (Catalonia, the Basque

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Country, and Madrid) during a particularly strong Spanish economy. Spain experienced an economic boom during the latter half of the 20th century that encouraged waves of non-Catalonian immigrants (primarily from rural, monolingual regions of Southern and Central Spain) to Catalonia, a dominant industrial Autonomous Region (Vallverdú 1984, 26; 1991, 21; Vila-Pujol 2007, 63). More than two million (Spanish-L1) non-Catalonian immigrants moved to Catalonia from 1950 to 1975, such that by the late 1970's, over 40% of the population living in Catalonia ages 6+ were non-Catalonian Spanish immigrants (Gifreu 1983, 298). Vallverdú (1991, 21) notes that fewer than half of non-Catalonian immigrants learned to speak or write in Catalan during the second half of the 20th century as a result of the prohibition of Catalan in all public sectors during the Franco Regime (1939-1975).

Historically then, it is this population of 20th century immigrants that never learned Catalan that has most contributed to the modern (large) presence of L1-Spanish speakers in Catalonia. Still, recent immigration trends during the past decades largely echo those of the mid-20th century in that the urban capital of Barcelona continues to receive more non-Catalonian immigrants than any other entire regional territory in Catalonia,² with over 44% of the city's population in 2008 hailing from outside of Catalonia (Generalitat 2011, 38). Notably, over a third of all foreign immigration to Barcelona is presently constituted by L1-Spanish immigrants from Latin America, so although the influx of L1-Spanish speakers to Barcelona has been rather steady since the mid-20th century, the proportion of these speakers that speak Latin American (non-Peninsular) varieties of Spanish has considerably increased (IEC 2010; INE 2010).

Despite the considerable presence of L1-Spanish speakers in Barcelona and to a lesser extent the rest of Catalonia, reported linguistic competence in Catalan has steadily increased since the introduction of educational legislation, on April 18, 1983, which mandates that all public primary and secondary education must be offered in Catalan or a combination of Catalan and Spanish (Generalitat 2007). For example, in 2010, roughly 76% of the population born in Catalonia ages 35+ reported being able to write in Catalan, compared to roughly 95% ages 14-34 (IEC 2011, 5). Over 96% of the population born in Catalonia reported speaking proficiency in Catalan, alongside 57% for individuals born in Spain that immigrated to Catalonia and nearly 40% for all other foreign immigrants to Catalonia (IEC 2011, 4). Still, within Barcelona, nearly half (49.3%) the population (ages 2+) reports Spanish as their L1, compared to 28.7% for Catalan and 12.8% for Spanish and Catalan equally (IEC 2012).

In summary, research on CCS is particularly well suited to take place in Barcelona, which historically and presently continues to receive large waves of L1-Spanish immigrants, making it unique with respect to its particularly extensive situation of contact between native speakers of Catalan and Spanish. All (Catalonian) native speakers of Catalan are, to various degrees, bilingual in Catalan and Spanish. In contrast, whereas young L1-Spanish immigrants to Catalonia acquire Catalan as an L2 through (public) pre-university education, their parents are able to more severely limit their own acquisition of Catalan. Arguably, simply due to the extensive presence of Catalan-speakers and Catalan (as a co-official language with considerable media presence) in Catalonia, all residents of Catalonia develop a degree of passive bilingualism in Catalan, however minimal for some (cf. Báez de Aguilar 2008, 106-107; Wesch 1997, 294).

2.2. Linguistic Characterizations of Intervocalic Alveolar Fricative Voicing

In the following two subsections, two possible accounts for the presence of intervocalic alveolar fricative voicing in CCS are detailed.³ The first account ascribes this phenomenon in CCS to a language-external source, namely contact with Catalan. In contrast,

the second account discusses this phenomenon as motivated by language-internal mechanisms, namely lenition, in the context of any Spanish variety (as opposed to strictly those in contact with Catalan or other languages).

2.2.1. *Catalan as a Source Language for CCS Intervocalic Fricative Voicing*

Intervocalic fricative voicing has been ascribed in CCS to influence from Catalan on the basis of acoustic and articulatory research in both Spanish and Catalan (aside from references in endnote 1, see also Moll 1961; Pieras 1999). With respect to the production of fricatives, both Northern-Central Peninsular Spanish and Catalan feature an apical-alveolar voiceless /s/ in their phonemic inventories, articulated with a gesture of the tongue-tip toward the alveolar ridge (Hualde 2005, 47; Martínez Celdrán & Fernández Planas 2007, 110; Prieto 2004, 204-205; Quilis 1981, 234-235).

However, the majority of Catalan varieties (and for the purposes of this study, Central Catalan, spoken in Barcelona) feature an additional apical-alveolar phoneme, /z/, which word-initially and word-medially contrasts phonemically with /s/ and produces minimal pairs such as *pesar* ‘to weigh’ [pə.zá] (Spanish *pesar* [pe.sár]) and *passar* ‘to pass’ [pə.sá] (Spanish *pasar* [pa.sár]) (Julià i Muné 2008, 66-67). Critically, this phonemic voicing contrast is neutralized word-finally, resulting in voiceless [s] or voiced [z] depending on the voicing feature of the following segment (that is, the voicing neutralization of word-final Catalan alveolar fricatives [and in fact all Catalan sibilants] resolves by means of anticipatory assimilation). When followed by a voiced segment, such as a vowel, the word-final fricative is systematically voiced (e.g. *gos* [s] ‘dog’; *gos estrany* [z] ‘strange dog’) (Pieras 1999, 212; Prieto 2004, 208, 216). Bonet i Lloret (1998, 118-119) notes that this regressive voicing assimilation is post-lexical and presents no exceptions.

Thus, whereas voiced intervocalic fricatives are systematically present in Catalan (resultant from /z/ and as a product of voicing assimilation of word-final prevocalic /s/ and /z/), intervocalic [z] is unattested as a systematic feature of any monolingual Spanish variety. Accordingly, ascriptions of intervocalic [z] production in the Spanish of Catalan-Spanish bilinguals to cross-linguistic influence (cf. Winford 2003, 12) denote Catalan as the source language and Spanish as the recipient language. Productions of Spanish *pesar* ‘to weigh’ as [pe.zár] or *los años* ‘the years’ as [lo.zá.ɲos] on the part of an L1-Catalan speaker would evidence the transfer of, respectively, a Catalan phoneme into Spanish and a Catalan phonotactic rule (word-final prevocalic voicing assimilation) into Spanish. That is, Catalan /z/ would constitute a source for direct phonological transfer into Spanish, whereas Catalan voicing assimilation in word-final prevocalic contexts would constitute a source for transfer of a strictly phonetic voicing rule into Spanish.⁴

2.2.2. *Intervocalic Fricative Voicing as a Language-Internal Lenition Phenomenon*

