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Edited by Sonia Colina and Fernando Martínez-Gil

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This volume provides comprehensive and detailed coverage of Spanish phonology. It addresses major burning questions and pressing issues that have arisen in the study of Spanish phonology, and is an essential reading resource for graduate students and researchers in the field.

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SERIES EDITORS

MANEL LACORTE &
JAVIER MUÑOZ-BASOLS

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Este libro va dedicado a la memoria de mis padres (Fernando Martínez-Gil)
A mis padres (Sonia Colina)

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Introduction

In this introduction, we describe the content, structure, and organization of this volume; provide a summary of each of the sections and their corresponding chapters; and indicate the contribution of each author to the advancement of current research in Spanish phonology; we conclude with a brief section of acknowledgments of anyone who has helped us in bringing the volume to fruition.

Phonology, as one of the traditional subdisciplines of modern linguistics, has been at the forefront of linguistic research since the beginning of the 20th century. The phonology of Spanish, a major world language, has likewise attracted the attention of numerous linguists, first guided by descriptive purposes and later by the generative linguistics goal of explaining native speaker competence. Building on almost two centuries of phonological research, this volume aims to cover the most relevant topics in Spanish phonology today. Recent decades have seen an increase in work in various areas of experimental linguistics related to phonology, such as phonetics, laboratory phonology, sociophonetics, and language acquisition. With increased research, the need arises for solid, accessible presentations of up-to-date research and state-of-the-art reviews of pertinent phonological topics. Guided by that need as well as the intrinsic value of presenting our current knowledge of Spanish phonology, this volume offers an overview of the current understanding of crucial topics for researchers and students involved in phonological and phonologically related research who want to obtain a panoramic view of the issues. While the chapters are not tied to any specific theoretical framework, they are written with the rigor and theoretical sophistication expected of major leaders in the field.

It is an unquestionable fact that the study of Spanish phonological patterns has experienced considerable advances in the past four decades or so, impelled initially by the emergence of new theoretical models that expanded on the initial generative research emanating from seminal studies such as those of Foley (1965), Harris (1969), and Cressey (1978), as well as numerous articles published by these and other authors during the 1970s. The emergence of new models of phonological analysis during the 1980s, including the autosegmental, syllabic, lexical, metrical, and intonational frameworks, as well as the irruption since the mid-1990s of Optimality Theory, undoubtedly the most influential phonological theory of the past decades, has not only produced a wealth of research that provides valuable new insights into the Spanish phonological system, thus significantly advancing our understanding of Spanish phonology, but also fostered a sizable expansion of the empirical coverage to sets of data that previously either had not been adequately explained or simply had not been taken into account.

Likewise, novel phonological theories that arose in the past few decades have been successfully applied to problems in a number of areas within the study of the Spanish sound structure, many of which had not been satisfactorily accounted for nor comprehensively explored in earlier periods, encompassing topics in the synchronic phonological analysis of segmental phenomena, the interaction of phonology with other areas of the grammar (phonetics, morphology, syntax), the study of phonological variation and historical change, and the development of phonological competence in both first and second language acquisition.

The idea for this *Handbook* grew from an effort to address what we consider to be the burning questions and pressing issues that have arisen in the study of Spanish phonology during the past three decades. Spanish is spoken by close to 500 million people as a native language, and about 100 million as a second language. Indeed, Spanish is currently the language with the second-largest number of native speakers in the world, only after Mandarin. It is widely recognized as a vehicle for artistic creativity, cultural diversity, and scientific research. And yet no single comprehensive up-to-date description of the Spanish phonological system from a theoretical (nondescriptive) perspective is currently available, even though such an account would seem indispensable for research and graduate coursework on the language's sound patterns in institutions of higher education, and also for the task of achieving a rigorous and complete characterization of its dialectal and stylistic diversity. An updated and in-depth description of Spanish phonology that encompasses allophonic and allomorphic variation in both standard and dialectal varieties, analyzed according to the latest theoretical frameworks, has yet to be produced, in spite of the considerable amount of research brought about by recent developments in phonological theory, as well as the availability of new technologies for the study of the speech sounds. This *Handbook* aims at rectifying this particular shortcoming by presenting a comprehensive and detailed coverage of Spanish phonology that cannot be attained in volumes addressing all areas of linguistics.

The objective of the *Handbook of Spanish Phonology* is to provide a comprehensive survey of current research on a wide range of topics on the phonological structure of Spanish: (a) its most prominent segmental processes; (b) its suprasegmental features, including syllable structure and syllabification, word accentual prominence, and intonation; (c) the ways Spanish phonology interacts with other modules of the grammar, namely, phonetics, morphology, and syntax; (d) the acquisition of Spanish phonology by first and second language learners; and (e) the analysis of phonological variation and sound change. The *Handbook* offers a state-of-the-art survey in the field of Spanish phonology, while at the same time making an essential contribution to two related but distinct fields, namely, Spanish linguistics and phonological theory.

The *Handbook* will be useful for a variety of audiences, ranging from researchers in Spanish phonology and Hispanic linguists to those engaged in research in phonology and linguistics in general. It is also suitable as core reading for advanced graduate-level phonology courses and seminars in Hispanic linguistics programs and as a reference book for researchers in linguistics and related fields with interest and/or specialization in phonology, phonological theory, and linguistics. Furthermore, given the current multidisciplinary interest in Spanish, The *Handbook of Spanish Phonology* is appropriate for reading lists in courses in the areas of cognitive science, first and second language acquisition, education, bilingualism, and speech and hearing science. After this introductory chapter, the book is structured around five major areas of research in Spanish phonology: segmental phonology, suprasegmental phonology, and closely related subareas, such as the interface (phonetics, morphology, and syntax), variation (dialectal and historical), and phonological acquisition of Spanish as a first language, as a second language, and as a heritage language. Each chapter deals with case studies of particular topics in Spanish phonology, and contains an introductory summary on how the theoretical approaches to the topic(s) under study have evolved during the past three decades and up to the present day. References at the end of each chapter guide the reader interested in further reading and research.

Part I: "Segmental Phonology"

In Chapter 1, Francesc Torres-Tamarit offers a comprehensive overview of the phonemic contrasts operative in Spanish. The theoretical framework employed is Optimality Theoretic, and the data are from north-central Peninsular Spanish. The empirical focus is on the following phonological processes: (i) nonassimilatory and assimilatory neutralization of place contrasts in coda nasal consonants, (ii) coda depalatalization, (iii) the distribution and neutralization of rhotic consonants, and (iv) the range of neutralization processes that target stop consonants in coda position. The analyses—the most informing formal analyses available in the literature—are framed within the two main approaches to phonemic contrast and neutralization developed within Optimality Theory: structure-based approaches based on licensing and positional faithfulness, which concentrate on determining in which environments phonemic contrasts are preserved or neutralized, and cue-based approaches such as Dispersion Theory, which focuses on the role of contrast in shaping sound inventories. A case of phonological opacity involving neutralization processes that target stop consonants in coda position is also analyzed in Optimality Theory with Candidate Chains, a derivational version of Optimality Theory. In Chapter 2, Fernando Martínez-Gil addresses the topic of voiced obstruents, the stop ~ spirant allophonic distribution, and the ways these segments interact with other phonological processes, in both standard and dialectal varieties of Spanish. The adequate formal description of the surface realization of voiced obstruents as spirants in certain contexts, a process widely known as *spirantization*, has been intensively debated from almost every conceivable theoretical perspective during the past few decades. Two fundamental issues have been at the heart of the debate: (a) the nature of the underlying segments and (b) the formal mechanism(s) that account for the surface distribution. This chapter reviews previous approaches to spirantization and proposes a constraint-based analysis of the stop ~ spirant surface distribution of Spanish voiced obstruents within the framework of Optimality Theory in an attempt to provide a principled solution to the problems that plagued former approaches to the topic, and at the same time extends its empirical coverage to several sparsely studied facts of dialectal variation. In this approach, the stop ~ spirant distribution follows from the interaction of faithfulness and markedness constraints, as is standard in Optimality Theory, which accounts for the core of the stop ~ spirant distribution in a straightforward manner, independently of whether underlying stops or spirants are assumed. In Chapter 3, Carolina González presents a comprehensive overview of consonant assimilation in Spanish. Four main types are discussed and exemplified with data from diverse Spanish dialects: specifically, place assimilation, voice assimilation, manner assimilation, and gemination (total assimilation). She discusses several empirical issues related to the study of consonant assimilation in Spanish, the most important being the extent to which some of the documented assimilatory phenomena in this language are categorical vs. gradient, or optional vs. obligatory. This impinges on how best to analyze variable assimilation theoretically. It is suggested that future studies should investigate the possible connection between apparently unrelated assimilatory phenomena, such as interdentalization and gemination, in order to increase our understanding of consonant assimilation in Spanish. After a brief overview of recent theoretical frameworks used in the phonological analysis of assimilation, the chapter presents a case study of palatalization in Chilean Spanish that connects to some of the empirical and theoretical issues raised previously. In Chapter 4, Jesús Jiménez and Maria-Rosa Lloret address the topic of vowel harmony, the phonological phenomenon that requires vowels in certain morphological or prosodic domains to agree in specific phonological features. The authors present a thorough revision of vowel harmony in southeastern Peninsular Spanish, where the loss of some final consonants is compensated by opening the preceding vowel, and the lax character of this vowel extends to the preceding syllables. Although the opening of the rightmost vowel is usually transmitted to the left irrespective of the morphological filiation of the deleted consonant (as in Granada and Murcia), vowel harmony may be limited to lax vowels related to the loss of consonants belonging to certain inflectional suffixes (as in Jaén). The behavior of high vowels is another source of variation: they can either fully participate in the process (as in Jaén) or act as neutral vowels (as in Granada and Murcia). Regarding the harmonic domain, vowel harmony obligatorily targets the stressed syllable—the most prominent in the word—but it can also affect the stressed and the posttonic syllables—the main foot—or all the syllables in the word, sometimes permitting gapped configurations (as in Granada). After formalizing the different harmonic patterns attested in southern Peninsular Spanish within a prominence-based licensing approach in Optimality Theory, the vowel harmony typology is extended to other Iberian Romance varieties displaying vowel harmony (Cantabrian Spanish, Asturian, and Valencian Catalan).

Part II: "Suprasegmental Phonology"

