John M. Lipski

Spanish vocalic epenthesis: the phonetics of sonority and the mora

Abstract: This study presents a model of Spanish vocalic epenthesis based on a combination of observed and elicited data. It is proposed that the presence or absence of a mora dictates the position and phonetic realization of "repair" vowels. When faced with impermissible onset and coda clusters, e.g. in attempting to pronounce foreign words, Spanish exhibits a number of syllabic repair strategies involving epenthesis of /e/ or insertion of a ghost (svarabhakti) vowel. It is proposed that the unifying predictor of the position and phonetic nature of epenthetic vowels is the presence/absence of a mora. Since epenthetic vowels do not add phonological weight, i.e. carry no mora, a full vowel added during the repair of non-permissible clusters must acquire its mora through licensing. The only available licenser is an unsyllabified moraic consonant. Svarabkahti vowels cannot acquire a mora, hence their fleeting nature and the fact that they are typically not lexicalized.

1 Introduction

The Spanish syllable has figured prominently in linguistic analyses, including structuralist, generative, and Optimality Theory approaches (e.g. taking as landmarks Granda 1966, Harris 1983, Colina 2006). The fundamental consonant patterns can be described in straightforward fashion. Any Spanish consonant can occur as a simple onset, while Spanish onset clusters have a maximum of two elements, the first of which must be a stop or the fricative /f/, and the second of which must be a liquid (/l/ or /ɾ/);[1] the clusters **tl-* and **dl-* are disallowed. Word-final coda consonants are limited to the set {/d/, /s/, /l/, /ɾ/, /n/, and marginally /x/}, but word-internally (as well as word-finally in foreign borrowings), any Spanish consonant except for /x/ and the palatals /j/, /ɲ/, and /ʎ/ can appear in the coda. Coda clusters in patrimonial Spanish words only appear word-internally, and take the form /-Cs/, where the first consonant comes from the set {/b/, /d/, /l/, /ɾ/, /n/}. Whereas most of the research has been directed at

1 Under the assumption that semivocalic elements in rising diphthongs such as *bueno* 'good' and *diez* 'ten' are located in the nucleus (e.g. Harris 1983: 25).

John M. Lipski, The Pennsylvania State University

characterizing actually occurring syllable types, there has been a complementary effort to account for non-occurring combinations, typically invoking sonority sequencing as the primary well-formedness criterion. Less mention is made of repair strategies involving non-permissible clusters, except for the omnipresent addition of prothetic /e/ to word-initial /sC-/ clusters in foreign borrowings or Spanish-influenced interlanguage: *ski* > *esquí*. In the contemporary Spanish-speaking world, there is an ongoing process of phonotactic adaptation of foreign words containing phonotactically non-permissable clusters, sometimes only temporarily as the result of transitory current events or attempts to speak another language, and sometimes more permanently; syllabic repair strategies are commonly applied in such cases. The present essay offers a broader analysis of Spanish consonant-cluster repair strategies involving vocalic epenthesis, addressing both the placement of the epenthetic vowel and its phonetic and phonological content. The following facts are drawn together:

(1) Word-initial /sC-/ clusters are repaired by adding /e/ before the /s/ (*stop* > *estop*) rather than between /s/ and the following consonant (**setop*).
(2) The same occurs with word-initial clusters of clearly decreasing sonority (/mba-/ > *emba* not **meba*).
(3) Word-initial clusters of equal sonority or adjacent points on the sonority scale (e.g. *ps-*, *kn-*) do not add an epenthetic /e/ either before the first consonant or between the consonants but rather are realized with a fleeting schwa-like svarabhakti vowel between the consonants.
(4) Word-final consonant clusters of increasing sonority are repaired by inserting /e/ between the consonants rather than following the consonants, even when a permissible word-initial cluster would occur (*Sadr* > *Sader*, not **Sadre*).

It will be proposed that relative sonority in consonant clusters is intimately related to the mora, which has most often been evoked to account for stress assignment and the minimal prosodic word. Rather than defining the mora epiphenominally (e.g. as indicated by the presence of a long vowel, a geminate consonant, or a stress-attracting syllable), a sonority-based approach will be presented, together with an empirical phonetic correlate of the presence or absence of a mora: the placement and realization of full epenthetic or svarabhakti vowels. The remainder of the study is organized as follows. The treatment of word-initial /sC-/ clusters in terms of sonority is combined with a discussion of putative violations of preferred syllable configurations. This is followed by a discussion of other word-initial and word-final clusters that violate sonority-sequencing requirements for Spanish, and which are repaired by vocalic epenthesis when borrowed or when Spanish speakers attempt spontaneous pronunciation. The mora is then defined in terms of relative sonority, and the ensuing model is given an Optimality Theory demonstration. An appendix contains a brief description of the phonetics of vocalic epenthesis as a repair strategy in Spanish.

2 Epenthesis in Spanish: /s/ + C clusters and sonority sequencing

The role of sonority in Spanish syllable formation is widely accepted, and forms the core of most proposals for syllabification and syllable well-formedness (e.g. Colina 2006, 2009; Harris 1983, 1989; Hualde 1991, 1999; Morelli 2003, Shepherd 2003). In Spanish syllables, sonority rises strictly from onset to nucleus, and generally falls strictly from nucleus to coda (with the special case of complex codas, all of which occur word-internally in patrimonial Spanish words and have /s/ as the second element). Assuming the general sonority hierarchy OBSTRUENT << NASAL << LIQUID (<< GLIDE) << VOWEL, complex onsets exhibit a minimal sonority distance requirement. Although in matters concerning sonority, stops and fricatives usually group together as obstruents, the fricative /s/ (and in those Peninsular dialects that contain this phoneme, also /θ/) behaves exceptionally. Unlike /f/ (and, according to Harris 1983, also /x/), /s/ cannot occur in onset clusters, and borrowed words beginning with /s/ + C inevitably add a prothetic /e/, this being the Spanish default vowel[2] (assumed to be maximally underspecified, e.g. Archangeli 1988, Lombardi 2003) employed for syllable repair: *esquiar* < *ski* 'to ski,' *esmóquin* < *smoking [jacket]* 'tuxedo,' *estrés* < *stress*, *escáner* < *scanner*. The phonotactic incongruity of word-initial complex onsets beginning with /s/ is so strong that most Spanish speakers find it difficult to suppress the prothetic response when attempting to pronounce foreign words beginning in /sC-/ (e.g. Carlisle 1991).[3]

The prohibition of /sC-/ onset clusters in Spanish has been attributed to the need to maintain monotonically rising sonority (e.g. Gutiérrez Rexach 2006: 465). Matters are clear for /s/ + OBSTRUENT clusters, since even if stops and fricatives are placed at the same level of sonority, Spanish onset clusters must

2 Eddington (2001) believes that epenthesis/prothesis with /e/ occurs because /e/ is the most commonly occurring vowel before initial sC- clusters, reflecting the historical process, and that epenthesis occurs to the left of the *sC* cluster because word initial *seC-* is much less common than word initial *esC-*. This usage-based approach ignores the fact that [e] is also used to break up other non-occurring onset and coda clusters.

3 Even in languages such as English and Italian, which freely tolerate word-initial sC- clusters, there is evidence that the /s/ is actually a coda consonant (Davis 1990, Kaye 1992).

rise in sonority. However, onset clusters of the form /fr/ and /fl/ freely occur in Spanish as easily as STOP + LIQUID clusters, but */sl-/ and */sr-/ are not allowable onsets. Martínez-Gil (2001) proposes that /f/ clusters with stops and that /s/, /θ/ and – contra Harris (1983) – also /x/, occupy a position on the sonority scale intermediate between stops and sonorants (grouping together nasals and liquids), which accounts for the impossibility of clusters beginning with /s/. The higher sonority value for sibilants is justified by the fact that they are distinctively specified as [+continuant]; /f/, on the other hand, does not have this specification distinctively, since Spanish contains no labiodental stops. From both an articulatory and perceptual viewpoint this answer appears to hinge on a terminological technicality, artificially dividing voiceless fricatives into two separate categories. In large areas of Spain and Latin America, /f/ is realized as a bilabial fricative [ɸ], for which [+continuant] would consequently be phonologically distinctive (e.g. separating minimal pairs such as *pino* 'pine' vs. *fino* 'fine'). Regardless of these quibbles, there is strong circumstantial evidence that at least in the case of putative onset clusters /s/ does indeed behave as a more sonorous element than other obstruents, and has done so since the earliest stages of the Romance languages.