As discussed above, Spanish lacks a voiced alveolar fricative phoneme /z/. Nevertheless, voiced productions of [z] are frequent in many Spanish dialects as a product of anticipatory voicing assimilation to a following voiced consonant (Hualde 2005, 107). In Spanish varieties that do not exhibit aspiration or deletion of /s/ in pre-consonantal positions, such as Mexican Spanish and North-Central Peninsular Spanish, [s] and [z] are found in complimentary distribution: *rasco* ‘I scratch’ [rás.ko]; *rasgo* ‘feature’ [rás.ɣo] (Hualde 2005: 160; Quilis 1993; Navarro Tomás 1918: 83).⁵ Crucially, however, monolingual varieties of Spanish are not claimed to exhibit /s/-voicing intervocalically, that is, the aforementioned Spanish voicing assimilation rule does not include the context of a following vowel as a triggering environment for voicing. Instead, intervocalic /s/-voicing is claimed to be restricted to select contact varieties of Spanish, notably CCS (cf. Pieras 1999) and those in contact with Quechua, such as the Spanish of Colombia (cf. Montes Giraldo 1984) and

Highland Ecuador Spanish (cf. Lipski 1989; 1994).

Nevertheless, recent acoustic research has shined light on these claims and suggests that it may not be accurate to describe intervocalic /s/ voicing as strictly absent in monolingual varieties of Spanish. Schmidt & Willis (2011, 7) found that in the semi-spontaneous Mexican Spanish speech from 12 speakers of Mexico City, 9% of intervocalic /s/ tokens produced were voiced. Torreira & Ernestus (2012, 136, 138) found that in casual, spontaneous Madrid Spanish speech (extracted from a corpus comprised of 52 Madrid speakers), 34% of intervocalic /s/ tokens were voiced. Intervocalic voicing in this variety showed sensitivity to effects of word position (favored word-finally over word-medially and word-initially) and speech rate (favored with faster speech rate).

In light of these data, it has been proposed that intervocalic /s/ voicing in Spanish be understood as a lenition phenomenon, analogous to other forms of /s/-reduction (such as aspiration and deletion) found in Spanish (File-Muriel & Brown 2010; 2011; Torreira & Ernestus 2012). Within gestural phonology (cf. Browman & Goldstein 1991), the voicing of intervocalic /s/ can be modeled as a product of the relative timing and coordination of opposing (or conflicting) glottal gestures necessary to restrict voicing during the fricative segment and permit voicing during the adjacent vowel segments. Particularly in fast speech, vocal fold abduction for a voiceless [s] may be undershot, resulting in consistent voicing throughout the intervocalic /s/ sequence. In summary, acoustic data for the Spanish of Mexico City and Madrid suggests that intervocalic /s/ voicing may be present, to various degrees, in all varieties of Spanish, and is not strictly limited to those varieties in contact with Catalan or Quechua. Nonetheless, intervocalic [z] remains unattested as a systematic feature of any monolingual Spanish variety. That is, while intervocalic [z] has only been found as a systematic feature (i.e., a majority variant used over [s]) in select contact varieties of Spanish, its apparition in select monolingual varieties of Spanish has been less systematic and restricted to more casual speech.

2.3. Prior Research on Intervocalic Fricative Voicing in Barcelonan CCS

Prior treatments of phonetic features of CCS often discuss [z] as a product of Catalan-Spanish transfer that characterize a Catalanized variety of Spanish of Catalan-dominant speakers. For example, impressionistic interviews by Sinner (2002) suggest that [z] is a possible marker (cf. Labov 1972) of Barcelonan CCS speech. Having interviewed 12 speakers of CCS and monolingual (Madrid) Spanish ages 27-41 regarding their awareness of linguistic features of Catalanized Spanish, the only phonetic feature named by all speakers was the velarization of the alveolar lateral /l/ to [ɫ], suggestive of a stronger status as a linguistic stereotype (cf. Labov 1972; 2001) than intervocalic [z], which was named only by CCS speakers. Madrid speakers commented that heavily Catalanized Spanish, and in particular [ɫ], sounded ugly, uneducated, and rough. Moreover, three CCS speakers admitted feeling an “obligation to correct or adjust their [Spanish] pronunciation when talking in public...” (Sinner 2002, 163, 165-166).

Wesch (1997) examined possible effects of age and social class on the frequency of [z] in Barcelonan CCS. Having recorded spontaneous speech samples from 24 CCS speakers, Wesch (1997, 296) reported [z] as a frequent variant, though unlinked to any of these social factors. Parallel results describing [z] production as frequent and unlinked to social factors (gender, age, social class) have been found for the CCS spoken in Palma de Mallorca and Sóller, Balearic Islands (respectively, Pieras 1999; Serrano Vázquez 1996).

To synthesize, intervocalic [z] has reported as present in the spontaneous speech of Barcelonan (and even Majorcan) CCS speakers. It may additionally not be linked to negative stereotypes of overly Catalanized Spanish. Still, research regarding concrete intervocalic /s/

production in Barcelonan CCS is lacking, as the aforementioned study merely describes [z] as either generally present or absent, without empirical acoustic analysis. Moreover, linguistic factors that condition intervocalic [z] usage have yet to receive attention. In the present study, we offer a quantitative and empirical examination of the extent to which [z] has entered formal registers of Barcelonan CCS, and explore linguistic factors that condition each variant's usage as mediated by Catalan usage and exposure. We address the following research questions:

1. How present is intervocalic [z] in formal registers of Barcelonan CCS speech?
2. What linguistic factors condition its usage?
3. To what degree is CCS [z] production resultant from language-contact effects?

3. Methodology

3.1. Subject Population

The data analyzed for this study came from a select subset of the Barcelonan CCS-speaking population, namely twenty 18-27 year old female speakers.⁶ The decision to examine the speech of this specific population was grounded in standard sociolinguistic principles of language variation and change, as discussed primarily by Labov (2001). To begin, it is widely accepted that "...women are the principal innovators in the process of [linguistic] change... [in that] women conform more closely than men to sociolinguistic norms that are overtly prescribed but conform less than men when they are not" (Labov 2001, 293-294; additionally Chambers 2004, 352). Since stigmatized and/or non-standard linguistic variants are typically avoided in formal speech registers (Moreno Fernández 2009, 101; Tagliamonte 2012, 34), we can examine women's speech (in particular, formal speech, elaborated below in section 3.2) as a means of gathering more conservative estimates of the degree of intervocalic [z] usage in modern Barcelonan CCS.