In Chapter 5, Sonia Colina discusses phonotactic constraints—restrictions over sequences of segments—on Spanish syllable structure, organized around two major types: those driven by sonority, a factor that plays an important role in determining the sequencing of segments within syllabic constituents; and those that refer to specific segments and their featural makeup, often reflecting the affinity or lack of it between a specific feature and a syllabic position. The phonotactics of segments and features are discussed in connection with the phonotactics of the onset, nucleus, and coda, simple and complex, noting that some phonological processes in Spanish (e.g., nasal assimilation, obstruent coda neutralization) are ultimately a consequence of segmental and featural phonotactics. In addition, this chapter summarizes recent work pertinent to dialectal variation in phonotactics, in connection with complex onsets in some varieties of Chilean Spanish and with prevocalic postconsonantal glides in Sonoran Mexican Spanish. Arguments and preliminary experimental results are introduced regarding the proposal that glides could be part of a complex onset in this variety (instead of the nucleus, as in most varieties of Spanish). In Chapter 6, Ellen M. Kaisse reviews the phonetic and phonological characteristics of glides, as well as their syllabification. Phonetic characteristics of glides that distinguish them from vowels can include short duration, absence of a steady state, and gradual formant transitions. Phonologically, glides in Spanish are allophones of underlying vowels and are realized as obstruents in syllable onset position: [ɟ, ʝ, g^w, $ɣ^w$]. When a high vowel is adjacent to a more sonorous vowel, the lower vowel forms the peak of the syllable and the higher vowel is realized nonsyllabically. Several arguments are summarized that indicate that a prevocalic glide is syllabified in the nucleus when a consonant precedes it, but that the glide fills the onset and becomes an obstruent when no consonant precedes. Kaisse also argues for the lexical specification of exceptional hiatus, where a high vowel is realized as a separate peak even though it abuts another vowel. In Chapter 7, José Ignacio Hualde reviews the reduction of lexically heterosyllabic vowel sequences in Spanish. At the lexical level, word-internal vowel sequences may be syllabified as either tautosyllabic (diphthong) or heterosyllabic (hiatus). Postlexically, hiatus, both within words and across word boundaries, may be avoided by merger of heterosyllabic vowels in a single syllable. However, not all sequences undergo merger or may do so with equal readiness. Syllable count in poetry provides useful evidence regarding which specific types of sequences may be reduced to a single syllable. Hualde examines the factors that have been claimed to affect the likelihood of merger and the phonetic realization of merged sequences. In Chapter 8, Iggy Roca provides an account of both verb and nonverb primary stress in Spanish. The location of word stress is often not uniform, both in Spanish and in other languages. In nouns and the like, Spanish stress invariably occurs within the confines of the "stem," and the possible additional "desinence" is hence ignored: cf. *s'**á**ban]a* 'bedsheet', *sav'**a**n]a* 'savannah', with "]" separating the stem from the *-a* desinence, itself systematically stressless: cf. **saban]'**á***, with the *-a* desinence illegitimately ("*") stressed. In verbs, stress in turn is usually borne by certain given morphemes, e.g., the theme vowel in past tenses (e.g., *cant-**á**-ba-mos* 'we used to sing') or the TAM (Tense Aspect Mood) morpheme in future-oriented ones (*cant-a-**r**'**e**-mos*). In impersonal forms (infinitive, gerund, and past participle), stress also falls on the theme vowel (e.g., *cant-'**a**-r*, *cant-'**a**-ndo*, *cant-'**a**-do*), diphthongized in the 2nd and 3rd conjugations (*corr-**ie**-ndo* 'running', *par-**ie**-ndo* 'giving birth') and with the past participle vowel raising to *i* (*corr-**i**-do*), all of this in contrast with the infinitive *corr-**e**-r*. This chapter concludes with a detailed account on the relation of stress and the syllabification of vowel–high vowel and high vowel–vowel clusters into either one or two syllables. In Chapter 9, Pilar Prieto and Paolo Roseano summarize the current state of the research about Spanish intonation and aim at pointing out the most relevant issues and challenges in this research field. The first section of the chapter contains an overview of the linguistic functions of intonation in Spanish, as well as an explanation of some basic concepts. The second section comprises a summary of the most important advances in Spanish intonation research in the past few decades. The third section presents a panorama of the main research issues that are currently being investigated and will probably gain momentum over the next few years, among which are the adoption of a universally accepted coding system for transcribing Spanish intonation, as well as the proper integration of intonation into other areas of linguistic inquiry such as syntax and pragmatics.

Part III: "Interfaces"

In Chapter 10, Travis G. Bradley examines the patterning of rhotics in north-central Peninsular Spanish within the context of contemporary research on the phonetics-phonology interface. He reviews experimental studies that have provided detailed information about the production and perception of these consonants, which have found that the phonetic realization of rhotics is much more continuous and gradient than suggested by the discrete and categorical symbols of broad transcription. Within this context, Bradley presents a novel analysis of Spanish rhotics that formalizes a modular interface between an optimization-based phonology and an implementation-based phonetics. He argues that both operate on articulatory gestures that can be coupled, or coordinated with each other in time, as represented in an intergestural coupling graph. When optimal coupling graphs are phonetically implemented, lawful changes in the overlap and magnitude of gestures give rise to gradient and continuous variation in the articulatory and acoustic output. Furthermore, combining perceptual distinctiveness with gestural coupling makes possible a simpler analysis of the phonological distribution of Spanish rhotics, as compared with two alternative theoretical accounts. The proposed analysis distinguishes between phonology and phonetics as distinct but representationally linked modules. In Chapter 11, Rebeka Campos-Astorkiza explores how laboratory phonology methods have been applied to Spanish phonology by utilizing experimental and instrumental approaches, which allow researchers to advance theoretical models based on empirical findings, as well as the use of systematic data analysis, which usually goes hand in hand with an expanded view of phonology compared to traditional or generative phonology. Laboratory studies have been crucial in the development of phonological theories that explicitly address and model the phonetics-phonology interface. Given the wide range of laboratory studies dealing with Spanish phonology, this chapter discusses four areas that have attracted considerable attention, including studies that are hypothesis based and aim to contribute to theories of phonology, and at the same time challenges previous assumptions regarding Spanish sound patterns; it also introduces diverse methodologies focusing on different types of data, namely, acoustic and articulatory data, including stop weakening, nasal place assimilation and velarization, /s/ weakening, and the realization of vowel sequences. In Chapter 12, Miquel Simonet reviews the experimental phonological encoding literature about the Spanish syllable. During speech comprehension, listeners engage in phonological encoding, a phenomenon that comprises processes such as assigning gradient acoustic information to discrete phonemic categories (categorization), detecting possible word onsets in a continuous signal (segmentation), and locating words in the lexicon (lexical activation, competition, and recognition). The encoding evidence reviewed suggests that listeners whose native language is Spanish deploy their knowledge of their language's syllabification patterns in order to segment the speech chain into processable chunks, and to activate (and deactivate) word entries in the mental lexicon, and that Spanish speakers' knowledge of the phonology of their language includes the syllable. Most aspects of Spanish speakers' phonological knowledge, such as assimilation or lenition rules, remain to be investigated from the perspective of phonological encoding. In Chapter 13, María Ohannesian takes on a survey of allomorphic variation in Spanish. After a brief general overview of the topic, this chapter presents an Optimality Theoretic analysis of allomorphy in Spanish focusing on a well-known case involving morphophonology, namely, the diphthongization of the Vulgar Latin open mid vowels in tonic position and its overapplication in specific derived contexts such as evaluative derivation. The chapter also addresses the suitability of Optimality Theory for dealing with phonological opacity phenomena, and the different attempts to solve this problem, whether from parallel or from stratal perspectives. This chapter frames allomorphic variation in Spanish within the Stratal Optimality Theory model, paying especial attention to the difference between external (or optimizing) and internal (or nonoptimizing) allomorphy. While allomorph selection is subject to the Emergence of the Unmarked effects in the external allomorphy (that is, allomorph choice improves unmarked structures), in the case of internal allomorphy the selection is arbitrary and must be lexically specified. In Chapter 14, Caroline R. Wiltshire reviews various accounts of plural and gender allomorphy with the goal of trying to distinguish between what must be stored as lexical information and what can be predicted in these morphophonological phenomena. She argues for a limited role for epenthesis in plural formation, in order to streamline the classes required for allomorphy and reassign some information from stored allomorphy to predictable phonology. In Chapter 15, Eulàlia Bonet describes the segmental and suprasegmental phonological phenomena that are found at the phrasal and sentential levels, and describes and discusses the behavior of the definite article, which involves the interaction of phonology and syntax with morphology. She examines the interactions between syntax and phonology and approaches to this interface, and investigates questions such as (i) whether syntax is blind to phonological information or is sensitive to it, an issue that is exemplified with prosodically motivated syntactic movement; and (ii) whether phonology has access to syntactic information. Most approaches to the syntax-phonology interface are indirect reference approaches (i.e., syntactic structure is not accessed directly by the phonology but is mapped onto prosodic constituents of different sizes). In Optimality Theoretic approaches, specific constraints relate syntactic structure and prosodic structure, capturing the observed lack of isomorphism between the two types of structures. This point is illustrated through the discussion of phrasing in Spanish, in which constraints on maximal and minimal prosodic size interact with constraints that align syntactic and prosodic structure. Bonet's contribution also briefly discusses direct reference approaches. Finally, in Chapter 16, Rafael A. Núñez Cedeño, Lucía Badiola, and Ariane Sande-Piñeiro analyze the widely studied topic of unexpected insertion of [s]/[h], which they label *Surprise-[s]*, in popular Dominican Spanish. Among other claims, it has been regarded as hypercorrection of the deletion of rhyme /s/; it has also been held to be subject to constraints on syllable position; and it has been thought to obey voicing restrictions across a word boundary and phrase-finally. This chapter seeks to gain a deeper understanding of Surprise-[s] by proposing two different hypotheses regarding its appearance. First, the chapter attempts to demonstrate that its distribution is not due to any phonological restrictions but, rather, to the phonotactic and lexical frequencies of some consonantal sequences in Spanish. And, second, the authors show that whereas underlying /s/ resyllabifies, Surprise-[s] fails to do so. They propose that there exists an abstract, syntactic disjuncture expressed in terms of a metrical grid, preventing Surprise-[s] from resyllabifying.

Part IV: "Spanish Phonology and Acquisition"

In Chapter 17, Conxita Lleó describes the acquisition of L1 Spanish segments, vowels, and consonants, and the acquisition of L1 Spanish prosody, namely, syllables, metrical feet, prosodic words, and phonological phrases. She also presents a novel study of the acquisition of intonation by three monolingual German, three monolingual Spanish children, and three German-Spanish bilingual children. Child utterances produced at two time points were analyzed within the Autosegmental-Metrical model of intonation. Lleó finds that the bilingual children, heritage speakers of Spanish, with German as the dominant language, acquired the intonation of each language in a way that can be considered autonomous, but there was also influence of one language onto the other, with transfer of a German pitch accent onto Spanish. In Chapter 18, Holly J. Nibert reviews the advances in experimental research on second language acquisition of Spanish phonology and phonetics. In recent decades, researchers in Spanish phonology and phonetics have turned their attention to the acquisition of the language's sound system by adult second language (L2) learners, resulting in a better understanding of the L2 acquisition of Spanish phonology and phonetics. However, it remains difficult to articulate a broader understanding of the facts of Spanish and their implications, due in part to a need for further studies but also to confounding theoretical and methodological variation across studies that complicates their connection. The main goal of Nibert's chapter is twofold: first, to outline five interrelated guiding principles regarding future experimental research goals and methodologies; and, second, to review a selection of model studies that illustrate these principles, with an eye toward facilitating an explicit connection of findings as well as their practical application to L2 pronunciation instruction, with a main focus on vowels and, to a lesser extent, prosody. The chapter thus is intended as a contribution to our current understanding of the L2 acquisition of Spanish phonology and phonetics, as well as making a positive impact on the ongoing development of the field. In Chapter 19, Nicholas Henriksen, Lorenzo García-Amaya, Andries W. Coetzee, and Daan Wissing survey a case of language contact in Patagonia, with focus on durational control in the acquisition of Spanish and Afrikaans phonology. Its two main goals are, first, to investigate the effect of long-term bilingualism on patterns of temporal organization of speech in a unique language-contact situation in Patagonia, Argentina, and, second, to examine specific aspects of the phonetic and phonological grammars that contribute to cross-language transfer effects. The analysis draws from a corpus of read speech obtained from three speaker groups: L1 Afrikaans/L2 Spanish bilingual speakers who live in Patagonia, Argentina; speakers of L1 Spanish, also from Patagonia, Argentina; and speakers of L1 Afrikaans from South Africa. It is shown that Afrikaans-Spanish bilinguals display native-like patterns in consonant variability in both languages, but not in vowel variability. Specifically, the bilingual speakers show native-like patterns in the vowel variability of their L2 Spanish, but not of their L1 Afrikaans. It is also shown that differences between the Afrikaans control and bilingual speakers stem from differences in how each speaker group controls local segmental duration in their speech, namely, via phonemic vowel contrasts, stress-induced vowel reduction, and final lengthening. The authors argue that this finding of L2-to-L1 influence for vowels (but not consonants) derives from a combination of two forces: the presence of phonetic and phonological processes affecting vowels in L1 Afrikaans, and the relative complexity of phonotactic patterns in Afrikaans compared to Spanish. Altogether, this chapter's findings speak to the malleability of temporal organization patterns in bilingual grammars, especially in situations of close long-term contact where the L2 becomes the dominant language. In Chapter 20, Rajiv Rao examines the phonological system of adult heritage speakers of Spanish in the United States. He provides an overview of the relatively young history of research on the phonological system of heritage Spanish that has been conducted within a range of US-based contexts (i.e., specifically on Spanish-English bilinguals). At the segmental level, Rao focuses on vowels, mainly in terms of reduction processes, but also considering perception versus production and vowel sequences, and on consonants, discussing a series of linguistic and extralinguistic factors that influence voiced and voiceless stops, laterals and rhotics, and fricatives. At the less-studied suprasegmental level, Rao presents work on statement and question intonation, speech rhythm, and stress. Finally, he concludes by aiming to inform and inspire ways of advancing the field through a series of points for researchers to consider critically (e.g., data elicitation procedures, methods of drawing interspeaker comparisons) and, more important for this volume, ideas for bridging the gap between acoustic analysis and phonological theory.