3 On the locus of onset-cluster epenthesis: a first look

In Spanish putative *sC-* onset clusters are always converted to *esC-* combinations, never, for example, **seC-* as might occur e.g. with borrowings into Japanese and with early Portuguese borrowings into Central African languages (e.g. *escola* 'school' > Kimbundu *sicora*, *escoba* 'broom' > Kikongo *sicoba*; Lipski 2002). The fact that Spanish resolves the issue by the syllabification [es-C...] is consistent with the fact that /s/ is a well-integrated coda consonant in Spanish, but what is less clear is why *esC-* is the REQUIRED solution. In Optimality Theory terms, any solution involving epenthesis represents a violation of DEP, prohibiting the insertion of phonological material not present underlyingly. The solution *esC-* also violates *CODA or the preference for coda-less open syllables, which while not a highly-ranked constraint in Spanish, is demonstrably active both diachronically and synchronically. **seC-* on the other hand would represent a faithfulness violation of contiguity, e.g. CONTIG-IO; Shepherd (2003: 27f.), among others, suggests this constraint as operative in the case of Spanish prothetic *e-*, given "the tendency of epenthesis and deletion to occur at constituent edges, rather than medially."[4] While an appeal to CONTIG-IO produces the correct results, Spanish does not have an independently demonstrable tendency to avoid contiguity disruptions as the result of phonological processes; this can be most clearly seen in processes that involve morpheme boundaries, e.g. in the pluralization of nouns and adjectives ending in a consonant: /papel + s/ > *papeles* 'papers' or in diminutives of names ending in /-s/: *Carlos* + /ito/ > *Carlitos*. CONTIG by itself does not appear to provide sufficient justification for the choice of prothetic *esC-* rather than epenthetic **seC-* as a Spanish repair strategy. A revised OT model will be proposed in a following section.

There is considerable cross-linguistic evidence, including data from first language acquisition and language disorders, that in word-initial /s/ + C clusters the /s/ is frequently not part of a complex onset, but may be part of an appendix (references summarized in Goad & Rose 2004; also Davis 1990), or in Government Phonology linked to a preceding empty nucleus (Kaye 1992). This is true even in clusters with indisputably rising sonority, such as /s/ + SONORANT. To explain Spanish prothetic /e/ simply in terms of the appendix status of cluster-initial /s/ is circular, since the putative appendix status of /s/ is based precisely on the existence of phenomena such as epenthesis, syllabification, and place-identity constraints. In the search for a more enlightening solution, it is useful to examine other configurations that trigger epenthesis in Spanish. In this fashion it may be possible to situate the "special" status of /s/ + C clusters within a more general model.

4 Epenthesis in Spanish word-final complex codas

Unlike, e.g., Portuguese, Spanish freely tolerates foreign words with non-Spanish single codas (e.g. *club, grog, input, internet, Facebook*); although these consonants may be reduced or deleted in casual speech (presumably due to the markedness of these coda consonants), epenthetic vowels are not added. Similarly, Spanish tolerates complex codas not conforming to the Spanish /-Cs/ configuration, as long as they exhibit decreasing sonority, as in *York, comfort, Grant*, sometimes with deletion of the final consonant in colloquial speech but never with epenthesis (e.g. Bonet 2006: 317). In contrast to onset position, there is no strong Minimal Sonority Condition for complex codas, merely the requirement that sonority decrease monotonically (respecting, e.g. Clements' 1990 Dispersion Principle: maximize sonority difference in the onset and minimize in the coda). The

4 Strictly speaking this statement is not quite accurate, since deletion of some word-internal coda consonants commonly occurs in most varieties of Spanish.

many Catalan surnames such as *Front, Brucart, Guitart, Gelabert* found throughout the Spanish-speaking world do not produce the phonotactic unease provoked by initial *sC-* clusters. In coda position /s/ does not appear to be more sonorous than other obstruents. To the extent that Spanish speakers actually pronounce both segments in foreign words with complex codas, there is no observable tendency to insert epenthetic vowels either in /-sC/ codas or in /-Cs/ codas: neither English *box* [baks] nor *ask* [æsk] triggers epenthesis in the L2 English of Spanish speakers. Even complex codas containing two non-sibilant obstruents do not normally provoke spontaneous epenthesis: *soft* [sɔft] and *act* [ækt] can be pronounced by most Spanish speakers without phonotactic distress. The variability of reduction in coda clusters of non-increasing sonority stands in contrast to the exceptionless nature of word-initial epenthesis.

The same does not hold for word-final complex codas that exhibit rising sonority. In such cases, an epenthetic vowel (usually the Spanish default vowel [e]) is inserted between the two coda consonants, even when the coda cluster could occur as a Spanish complex onset. Thus, for example, the Arabic name *al Sadr* (which became prominent during the second Gulf War) is typically pronounced [al.sa.ðer] rather than *[al.sa.ðre], despite the fact that /dr-/ is a perfectly acceptable Spanish onset cluster. Other examples (from Bonet 2006: 318) include *single* > [siŋ.gel] 'a single-play record,' *Lidl* > [li.ðel] 'name of a supermarket chain,' and numerous spontaneous pronunciations of English words ending in OBSTRUENT + (SYLLABIC) LIQUID, such as *table* > [te.βel], *finger* [fiŋ.ger], *apple* [a.pel], and so forth.[5] The position of epenthetic vowels in word-final clusters of rising sonority appears at first glance to be a counterexample to Spanish syllabification algorithms that maximize onsets rather than codas (Harris 1983, 1989; Hualde 1991, 1999) as well as a counterexample to contiguity.

Epenthesis also occurs – both in momentary approximations to foreign words and in assimilated loans – when accommodating words ending in complex codas with rising sonority that do not represent possible Spanish onset clusters, such as Arabic *Ibn* [i.βen] and the Spanish-influenced realization of English words ending phonetically in syllabic consonants, e.g. the pronunciation of *happen* as [xa.pen]. In such cases, the epenthetic vowel could in theory be inserted after the two consonants (*[iβ.ne], *[xap.ne]) but this does not occur. Epenthesis in word-final coda clusters does not respect contiguity, which casts additional doubt on a contiguity-based explanation for *esC-* rather than **seC* in repair of /sC-/ onset clusters. An avoidance of complex onsets could in principle be invoked in those instances where the coda cluster is a possible Spanish onset

5 In all of these instances except for the cluster /dl/, the OBSTRUENT + LIQUID groups form possible onsets in Spanish.

(Bonet 2006: 336 considers but rejects this possibility), but Spanish shows no other signs of avoiding complex onsets.[6] Bonet (2006) analyzes cases such as *Sadr* > [sa.ðer] in terms of alignment constraints, i.e. maintaining the alignment of the right edge of the syllable with the right word boundary. Since there are no productive epenthesis processes in Spanish that target coda clusters with falling sonority, the alignment approach produces the correct answers with no counterexamples. At the same time, this proposal yields the incongruous result that syllable-word boundary alignment is highly ranked at the end of the word, but is easily over-ridden word-initially, as evidenced by the treatment of /sC-/ onset clusters.