The speech patterns of youth speakers is useful for making inferences about the most current language trends, since in the typical comparison of youth speakers' speech to that of older generations of speakers (known as the 'apparent time construct,' cf. Bailey 2004; Bailey, Wikle, Tillery, & Sand 1991; Chambers 2004), the speech of younger speakers has been shown to reflect the most contemporary trajectories of language variation or a given change in progress (Tagliamonte 2012, 43-45).

In sum, although this study does not seek to assess possibilities for language change, the speech of youth female Barcelonan speakers is nevertheless useful for inspecting the degree to which intervocalic [z] production currently pervades formal or careful CCS speech.

3.2. Instruments and Data Collection

The first instrument in this study was a written sociodemographic questionnaire adapted from Pieras (1999). It consisted of a series of questions regarding each participant's family background and personal information, education, occupation, language use, and self-reported competence in Spanish and Catalan.

The second instrument was a Spanish recorded reading. Participants were asked to carefully read aloud, using their best Spanish pronunciation, a series of 76 two-word phrases that featured numerous linguistic contexts of intervocalic /s/, controlled in their distribution with respect to the linguistic factors detailed in section 3.3.2 and placed within a carrier phrase to reduce pitch contour variation. Target phrases were interspersed with 86 filler phrases that did not feature intervocalic /s/. In order to avoid confounds of vowel height on

/s/ production (cf. File-Muriel & Brown 2011), /s/ tokens were surrounded by two low /a/ vowels, reported to least affect the energy frequencies of fricative segments (Quilis 1981, 235). While the data elicited from a word-reading task are not directly comparable with spontaneous speech, they reveal interesting and valid insights as to the kinds of variants produced in a formal speech style, which is particularly relevant when trying to assess relative levels of prestige or stigma associated with linguistic variants. As discussed in the previous section, intervocalic [z] usage in this task is estimated to undershoot actual production rates in natural, spontaneous speech. Moreover, this task affords the researcher with significant control over the speech produced by the participant, facilitating the production of a more balanced number of /s/ tokens per linguistic context across each participant (Moreno Fernández 2009, 314).

A brief third instrument, a Catalan recorded reading of 6 short phrases, was administered at the end of the experimental session as a means of confirming that all participants systematically produced Catalan [s] and [z] in phonemic environments of word-medial and word-initial intervocalic /s/ and /z/ (respectively), as well as [z] in the intervocalic word-final environment. Target items were interspersed among 6 additional phrases without intervocalic /s/ or /z/. Since all participants produced [s] and [z] in the expected environments, this permits the interpretation of their CCS production as subject to transfer effects from Catalan.

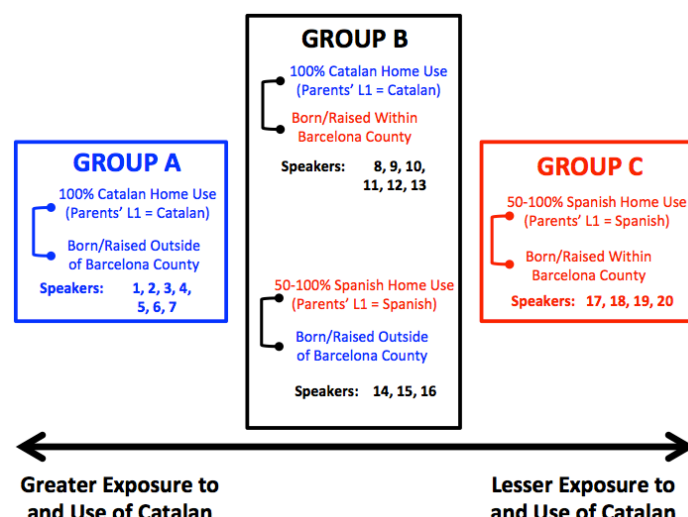
Participants were recruited by means of flyers posted at Barcelona university campuses, since university students tend to be in their twenties or 18-19 years old. Each participant was recorded individually during one experimental session using an SE50 Samson head-mounted condenser microphone and an H4n Zoom digital recorder in an audiometric booth in the phonetics laboratory at the *Universitat Autònoma de Barcelona* or in an empty classroom at the *Universitat de Barcelona* or *Universitat Pompeu Fabra*.

3.3. *Independent Variables*

3.3.1. *Social Factor Groups*

As a means of assessing effects of language dominance on CCS intervocalic /s/ production, youth female Barcelonan speakers were classified into three groups based on a gradient, crude measure of language dominance, namely a social construct of degree of exposure to and use of Catalan (figure 1). Home language use (while growing up) was selected for incorporation into the social construct because it is intrinsically linked to Catalan usage. In the absence of a formalized proficiency measure, home language use serves as an indicator of language dominance (for example, age of acquisition of Catalan as either 0-3 years old [L1] or 6+ years old [L2, acquired in school]). Catalan home usage was divided into two extremes: 100% Catalan use vs. 50-100% Spanish use.⁷ Additionally, locality of residence was selected for incorporation into the social construct because it is intrinsically linked to the amount of Catalan that subjects are exposed to from their community. The city of Barcelona is well known as the area of Catalonia with the highest presence of Spanish and lowest reported usage of Catalan (Lleó, Cortés, & Benet 2008, 186). Census polls (cf. IEC 2010) indicate dramatically higher daily usage rates of Catalan in smaller counties and towns just outside of Barcelona County (still within the region of Barcelona, such as Sabadell) than in the urban capital (consistent with self-reported language use estimates by each participant in the sociodemographic questionnaire), and accordingly we divided speakers into two groups of locality of residence: within Barcelona County and outside of Barcelona County. Note that subjects raised outside of Barcelona County travel to Barcelona almost daily for school and/or for their jobs.⁸

Figure 1 - Hierarchical Social Construct of Catalan Exposure and Use as a Crude Measure of Language Dominance



3.3.2. Linguistic Factor Groups

On the basis of prior research on fricative voicing and other sound change phenomena in Romance, the effects of five linguistic factors on intervocalic /s/ production were explored: (1) syllable position, (2) stress, (3) accentual unit, (4) morpheme class, and (5) cognate status.

Syllable position (intervocalic in all cases) was coded as either word-medial (e.g. *payasa contenta* 'happy clown') or word-final (e.g. *caminarás aquí* '2.s. will walk here'). Torreira & Ernestus (2012) found that voicing in Madrid Spanish was more frequent in the word-final context than both the word-medial context and the word-initial context (e.g. *la sábana* 'the sheet'), which equally disfavored voicing. For CCS, examples of intervocalic voicing reported in Pieras (1999), Serrano Vázquez (1996), Vann (2001), and Wesch (1997) are exclusively word-final. We may expect that CCS voicing be more strongly disfavored word-medially because this position is the site of a Catalan phonemic voicing contrast absent in Spanish, whereas the word-final position constitutes a site of purely phonetic voicing for both languages (albeit systematic in Catalan, as discussed in section 2.2.1).