Part V: "Variation and Change in Spanish Phonology"

In Chapter 21, John M. Lipski examines phonological variation in the Spanish phonological system, (vs. the more commonly studied subphonemic regional and sociophonetic variation). The majority of instances examined involve consonants, and range from the retention/loss of phonemes in all contexts (e.g., /θ/ and /ʎ/) to partial neutralization in specific positions (e.g., between /l/ and /ɾ/, /ɾ/ and /r/, and /ɾ/ and /d/). Phonological variability in the vowel system includes distinctive laxing in eastern Andalusian dialects, and partial neutralization of mid-high vowel contrasts in Spanish dialects in contact with Arabic and Quechua. Ongoing phonetic variation is also leading to emergent oppositions that may coalesce in some dialects (e.g., intervocalic voiced stops, phonological glottal stops, distinctive vowel length). In Chapter 22, Manuel Díaz-Campos and Valentyna Filimonova define and illustrate the concept of a sociophonological variable as a function of diatopic, diastratic, and diaphasic aspects of variation across Spanish-speaking communities. They are guided by the leading views on phonetic variation, sociophonological variables, and approaches to the study of sociophonological phenomena. The term *sociophonological variation* is used to emphasize the implications that a phenomenon could have for the sound system of a language, ranging from stigma to prestige and to language change more broadly. The perspective of the quantitative variationist method is used to define the sociolinguistic variable and apply it to the study of such Spanish-language phenomena as lateralization, elision, and gliding of liquid consonants; hiatus resolution; elision of the syllable-final /s/; velarization in consonant clusters; and intervocalic /ɾ/ deletion, among other variables. While by no means an exhaustive account, the chapter attempts to present not only a variety of relevant phenomena situated in the contemporary context but also a wide geographical and theoretical scope of sociolinguistic study of sound variation. In Chapter 23, Gary K. Baker and D. Eric Holt offer an overview of theoretical concepts and approaches to the study of Spanish diachronic phonology and explore a number of the principal changes that characterize the phonological evolution of Spanish from Latin. A variety of contemporary approaches are surveyed, both rule based and constraint based, including treatments that rely on nonlinear and geometric representations of features, as well as various levels of prosodic and metrical constituency, and that adopt multiple functional considerations based in both perception and production. A major focus of the chapter is the extent to which phonological treatments increasingly exploit our growing understanding of the subtle articulatory and acoustic/perceptual details of human speech, as in listener-based accounts, in which perceptual biases may lead to reanalysis of underlying forms. Also emphasized is the considerable role of structural and systemic influences: syllable structure, for example, and the ways it interacts with the phonetic component, drives much phonological change in Hispano-Romance and allows for a more perspicuous understanding of the mechanisms underlying some change. The chapter concludes with an extended sketch of a gesture-based analysis of the origins of Spanish palatal sonorants /ʎ, ɲ/, in which the authors claim that an increasing degree of intergestural timing and overlap was a response to syllable-based dynamics. Finally, in Chapter 24, André Zampaulo explores the emergence of palatal consonants in the history of the Romance languages, and suggests that it represents a case of phonological innovation, since Latin displayed only labial, dento-alveolar, and velar consonants. Because of their variability, complexity, and, in many respects, unique diachronic paths, Spanish palatals constitute a challenging case study worth the attention of Romance and general linguists alike. This chapter reviews the origins of such segments and presents a formal account that builds on the insights of previous proposals. Specifically, it provides a constraint-based analysis that focuses on the initiation of a change event during the interaction between a speaker and a listener-turned-speaker in spoken communication. A sound change is formalized as the difference in constraint ranking between the faithful realization of the speaker's input and the listener-turned-speaker's reanalysis (as input) of one of the unfaithful realizations of the original speaker's input. The word *palatal* in the present analysis is used as a cover term for a range of sounds whose passive place of articulation includes not only the palate itself but also the postalveolar region. As such, the emergence of sonorants [ʎ, ɲ] and obstruents [ɟ, ʝ, ʒ, ʃ, tʃ] in the history of Spanish is discussed.

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Sonia Colina and Fernando Martínez-Gil

Part I
Segmental phonology

1

Phonemic contrast and neutralization

Francesc Torres-Tamarit

1. Introduction: the notion of contrast and neutralization

The phonology of a language is best characterized as a set of phonologically contrastive pairs or natural classes of sounds, that is, sounds that appear in opposition with each other. Contrastive sounds in a particular language, traditionally referred to as *phonemes*, can usually occupy the same structural position within a word and automatically trigger a change in meaning. For instance, consider the examples in (1), in which only the first vowel in each word changes. Each of these vowels occupies the nucleus position of the stressed syllable and changes the meaning of each word. These data serve to illustrate one feature of Spanish, namely that it has a system of five contrastive, or phonemic, vowels. Words like these that are distinguishable from each other by only one contrastive sound are referred to as *minimal pairs* (e.g. *piso/peso*).

(1) Phonemic vowels in Spanish

p[ˈi]*so* 'flat' *p*[ˈe]*so* 'weight' *p*[ˈa]*so* 'step' *p*[ˈo]*so* 'deposit' *p*[ˈu]*so* 'he put'

However, a language like Belarusian (Slavic), which also has the five contrastive vowels /a, e, i, o, u/, neutralizes the contrast between the mid vowels /e, o/ when these occur in unstressed position; both /e/ and /o/, which are contrastive in stressed position (e.g. [ˈn**o**ɣi] 'legs'; [ˈr**e**ki] 'rivers'), neutralize to [a] in unstressed position (e.g. [n**a**ˈɣa] 'leg'; [r**a**ˈka] 'river') (Crosswhite 2004), a phonological process known as *vowel reduction*. Neutralization, or contrast reduction, occurs when a phonological contrast, like the one holding between the two mid vowels /e, o/ in Belarusian, is suspended in certain structural environments, such as unstressed position. Some Romance languages also exhibit this phenomenon of vowel reduction, like most eastern Catalan varieties, for instance, in which /a, e, ɛ/ in stressed position alternate with a schwa in unstressed position, [ə], and /o, ɔ/ alternate with [u] (Mascaró 1976; Wheeler 2005). Contrast neutralization can be schematically represented as in Figure 1.1a, in which two phonologically contrastive sounds /α/ and /β/ neutralize, for instance, to [α] in certain restricted environments, here represented by the context C_i. Neutralization should not be confounded with allophonic alternations (Figure 1.1b), in which a single contrastive sound maps onto more than one context-dependent phonetic realization; allophones stand in complementary distribution. Allophonic alternations can be seen in Spanish between the contrastive voiced stops /b, d, g/ and their corresponding approximant allophones [β, ð, ɣ] (e.g. [ˈ**b**ota] 'boot', but [la ˈ**β**ota] 'the boot') (see the chapter "Spirantization and the Phonology of Spanish Voiced Obstruents").

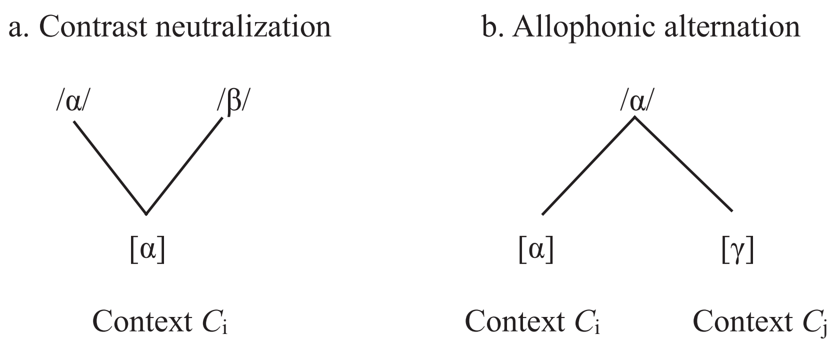


Figure 1.1 Contrast neutralization and allophonic alternation

In the schematic representation in Figure 1.1a, the neutralized sound in context C_i, [α], is identical to one of the contrastive sounds, /α/. However, the neutralized segment can also be distinct from both contrastive sounds. Yu (2011) establishes a simple typology of contrast reduction that distinguishes between (i) *structure-preserving reduction*, (ii) *structure-building reduction*, and (iii) *free variation*. In structure-preserving reduction, the neutralized sound is identical to one of the two contrastive sounds, as in the schematic representation. In structure-building reduction, the resulting sound after contrast reduction is not identical to either of the two constrastive sounds (like vowel reduction in Belarusian or Catalan). Finally, a single form can vary between two or more sounds, in which case contrast reduction is subject to free variation.

Neutralization can be further divided into assimilatory versus nonassimilatory contrast reduction. In the former, neutralization is the result of assimilating a specific set of features, or feature values, depending on the theory of phonological representations, to a target from a neighboring segment. In the latter, contrast is lost in specific positions without acquiring any feature or feature value from a neighboring segment, most of the time owing to the absence of such a neighboring segment.

In phonological theory, two major approaches to phonemic contrast and neutralization still coexist today: *structure-based approaches* and *cue-based approaches* (see Yu 2011; Hall 2011 for more details). On the one hand, structure-based approaches focus on identifying the prosodic or structural positions that disfavor the preservation of phonological contrasts. This approach has been extensively explored within Optimality Theory (henceforth OT; for a comprehensive introduction to Optimality Theory, see McCarthy 2008) under the rubric of *positional faithfulness* (Beckman 1998; Lombardi 1999, 2001). In Optimality Theory, contrast reduction is always the result of ranking a markedness constraint against an illicit phonological structure above a faithfulness constraint that requires preservation of such a phonological contrast. If markedness outranks faithfulness, contrast reduction is pervasive in the language and phonological contrast is never visible. For example, a language with no voiced stops, like Hawaiian (Schütz 1994), ranks the markedness constraint *VoicedObstruent, against voiced obstruents, above the faithfulness constraint Ident-[voice], which is violated when the feature specification for voice in the output is different from the voice specification in the input. Spanish has both voiceless and voiced stops. However, it only has voiceless fricatives and affricates (there are no [z] or [d͡ʒ]), except

/ʝ/ (see section 2.3 for more details). In this sense, Spanish also exhibits an unmarked system in its series of fricatives (a less stringent constraint against voiced continuant obstruents outranks IDENT-[voice]). In order to restrict contrast reduction to specific positions, a positional faithfulness constraint that incorporates the prosodic or structural position in which the phonological contrast is maintained must outrank the relevant markedness constraint against the offending segment. In languages with obstruent final devoicing like Catalan, for instance, in which voiced obstruents devoice in word-final coda position, but in which obstruents maintain their voicing specification in onset position, the positional faithfulness constraint IDENT(ONSET)-[voice] dominates *VOICEDOBSTRUENT, which in turn dominates the more general, context-free faithfulness constraint IDENT-[voice]. This ranking is exemplified in (2) for Catalan obstruent final devoicing. The variety of Spanish spoken by native speakers of Catalan also exhibits obstruent final devoicing, as do some South American varieties of Spanish. The ranking of *VOICEDOBSTRUENT above IDENT-[voice] is responsible for selecting the output candidate with a final voiceless obstruent. When the same obstruent is syllabified in onset position owing to the presence of an inflectional suffix, the positional faithfulness constraint IDENT(ONSET)-[voice] is responsible for blocking devoicing. Notice that the underlying voiced stop spirantizes in onset position when followed by a vowel, resulting in [ð], like in Spanish. In this chapter most neutralization effects will be accounted for using positional faithfulness.