5 More on Spanish word-initial epenthesis: decreasing sonority onset clusters

A look at the phonotactic accommodation of other non-permissible onset clusters in Spanish suggests alternatives to both alignment and contiguity as the ultimate motivating force behind the placement of epenthetic vowels in Spanish. In addition to the well-documented treatment of words beginning with *sC-* clusters, there are other instances of epenthetic vowels in Spanish used to repair non-permissible complex onsets, and which argue against the "special" status of /s/ in onset clusters. Consider first onset clusters that exhibit monotonically decreasing sonority, similar to *sC-* onsets. A typical case occurs with prenasalized obstruents, which have come into contact with Spanish at various points in its history. The most extensive contacts involved African languages, and there is indirect evidence that Africans who acquired Spanish as a second language under conditions of forced servitude (first in Spain, later in Spanish America) prenasalized word-initial voiced obstruents (Lipski 1992) as well as retaining African lexical items containing prenasalized consonants. The Afro-Iberian creole language Palenquero spoken in San Basilio de Palenque, Colombia, bears witness to this process, with Spanish-derived words such as *ndo* < *dos* 'two,' *ngande* < *grande* 'large,' *ndulo* < *duro* 'hard,' *mbulo* < *burro* 'donkey,' etc. (Friedemann &

6 Colina (2006) does analyze the lack of resyllabication in combinations such as *club latino* 'Latin club' as **clu-bla-ti-no* not in terms of *COMPLEX ONSET but rather as a manifestation of alignment constraints. For onset clusters beginning with a voiced obstruent, Spanish has a history of occasionally resyllabifying the obstruent into the coda of the preceding syllable, thence into the nucleus as a glide, e.g. *pa-dre* > *pai-re* 'father' (Lipski, 1994; Martínez-Gil 1996, 1997; Piñeros 2001).

Patiño Rosselli 1983: 99–100). Literary texts from early modern Spain and Latin America contain imitations of Africans' halting attempts at speaking Spanish, and what were probably prenasalized consonants were perceived as containing a prothetic /e/, or in a few rare cases, /a/:

(1) No *ensa* (< sa) discreto '[we] are not discreet' (Lope de Vega 1894: 363; 'El santo negro Rosambuco') [Spain, 17th century]

gente *embrancas* (< *branca*) 'white people'; Estornudar gente *enblancas* (< *blancas*) 'white people are sneezing' (Andrés de Claramonte, *El valiente negro en Flandes*, Claramonte 1951) [Spain, 17th century]

si el cuerpo tenemo *enpreto* (< *prieto/preto*) 'if our bodies are black' (Vélez de Guevara, *El negro del serafín*, Sánchez 1979) [Spain, 17th century]

Bailar como un *andimoños* (< *demonio*) 'to dance like a demon' (Lope de Vega "La madre de la mejor"; 1893: 368) [Spain, 17th century]

mi pecho está girviendo como agua que pela *engallina* (< *gallina*) 'my chest is boiling like water that scalds chickens' (Benítez del Cristo, *Los novios catedráticos* (1930); [Cuba, 19th century]

si cabeza *m'enduele* (< me duele) bamo la casa Mundo 'if my head hurts, let's go to Mundo's house' (Cabrera 1971: 517) [Cuba, early 20th century]

aprende a mandá primero que a *engoberná* (< *gobernar*) 'learn to rule before governing' (Cabrera 1970) [Cuba, early 20th century)

African words, mostly from Bantu languages, borrowed into Afro-Cuban cults, often added a prothetic /e/: *mbala* > *embala* 'boniato,' *ndoki* > *endoki* 'witch doctor,' *nkento* > *enkento* 'wife,' *nganga* > *enganga* 'witchcraft,' *mbok* > *emboco* 'wrestler, executioner' (García González & Valdés Acosta 1978: 21; Núñez Cedeño, Alúm, & Nodal 1985: 270; also Núñez Cedeño 1988: 150).

As in the previous examples, when contemporary Spanish speakers are faced with foreign words beginning with prenasalized consonants the phonotactic resolution almost always involves a prothetic [e], e.g. *Nkrumah* [eŋ.kru.ma] (surname of the first president of Ghana), *Nguema* [eŋ.gé.ma] (surname of the current president of Equatorial Guinea), *etc.* When Spanish speakers with no knowledge of Guaraní read Paraguayan literature in which Guaraní lexical items are commonly inserted, a prothetic vowel is also pronounced in words like *mboy* [em.boj] 'how much.' The Guaraní variety spoken in the indigenous communities of Misiones province in Northeastern Argentina is *Mbyá* [ᵐbɯ.á], which is pronounced by monolingual Spanish speakers as [em.bi.á]. In phonotactic repairs of prenasalized consonants (implicitly analyzed by Spanish speakers as NASAL + OBSTRUENT clusters), continguity is respected, but alignment is not: prenasalized consonants are never incorporated through the addition of an epenthetic vowel between the two "halves": **meb-*, **ned-*, etc.

A related case involves word-initial (preconsonantal) syllabic consonants. In the traditional Spanish dialect of northern New Mexico, syllabic sonorants occasionally arise (Espinosa 1925, Lipski 1993, Piñeros 2005). One of the most frequent combinations, still to be heard in this archaic dialect, involves the possessive *mi* 'my' + noun beginning with a labial consonant, e.g. *mi papá* > [m̩.pa.pá] 'my father,' *mi paquete* [m̩.pa.ké.te] 'my package.' Although the syllabic nasal has survived in vernacular speech, for many younger speakers it has accreted a prothetic vowel: *empapá*, a variant that appears in a regionalist literary text (Arellano 1992: 91):[7]

(2) Les dio muncho miedo y corrieron derecho a la casa de *enpapá* como era la más cerca 'They got really scared and ran straight to my dad's house, since it was the closest.'

Salió *enpapá* cuando oyó el bullicio y ya entraron las tres más muertas que vivas.

'my dad came out when he heard the racket and the three women entered, more dead than alive.'

As with the case of word-initial prenasalized consonants, the prothetic vowel extruded from word-initial syllabic nasals does not respect alignment conditions, although contiguity is maintained.

6 The treatment of complex onsets with non-decreasing sonority

There are also occasions when Spanish speakers are faced with onset clusters containing elements either of equal sonority or exhibiting rising sonority but contiguous on the sonority scale, thereby violating sonority sequencing. Examples

7 The treatment of the syllabic nasal mirrors that of prenasalized obstruents, and also parallels the evolution of preverbal clitics in Catalan, which in proclitic position evolved from the configuration C + /e/ to /e/ + C e.g. *me* > **m̩* > *em* (Moll 1952: 192; Badia i Margarit 1981: 294–296). Espinosa observes that the same process has been proposed for proto-Indo European evolution into Latin, for example **km̩tom* > *centum* 'hundred,' **dekm̩* > *decem* 'ten' (Brugmann 1905: 133; Sommers 1914: 41–46). Similar developments occurred in Oscan and Umbrian (Lindsay 1894: 273–275).

include *psi* 'the Greek letter,' *Phnom Penh* (the capital of Cambodia), *Tbilisi* (capital of the Republic of Georgia), *Knack, Knoll, Knecht* (surnames of Germanic origin, common in parts of South America), B'nai Brith, Mladić (former Serbian general), etc. Although assimilated borrowings typically delete the first consonant (e.g. *(p)sicología* 'psychology'; Hualde 2005: 77), when attempting to pronounce such words for the first time Spanish speakers frequently strive to retain both consonants by means of repair strategies. Unlike what occurs in the case of initial clusters of falling sonority and final clusters with rising sonority, Spanish speakers do not usually make use of the epenthetic [e] that is readily available as a repair strategy in other environments. Inserted instead is a *svarabhakti* vowel (Hualde 2005: 113) or truncated timing slot between the two consonants. Unlike the case of complex onsets with falling sonority and complex codas with rising sonority, the epenthetic vowel in these complex onset repairs is typically shorter than a full Spanish [e], may be devoiced, and exhibits a less well-defined formant structure than other Spanish vowels, more often resembling the excrescent segment characteristically found within OBSTRUENT +LIQUID onset clusters (Bradley 2002, 2006, Bradley & Schmeiser 2003; Ramírez 2006), although being schwa-like in having a centralized articulation rather than being a fleeting duplicate of the following vowel. This element may not represent a target of phonological epenthesis but rather the "pulling apart" of individual consonantal gestures, which momentarily opens the vocal track and extrudes a brief vocalic sound (e.g. Davidson & Stone 2003, Gafos 2002). Alignment of left word and syllable boundaries is maintained but contiguity is apparently violated, even when an acceptable Spanish coda would result if a prothetic rather than an inter-consonantal vowel were inserted.