Effects of stress were explored considering each adjacent segment to /s/ (cf. Campos-Astorkiza forthcoming). As sequences of /a/ + /s/ + /a/ permit four possible combinations of stress (e.g. /ásá/, /ása/, /asá/, and /asa/), stress was considered as two factor groups: preceding vowel stress (e.g. *serás apto* '2.s. will be suitable' [se.rá.sáp.to] - stressed; *fueras apto* 'that 2.s. were suitable' [fwé.ra.sáp.to] - unstressed) and following vowel stress (e.g. *fueras apto* 'that 2.s. were suitable' [fwé.ra.sáp.to] - stressed; *fueras animado* 'that 2.s. were animated' [fwé.ra.sa.ni.má.ðo] - unstressed). Word-medial /s/ tokens exhibited only /ása/ and /asá/ stress patterns, rendering the two factor groups redundant, and were coded only for following vowel stress. Hualde (2005, 244) notes that stressed syllables have longer durations in Spanish than unstressed syllables, which would facilitate a more independent series of articulatory gestures across the /a/ + /s/ + /a/ sequence (cf. Browman & Goldstein 1991). Accordingly, we predicted that voicing would be most favored across unstressed /a/ + /s/ + /a/ sequences, as these least facilitate the independent series of articulatory gestures necessary for the voicing of each vowel (i.e., vocal fold adduction) and voicelessness of /s/ (i.e., vocal fold abduction). That is, a sequence such as /asa/ would most favor fricative voicing since the vowels adjacent to /s/ are maximally short (compared to their stressed counterparts), inhibiting coordination of vocal fold abduction for /s/ relative to the adduction gestures for the adjacent vowels.

Accentual unit, applicable only to word-final /s/ tokens, was coded as either single for /s/ tokens in a function word + noun phrase (e.g. *las aguas* 'the waters') or double for /s/

tokens in a noun/verb + adjective/adverb phrase (e.g. *aguas ácidas* ‘acidic waters’). The function words used as experimental stimuli (e.g. determiners, demonstrative pronouns, prepositions) lack lexical stress, and thus form a single accentual unit (or stress domain) with the following lexically stressed noun/adjective/adverb, which following Browman & Goldstein (1991) and Hualde (2005) would facilitate greater coarticulation of /s/ with adjacent segments (Hualde 2005, 233-234, 244). Accordingly, we predicted that voicing would be favored in single accentual units (e.g. *las aguas* ‘the waters’). This factor was additionally motivated by Campos-Astorkiza (forthcoming), who hypothesized for Spanish that single accentual units would show differences in /s/ voicing assimilation from double accentual units.⁹

Morpheme class, applicable only to word-final /s/ tokens, was coded as verbal inflection (e.g. *fuera s ágil* ‘that 2.s. were agile’), nominal inflection (e.g. *amiga s altas* ‘tall friends’), or lexical stem (e.g. *atla s amplio* ‘wide atlas’). Its consideration was motivated by general principles of sound change (cf. Bybee 2002), in that “lexical representations, including phonological representations, are linked in a connectionist network to other lexical representations, allowing generalizations to emerge which form the basis for the spread of the sound change to new words depending on phonetic or morphological resemblance” (Phillips 2006, 182). No effects of morpheme class were found for intervocalic /s/ voicing in Madrid Spanish (Torreira & Ernestus 2012).

Cognate type, applicable only to word-medial /s/ tokens, was coded as either cognate with /z/ (e.g. *casa grande* ‘big house’ - Catalan *casa* /káza/) for words which in Catalan featured /z/ or cognate with /s/ (e.g. *masa grande* ‘big dough’ - Catalan *masa* /mása/) for words that in both languages featured /s/. Following Brown & Harper (2009) and Costa, Santesteban, & Caño (2005), cognate with /z/ tokens were expected to most facilitate CCS /s/-voicing in the sense that these tokens, within an interconnected bilingual lexicon, trigger a parallel lexical activation of a Catalan cognate that features /z/ as a source for direct transfer to CCS via parallel lexical activation.

3.4. Analysis of Dependent Variables

Audio data, consisting of 1,520 tokens intervocalic /s/, were submitted to acoustic analysis as *wav* files using Praat. However, due to speaker disfluencies (most often in cases of word-final intervocalic /s/ in which a pause was inserted between the words [e.g. *aguas ácidas* ‘acidic waters’]), 87 /s/ tokens were excluded, leaving 1433 for spectral analysis.

Fricative voicing was measured as a function of the percentage of an /s/ segment’s duration that was voiced. In order to calculate voicing durations in each /s/ segment, fricative boundary segmentation was performed manually by marking left and right boundaries for each /s/ segment by using both the waveform and spectrogram to respectively find the zero-intercept in the waveform closest to the first and last signs of aperiodic noise (cf. Erker 2012; File-Muriel & Brown 2010; 2011; Schmidt & Willis 2011). Once /s/ segments were segmented, exact voicing durations were measured as portions of the /s/ segment with a fundamental frequency (that is, a pitch track), a voice bar at the bottom of the spectrogram, and glottal pulses (cf. Campos-Astorkiza forthcoming; File-Muriel & Brown 2010; 2011; Gradoville 2011; Schmidt & Willis 2011; Torreira & Ernestus 2012). Voicing duration measurements were calculated only after adjusting the Praat spectrogram viewing window to be twice the size of the /s/ segment and centered on the /s/ segment, as the F0 contour in the spectrogram is calculated with respect to the segments in the visible window. Our choice to pursue this manual measuring of the duration of F0 track (as accompanied by glottal pulses and the voice bar) as opposed to using Praat’s voicing report function was motivated by the random probability for error in relying on the voice report function, whose pulse-based

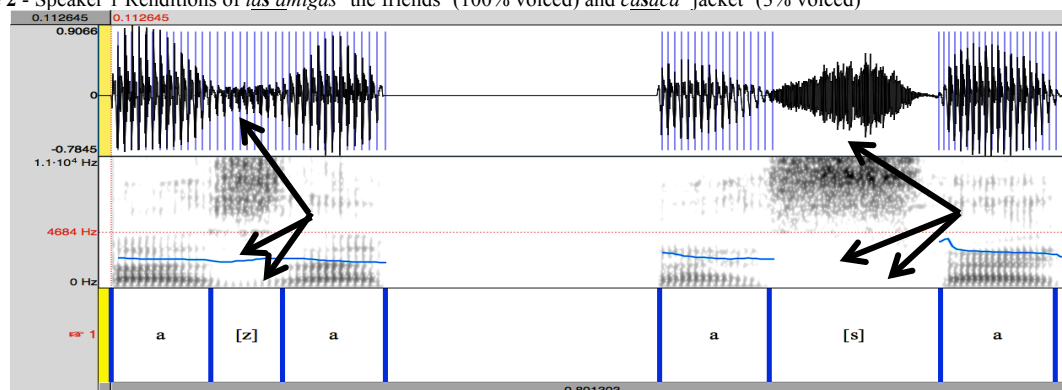
algorithm occasionally reports invalid percentages of locally unvoiced frames that do not match the spectral activity shown in the spectrogram (Gradoville 2011: 69-71). We may additionally note that further justification for voicing duration as a measure of fricative voicing for CCS data is briefly discussed in endnote 10.