(2) Positional faithfulness analysis of final obstruent devoicing in Catalan

/nəbod/ 'nephew'	IDENT(ONSET)-[voice]	*VOICEDOBSTRUENT	IDENT-[voice]
☞ a. [nəˈβot]		*	*
b. [nəˈβod]		**!	
/nəbod-ə/ 'nice'	IDENT(ONSET)-[voice]	*VOICEDOBSTRUENT	IDENT-[voice]
☞ a. [nəˈβoðə]		**	
b. [nəˈβotə]	*!	*	*

On the other hand, there also exist phonetically based OT approaches to contrast neutralization. These accounts rely on the notion of perceptual cues, like *licensing by cue* or the *P[erceptual]-map* (Steriade 1994, 1997, 2001, 2008; Hayes 1999). In cue-based approaches, contrast neutralization is claimed to be the effect of poor perceptual cues linked to specific environments; if in a certain position the perceptibility of a contrast is diminished, then the phonological contrast is cancelled. Licensing by cue, like positional faithfulness, rests on the notion of licensing: contrasts are licensed in some environments, but not in others. However, in cue-based approaches to neutralization, the positions are identified not on formal structural distinctions, but instead on phonetic grounds such as those supplying the auditory cues for perceiving the contrast. Different phonetic cues relate with different environments, which can be arranged according to a scale of perceptibility that ranges from the best environment for the perception of the contrast to the worst one. From this phonetic knowledge, a fixed hierarchy of universally ranked constraints is projected that prohibits the relevant phonological contrast in those environments. For instance, the perception of a voicing contrast in obstruents is more difficult in final position than in presonorant position. This is so because the latter context provides more perceptibility cues than the former, and a larger number of cues correlates with higher distinctiveness. To formalize this fact, the markedness constraint *VOICE/__#, which militates against voiced obstruents in word-final position, is always ranked higher than *VOICE/__[+son], which prohibits voiced obstruents before sonorants. Then, placing the faithfulness constraint PRESERVE-[voice], against devoicing and parallel to IDENT-[voice], in different positions with respect to the fixed hierarchy of markedness constraints produces different patterns of voicing neutralization.

At this point it is necessary to make explicit what determines the status of contrastiveness in OT analyses of phonological contrast and neutralization. This is constraint interaction. If a faithfulness constraint that requires maintenance of a feature outranks a markedness constraint against such a feature, the language exploits that feature contrastively. Therefore, phonemic inventories in OT are just by-products of constraint ranking. However, the learning procedure known as *lexicon optimization*, which guides language learners in encoding morphemic underlying forms in the absence of alternations and therefore of independent evidence, allows them to come up with a set of contrastive segments (see Prince and Smolensky 1993: 225 for more details). From now on the terms *phoneme* and *contrastive sound* or *segment* will be used indistinguishably.

Although contrastive segments are in principle seen as epiphenomenal in OT, there is one specific theory of segment inventories that is implemented in OT terms, *Dispersion Theory* (Flemming 1995, 2002). Dispersion Theory seeks to explain the shape and size of segment inventories, both contrastive or underlying and surface inventories, by means of three types of constraints: MAXIMIZECONTRAST constraints, which force specific numbers of surface contrasts; MINIMALDISTANCE constraints, which call for robust contrasts; and MINIMIZEEFFORT constraints, which disfavor marked articulatory gestures. Later on a Dispersion Theoretic analysis of the distribution of rhotic consonants in Spanish will be presented as developed by Bradley (2006).

The remainder of this chapter is as follows. In section 2 the inventory of contrastive and surface segments in Spanish is presented, as well as the basic feature geometric representations attributed to Spanish segments that will be tacitly assumed in subsequent analyses. Section 3 deals with the main set of neutralization processes: (i) nonassimilatory and assimilatory neutralization of place contrasts in coda nasal consonants, (ii) coda depalatalization, (iii) the distribution and neutralization of rhotic consonants, and (iv) the range of neutralization processes that target stop consonants in coda position. The analyses of these processes are couched within the formalism of OT, and most of them are based on previous literature. Analyses reported from previous literature are sometimes slightly modified in order to achieve an understanding of neutralization in Spanish that is as comprehensive and uniform as possible. Section 4 concludes the chapter. All the data presented in this chapter are accompanied by their source reference so the reader can easily find more detailed information.

2. The contrastive segment inventory of Spanish

2.1. Vowels

As already noted, Spanish has five contrastive vowels (see Campos-Astorkiza 2012; Martínez-Gil 2012 for other recent accounts of Spanish phonemes). These are illustrated in (3) as classified in Hualde (2005).

(3) The vocalic phonemes of Spanish (Hualde 2005)

	Front	Central	Back
High	i		u
Mid	e		o
Low		a	
		← Nonround	Round

Spanish has two pairs of front and back vowels, two high vowels (/i, u/) and two mid vowels (/e, o/), respectively, and one low central vowel (/a/). The vocalic system of Spanish is simple in comparison with other Romance languages. First, there is no contrast between close and open mid vowels (/ɛ, ɔ/), as in Catalan (Mascaró 1976; Wheeler 2005), Standard Italian (Krämer 2009), or Portuguese (Mateus and d'Andrade 2000) (French, Occitan, and Rhaeto-Romance also have rounded front vowels; see Bonet and Torres-Tamarit to appear). Navarro Tomás (1932) describes a context-dependent allophonic distribution among close and high mid vowels for Spanish, but more recent findings demonstrate a mismatch between acoustic and articulatory data: Martínez Celdrán and Fernández Planas (2007) have shown that no systematic openness can be supported from their acoustic data; although their articulatory data show a systematic effect of openness precisely in those contexts pointed out by Navarro Tomás (1932), there is little if any evidence for positing an allophonic distribution between close and open mid vowels given that any such distinction is completely absent from the acoustic signal.

Second, Spanish has no phonological process of stress-dependent vowel reduction as exists in Catalan or Standard Italian, in which the surface inventory of vowels is reduced in unstressed position. Nadeu (2013) has investigated the effects of stress and pitch accent in the acoustic realization of Spanish vowels and has concluded that there is no phonologized use of vowel quality to signal stress across speakers.

Third, neither nasalization nor duration is contrastive in Spanish vowels. All contrastive vowels in Spanish are oral and short. However, according to Hualde (2005: 123), nasalization is an allophonic feature in some Caribbean and Andalusian dialects when a vowel is followed by a nasal consonant that can occasionally delete (e.g. [pãŋ] ~ [pã] 'bread'). Given the gradual and variable character of such context-dependent nasalization, we can conclude that there is no allophonic alternation between oral and nasal vowels in Spanish, at least from a phonological perspective.

2.2. Glides

Spanish has two approximant glides: the palatal high glide [j] and the labiovelar high glide [w]. Both glides can form rising and falling diphthongs in combination with all nonhigh vowels, in both stressed and unstressed position. Combinations of two distinct high vowels always result in a rising diphthong ([ju, wi]), except in some parts of northern Spain (Navarro Tomás 1932: 65), and the combinations *ji, *ij, *wu, and *uw are impossible. In (4) the possible combinations of rising and falling diphthongs are exemplified. Spanish also has the triphthongs [jaj, jej, waj, wej] in words like *desprec*[ˈjaj]*s* 'you-PL disregard', *limp*[ˈjej]*s* 'you-PL clean-SUBJ', *averig*[ˈwaj]*s* 'you-PL find out', and *b*[ˈwej] 'ox' (Navarro Tomás 1932: 68).

(4) Rising and falling diphthongs in Spanish

rising		*falling*		*rising*		*falling*	
j+V		*V+j*		*w+V*		*V+w*	
*ji		*ij		ˈrwiðo	*ruido* 'noise'	*iw	
ˈpjeðɾa	*piedra* 'stone'	ˈpejne	*peine* 'comb'	ˈpweɾta	*puerta* 'door'	ˈfewðo	*feudo* 'feudal grant'
ˈraβja	*rabia* 'anger'	ˈbajle	*baile* 'dance'	aˈxwaɾ	*ajuar* 'dowry'	ˈkawsa	*causa* 'cause'
ˈlaβjo	*labio* 'lip'	esˈtojko	*estoico* 'stoic'	ˈaɾðwo	*arduo* 'arduous'	ˈsowl	*soul* 'soul'
ˈbjuða	*viuda* 'widow'	*uj		*wu		*uw	

Some words containing rising diphthongs accept pronunciations with a hiatus (e.g. [bi.ˈa.xe] ~ [ˈbja.xe] 'trip', [su.ˈa.βe] ~ [ˈswa.βe] 'soft', [ˈkɾu.el] ~ [ˈkɾwel] 'cruel') (Navarro Tomás 1932: 67). According to Harris (1983), prevocalic glides are not part of the onset and are syllabified in the nucleus. This claim is based on the observation that Spanish rhymes (nucleus + coda) allow up to three segments (e.g. *p*[eɾs]*picaz* 'keen-sighted'). If prevocalic glides were syllabified in a complex onset, one would expect the existence of syllables like *[pweɾs], for instance, which are in fact unattested (cf. [ˈpweɾ.ta], [peɾs.pi.ˈkaθ]) (see the chapter "Phonotactic Constraints on Syllable Structure").

With respect to the contrastive status of glides, should glides be considered phonemic, or should they be derived from high vowels? A first observation is that there exist (near-)minimal pairs in which high vowels contrast with glides in both rising and falling diphthongs, as illustrated in (5) with data from Hualde (2004).

(5) (Near-)minimal pairs containing high vowels and glides (Hualde 2004)

du.ˈe.to	'duet'	but	ˈdwe.lo	'duel'
pi.ˈe	'I chirped'	but	ˈpje	'foot'
re.i.ˈɾe	'I will laugh'	but	rej.ˈne	'I ruled'

Despite these (near-)minimal pairs, most phonological analyses derive glides from underlying high vowels whenever the context for gliding is met, that is, if there is a non-stress-bearing high vowel adjacent to another vowel (cf. [ma.ˈɾi.a] 'Mary' versus [ma.ˈɾja.no] 'Marian'). What needs to be explained is the blocking of the gliding process. Exceptional hiatuses in Spanish like those in the left column in (5) are in fact conditioned by both prosodic and morphological factors (Colina 1999; Harris and Kaisse 1999; Hualde and Prieto 2002; Hualde and Chitoran 2003; Hualde 2004; Cabré and Prieto 2007; Cabré and Ohannesian 2009). First, some exceptional hiatuses containing a high vowel are due to paradigmatic pressure effects in which the high vowel is stressed in other morphologically related forms ([pi.ˈe] but [ˈpi.o] 'I chirp'). Second, blocking of gliding can also be due to the presence of a morphological boundary ([bi-ˈe.njo] 'biennium'). Third, there is a prosodic initiality condition according to which high vowels preceding other vowels at the left edge of stems are less prone to glide. The further it is from the left word edge, and also the further from the stressed vowel, the higher the probability that a high vowel will glide ([di.ˈa.lo.ɣo] 'dialogue' but [di.a.ˈlo.ɣo] ~ [dja.ˈlo.ɣo] 'I dialogue', [dja.lo.ˈɣe] 'I dialogued'). After stress, there are no hiatuses in Spanish ([is.ˈto.ɾja] 'history'; cf. *[is.ˈto.ɾi.a]) (see the chapter "Glides and High Vowels in Spanish" for more details).