7 Moras and the licensing of epenthetic vowels

The survey of synchronically productive epenthetic processes in Spanish highlights the potential shortcomings of postulating alignment, contiguity, or coda constraints as the primary motivation for an apparently cohesive phenomenon. Needed is a unifying predictor of the position and phonetic nature of the epenthetic vowel. Such an element is the MORA, the unit of phonological weight. The concept of the mora has a long history in phonological theory, and refers in general to a unit of syllabic length ("long" vs. "short" syllables) and/or weight (potentially attracting stress accent). Seen in these terms moras are defined epiphenomenally, as indicated by McCawley (1978): "The only reasonable definition of 'mora' that I am aware of is 'something of which a long syllable consists

of two and a short syllable consists of one.'" Based on extensive cross-linguistic research Hyman (1985) offers a comprehensive proposal for the mora as a phonological prime (cf. also Broselow 1995, Hayes 1989, inter alia), and the mora has made its way into models of Spanish syllable and word structure (e.g. Colina 2006, Harris 1992, Hualde 1999, Lipski 1997, among others). With respect to consonants, onsets do not carry moras; all moraic consonants are ultimately found in coda position.

The aforementioned studies embody an epiphenomenal definition of the mora, e.g. found in long vowels, geminate consonants, or "heavy" stress-attracting syllables. Syllables, however, are typically defined in terms of sonority, and Spanish syllabification algorithms make essential use of relative sonority (e.g. Harris 1989; Hualde 1991, 1999), and it is therefore appropriate to directly define the mora based on sonority. In order to account for vocalic epenthesis in Spanish the following sonority-based definition of the mora is consistent with observed phenomena:

(3) Define as **MORAIC** (in Spanish) any segment immediately followed by a segment OF LOWER SONORITY (or by no segment at all).

This is not the first time that moras have been defined in terms of the relative sonority of contiguous segments. Zec (1995: 91–92) offers a similar proposal as a necessary condition for a segment to project a mora,[8] with the difference that the sonority of the moraic segment be equal to or higher than the following segment. In Spanish this works for word-internal sequences of consonants (Spanish has no phonological geminates or long vowels), but as shown below, does not account for the treatment of foreign words beginning with two consonants of equal sonority.[9] For Spanish, the condition in (3) is assumed to be not only necessary but also sufficient, i.e. every segment so defined is moraic. The sufficiency condition is implicit in Zec's model, and is explicitly required for Spanish. Under

8 For Zec the mora is the phonological prime, and the sonority conditions merely allow moras to be projected. It is not clear whether this difference has any empirical consequences.

9 For learned and non-patrimonial words with single coda obstruents, e.g. *doctor, Magdalena*, the coda consonant is almost always realized as a weak approximant or is vocalized into the nucleus (e.g. Lipski 1994, Martínez-Gil 1990, 1996, 1997; Piñeros 2001) while the following onset consonant may retain an occlusive articulation, even extending to the voiced obstruents /b/, /d/, and /g/, which are more frequently realized as approximants in other prevocalic environments.

this definition, all vowels (as well as postnuclear, but not prenuclear glides) carry a mora, as do all coda consonants.[10]

Given this definition of moras, the existence and placement of epenthetic vowels in Spanish can be characterized more systematically. Since epenthetic vowels do not add phonological weight (Hyman 1984: 71f.; Piggott 1995; Piggott & Singh 1985), i.e. carry no mora, a full epenthetic vowel added during the repair of non-permissible onset and coda clusters must acquire its mora through licensing. The only available licenser of an epenthetic vowel is a "stray" moraic consonant (which, by virtue of being part of a non-permissible Spanish cluster, is originally unsyllabified). The repair strategies described in sections 2–6 can be re-cast in terms of the presence of unsyllabified moras.

Beginning with word-final clusters of increasing sonority, in a word like *Sadr*, the /a/ and the /ɾ/ are both moraic while the /d/ is not. Since the /d/ is not moraic, it cannot be syllabified as a coda and must therefore be part of an onset. The /ɾ/, being moraic, cannot become part of a (complex) onset, thus ruling out an eventual resolution of the form *[sa.ðɾ...]. All moras must be associated with syllabic rhymes and since in Spanish all syllables must contain a nuclear vowel, an epenthetic vowel is licensed by the moraic /ɾ/, which becomes the coda of the syllable [ðer]. A similar series of deductions pinpoints the location of the epenthetic vowel in the Spanish-influenced pronunciation of English *happen* as [xa.pen]/*[xap.ne]. The /n/ is moraic and must therefore be syllabified as a coda, while the /p/ is non-moraic and can only be an onset. In this analysis, alignment considerations are coincidental, as is the violation of contiguity. Relative sonority configurations, together with the need for an epenthetic vowel to be licensed by a moraic consonant (in coda position) converge on a single location for the epenthetic vowel.

An identical procedure predicts the position of epenthetic vowels in word-initial clusters of declining sonority including nasal + C and /s/ + C. In *mboy*, the /m/ is moraic and the /b/ is not. An epenthetic vowel between the /m/ and the /b/ would encounter no moraic consonant as a licenser, thus ruling out

10 If it is assumed that /s/ is actually more sonorous than stops, then the first element of complex codas such as those in *obstáculo* 'obstacle,' *bíceps*, etc. should not be moraic. When the coda obstruent is actually pronounced in such words, however, it never emerges as a stop, but rather as some sort of weak approximant, arguably with sonority levels approaching that of glides. The same reasoning could be applied to single-obstruent codas, as in *doctor, acto* 'act,' *fiebre aftosa* 'hoof and mouth disease.' However word-internally it will be necessary to add a condition to the definition, namely that an element is moraic if followed by an element of equal sonority, just in case it is also preceded by an element of higher sonority. This will account for words like *himno* 'hymn, *burla* 'mockery,' *alrededor* 'around,' while not assigning a mora to the /t/ of *Tbilisi*.

**meboy* as a possible repair. The epenthetic vowel must be placed before the /m/, which being moraic licenses the inserted vowel and serves as a coda. A word like *stress* receives a similar treatment. Neither the /t/ nor the /ɾ/ is moraic, thereby ruling out **setrés*, which would contain an unlicensed epenthetic vowel. The /s/, being moraic, emerges as a coda consonant licensing the prothetic vowel, producing the actually occurring *estrés*.[11]

8 The repair of initial clusters with non-decreasing sonority

Onset clusters that do not decrease in sonority, such as *pn-, kn-, tb-, ml-*, etc. contain no moraic consonants; therefore neither consonant can be syllabified as a coda. Although ultimately deletion of the first consonant may emerge as a permanent solution (possibly due to the markedness of a non-moraic consonant that cannot be syllabified as an onset), in "first encounters" with foreign words speakers often strive to accommodate every segment in some fashion. In onset clusters with non-decreasing sonority the only potential place for an epenthetic vowel is between the two consonants. In this situation a full epenthetic vowel is unable to acquire a mora from either of the flanking consonants and this is reflected in the effervescent nature of the inserted vocalic element, which almost never emerges as a full [e] or a truncated copy of the following vowel but rather more like a fleeting svarabhakti vowel with schwa-like articulatory and acoustic traits.[12] An epenthetic vowel has never become lexicalized in such situations, as has occurred with epenthetic vowels licensed by moraic consonants (e.g. *estrés, escáner*), and the historical trend of eliminating the first consonant highlights

11 Singh (1985: 273) discuss the asymmetries of prothesis and anaptyxis, and argues that sonority sequencing is responsible: "An unacceptable word-initial cluster is broken up by the insertion of a vowel before the most sonorous segment." This accounts for the difference between /s/+C with prothesis and stop + liquid with anaptyxis. Davidson et al. (2004) tested English speakers' attempts to pronounce non-permissible onset clusters, containing consonants of equal sonority or rising sonority but adjacent on the sonority hierarchy. Epenthesis of a weak schwa (between the two consonants) was by far the most common repair strategy. Davidson and Stone (2003) used ultrasound for English speakers attempting to pronounce initial *zg-* and determined that the target was actually a schwa and not an excrescent vowel formed by gestural mistiming.