The coding scheme used for the classification of voiced [z] and voiceless [s] productions of intervocalic /s/ reflected actual distributions of voicing percentages in our data, as well as voicing thresholds reported in prior empirical research in Catalan and Spanish. Unfortunately, however, relatively few empirical studies have reported voicing thresholds for Spanish and/or Catalan. File-Muriel & Brown (2010, 46-47; 2011, 224-225) note that the majority of empirical research on /s/ lenition phenomena in Spanish establish thresholds between /s/ variants impressionistically, using native speaker judges to code /s/ productions by ear. For Catalan, this coding method was utilized most recently by Benet, Cortés, & Lleó (2012, 396-397) to distinguish between voiced [z] and voiceless [s] productions.

Still, there are some examples of voicing thresholds for monolingual Spanish data. Schmidt & Willis (2011, 6) found that voiced [z] productions in Mexico City Spanish tended to exhibit voicing durations lasting 60% or more of the segments' durations, and accordingly coded tokens with 59% or less voicing as [s] and tokens with 60% or more as [z]. For Madrid Spanish, tokens discussed as voiced [z] were exclusively those with 100% voicing (Torreira & Ernestus 2012, 133). Campos-Astorkiza (forthcoming) applied coding schemes that matched the trends in her data; most /s/ tokens preceding a voiceless consonant exhibited voicing durations of 20% or less and were coded as [s], whereas most /s/ tokens preceding a voiced consonant exhibited voicing durations of 90% or more and were coded as [z]. For our present CCS data, 95% of the /s/ tokens produced fell either below 30% voicing or above 60% voicing, and we accordingly have coded as voiceless [s] those productions with 0-30% voicing durations and as voiced [z] those productions with 60-100% voicing durations (thus removing from further analysis 71 tokens with voicing durations between 30% and 60%).¹⁰

Figure 2 offers an illustrative comparison between /s/ productions coded as [z] and [s] from speaker 1. For ease of comparison, /s/ productions have been spliced adjacent to one another, separated from their original phrasal contexts (within a carrier phrase).

Figure 2 - Speaker 1 Renditions of *las amigas* 'the friends' (100% voiced) and *casaca* 'jacket' (3% voiced)



The remaining total of 1,362 tokens coded as [s] and [z] were submitted to variable-rule logistic regressions using Goldvarb, a well-established statistical program for variationist sociolinguistics (Moreno Fernández 2009, 316-317; Tagliamonte 2006). Aside from being able to handle particularly unbalanced datasets (typical of sociolinguistic speech data), Goldvarb also offers the advantage of being able to easily handle nested independent variables (i.e., multiple statistical iterations are unnecessary for independent variables that apply to only a subset of the data) (Roy 2013, 265; Tagliamonte 2006, 178-181; 2012, 156). Recall from section 3.3.2 that independent variables such as cognate status applied only to

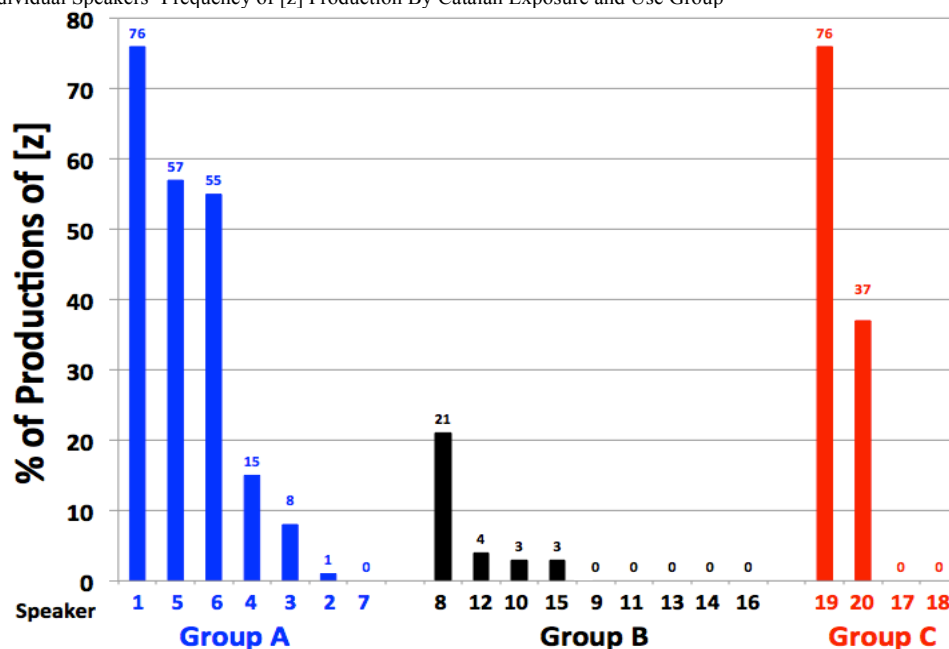
specific subsets of the total intervocalic /s/ data.

4. Results

4.1. Production of [z] by Individual Speaker

A descriptive statistical analysis of each participant's frequency of [z] production is illustrated in figure 3, organized by social construct group.

Figure 3 - Individual Speakers' Frequency of [z] Production By Catalan Exposure and Use Group



CCS speakers appear to pattern into a group of consistent ‘voicers’ for whom [z] is an even more competitive variant of /s/ than [s] (speakers 1, 5, 6, and 19, with [z] frequencies at 50% or higher), and a remaining group of ‘non-voicers’ for whom voiceless [s] is the majority (if not categorically favored) variant of /s/ in formal CCS speech. Considering that these [z] productions were produced by speakers instructed to speak using their best Spanish pronunciation, these data suggest that intervocalic fricative voicing is a particularly pervasive feature of CCS. Although group A (with the highest Catalan exposure and usage) has more ‘voicers’ than groups B and C, note that all groups show within-group heterogeneity, which is to be expected particularly for non-standard variants (as discussed in section 3.1 and additionally endnote 12). A degree of this variability may be linked to differences in Catalan proficiency. Subjects 2 and 7, for example, who used [z] 0-1% of the time, reported slightly lower self-competency ratings in Catalan than the other members of group A, who showed higher voicing rates. However, these ratings did not vary across speakers in group C, who nonetheless exhibited the maximum range of [z] production rates across speakers (0-76%). We shall comment further on the curiously high rates of [z] production of speakers 19 and 20, members of the group with the least amount of usage of and exposure to Catalan, in the discussion section (5.1).