2.3. Consonants

The set of phonemic consonants in north-central Peninsular Spanish is given in (6). Spanish exhibits a set of three pairs of stops, voiced and voiceless, distributed along three places of articulation: bilabial /p, b/, dental /t, d/, and velar /k, ɡ/. There are three contrastive nasals: bilabial /m/, alveolar /n/, and palatal /ɲ/, and two rhotic consonants: a trill /r/ and a tap /ɾ/ (see section 3.3 for more details on the distribution of rhotics). Five contrastive fricatives are found (/f, θ, s, ʝ, x/). All fricatives are voiceless except for /ʝ/, which has replaced the palatal lateral /ʎ/ in *yeísta* dialects of Spanish; the palatal lateral is conserved in parts of Spain, the Andean region, Paraguay (Hualde 2005: 8), and the variety of Spanish spoken by some native speakers of Catalan, in which the words *vaya* and *valla* create a minimal pair ([ˈbaʝa] 'go-SG.PRES.SUBJ' versus [ˈbaʎa] 'fence'), which are otherwise merged in *yeísta* dialects in favor of [ˈbaʝa]. The only lateral found in all Spanish dialects is the alveolar one, /l/. The voiceless interdental fricative /θ/ is present only in north-central

Peninsular Spanish. In all other Spanish dialects, referred to as *seseo* dialects, *casa* [ˈkasa] 'house' and *caza* [ˈkaθa] 'hunting' do not create a minimal pair (both words are pronounced [ˈkasa]). There is yet one more phonemic system, referred to as *ceceo*, originally from parts of Andalusia and now present in some Central American areas like El Salvador, Honduras, and Nicaragua, in which there is no phonemic /s/ and words like *seta* 'mushroom' and *ceta* 'zed' are pronounced equally as [ˈθ̪eta], a predorso-dental fricative (Hualde 2005: 156). The voiceless velar fricative /x/ likewise receives different phonetic interpretations depending on the dialect: uvular [χ], characteristic of Castilian Spanish; velar [x], characteristic of Mexico, Peru, and Argentina, and used in this chapter for north-central Peninsular Spanish for ease of exposition; palatal fricative [ç], found in Chile before the front vowels /i, e/; and [h] in Caribbean Spanish, Central America, Colombia, Andalusia, and the Canary Islands (Hualde 2005: 156). Therefore, in the latter dialects /h/ can be considered a phoneme of Spanish, although it is also an allophone of /s/ due to the process of /s/ aspiration in coda position (see the chapter "Vowel Harmony" for more details on /s/ aspiration). Spanish has only one voiceless postalveolar affricate, /t͡ʃ/. In areas of Chile this affricate is realized as an alveolar affricate [t͡s], and in the Canary Islands it can be realized as a voiceless or voiced palatal stop [c ~ ɟ] ([muˈcaco] ~ [muˈɟaɟo] 'young man') (Hualde 2005: 152). In parts of Andalusia, northern Mexico (Sonora and Chihuahua), Panama, and parts of Chile, there is no affricate whatsoever, and /t͡ʃ/ has been replaced by the voiceless postalveolar fricative /ʃ/ (Hualde 2005: 152).

(6) The consonantal phonemes of Spanish

	bilabial	labiodental	dental	alveolar	postalveolar	palatal	velar
stop	p b		t d				k g
nasal	m			n		ɲ	
trill				r			
flap				ɾ			
fricative		f	θ	s		ʝ	x
affricate					t͡ʃ		
lateral				l			

The status of the voiced palatal fricative /ʝ/ as a phoneme is not without controversy (see Hualde 2004, 2005; Rost Bagudanch 2014; and Lloret and Martínez-Paricio to appear for more details). In Castilian Spanish, /ʝ/ can receive a set of phonetic realizations that range from the palatal glide [j] to different degrees of constriction depending on the structural context: a fricative [ʝ], a stop [ɟ], and even an affricate [ɟ͡ʝ] (e.g. *yema* [ˈjema] ~ [ˈʝema] ~ [ˈɟema] ~ [ˈɟ͡ʝema] 'yolk') (see Aguilar 1997; Martínez Celdrán and Fernández Planas 2001). Hualde (2004) points out that it is more appropriate to see these realizations as a gradient along a continuum of degree of constriction, and that a four-way categorization is just the result of imposing a symbol from the International Phonetic Alphabet on each realization. There are two possible phonological interpretations of these facts. On the one hand, if [ʝ] can be seen as the strengthening of [j] in onset position, [ʝ] could be derived from the phonemic vowel /i/, because the glide can be derived contextually from the vowel, as stated in the previous subsection. Under this view, all cases of [ʝ], including those without a morpheme boundary, would derive from /i/ (e.g. *calle*

[ˈkaʝe] < /kaie/ 'street', *mayo* [ˈmaʝo] < /maio/ 'May'). Such an interpretation finds evidence in morphophonological alternations like *rey* [ˈrej] 'king', with a glide, and [ˈreʝes] 'kings' (or [ˈreʒes] or [ˈreʃes] in Argentinian Spanish). If the /i/ is syllabified in coda position, it is realized as a glide. In onset position, the /i/ undergoes fortition (see Harris and Kaisse 1999 for more evidence in favor of a single underlying representation /i/). However, one could argue that the near-minimal pairs in (7) are sufficient evidence to posit a distinct /ʝ/ phoneme.

(7) Near-minimal pairs between [j] and [ʝ] (Hualde 2004)

de.ˈsjeɾ.to	'desert'	but	des.ˈʝe.lo	'thawing'
a.ˈβjeɾ.to	'open'	but	ab.ˈʝek.to	'abject'
bo.ˈnja.to	'yam'	but	ˈkon̠.ʝe.βa	'it implies'

A closer look at these data reveals that the contrast between [j] and [ʝ] can be simply derived from a difference in syllabification, which correlates transparently with morphological structure: all the words in the right column contain a prefix. An OT alignment constraint requiring the left edge of the stem to coincide with the left edge of a syllable would force the stem to be syllabified independently from the prefix, and then a strengthening process would derive the fricative realization of /i/ when followed by another vowel. However, there is a very interesting contrast in some dialects of Spanish that seems to support a second interpretation of the facts whereby there is a near-phonemic distinction between two contrasts, each of them along its own continuum: the high vowel/glide contrast, on the one hand, and the glide/fricative/obstruent contrast, on the other hand, most probably due to an effect of orthography or *fetichismo de la letra* (Rosenblat 1963). This is most clear in Argentinian Spanish, in which the palatal consonant under scrutiny has undergone a process of strengthening toward obstruents, either [ʒ] or [ʃ] (e.g. *yema* [ˈʒema] or [ˈʃema]). However, orthographic (*h*)*i* is pronounced [j] or [ʝ] (e.g. *yerba* [ˈʒeɾβa] 'yerba mate' but *hierba* [ˈjeɾβa] ~ [ˈʝeɾβa] 'grass'). Castilian Spanish also shows this intricate word-dependent contrast between two categories ranging along the degree of constriction, as put forward in Hualde (2004, 2005) and illustrated in (8), in which different words show a different cutoff point along the continuum ranging from the approximant glide to the voiced palatal stop.

(8) Different cutoff points along the constriction scale (Hualde 2004)

hiato	'hiatus'	i.ˈa.to ~	ˈja.to		
hiena	'hyena'		ˈje.na ~	ˈʝe.na	
yema	'yolk'		(ˈje.ma ~)	ˈʝe.ma ~	ˈɟe.ma

The situation depicted in (8) is difficult to account for by any model of phonology based exclusively on categorical representations and a mere interpretative phonetics component. This state of affairs could just be a synchronic static picture of a distribution that is characteristic of situations of in-progress language change. In such a scenario, two distinct classes of words start behaving differently due to orthography and perhaps lexical frequency. One can imagine that this unstable situation may develop into a robust phonological system with two contrastive sounds over time, one vocalic (/i/) and the other consonantal (/ʝ/).

2.4. Featural specifications

Most of the phonological analyses of neutralization processes presented in section 3 rely on the basic feature geometry in Figure 1.2, based on Lloret and Martínez-Paricio (to appear), which is adapted from Uffmann (2011) (see also Núñez Cedeño 2014 for an account of phonological features in Spanish using feature geometrical representations). The assumed feature geometry is enough to account for the processes of Spanish that we are interested in.

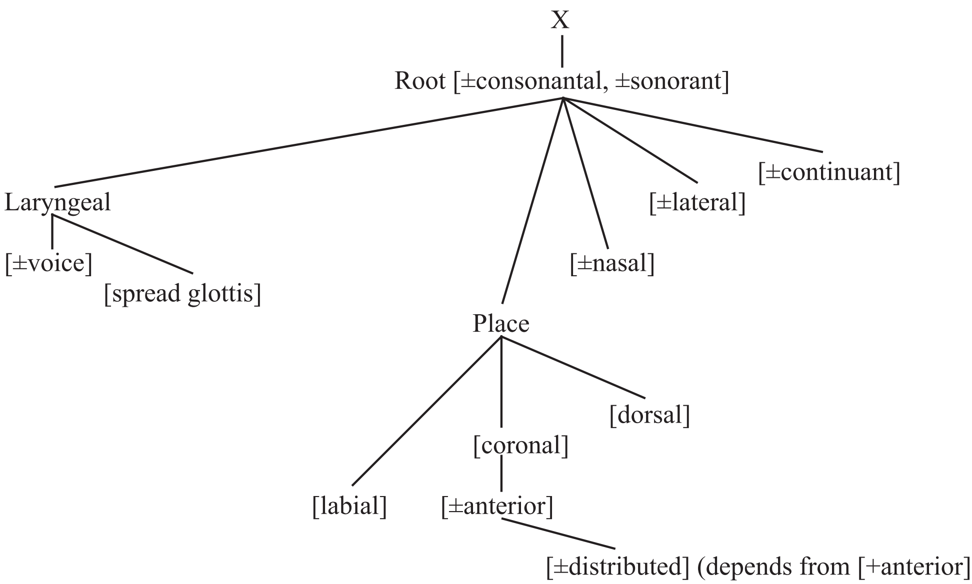


Figure 1.2 Feature geometry for consonants

Source: Adapted from Lloret and Martínez-Paricio (to appear).

In a feature geometrical tree, features are hierarchically organized in different tiers. We assume all phonological features to be binary except for the major place features [labial], [coronal], and [dorsal], as is common in the phonological literature (for theories of feature underspecification, see Archangeli 2011), and [spread glottis]. The segmental root, linked to a skeletal or timing position that mediates between melody and syllabic structure, is equivalent to the features [±consonantal, ±sonorant]. These two features are equated with the root because they never assimilate or dissimilate. They distinguish two major classes of segments: consonants, which are [+consonantal], and vowels, which are [–consonantal]. The feature [±sonorant] distinguishes between obstruents (stops and fricatives), which are [–sonorant], and sonorants (the remaining consonants and all vowels), which are [+sonorant]. Three terminal manner features are immediately dominated by the root: [±continuant], which distinguishes fricatives, which are [+continuant], from stops, which are [–continuant] (the affricate /t͡ʃ/ is both [+continuant] and [–continuant]); [±lateral], which characterizes laterals, which are [+lateral], versus rhotics, which are [–lateral] (the two rhotics can be distinguished by the feature [±trill], or [±tense], but we will argue in favor of considering trills as [–continuant] and flaps as [+continuant]); and [±nasal], which differentiates between nasals and nonnasal consonants. The root node also dominates two more nodes, Laryngeal and Place, each of which dominate their own respective terminal features. The Laryngeal node dominates [±voice], which distinguishes voiced from voiceless segments, and [spread glottis], which is characteristic of voiceless fricatives (see Lloret and Martínez-Paricio to appear for a more detailed discussion of [spread glottis]). We assume that only /s/ has the feature [spread glottis] in Spanish, which we conceive as a monovalent feature. The Place node directly dominates three monovalent features, [labial], [coronal], and [dorsal]. Only the feature [coronal] dominates two terminal features, [±anterior] and [±distributed]. Segments which are (inter)dental and alveolar are [+anterior], and postalveolar (or prepalatal) segments are [–anterior]. Within [+anterior] segments, [+distributed] characterizes /s/, and [–distributed] characterizes /θ/. All velar consonants are [dorsal], and the palatal nasal is characterized as being both [coronal] and [dorsal], as in Piñeros (2011), among others. A table with the featural specifications for all consonants is illustrated in (9a); "x" stands for the presence of a monovalent place feature.

According to Unified Feature Theory (Clements and Hume 1995), both consonants and vowels share the same features (Figure 1.3) (we present the featural specification of vowels although no process involving them will concern us). The Place node is characterized in this theory as C-place, which dominates a Vocalic node. This node dominates in turn two more nodes: V-place and Aperture. It is enough for a five-vowel system like Spanish that V-place dominates only two features, [coronal] and [dorsal]. Aperture dominates the feature [open]. For consonants, the C-place node directly dominates the three terminal place features not dominated by the Vocalic node (see Uffmann 2011 for more details on feature geometry and the Unified Feature Theory). The front vowels (/i, e/) are thus [coronal], and the back vowels (/u, o/) are [dorsal]. The aperture feature [open] distinguishes between high vowels and mid vowels, the latter being specified for V-place and for [open]. The low vowel (/a/) is only specified for [open] and is neither [coronal] nor [dorsal]. This characterization of vowels resembles that of Element Theory (Backley 2011). Featural specifications for vowels are illustrated in (9b).