12 According to Fleischhacker (2001: 85) epenthetic vowels are placed "exactly where they are least auditorily obtrusive – between the members of an underlying obstruent + sonorant cluster, but before a sibilant + stop cluster – unless a conflicting constraint forces otherwise (e.g. across-the-board anaptyxis, to satisfy a phonotactic banning consonants in non-prevocalic position)."

the difference between first approximations – which may include unconventional and uncomfortable strategies and articulations – and phonologically stable accommodation, which only draws upon fully integrated segments articulatory gestures. The epenthetic segments that arise when Spanish speakers attempt to pronounce non-permissible onset clusters with non-decreasing sonority fit the definition of *semisyllables* (e.g. Cho & King 2003: 187): (a) no mora; (b) no nucleus; (c) no coda; (d) no stress/accent/tone; (e) prosodically invisible; (f) well-formed onset; (g) restricted to morpheme peripheral position. By allowing semisyllables into the prosodic hierarchy, it is possible for all elements to be associated with a syllable (full or semi), without necessarily being associated with a mora or a foot.[13] In the accommodation of words such as *Tbilisi, Knack*, etc. no full epenthetic vowel will produce a moraic syllable since neither of the two consonants is moraic, and therefore cannot be syllabified as a coda. Synchronically, the prohibition against deleting consonants in onset clusters is very strong, and the least phonological disruption is produced by the insertion of a semisyllable, in effect a brief intrusive element that overcomes the articulatory unfamiliarity of the cluster without adding a clearly distinguishable epenthetic vowel.

9 A basic OT model

The presence and phonological placement of epenthetic vowels in non-permissible clusters can be illustrated within the framework of Optimality Theory by means of a series of independently-motivated constraints, including the following:

MAX: no deletion

DEP: no epenthesis

SSC: sonority sequencing condition (syllable onsets must increase in sonority and syllable codas must decrease in sonority)

MSD: maximal sonority distance for onset clusters

SYL-μ: all syllables must contain a mora

μ-SYL: all moras must be syllabified with a full vowel nucleus

13 Kiparsky (2003: 156) offers an alternative definition of semisyllable, which differs from the above traits in being essentially an unsyllabified mora, lacking onsets (or non-branching onsets). In Spanish, semisyllables are not moraic, in contrast to Kiparsky's proposal.

The constraint **MAX** is un-dominated; synchronically Spanish does not routinely resolve non-permissible consonant clusters through deletion. The sonority-based constraints **SSC** and **MSD** are also un-dominated, as are the requirements that every syllable contain a mora and that every mora be associated with a full syllable. In the following tableaux the symbol ζ will be used to refer to the non-moraic svarabhakti vowel used to break up onset clusters with non-decreasing sonority. The standard assumption that the Spanish default vowel [e] is non-moraic when added through epenthesis is also in effect. It is also the case in Spanish that the underlying mora count is not altered in epenthetic repair.

The following tableaux exemplify the interaction of moras, sonority, epenthetic vowels, and svarabhakti vowels. The Spanish epenthetic vowel [e] can only be added when a previously unsyllabified moraic consonant is available to license the vowel from the coda position. The svarabhakti vowel [ζ] remains non-moraic and non-syllabic. In each instance the total mora count remains unchanged, irrespective of the presence of epenthetic or excrescent vowels; this is a fundamental facet of Spanish phonological repair.

The derivation *ski* > [es.ki] with prothetic [e] is given in Tableau 1. The /s/ is moraic and therefore requires a full epenthetic vowel (the Spanish default vowel /e/) in order to be realized. The syllabified moraic consonant always appears in coda position.

Tableau 1: *ski* > [es.ki]

/ski/ | | μ μ	SSC	MAX	SYL-μ	μ-SYL	DEP
[ski]	!*			*	
[si]/[ki]		!*			
[se.ki]			!*	*	*
☞ [es.ki]					*
[sζ.ki]			!*	*	(*)
[sζki]				!*	(*)
[ζs.ki]				!*	(*)

The derivation for *psi* > [pζsi] containing an onset cluster with non-decreasing sonority is shown in Tableau 2. Neither consonant is moraic, which precludes epenthesis of the default vowel /e/. Since /ps-/ is a non-permissible onset cluster in Spanish the svarabhakti vowel appears between the two consonants; it cannot

appear before the (non-moraic) /p/ because this would result in a mora-less syllable.

Tableau 2: *psi-* > [pζsi]

/psi/ | μ	MSD	MAX	SYL-μ	μ-SYL	DEP
[psi]	!*				
[si]/[pi]		!*			
[pe.si]			!*		*
[ep.si]			!*		*
[pζ.si]			!*		(*)
☞ [pζsi]					(*)
[ζp.si]				!*	(*)

The derivation of *Sadr* > [sa.ðeɾ] containing a coda cluster with rising sonority is shown in Tableau 3. The /ɾ/ is moraic and requires syllabification by the full epenthetic vowel /e/.

Tableau 3: *Sadr* > [sa.ðeɾ]

/sadr/ | | μ μ	SSC	MAX	SYL-μ	μ-SYL	DEP
[saðɾ]	!*				
[sað]/[saɾ]		!*			
sað-ɾ				!*	
[sa.ðɾ]				!*	
[sa.ðζɾ]				!*	
sa.ðɾζ			!*	*	(*)
[sa.ðre]			!*	*	*
☞ [sa.ðeɾ]					*

In Tableau 4 the derivation of the word-initial syllable *mba* > [em.ba] with decreasing sonority in the onset cluster is shown. The /m/ is moraic and is incorporated into coda position together with the full epenthetic vowel /e/.

Tableau 4: *mba-* > [em.ba]

/mba/ | | μ μ	SSC	MAX	SYL- μ	μ- SYL	DEP
[mba]	*!			*	
[ba]/ma]		!*		*	
[m.ba]				!*	
[me.ba]			!*	*	*
[mζ.ba]			!*	*	(*)
[ζm.ba]				!*	(*)
☞ [em.ba]					*

10 Summary and conclusions

The preceding sections have proposed a model to account for the nature and placement of epenthetic vowels as syllable repair strategies in Spanish, based on relative sonority relationships among contiguous segments. Taking as a point of departure the postulate that epenthetic vowels lack phonological weight, it has been proposed that a full epenthetic vowel (in this case the Spanish default vowel /e/) can only be licensed by an unsyllabified moraic consonant, i.e. the second element in word-final clusters of increasing sonority or the first element of word-initial clusters of decreasing sonority. The moraic consonant then becomes the coda of the epenthetic syllable, whose nucleus is the default vowel /e/. In phonotactically non-permissible onset clusters of non-decreasing sonority neither consonant is moraic and a full epenthetic vowel cannot be licensed; if Spanish speakers attempt to pronounce both consonants a non-moraic svarabhakti-vowel semi-syllable is usually inserted between the two consonants.[14] The common thread uniting all Spanish consonant cluster repairs is that the mora count remains unchanged.[15] The placement and phonetic nature of the epenthetic

14 Broselow (1987: 293; 1992) demonstrates that many of the same repair strategies are used by English speakers when faced with onset clusters with decreasing or equal sonority.

15 Although moras have frequently been invoked to account for stress placement in quantity-sensitive languages, it is not axiomatic that moras are phonologically relevant only in quantity-sensitive languages. The present study is orthogonal to the ongoing debate as to whether contemporary Spanish is a quantity-sensitive language (see Piñeros' article in this volume).

vowel in effect represent empirical phonetic correlates of moraicity; the appendix contains a visual illustration. This preliminary exploration embodies the potential for adding another dimension to the understanding of Spanish syllable structure.

References

Archangeli, Diana. 1988. Aspects of underspecification theory. *Phonology* 5.183–207.