4.2. Social and Linguistic Constraints on [z] Production

Results from Goldvarb analyses are reported in tables 1 and 2 in the form of weighted,

hierarchical rankings of social and linguistic factors that favor the production of [z] over [s]. Social and linguistic factor groups were separated in statistical iterations (cf. Tagliamonte 2012, 129). Factor weights of above .5, in bold, indicate that [z] is favored by an independent variable level (e.g. group A speech, unstressed syllable context, etc.), and range values indicate the relative strength of effect of each independent variable. As Goldvarb cannot run inferential statistics without some degree of variation in dependent variable outcomes for each independent variable, categorical data (i.e., 0% or 100% [z] production) were submitted to a Fisher's Exact Test, which is a conservative version of the Chi-Square test more appropriate for categorical data (Gorman & Johnson 2013, 219-220). These results have been integrated into each table as p-value statistics instead of factor weights.

Table 1 - Varbrul Logistic Regression Weights for [z] Production by Social Construct Group

| Total N: 1362 | | Corrected Mean: .121 | |
|---|------------|----------------------|-----|
| Social Construct Group | Weight | % [z] | N |
| A | .77 | 32.1 | 458 |
| B † | .21 | 3.5 | 634 |
| C | .74 | 28.5 | 270 |
| RANGE | <i>.56</i> | | |
| Log Likelihood = -544.395, Logistic Regression Model Significance: p<.001 | | | |

Table 2 - Logistic Regression Weights for [z] Production by Linguistic Factor per Social Construct Group

| GROUP A | | | |
|---|--------------------------------------|----------------------|-----|
| Total N: 458 | | Corrected Mean: .405 | |
| Syllable Position | Weight / Fisher's Exact Test p-value | % [z] | N |
| Word-Final Intervocalic | p<.001 | 42.1 | 349 |
| Word-Medial Intervocalic | | 0.0 | 109 |
| Accentual Unit | | | |
| Double | .52 | 43.5 | 271 |
| Single | .43 | 37.2 | 78 |
| RANGE | <i>.09</i> | | |
| Following Vowel Stress | | | |
| Unstressed | .53 | 34.2 | 230 |
| Stressed | .48 | 30.0 | 228 |
| RANGE | <i>.05</i> | | |
| Preceding Vowel Stress | | | |
| Unstressed | .52 | 42.7 | 213 |
| Stressed | .47 | 41.2 | 136 |
| RANGE | <i>.05</i> | | |
| Log Likelihood = -256.265, Logistic Regression Model Significance: p<.001 Not selected as significant: Morpheme Class, Cognate Type | | | |
| GROUP B | | | |
| Total N: 634 | | Corrected Mean: .029 | |
| Syllable Position | | | |
| Word-Final Intervocalic | .60 | 4.3 | 491 |
| Word-Medial Intervocalic | .19 | 0.7 | 143 |
| RANGE | <i>.41</i> | | |
| Log Likelihood = -92.694, Logistic Regression Model Significance: p=.017 Not selected as significant: Preceding Vowel Stress, Following Vowel Stress, Accentual Unit, Morpheme Class, Cognate Type | | | |
| GROUP C | | | |
| Total N: 270 | | Corrected Mean: .361 | |
| Syllable Position | | | |
| Word-Final Intervocalic | .69 | 36.4 | 209 |
| Word-Medial Intervocalic | .06 | 1.6 | 61 |
| RANGE | <i>.63</i> | | |
| Accentual Unit | | | |
| Double | .53 | 39.0 | 164 |
| Single | .39 | 26.7 | 45 |
| RANGE | <i>.14</i> | | |
| Log Likelihood = -157.187, Logistic Regression Model Significance: p=.006 Not selected as significant: Preceding Vowel Stress, Following Vowel Stress, Morpheme Class, Cognate Type | | | |

† Group B was initially broken into two groups based on locality of residence, but the separation into two groups did not significantly contribute to the model's ability to account for variance in [z] production as determined by a Chi-Square test (p>.05) evaluating log likelihood differences between the model with group B separated into two and the model with group B as a single group (cf. Young & Bayley 1996).

Summarizing the results presented in table 1, intervocalic /s/-voicing is favored by groups A and C, who show average frequencies of [z] production of 32.1% and 28.5% respectively, and is disfavored by group B (with an average frequency of [z] production of 3.5%). Summarizing the results presented in table 2, whereas all groups show a significant sensitivity to syllable position, groups A and C both show a significant sensitivity to accentual unit, and only group A shows an additional significant sensitivity to the stress of each of the two vowels in the /asa/ sequence. The range hierarchies show that syllable position is the strongest constraint across all groups, followed by accentual unit for groups A and C, and lastly stress effects for group A.

5. Discussion

5.1. Usage Patterns of Intervocalic [z] in Careful CCS Speech

With respect to the presence of intervocalic [z] in formal registers of Barcelonan CCS, our results suggest that [z] is not uncommon; [z] in fact is a competitive (majority) variant of /s/ for select bilingual speakers of both greater and lesser Catalan exposure and use (e.g. speakers 1, 5, 6, 19, and 20 in figure 3). Notably, [z] is not used preferentially over [s] on average by any whole speaker group (as indicated by [z] usages of no higher than 50% in table 1), suggesting that since Wesch (1997), [z] has not become a normative speech variant fully adopted into formal speech registers of the Spanish of Barcelona. Nevertheless, as the speech data gathered reflect careful Spanish pronunciation, the observed intervocalic /s/-voicing suggests that [z] remains a vitalic variant of /s/ in spontaneous CCS speech, consistent with the data reported by Wesch (1997).

With respect to linguistic factors conditioning [z] production, all speaker groups showed sensitivity to syllable position in the same (predicted) direction, strongly (if not categorically) favoring [s] over [z] word-medially. Additionally, while groups A and C (the only groups with ‘voicers’) showed sensitivity to accentual unit,¹¹ only group A showed sensitivity to effects of stress, favoring [z] production across sequences of unstressed /asa/ as predicted within models of gestural phonology (cf. Browman & Goldstein 1991). In our data, speaker groups that most consistently use [z] show the most complex patterns of linguistic constraints. However, the consistent trend across all groups is that [z] production is principally (if not exclusively) constrained by syllable position.