(9) Summary of featural specifications for contrastive segments in Spanish

a. Consonants

	Root		Laryngeal		Place					Manner		
	[cons]	[son]	[voi]	[sp gl]	[lab]	[cor]			[dor]	[nas]	[lat]	[cont]
							[ant]	[distr]				
p	+	–	–		x					–	–	–
b	+	–	+		x					–	–	–
t	+	–	–			x	+	–		–	–	–
d	+	–	+			x	+	–		–	–	–
k	+	–	–						x	–	–	–
g	+	–	+						x	–	–	–
f	+	–	–		x					–	–	+
θ	+	–	–			x	+	–		–	–	+
f	+	–	–	x		x	+	+		–	–	+
ɟ	+	–	+			x			x	–	–	+
x	+	–	–						x	–	–	+
t͡ʃ	+	–	–			x	–			–	–	– +
m	+	+	+		x					+	–	–
n	+	+	+			x	+	+		+	–	–
ɲ	+	+	+			x			x	+	–	–
ɾ	+	+	+			x	+	+		–	–	+
r	+	+	+			x	+	+		–	–	–
l	+	+	+			x	+			–	+	+

b. Vowels

	V-place		Aperture
	[cor]	[dor]	[open]
i	x		
e	x		x
a			x
o		x	x
u		x	

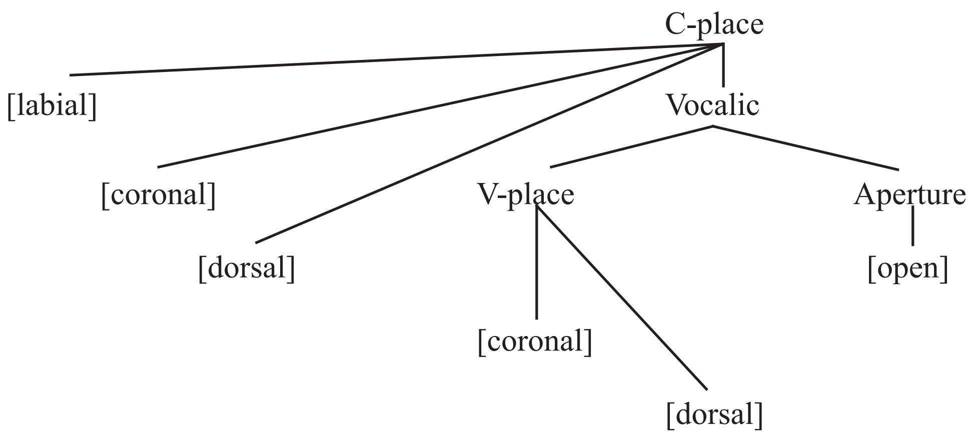


Figure 1.3 Feature geometry for vowels

Source: Adapted from Uffmann (2011).

3. Neutralization processes in Spanish

3.1. Nasal place assimilation and neutralization

In this section we describe and formalize one of the major neutralization processes in Spanish, nasal place assimilation (see also the chapter "Consonant Assimilation"). We have so far established that Spanish makes use of a triple place contrast within nasals. In syllable onset position, the bilabial, alveolar, and palatal nasals contrast (10). Recall that phonemic contrast in onset position is guaranteed by the undominated position of the IDENT(ONSET) family of faithfulness constraints.

(10) Nasal contrast in onset position

[ˈkana] 'gray hair'
[ˈkama] 'bed'
[ˈkaɲa] 'cane'

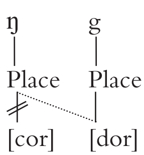
However, the three-way place contrast is neutralized in coda position, both medially and word-finally. As exemplified in (11), in medial position all nasals assimilate to the place of articulation of the following consonant. Nasals acquire bilabial, labiodental, dental, alveolar, postalveolar, and velar place specifications depending on the place specification of the following onset consonant. (For other structure-building neutralization processes, like voice assimilation, see the chapter "Consonant Assimilation".)

(11) Nasal place assimilation (Hualde 2005: 104)

[ˈkampo]	‘field’
[ˈeɱfasis]	‘emphasis’
[ˈansja]	‘anxiety’
[ˈtanto]	‘so much’
[ˈaɲt͡ʃo]	‘wide’
[ˈaŋka]	‘haunch’

We follow Piñeros (2006) and Colina (2009) in making use of the constraint Coda-Condition, defined in (13) to exclusively target nasal consonants. This markedness constraint incorporates the idea that coda consonants cannot license their own place features. However, in a place-sharing configuration in which the consonant in coda position shares the same place specification as a following onset, Coda-Condition is satisfied. In autosegmental terms, place assimilation is represented as in (12). The segment [ŋ] stands for a nasal consonant that has acquired its velar place specification from a following velar stop via an autosegmental operation of *spreading-cum-delinking*. Laterals also acquire the place of articulation of the following consonant (e.g. interdental lateral as in *e*[l̟ θ]*irco* ‘the circus’; dental lateral as in *e*[l d]*ía* ‘the day’; alveolar lateral as in *e*[l r]*ío* ‘the river’; palatal lateral as in *e*[ʎ ɟ]*eso* ‘the plaster’) except when the following consonant is labial, because [labial] and [+lateral] are incompatible features, or velar (e.g. *e*[l β]*arco* ‘the ship’; *e*[l ɣ]*ato* ‘the cat’). Therefore, Coda-Condition targets both nasals and laterals; the constraints *[labial]&[+lateral], against labial nasals, and *[ʟ], against velar laterals, outrank Coda-Condition. The faithfulness constraint Ident-[place] is defined in (14), violated in output forms exhibiting nasal place assimilation.

(12) Nasal place assimilation



(13) Coda-Condition[nasal] (based on McCarthy 2008)

Assign one violation mark for every token of a place feature that is associated with a nasal consonant in the syllable coda.

(14) Ident[place]

Assign one violation mark for every input-output discrepancy between place specifications.

Consider an input form like /son ɡatos/ ‘they are cats’ in (15). Candidate (15b) fatally violates Coda-Condition[nasal] because the coda is linked to its own place specification, in this case [coronal]. The winning candidate (15a), in which the [dorsal] place specification of the following onset spreads, violates low-ranked Ident-[place]. In the following tableaux, a W indicates that a winner-favoring constraint dominates a loser-favoring constraint, indicated by L.

(15) Tableau for /son ɡatos/ → [ˈsoŋ ˈɡatos]

/son ɡatos/	Coda-Cond[nas]	Id-[pl]
☞ a. [ˈsoŋ ˈɡatos]		*
b. [ˈson ˈɡatos]	*W	L

Word-finally before a pause, nasals also neutralize. In most dialects of Spanish, we only find [n] in this position. Sometimes this is even reflected in the orthography, like in the word *ron* [ˈron] from English 'rum', or *esmoquin* [esˈmokin] from English 'smoking'. Sometimes it is not, like in *referéndum* 'referendum', which is pronounced [refeˈɾendun] anyway, or *álbum* 'album', pronounced [ˈalβun] (cf. *álbumes* [ˈalβumes], but also [ˈalβunes] and less commonly [ˈalβuns]; see Lloret and Mascaró 2006; Bermúdez-Otero 2006). In other Spanish dialects, however, the point of articulation of word-final nasals is velar, instead of coronal (e.g. [ˈroŋ], [refeˈɾenduŋ], [ˈalβuŋ]). We follow some analysts in interpreting these nasals as debuccalized (see Trigo 1988; Bakovic 2000). More alternations between [n] and [m] are exemplified in (16), taken from Lloret and Mascaró (2006). No alternations between [n] and [ŋ] exist because velar nasals are not contrastive in Spanish.

(16) [n] ~ [m] alternations

isla[n]	'Islam'	islámico	'Islamic'
íte[n]	'item'	itemización	'itemization'
oh[n]	'ohm'	óhmico	'ohmic'
tóte[n]	'totem'	totemismo	'totemism'
Abrahá[n]	'Abraham'	abrahámico	'Abrahamic'
Vietna[n]	'Vietnam'	vietnamita	'Vietnamese'
Amsterda[n]	'Amsterdam'	amsterdamés	'Amsterdamese'
Surina[n]	'Surinam'	surinamés	'Surinamese'
Fro[n]	'Fromm'	frommiano	'Frommian'

Neutralization in absolute final position can be attributed to two context-free markedness constraints against noncoronal place features, *[dorsal] and *[labial] (17). The strategy adopted to satisfy these constraints is not achieved by means of spreading, because there is no consonant from which any place feature could spread. Instead, the input place feature, if it is not [coronal], maps onto [coronal]. The fact that [coronal] is inserted and not, for instance, [dorsal] derives from the same universally ranked constraint hierarchy that motivates centralization (neutralization toward [coronal]) (17). This fixed hierarchy derives from the relative markedness of place specifications (Lombardi 1999, 2001); the feature [coronal] is less marked than [labial] and [dorsal].

(17) Universally ranked place markedness constraints (Lombardi 2001)

*[dorsal], *[labial] >> *[coronal]

For velarizing dialects, the high ranking of Coda-Condition[nasal] is enough to derive neutralization. We claim that word-final nasals before a pause in velarizing dialects do not acquire a [dorsal] feature, which would be ruled out by the universal constraint ranking in (17), but rather are debuccalized; that is, they have no place (but see Ramsammy 2013 for an interpretation of final velar nasals as nasals fully specified for place). Placeless nasals surface phonetically as velar nasals because of the necessary lowering of the velum. Placeless segments violate the markedness constraint Have-Place.

Tableaux (18) and (19) illustrate the ranking that is necessary to account for nonvelarizing and velarizing dialects, respectively. The candidates that include [ŋ] have undergone debuccalization, but not insertion of [dorsal] (usually debuccalized nasals are transcribed as [ɴ], the IPA symbol for uvular nasals); candidates with a [dorsal] specification are omitted. In nonvelarizing dialects (18), the ranking of *[labial] above *[coronal] and Ident-[place] discards the faithful candidate (c) with a final labial nasal. Candidate (18b), with debuccalization, is discarded because it violates the undominated constraint Have-Place, which is ranked above Coda-Condition[nasal], *[coronal], and Ident-[place] (using Max-[place] would be more appropriate since place features are monovalent, but we use Ident-[place] instead for ease of exposition). In velarizing dialects (19), however, Have-Place is dominated, and debuccalization can apply without violating any other constraint; recall that in the absence of a place feature, *[labial] and *[coronal] are vacuously satisfied, as well as Ident-[place].

(18) Tableau for /album/ → [ˈalβun]

/album/	*[lab]	Have-Pl	Coda-Cond[nas]	*[cor]	Id-[pl]
☞ a. [ˈalβun]			*	*	*
b. [ˈalβuŋ]		*W	L	L	L
c. [ˈalβum]	*W		*	L	L

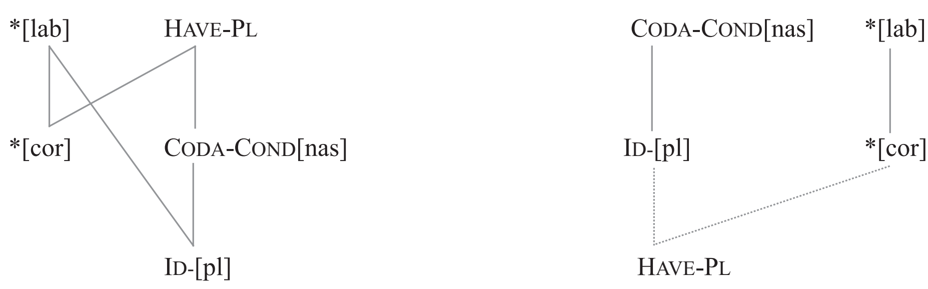
(19) Tableau for /album/ → [ˈalβuŋ]

/album/	Coda-Cond[nas]	*[lab]	Id-[pl]	*[cor]	Have-Pl
☞ a. [ˈalβuŋ]					*
b. [ˈalβun]	*W		*W	*W	L
c. [ˈalβum]	*W	*W			L

The two OT grammars are represented as a Hasse diagram in (20); lines stand for domination relations, and dashed lines indicate disjunctive rankings (see McCarthy 2008 for more details on constraint rankings in OT and how to represent them).