Arellano, Juan Estevan. 1992. *Inocencio: Ni pica ni escarda, pero siempre se come el mejor elote*. México: Grijalbo.

Badia i Margarit, Antoni. 1981. *Gramàtica històrica catalana*. Valencia: Eliseu Clement.

Benítez del Cristo, Ignacio. 1930. Los novios catedráticos. *Archivos del Folklore Cubano* 5(2). 119–46.

Bonet, Eulalia. 2006. Gender allomorphy and epenthesis in Spanish. In Fernando Martínez-Gil & Sonia Colina (eds.), *Optimality-theoretic studies in Spanish phonology*, 312–338. Amsterdam & Philadelphia: John Benjamins.

Bradley, Travis. 2002. Gestural timing and the resolution of /Cr/ clusters in Romance. ROA 529–0702.

Bradley, Travis. 2006. Spanish complex onsets and the phonetics–phonology interface. In Fernando Martínez-Gil & Sonia Colina (eds.), *Optimality-theoretic studies in Spanish phonology*, 15–38. Amsterdam/Philadelphia: John Benjamins.

Bradley, Travis & Ben Schmeiser. 2003. On the phonetic reality of Spanish /r/ in complex onsets. In Paula Kempchinsky & Carlos-Eduardo Piñeros (eds.), *Selected Proceedings of The 6th Hispanic Linguistics Symposium*, 1–20. Somerville MA: Cascadilla.

Broselow, Ellen. 1987. Non-obvious transfer: on predicting epenthesis errors. In Georgette Ioup & Steven Weinberger (eds.), *Interlanguage phonology: the acquisition of a second language sound system*, 292–304. Cambridge, MA: Newbury House.

Broselow, Ellen. 1992. Transfer and universals in second language epenthesis. In Susan Gass & Larry Selinker (eds.), *Language transfer in language learning, revised edition*, 71–86. Amsterdam & Philadelphia: John Benjamins.

Broselow, Ellen. 1995. Skeletal positions and moras. In John Goldsmith (ed.), *The handbook of phonological theory*, 175–205. Cambridge, MA: Blackwell.

Brugmann, Karl. 1905. *Abrégé de grammaire comparé des langues indo-européennes*. Paris: Klincksieck.

Cabrera, Lydia. 1970. *Refranes de negros viejos*. Miami: Ediciones CR.

Cabrera, Lydia. 1971. *El monte*. Miami: Ediciones C. R.

Carlisle, Robert. 1991. The influence of environment on vowel epenthesis in Spanish/English interphonology. *Applied Linguistics* 12.76–95.

Cho, Young-mee Yu & Tracy Holloway King. 2003. Semisyllables and universal syllabification. In René Kager, Joe Pater & Wim Zonneveld (eds.), *Constraints on phonological acquisition*, 183–212. Cambridge: Cambridge University Press.

Claramonte, Andrés de. 1951. La gran comedia del valiente negro en Flandes. In Ramón de Mesonero Romanos (ed.), *Dramáticos contemporáneos a Lope de Vega*, 491–509. Madrid: Biblioteca de Autores Españoles.

Clements, G. N. 1990. The role of the sonority cycle in core syllabification. In John Kingston & Mary Beckman (eds.), *Between the grammar and physics of speech: Papers in Laboratory Phonology 1*, 283–333.

Colina, Sonia. 2006. Optimality-theoretic advances in our understanding of Spanish syllable structure. In Fernando Martínez-Gil & Sonia Colina (eds.), *Optimality-theoretic studies in Spanish phonology*, 172–204. Amsterdam & Philadelphia: John Benjamins.

Colina, Sonia. 2009. *Spanish phonology: A syllabic perspective*. Washington, DC: Georgetown University Press.

Davidson, Lisa, Peter Musczyk & Paul Smolensky. 2004. The initial and final states: Theoretical implications and experimental explorations of Richness of the Base. In René Kager, Joe Pater, & Wim Zonneveld (eds.), *Constraints on phonological acquisition*, 321–368. Cambridge: Cambridge University Press.

Davidson, Lisa & Maureen Stone. 2003. Epenthesis versus gestural mistiming in consonant cluster production: an ultrasound study. In Mimu Tsujimura & Gina Garding (eds.), *WCCFL 22 Proceedings*, 165–178. Somerville, MA: Cascadilla Press.

Davis, Stuart. 1990. Italian onset structure and the distribution of *il* and *lo*. *Linguistics* 28. 43–55.

Eddington, David. 2001. Spanish epenthesis: formal and performance perspectives. *Studies in the Linguistic Sciences* 31. 33–53.

Fleischhacker, Heidi. 2001. Cluster-dependent epenthesis asymmetries. *UCLA Working Papers in Linguistics* 7. 71–116.

Friedemann, Nina S. de & Carlos Patiño Rosselli. 1983. *Lengua y sociedad en el Palenque de San Basilio*. Bogotá: Instituto Caro y Cuervo.

Gafos, Adamantios. 2002. A grammar of gestural coordination. *Natural Language and Linguistic Theory* 20.269–337.

García González, José & Gema Valdés Acosta. 1978. Restos de lenguas bantúes en la región central de Cuba. *Islas* 59. 3–49.

Goad, Heather & Yvan Rose. 2004. Input elaboration, head faithfulness, and evidence for representation in the acquisition of left-edge clusters in West Germanic. In René Kager, Joe Pater & Wim Zonneveld (eds.), *Constraints on phonological acquisition*, 109–157. Cambridge: Cambridge University Press.

Granda, Germán de. 1966. *La estructura silábica y su influencia en la evolución fonética del dominio ibero-románico*. Madrid: Consejo Superior de Investigación Científica.

Gutiérrez-Rexach, Javier. 2006. Sonority scales and syllable structure: toward a formal account of phonological change. In Fernando Martínez-Gil & Sonia Colina (eds.), *Optimality-theoretic studies in Spanish phonology*, 447–469. Amsterdam & Philadelphia: John Benjamins.

Harris, James. 1983. *Syllable structure and stress in Spanish: A non-linear analysis*. Cambridge, MA: The MIT Press.

Harris, James. 1989. Sonority and syllabification in Spanish. In Carl Kirschner & Janet Decesaris (eds.), *Studies in Romance linguistics*, 139–153. Amsterdam & Philadelphia: John Benjamins.

Harris, James. 1992. Spanish stress: The extrametricality issue. Bloomington, IN: University Linguistics Club.

Hayes, Bruce. 1989. Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20.253–260.

Hualde, José Ignacio. 1991. On Spanish syllabification. In Héctor Campos & Fernando Martínez-Gil (eds.), *Current studies in Spanish linguistics*, 475–493. Washington, DC: Georgetown University Press.