The high rates of intervocalic [z] production by select speakers of group C (raised in Barcelona in a Spanish-speaking home environment by L1-Spanish immigrants to Catalonia) are an intriguing finding and warrant further investigation. Since this feature has been traditionally ascribed to L1-Catalan speakers that acquire Spanish as a second language, it is unexpected that an L1-Spanish speaker, in careful Spanish speech, would not only use [z] more often than [s], but would actually match the voicing rate of the most consistent L1-Catalan ‘voicer’ (e.g. speakers 19 and 1 in figure 3).¹² Such a finding is inconsistent with the data reported by Sinner (2002) regarding negative attitudes associated with heavily Catalanized Spanish speech and, on the part of Barcelonan CCS speakers, a feeling of the need to carefully monitor and correct their Spanish. However, since the only CCS feature named by non-CCS speakers and overtly associated with a linguistic stereotype of ‘ugly Spanish’ was the velarized [ɫ], it is possible that less salient or well-recognized CCS features, such as [z], may not be linked to these negative attitudes. In this sense, such a feature could have greater potential to be adopted by speakers of lesser Catalan dominance, which could account for its present use in the careful speech of speakers 19 and 20.¹³ As this conjecture is speculative, a larger-scale apparent time study, which, in addition to incorporating additional

social factors such as gender, age, and social class, also collected perception and attitudinal data on [z] in formal and casual Barcelonan speech, is needed (and is currently underway) to fully account for the current data trends.

5.2. *Considerations of Language-Internal vs. Language-External Influences on CCS [z]*

As previously discussed in section 2.2.2, intervocalic fricative voicing can be understood as a lenition phenomenon arisen from strictly language-internal mechanisms of speech. Schmidt & Willis (2011) and Torreira & Ernestus (2012) respectively show that for the (monolingual) Spanish of Mexico City and Madrid, intervocalic fricative voicing is not only present, but even fairly common. The 9% voicing rate found for semi-spontaneous Mexico City Spanish is considerably lesser than that found for spontaneous Madrid Spanish, 34%, but can likely be accounted for due to differences in speech formality. Moreover, voicing rates in Madrid Spanish were found to be sensitive to speech rate, with voicing being favored in faster speech (Torreira & Ernestus 2012, 138). In the present study, effects of preceding and following vowel stress were found for the most consistent group of ‘voicers.’ Voicing was favored across unstressed contexts, consistent with an account of lenition effects within gestural phonology (cf. Browman & Goldstein 1991). Additionally, an effect of syllable position was found across CCS speaker groups, favoring [z] production word-finally. This word-final context was also found to favor voicing over the word-medial (and word-initial) position in Madrid Spanish. Torreira & Ernestus (2012, 129, 144) account for this finding by noting that reduction phenomena in Spanish are predicted to be more common in prosodically weaker positions (e.g. word-finally), and draw a parallel with the increased tendency for /s/-aspiration specifically in word-final position in other dialects of Spanish.

Although language-internal lenition effects can account for the aforementioned trends observed in the present CCS data, there are significant trends that an appeal to strictly language-internal factors seems unable to account for. The first trend involves the sheer frequency with which intervocalic /s/-voicing is observed in our bilingual data. As discussed above, voicing rates in Mexico City Spanish from Schmidt & Willis (2011) and Madrid Spanish from Torreira & Ernestus (2012) reflect semi-spontaneous and spontaneous speech, precisely the kinds of speech that are more conducive to reduction phenomena. In our formal CCS data, which disfavors both lenition effects in general as well as variants reflecting non-standard language norms, several speakers exhibited voicing rates of upwards of 50%. The substantial presence of [z] production in formal Spanish speech on the part of Catalan-Spanish bilinguals, in addition to the fact that the majority of ‘voicers’ were L1-Catalan speakers, suggests that intervocalic fricative voicing in CCS is not a product of purely language-internal mechanisms of lenition.

The second trend involves the strength of effect observed for syllable position in our bilingual data. Recall from section 2.2.1 that the word-medial context in Catalan is a site of phonemic voicing contrast between /s/ and /z/, whereas this contrast is neutralized word-finally and yields systematic voicing as a result of anticipatory voicing assimilation to a following (voiced) vowel. In the present study, approximately 99% of all observed CCS [z] productions occurred in the word-final context. Unfortunately, Torreira & Ernestus (2012) do not report the actual distributions of their [z] tokens according to syllable position (and Schmidt & Willis [2011] only examined the word-medial intervocalic context).¹⁴ Still, no linguistic factor effects on [z] production are discussed in a context that would suggest that they might be approaching a categorical or even near-categorical application in Madrid Spanish. Accordingly, the nearly categorical absence of intervocalic [z] word-medially observed in our CCS data, alongside a lack of mention of any categorical application of this constraint in monolingual varieties of Spanish, seems more plausible to

attribute to Catalan influence (via a barring of phonemic transfer of Catalan /z/ to CCS) than to simply weaker lenition rates in the word-medial positions of any Spanish variety. Moreover, it should be noted that our CCS data suggest that any transfer from Catalan to Spanish with respect to alveolar fricatives is strictly phonetic, rather than phonemic.

In summary, rather than argue that intervocalic [z] production in CCS is a product of strictly language-internal mechanisms, we believe our data better support an account that appeals to a combination of language-internal and language-external influences. Significant effects of stress and syllable position, while motivated by language-internal properties of lenition, are additionally subject to effects of language contact with Catalan, which in CCS appear to significantly bolster the strength of the syllable position constraint, as well as more generally facilitate the notably frequent use of [z] even in formal speech contexts.

6. Conclusion and Suggestions for Future Study

The present study has aimed to provide an in-depth, quantitative approach to examining intervocalic [z] production in Barcelonan CCS. We have provided evidence that [z] is produced (often as a very competitive variant of /s/) in formal speech registers, which underestimates its actual presence in natural (spontaneous) CCS speech. Intervocalic /s/-voicing was found to be conditioned by a set of linguistic factors, most notably syllable position. An appeal to language-internal and language-external factors, in particular contact-induced innovation, has been argued to account for several trends in the collected CCS data. Future research on intervocalic fricative voicing in Spanish varieties would benefit from the collection of speech data from a variety of speech registers (and dialects) so that a more accurate comparison of voicing rates across monolingual and contact varieties of Spanish can be made. Moreover, future research specifically on [z] production in CCS would benefit from the examination of a considerably expanded data set that could speak to possible effects of age, gender, and social class on [z] production as a means of better assessing whether or not [z] production shows signs of a linguistic change in progress. To this end, perception and attitudes research concerning CCS features, and in particular [z], would additionally contribute to our understanding of how perceptual salience affects speakers' attitudes toward language features and their subsequent linguistic behavior with respect to these features.

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¹ Descriptive summaries and specific accounts of various morphological, syntactic, lexical, pragmatic, and phonetic influences of Catalan on CCS can be found in each of Badia i Margarit (1964), Casanovas Català (1995), Payrató (1985), Serrano Vázquez (1996), Sinner (2002), Torres, Fernández Planas, Blasco, Forment, Pérez, & Illamola (2013), Vann (2001; 2007), Wesch (1997), and references therein.