(20) Hasse diagrams for nasal place assimilation and nasal place neutralization

a. Nonvelarizing dialects b. Velarizing dialects



3.2. Coda depalatalization

Besides neutralization of /m/ as in *álbu*[n] (cf. *álbumes*), this process of place centralization, as we could call it, also affects the palatal nasal /ɲ/ and the palatal lateral /ʎ/, which surface as [n] and [l] in coda position, respectively. The [ʎ] ~ [l] alternation exists only in *lleísta* dialects, those that have contrastive /ʎ/ instead of the palatal fricative /ʝ/. For *yeísta* dialects, the alternation between [ʝ] and [l] could be better accounted for by means of phonologically conditioned allomorph selection. The data in (21) are taken from Lloret and Mascaró (2006). Transcriptions are orthographic; *ñ* stands for [ɲ], and *ll* for [ʎ].

(21) Nasal and lateral depalatalization

	Word-final		Nonfinal in inflection		Nonfinal in inflection and derivation	
a.	[n]		[n]		[ɲ]	
	desdén	'disdain'	desdenes	'disdains'	desdeñar	'to disdain'
					desdeñoso	'disdainful'
	Don	'sir'			doña	'madam'
	champán	'champagne'	champanes	'champagnes'	champañería	'champagne shop'
					champañera	'champagne cooler'
b.	[l]		[l]		[ʎ]	
	Él	'he'			ella(s)	'she/they-F'
					ello(s)	'it/they-M'
	aquel	'that'			aquella(s)	'that/those-F'
					aquello(s)	'that/those-M'
	doncel	'squire'	donceles	'squires'	doncella(s)	'maid(s)'
					doncellez	'maidenhood'
	clavel	'carnation'	claveles	'carnations'	clavellina	'small carnation'
	piel	'skin'	pieles	'skins'	pellejo	'skin (colloquial)'
c.	Assimilatory environment				Sabadellense	'from Sabadell'
	beldad	'beauty'			bello	'beautiful-M'

Lloret and Mascaró (2006) take the behavior of borrowings as clear evidence of the productivity of the centralization process. Centralization from /m/ to [n] and depalatalization from Catalan source forms, mostly proper nouns, are illustrated in (22). Orthographic *ny* in Catalan represents the palatal nasal [ɲ].

(22) Centralization in Spanish

/m/ → [n]	/ɲ/ → [n]	/ʎ/ → [l]
Prim	champán	Sabadell
Grimm	seny	Maragall
réquiem	Montseny	Coll
eslálom	Capmany	Urgell
módem	Fortuny	Llull
referéndum	Montmany	Collell
médium	Jubany	Bofill
Boom	Ferreny	Tusell
tedèum	Sispony	Creixell
fòrum	Montgrony	Moll

As has been shown for nasals in the previous subsection, we claim that lateral depalatalization is also due to a context-free markedness constraint on the [dorsal] place specifications typical of palatal segments, which are also specified for [coronal] (see 9a). We repeat the universal ranking of place markedness constraints in (23). Not only labial nasals are prohibited in coda position, but also palatal nasals and laterals.

(23) Universally ranked place markedness constraints

*[dorsal], *[labial] >> *[coronal]

Coda depalatalization is accounted for by ranking *[dorsal] above IDENT-[place], as illustrated in (24). The positional faithfulness constraint IDENT(ONSET)-[place] is responsible for choosing the candidate with the palatal lateral when syllabified in onset position.

(24) Positional faithfulness analysis of coda depalatalization

donceʎ	ID(ONS)-[pl]	*[dorsal]	ID-[pl]
☞ a. doncel			*
b. donceʎ		*W	L
donceʎ+a	ID(ONS)-[pl]	*[dorsal]	ID-[pl]
☞ a. donceʎa		*	
b. doncela	*W	L	*W

In order to explain the overapplication of depalatalization in onset position observed in the plural inflected forms in (21) (also observed in diminutive forms), Lloret and Mascaró (2006) propose an output-output faithfulness constraint IDENTITY-$O_{Base}O_{AffixedForm}$-[place] that prevents affixed forms from mapping faithfully onto the [dorsal] specification of nasals and laterals although syllabified in onset position (25). This kind of output-output faithfulness constraint in OT expresses paradigmatic pressure effects (see Benua 2000). See Lloret and Mascaró (2006) for a more detailed definition and discussion of what constitutes a base for output-output faithfulness constraints, and Bessett and Colina (2017) for a recent account of depalatalization in Spanish that extends Lloret and Mascaró's (2006) analysis of depalatalization by integrating diachronic data and loanword adaptation.

(25) Analysis of overapplication of depalatalization in inflected forms

donceʎ+es base: doncel	ID-OO-[pl]	ID(ONS)-[pl]	*[dorsal]	ID-[pl]
☞ a. donceles		*		*
b. donceʎes	*W	L	*W	L

The final grammar for nasal and lateral coda depalatalization is illustrated in (26) as a Hasse diagram.

(26) Hasse diagram for coda depalatalization

ID-OO-[pl]
|
ID(ONS)-[pl]
|
*[dorsal]
|
ID-[pl]

Another process of neutralization in Spanish that involves the alveolar lateral is liquid neutralization, by which the contrast between /l/ and /ɾ/ is neutralized in favor of [ɾ] in word-medial coda position (both *caldo* 'broth' and *cardo* 'thistle' can be realized as [ˈkaɾðo]), and in favor of [l] in word-final coda position in some dialects of Spanish (e.g. *amo*[l] 'love' but *amo*[ɾ]*es* 'loves'). We refer the reader to Martínez-Paricio (2008) for an OT analysis of these phenomena based on sonority distinctions among liquids (see also the references therein).

3.3. The distribution and neutralization of rhotic consonants

The distribution of the trill and the flap in Spanish is puzzling as this contrast is only found intervocalically. Stem-initially and after an homorganic heterosyllabic consonant, only the trill is possible; in coda position, the flap is typically realized ([r] is possible under emphatic speech); as the second member of a complex onset, only the flap is possible. Some data appear in (27), mostly taken from Bradley (2006) and Colina (2009) (see also Roca 2005; Colina 2010).

(27) Distribution of rhotics

a. Stem-initial position and after homorganic and heterosyllabic consonants (only [r])	[r]*osa*	'rose'
	pre[.r]*equisito*	'prerequisite'
	mata[.r]*atas*	'rat poison'
	con [r]*osa*	'with Rose'
	la [r]*osa*	'the rose'
	hon[r]*a*	'honor'
	al[r]*ededor*	'around'
b. Coda position (only [ɾ])	*ve*[ɾ]; *ve*[.ɾ] *osas* (cf. *ve* [r]*osas*)	'to see'; 'to see bears-F' (cf. '(s)he sees roses')
	ma[ɾ], *ma*[ɾ]*es* (cf. **ma*[r]*es*)	'sea', 'seas'
c. Intervocalic position	*ca*[r]*o*	'car'
	ca[ɾ]*o*	'expensive'
	pe[r]*o*	'dog'
	pe[ɾ]*o*	'but'
d. Second member of a complex onset	*g*[ɾ]*ano* (cf. **g*[r]*ano*)	'grain'
	b[ɾ]*azo* (cf. **b*[r]*azo*)	'arm'

Colina (2009) makes the following assumptions regarding the trill: (i) the trill is a single element (not a geminate), (ii) it is [–continuant], and (iii) it is less sonorous than the flap (for a detailed explanation of the notion of sonority, see the chapter "Phonotactic Constraints on Syllable Structure"). To these assumptions, we add the following: (i) flaps, as opposed to trills, are [+continuant], and (ii) continuancy is the feature that distinguishes trills from flaps in Spanish (Colina 2010 uses the feature [tense], but others assume an underlying flap that undergoes strengthening (Harris 1983; Bonet and Mascaró 1997 for Catalan; Roca 2005)). The phonotactic generalization according to which trills are banned after heterosyllabic glides (28) seems to support a [+continuant] characterization of flaps; the only exceptions to this generalization are two words borrowed from Basque (*aurragado* [awraˈɣaðo] 'tilled in a bad way' and *aurresku* [awˈresku] 'traditional Basque dance'). This generalization may be due to [+continuant] spreading, as in voiced stop spirantization (see the chapter "Spirantization and the Phonology of Spanish Voiced Obstruents"). For a word like *Israel*, pronounced as [i(r).ra.ˈel], in which the rhotic is preceded by a sibilant, things are a bit more complex: why does the rhotic following the sibilant surface as a trill and not a flap, if both the sibilant and the flap are [+continuant] segments? One could argue for assimilation of the sibilant to the rhotic (/sɾ/ → [ɾ.ɾ]) with concomitant strengthening of two adjacent flaps (ɾ.ɾ → [(r).r]). An additional argument in favor of considering trills as [–continuant] and flaps as [+continuant] is that only trills are possible in word-initial position, in line with the onset preference for less sonorous segments ([–continuant] segments are less sonorous than [+continuant] segments) (see also Colina 2009). Also, in most varieties of Spanish, obstruents in coda position must be [+continuant]. Flaps, but not trills, are precisely preferred in the coda position. In any case, which feature distinguishes flaps from trills is a complicated matter that is still under debate.

(28) After heterosyllabic glides, no trill

a[j.ɾ]*e*	'air'
vie[j.ɾ]*a*	'scallop'
bo[j.ɾ]*a*	'fog'
centa[w.ɾ]*o*	'centaur'

An analysis of the distribution of rhotics in Spanish within Dispersion Theory has been set out in Bradley (2006). In Dispersion Theory phonological contrast is directly evaluated by the grammar, which includes constraints that promote maximizing the perceptual distinctiveness of a contrast. For rhotics, this type of minimal distance constraint is $\text{S}\textsc{pace}_{\text{duration}}$, defined in (29a), according to which rhotic duration contrasts should be as robust as they are in intervocalic position; it is assumed that trills are intrinsically longer than flaps, and that this duration is better perceived in intervocalic position. The constraint $\text{S}\textsc{pace}_{\text{duration}}$ is therefore violated by any contrast in all contexts except for intervocalic contexts. $\text{I}\textsc{dent}_{\text{duration}}$ (29b) is the faithfulness constraint that penalizes input-output mismatches in terms of duration. The next relevant constraint is $*_{\sigma}$[ɾ, which penalizes flaps in onset position, a prominent position that requires stronger segments, a constraint based on sonority considerations (see Clements 1990). Finally, the two context-free markedness constraints *r and *ɾ are also relevant for the analysis.

(29) Constraints in Bradley (2006)

a. $\text{S}\textsc{pace}_{\text{duration}}$
   Potential minimal pairs differing in rhotic duration differ at least as much as rhotics do between vowels.
b. $\text{I}\textsc{dent}_{\text{duration}}$
   Corresponding input and output rhotics are identical in duration.
c. $*_{\sigma}$[ɾ
   A rhotic in syllable-initial position is [r].
d. *r
e. *ɾ

The contrast between trills and flaps in intervocalic position derives from ranking $\text{I}\textsc{dent}_{\text{duration}}$ above $*_{\sigma}$[ɾ, *r, and *ɾ, as illustrated in (30); the contrast in the input must be preserved in the output. In intervocalic position, $\text{S}\textsc{pace}_{\text{duration}}$ is never violated because the intervocalic context is the one that best enhances the perceptual contrast of duration between the two rhotics. Candidates (30b) and (30c) are ruled out because the constrast between the trill and the flap in intervocalic position has been neutralized.

(30) Rhotic-flap contrast in intervocalic position

VrV_1 – VɾV_2	SPACE$_{duration}$	IDENT$_{duration}$	$*_{\sigma}$[ɾ	*r	*ɾ
☞ a. VrV_1 – VɾV_2			*	*	*
b. Vr$V_{1,2}$		*W	L	*	L
c. Vɾ$V_{1,2}$		*W	*	L	*

However, in non-intervocalic contexts, like word-initial position or post-consonantically, the cues for perceiving the duration contrast between the two rhotics is diminished, and SPACE$_{duration}$, which dominates IDENT$_{duration}$, blocks the maintenance of the contrast, as shown in (31). The reason why the trill is preferred over the flap is the activity of the strengthening constraint $*_{\sigma}$[ɾ, which acts to ban flaps from the onset position in those contexts in which contrast cannot be maintained for perceptibility reasons.