Hualde, José Ignacio. 1999. La silabificación en español. In Rafael A. Núñez-Cedeño & Alfonso Morales-Front (eds.), *Fonología generativa contemporánea de la lengua española*, 170–188. Washington, DC: Georgetown University Press.
Hualde, José Ignacio. 2005. *The sounds of Spanish*. Cambridge: Cambridge University Press.
Hyman, Larry. 1985. *A theory of phonological weight*. Dordrecht: Foris.
Kaye, Jonathan. 1992. Do you believe in magic? the story of *S + C* sequences. *SOAS Working Papers in Linguistics* 2. 293–313.
Kiparsky, Paul. 2003. Syllables and moras in Arabic. In René Kager, Joe Pater & Wim Zonneveld (eds.), *Constraints on phonological acquisition*, 147–182. Cambridge: Cambridge University Press.
Lindsay, W. M. 1894. *The Latin language*. Oxford: Clarendon Press.
Lipski, John. 1992. Spontaneous nasalization in Afro-Hispanic language. *Journal of Pidgin and Creole Languages* 7. 261–305.
Lipski, John. 1993. Syllabic consonants and New Mexico Spanish: The geometry of syllabification. *Southwest Journal of Linguistics* 12. 109–127 [published 1998].
Lipski, John. 1994. Spanish stops, spirants and glides: From consonantal to [vocalic]. In Michael Mazzola (ed.), *Issues and theory in Romance Linguistics (selected papers from the Linguistic Symposium on Romance Languages XXIII)*, 67–86. Washington, DC: Georgetown University Press.
Lipski, John. 1997. Spanish word stress: The interaction of moras and minimality. In Fernando Martínez-Gil & Alfonso Morales-Front (eds.), *Issues in the phonology and morphology of the major Iberian languages*, 559–593. Washington, DC: Georgetown University Press.
Lipski, John. 2002. Epenthesis vs. elision in Afro-Iberian language: A constraint-based approach to creole phonology. In Teresa Satterfield, Christina Tortora & Diana Cresti (eds.), *Current issues in Romance languages*, 173–188. Amsterdam & Philadelphia: John Benjamins.
Lombardi, Linda. 2003. Markedness and the typology of epenthetic vowels. Rutgers Optimality Archive ROA-578.
Martínez-Gil, Fernando. 1990. Topics in Spanish historical phonology: A non-linear approach. Los Angeles, CA: University of Southern California dissertation.
Martínez-Gil, Fernando. 1996. El principio de la distancia mínima de sonoridad y el problema de la vocalizaci6n consonántica en el español dialectal de Chile. *Hispanic Linguistics* 8. 201–246.
Martínez-Gil, Fernando. 1997. Obstruent vocalization in Chilean Spanish: A serial versus a constraint based approach. *Probus* 9. 167–202.
Martínez-Gil, Fernando. 2001. Sonority as a primitive phonological features: Evidence from Spanish complex onset phonotactics. In Julia Herschensohn, Enrique Mallen & Karen Zagona (eds.), *Features and interfaces in Romance: essays in honor of Heles Contreras*, 203–222. Amsterdam & Philadelphia: John Benjamins.
McCawley, James. 1978. Notes on the historyu of accent in Japanese. *Recent developments in history phonology*, 287–307. The Hague: Mouton.
Moll, Francisco de B. 1952. *Gramática histórica catalana*. Madrid: Gredos.
Morelli, Frida. 2003. The relative harmony of /s+Stop/ onsets: Obstruent clusters and the sonority sequencing principle. In Caroline Féry & Ruben van de Vijver (eds.), *The syllable in optimality theory*, 356–371. Cambridge: Cambridge University Press.
Núñez Cedeño, Rafael A. 1988. The Abakuá secret society in Cuba: Language and culture. *Hispania* 71.148–154.

Núñez Cedeño, Rafael A., Rolando Alúm, & Roberto Nodal. 1985. The Afro-Hispanic Abakuá: A study of linguistic pidginization. *Orbis 31 (1–2)*. 263–284.
Piggott, G. L. 1995. Epenthesis and syllable weight. *Natural Language and Linguistic Theory* 13. 283–326.
Piggott, G. L. & Rajendra Singh. 1985. The phonology of epenthetic segments. *Canadian Journal of Linguistics* 30. 415–453.
Piñeros, Carlos-Eduardo. 2001. Segment-to-syllable alignment and vocalization in Chilean Spanish. *Lingua* 111. 163–188.
Piñeros, Carlos-Eduardo. 2005. Syllabic consonant formation in traditional New Mexico Spanish. *Probus* 17. 253–301.
Ramírez, Carlos Julio. 2006. Acoustic and perceptual characterization of the epenthetic vowel between the clusters formed by consonant + liquid in Spanish. In Manuel Díaz-Campos (ed.), *Selected Proceedings of the 2nd Conference on Laboratory Approaches to Spanish Phonetics and Phonology*, 48–61. Somerville, MA: Cascadilla Proceedings Project.
Rose, Yvan & Katherine Demuth. 2006. Vowel epenthesis in loanword adaptation: Representational and phonetic considerations. *Lingua* 116. 1112–1139.
Sánchez, Roberto. 1979. Luis Vélez de Guevara, *El negro del seraphín: A critical and annotated edition with introduction*. Tallahassee, FL: Florida State University dissertation.
Shepherd, Michael. 2003. *Constraint interactions in Spanish phonotactics: An optimality-theory analysis of syllable-level phenomena in the Spanish language*. Northridge, CA: California State University MA thesis. ROA 639-Shepherd.
Singh, Rajendra. 1985. Prosodic adaptation in interphonology. *Lingua* 67. 269–282.
Sommer, Ferdinand. 1914. *Handbuch der lateinischen Laut- und Formenlehre*. Heidelberg: Carl Winters.
Vega Carpio, Lope de. 1893. *Obras de Lope de Vega*. Madrid: Real Academia Española.
Zec, Draga. 1995. Sonority constraints on syllable structure. *Phonology* 12. 85–129.

Appendix: Visualizing epenthesis

An example of the prothetic /e/ in the traditional New Mexico Spanish realization of *mi papá* > *empapá* is given in Figure 1.

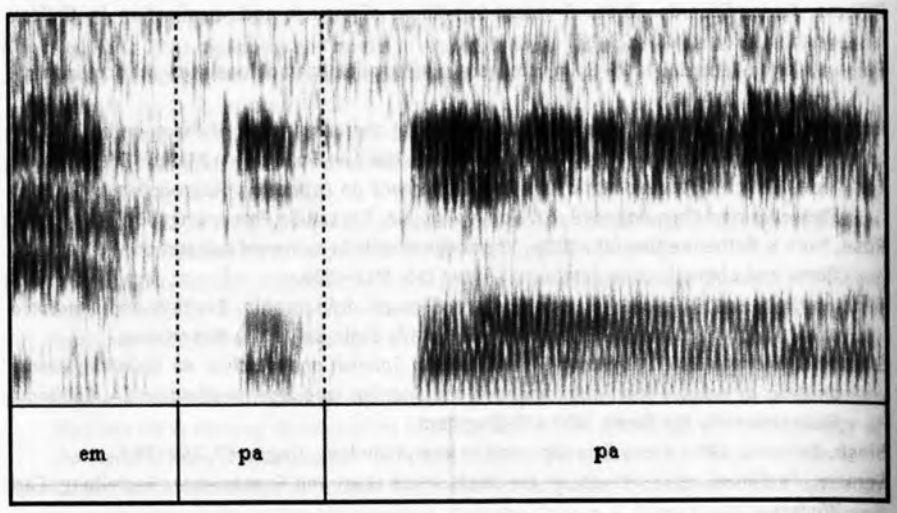

Figure 1: Realization of *mi papá* by a speaker of traditional New Mexican Spanish

As an informal demonstration of Spanish vocalic epenthesis five Spanish speakers (from Argentina, Colombia, Ecuador, Spain, and the United States) were presented with a number of foreign words beginning and ending with consonant clusters that are phonotactically impermissible in Spanish, and were asked to pronounce them "as though they were Spanish words." Onset clusters with prenasalized consonants (e.g. *Nguema*) almost always resulted in a prothetic [e], as did final clusters with non-decreasing sonority. Initial clusters with non-decreasing sonority added a svarabhakti vowel between the two consonants; the excrescent vowels were very short, often partially devoiced, and acoustically more centralized than Spanish /e/. Figure 2 shows the epenthetic [e] in the pronunciation of *Nguema* and *Al Sadr* by one of the Spanish speakers. Figure 3 shows svarabhakti vowels in the same speaker's pronunciation of the word *Ptaki* (a surname), and *Tblisi*. In Figure 4 the svarabhakti vowels and the two instances of epenthetic [e] are situated within the vowel space for representative tonic vowel tokens from the

same speaker is shown. The epenthetic vowels licensed by moraic consonants (in *Nguema* and *Al Sadr*) cluster very close to tonic /e/, while the svarabhakti vowels not licensed by a moraic consonant (in *Ptaki* and *Tblisi*) are centralized and schwa-like, as well as being much shorter than epenthetic /e/.