² That is, the immigrant population in the city of Barcelona is larger than that of the rest of the entire Barcelonan region, in addition to all other regions of Catalonia.

³ Note that since alveolar /s/ is the only Catalan sibilant shared by Spanish (with a normal distribution, as Spanish /f/ is absent word-finally save in foreign borrowings [Hualde, Olarrea, Escobar, & Travis 2010, 74]), the phenomenon of intervocalic fricative voicing discussed in this paper refers exclusively to alveolar fricatives. The terms 'intervocalic fricative voicing' and 'intervocalic /s/-voicing' are henceforth used synonymously, both referring to alveolar fricatives.

⁴ The transfer of Catalan /z/ into Spanish through cognate words like *pesar* 'to weigh' would, most generally, not give rise to minimal pairs between Spanish /s/ and /z/. Exceptional cases would include Spanish homophones for which only one meaning was expressed in Catalan by a cognate word with /z/ (for example, *mesa* 'board' [Catalan *mesa*] would be produced with /z/, whereas *mesa* 'table' [Catalan *taula*] would be produced with /s/). Still, a vast amount of quasi-minimal pairs would be created, such as *queso* 'cheese' [ké.so] (Catalan *formatge* [fur.má.dʒə]) and *peso* 'l.s. weigh' [pé.zo] (Catalan *peso* [pé.zu]). As for the transfer of the Catalan voicing assimilation rule into Spanish, [s] and [z] would exist in complimentary distribution as allophones of /s/, with [z] occurring in the context of a following voiced consonant or a following word-initial vowel, and [s] occurring in all other contexts.

⁵ Recent acoustic and articulatory analyses of Spanish /s/ voicing in the context of a following voiced consonant have suggested that voicing is gradient and often variable, showing sensitivity to speech style (cf. Campos-Astorkiza forthcoming; Romero 1999; Schmidt & Willis 2011).

⁶ The majority of participants were university students at the time of data collection. Additionally, following parent occupation distinctions detailed in Pieras (1999), all subjects hailed from a middle class socioeconomic background.

⁷ Though it would have been ideal to juxtapose a group of 100% Catalan and 100% Spanish home users, we could not find enough subjects that used exclusively Spanish at home, so the latter group includes individuals with at least 50% Spanish home use. Note that parent-L1 is controlled within each group: the 100% Catalan home use group has two Catalan-L1 parents, and the 50-100% Spanish home use group has two Spanish-L1 parents (that were born and raised in monolingual regions of Spain and immigrated to Catalonia as adults).

⁸ Moreover, we noted that speakers of groups B and C from Barcelona were raised in districts known for having greater and lesser usages of Catalan, such as Gràcia and Nou Barris, respectively (cf. Lleó et al. 2008).

⁹ Campos-Astorkiza (forthcoming) found, for her Peninsular Spanish data, that voicing assimilation rates of /s/ (to a following consonant) were unexpectedly similar between word-internal /s/ (word boundary absent) and word-final /s/ (word boundary present). She hypothesized that the similarity was due to the choice of word-final /s/ tokens used. All her word-final /s/ tokens were function words, and formed a single accentual unit with the consonant-initial noun that followed them. Thus, she hypothesized that the lack of differences between word-internal and word-final /s/ voicing assimilation rates was due to the fact that all /s/ tokens constituted single accentual units.

¹⁰ Fricative voicing phenomena are understood as gradient, occurring along a non-discrete continuum (Erker 2012; File-Muriel 2010; 2011; Gradoville 2011; Torreira & Ernestus 2012). Accordingly, the thresholds reported in prior Romance investigations in section 3.4 and those used in the present study are not intended to be interpreted as universal, categorical boundaries between [z]-[s] productions. Productions coded as [z] in these studies are better understood as "more or most voiced", in contrast with "less or least voiced" productions, coded as [s]. For more information on justification and methods concerning the binning or categorizing of gradient data in sociolinguistics, one may reference Tagliamonte (2006; 2012). Additionally, it may be noted that categorical coding schemes of [z] and [s] more accurately reflect the listener's categorical perception of voicing (particularly for languages with phonemic fricative voicing contrasts such as Catalan, Italian, and English). To this end, Rivas (2006) and Stevens, Blumstein, Glicksman, Burton, & Kurowski (1992) have shown for Italian and English, respectively, that categorical perception of [z] vs. [s] is principally cued by differences in voicing duration, in contrast with other correlates

of voicing such as overall segment duration.

¹¹ Groups A and C unexpectedly favored [z] in contexts of a double accentual unit. Since examples of prototypical CCS [z] production cited by Pieras (1999, 212), Serrano Vázquez (1996, 379), Vann (2001, 124), and Wesch (1997, 296) are all single accentual unit /s/ tokens, it is possible that this context (especially determiner + noun, as in *los amigos* ‘the friends’) is the most salient context for [z] production, and thus appears least in formal speech registers in which non-standard variants are typically most avoided. Further investigation incorporating the perception of voicing is certainly needed to confirm this speculation.

¹² Note that the converse finding (i.e., that select bilingual speakers of greater Catalan dominance showed little to no intervocalic /s/-voicing whatsoever, and thus patterned with bilingual speakers of lesser Catalan dominance) is somewhat less curious due to the conservative nature of the elicitation tasks employed. Since the speech data gathered represents a formal speech register (recall that participants were explicitly told to use their best Spanish pronunciation), non-standard speech variants like [z] were expected to be maximally avoided in the reading task employed (cf. Moreno Fernández 2009, 101; Tagliamonte 2012, 34).

¹³ We note that the same 20 speakers also participated in a parallel Spanish reading task that elicited the voiced lateral /l/ as a means of observing instances of CCS lateral velarization (that is, [ɫ] usage). Group C speakers (and for the present discussion, speakers 19 and 20 in particular) showed nearly no instances of [ɫ] production, in comparison with its prevalent use by group A speakers (Davidson, forthcoming). Thus, the presently observed (and unexpectedly high) voicing rates of speakers 19 and 20 may indeed be indicative of these bilingual speakers transferring only certain features from Catalan into their Spanish, which we have speculated to be reflective of differences in social meaning between [z] and [ɫ] (cf. Sinner 2002). Alternatively, it is possible that speakers 19 and 20 are simply not representative of group C bilingual speakers; that is, a larger sample of group C speakers could suggest that [z] production is not prevalent in this group of speakers.

¹⁴ Only average voicing durations are reported: the word-medial and word-initial contexts did not statistically differ (each roughly 29% voiced), although both differed from the average voicing duration of roughly 45% in the word-final context (Torreira & Ernestus 2011, 138).