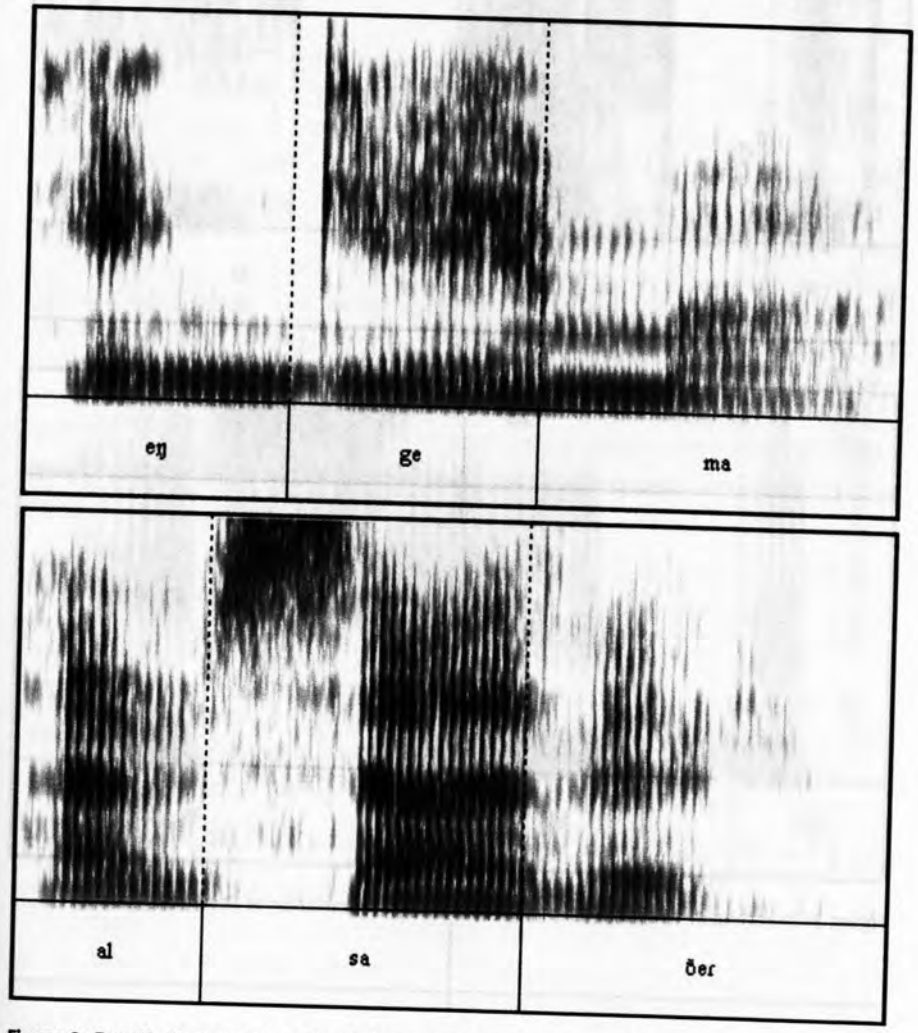

Figure 2: Epenthetic vowels in a Spanish speaker's pronunciation of *Nguema* and *Al Sadr*

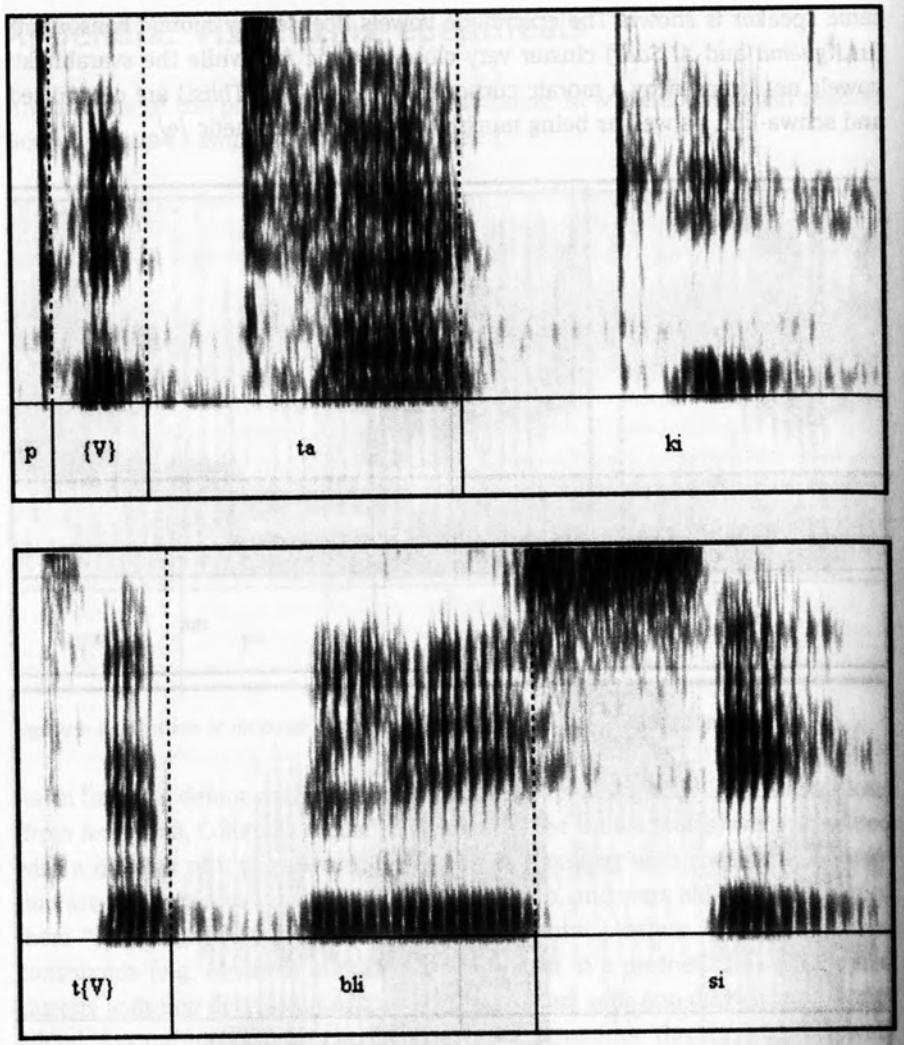

Figure 3: Svarabhakti vowels in a Spanish speaker's pronunciation of *Ptaki* and *Tblisi*

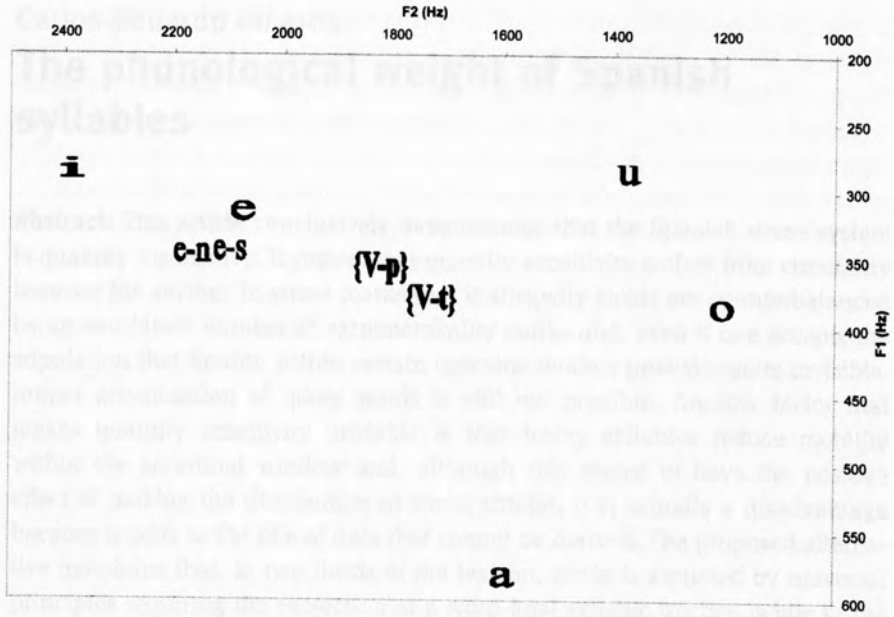

Figure 4: Full, epenthetic, and svarabhakti vowels of a Spanish speaker