(31) Neutralization in non-intervocalic position

rV_1 – ɾV_2	SPACE$_{duration}$	IDENT$_{duration}$	$*_{\sigma}$[ɾ	*r	*ɾ
☞ a. r$V_{1,2}$		*		*	
b. ɾ$V_{1,2}$		*	*W	L	*W
c. rV_1 – ɾV_2	*W	L		*	*W

One attractive aspect of Bradley's (2006) analysis is that it does not need any specific constraint banning trills in coda position (cf. Colina's 2009 *[r]/Coda) in order to account for neutralization toward the flap in coda position. The specific ranking of the low-ranked markedness constraints, with *r above *ɾ, is sufficient, as exemplified in (32). The same holds for complex onsets, in which the second element is always the flap.

(32) Neutralization in coda position

Vr_1 – V$ɾ_2$	SPACE$_{duration}$	IDENT$_{duration}$	$*_{\sigma}$[ɾ	*r	*ɾ
☞ a. ɾ$V_{1,2}$		*			*
b. r$V_{1,2}$		*		*W	L
c. Vr_1 – V$ɾ_2$	*W	L		*W	*

The Hasse diagram of Bradley's (2006) analysis of the distribution of rhotics in Spanish is shown in (33).

(33) Hasse diagram for the distribution of rhotics (Bradley 2006)

SPACE$_{duration}$
|
IDENT$_{duration}$
|
$*_{\sigma}$[ɾ
|
*r
|
*ɾ

3.4. Coda stop neutralization processes

In this section we focus on the phonology of stops in coda position in north-central Peninsular Spanish, which exhibits intricate patterns of neutralization and preservation of contrast that are usually subject to variation.

3.4.1. Word-final coda stops

If our analysis is limited to native words of Spanish, only a subset of consonants are allowed in word-final position, all of them being coronal: /ɾ, l, n, d, s, θ/; as noted earlier, /s/ in coda position is debuccalized to [h] in aspirating varieties of Spanish (Andalusia and Latin America; see the chapter "Vowel Harmony" for more details on the process of /s/ aspiration). Some examples appear in (34).

(34) Possible word-final consonants in Spanish

so[ɾ]	'sister (nun)'
so[l]	'sun'
so[n]	'they are'
se[ð]	'thirst'
to[s]	'cough'
pe[θ]	'fish'

In north-central Peninsular Spanish, word-final /d/ is realized as an approximant [ð], especially when it is followed by another word, either vowel-initial or consonant-initial, or a pronominal clitic. Some examples taken from Navarro Tomás (1932) appear in (35).

(35) Word-final /d/ in north-central Peninsular Spanish

juventu[ð] *estudiosa*	'studious youth'
liberta[ð] *absoluta*	'absolute freedom'
eda[ð] *media*	'Middle Ages'
eda[ð] *dorada*	'Golden Age'
llama[ð]*lo*	'call-PL him!'
escribi[ð]*nos*	'write-PL us!'

The specific realization of word-final /d/ is also subject to stylistic variation, and Navarro Tomás (1932) reports cases of weakening and partial devoicing in absolute final position, which he transcribes as [ð̥] (36).

(36) Weakened and partially devoiced word-final /d/ before pause

liberta[ð̥]	'freedom'
huéspe[ð̥]	'host'
bonda[ð̥]	'goodness'
virtu[ð̥]	'virtue'
veni[ð̥]	'come!-PL'
espera[ð̥]	'wait!-PL'
trae[ð̥]	'bring!-PL'
calla[ð̥]	'be-PL quiet!'

In colloquial speech, Navarro Tomás (1932) also reports cases of complete deletion of final /d/ (e.g. *virtu*[Ø], *verda*[Ø] 'truth', *juventu*[Ø], *liberta*[Ø], *uste*[Ø] 'you-formal', *Madri*[Ø] 'Madrid') that is not found in monosyllables (e.g. se[ð] 'thirst', re[ð] 'net', vi[ð] 'vine'). Finally, in some areas in Castile and Madrid, word-final /d/ is not only spirantized but also completely devoiced (e.g. *virtu*[θ], *verda*[θ], *juventu*[θ], *uste*[θ]); this same phenomenon of spirantization and final devoicing also targets /ɡ/, realized as [x], in some Castilian varieties, e.g. *bulldo*[x] 'bulldog'. The devoiced realization [θ] is dispreferred before vowel-initial words (e.g. *se*[ð] *enorme* 'enormous thirst'). Intermediate realizations like [ð̥], with partial devoicing, are also possible according to Hualde (2005). Word-final /d/ devoices and fails to undergo spirantization in the Spanish spoken by native speakers of Catalan, and in some parts of Latin America in careful speech, as reported by Hualde (2005) (e.g. *salu*[t] 'health', *Madri*[t]).

All other consonants in word-final position, that is, all obstruents except for /d/ (/p, t, k, b, ɡ, f, t͡ʃ, x, (ɟ)/) and noncoronal sonorants (/m, ɲ, (ʎ)/), are prohibited in such a position. In fact, most roots ending in these consonants take an inflectional ending /-e/ if they are patrimonial words or established loans (e.g. *nube* 'cloud', *toque* 'touch', *jefe* 'boss', *eje* 'axis'; see Harris 1999; Lloret and Mascaró 2006).

The situation is different when we look at borrowings, where all voiceless obstruents (the stops /p, t, k/, the affricate /t͡ʃ/, and the fricatives /f, x/) are possible; a nonborrowed word like *reloj* 'watch' is usually pronounced as [reˈlo], only as [reˈlox], in more affected speech or specific idiolects. All the data in (37) and (38) are taken from Navarro Tomás (1932), Hualde (2005), and Lloret and Mascaró (2006), or are my own.

(37) Word-final voiceless stops in Spanish

/p/		/t/		/k/	
[ˈket͡ʃup]	'ketchup'	[ˈaβitat]	'habitat'	[buˈtik]	'boutique'
[ˈkɾep]	'crêpe'	[aɾˈɣot]	'slang'	[anoˈɾak]	'anorak'
[esˈkajp]	'Skype'	[ˈswit]	'suite'	[aˈðok]	'ad hoc'
[esˈtop]	'stop'	[entɾeˈkot]	'entrecôte'	[koˈɲak]	'cognac'
[ˈwasap]	'WhatsApp'	[akˈθesit]	'additional prize'	[esˈtok]	'stock'
		[ˈθenit]	'zenith'	[tikˈtak]	'tick tock'
		[ˈimput]	'input'	[ˈblok]	'writing pad'
		[maˈmut]	'mammoth'	[biˈβak]	'bivouac'
		[roˈbot]	'robot'	[ˈfɾak]	'tailcoat'

(38) Word-final voiceless affricates and fricatives in Spanish

/t͡ʃ/		/f/		/x/	
[ˈkit͡ʃ]	'kitsch'	[ˈrif]	'Rif'	[ˈsix]	'Sikh'
[ˈmat͡ʃ]	'match'	[ˈnif]	'NIF (fiscal ID number)'	[ˈbox]	'boxwood'
[ˈθaɾeβit͡ʃ]	'czarevitch'	[ˈt͡ʃef]	'chef'		
[ˈkambɾit͡ʃ]	'Cambridge'	[naˈif]	'naïve'		
		[ˈpuf]	'pouf'		
		[ˈrozβif]	'roast beef'		
		[ˈpaf]	'pub'		

Regarding the realization of the word-final voiced stops /b, ɡ/ in borrowings, as happens with word-final /d/ in native words, the most common realization is an approximant (39). Final

/ɡ/ can also be realized as [x] in north-central Peninsular Spanish, and Hualde (2005) notes that [ˈklu] 'club', with deletion, is also possible (he also reports a less common pronunciation [ˈklub], with a final voiced stop, but not [ˈklup], as would be normal in the Spanish of native speakers of Catalan).

(39) Word-final voiced stops in Spanish

/b/		/ɡ/	
[ˈkluβ]	'club'	[θiɣˈθaɣ]	'zigzag'
[esˈnoβ]	'snob'	[bulˈðoɣ]	'bulldog'
[ˈxoβ]	'Job'		
[xaˈkoβ]	'Jacob'		

Apart from the pronunciations illustrated so far, Hualde (2005) notes that words ending in /k/ can also undergo voicing and spirantization, or even deletion albeit only for specific words (e.g. *coña*[k~ɣ~∅], but *blo*[k]), and that, as said, /ɡ/ can spirantize and further devoice in some subvarieties of north-central Peninsular Spanish (e.g. *bulldo*[ɣ~x], *zi*[ɣ~x]*za*[ɣ~x]; in this same position, /ɡ/ can also be merely devoiced: *bulldo*[k], *zi*[k]*za*[k]).

The situation of word-final underlying stops in Spanish is thus quite intricate. Hualde (2005) summarizes it as follows:

- Underlying nonvelar voiceless stops surface faithfully as such (e.g. /estop/ → [esˈtop]; /θenit/ → [ˈθenit]).
- The underlying velar voiceless stop can surface faithfully as such (e.g. /blok/ → [ˈblok]), or undergo voicing and spirantization, and even deletion in absolute final position (e.g. /koɲak/ → [koˈɲak~ɣ~∅] but *coña*[k] *extraño* 'strange brandy').
- Underlying voiced stops undergo spirantization. Deletion in non-monosyllables, and devoicing in nonlabials is also possible (e.g. /salud/ → [saˈluð~θ~∅]; /sed/ → [seð~θ]; /θiɡθaɡ/ → [θiɣ~xθaɣ~x]; /xakob/ → [xaˈkoβ]).

We can therefore conclude that, in word-final position, there is no neutralization between voiceless stops and voiced stops, which usually surface as approximants owing to final spirantization. However, there are two varieties in which there is some degree of neutralization involving coronals. In those varieties of north-central Peninsular Spanish that pronounce [ˈpeθ] (cf. [ˈpeθes]) and [ˈreθ] (cf. [ˈreðes]), /d/ and /θ/ neutralize in final position, and also /ɡ/ can neutralize with /x/ ([θixˈθax] cf. [θixˈθaɣeaɾ] 'to zigzag' and [ˈbox] 'boxwood', cf. [ˈboxes] 'boxwoods'). Also, in those varieties in which /d/ devoices but does not spirantize in word-final position, /d/ and /t/ neutralize in word-final position ([ˈret] 'net' but [ˈreðes] 'nets' and [ˈswit] 'suite' but [ˈswits] 'suites').

3.4.2. Word-internal coda stops

The distribution of stops in word-internal coda position is less intricate than the distribution found in word-final coda position, in the sense that there are no word-specific idiosyncratic pronunciations. According to Hualde (2005), the voicing contrast between the sets of voiceless stops (orthographic *p*, *t*, *c*, and *x* before a vowel) and voiced stops (orthographic *b*, *d*, *g*) is completely neutralized in the standard pronunciation of Peninsular Spanish. Furthermore, spirantization can also target both sets. Hualde (2005) notes that the realization of stops in word-internal coda position is gradual and subject to inter- and intra-speaker variation, and ranges from voiceless stops to voiced approximants, irrespective of the following onset consonant. The examples given by him are illustrated in (40).

(40) Gradual variation of word-internal coda stops

ó[p~b̥~b~β]*timo (óptimo)*	'optimum'	*o*[p~b̥~b~β]*tiene (obtiene)*	'(s)he obtains'
é[t~d̥~d~ð]*nico (étnico)*	'ethnic'	*a*[t~d̥~d~ð]*mirar (admirar)*	'to admire'
a[k~ɡ̊~ɡ~ɣ]*né (acné)*	'acne'	*a*[k~ɡ̊~ɡ~ɣ]*nóstico (agnóstico)*	'agnostic'
e[k~ɡ̊~ɡ~ɣ.s]*amen (examen)*	'exam'		

According to Hualde (2005), in some varieties of north-central Peninsular Spanish, orthographic *g*, but never orthographic *c*, can be pronounced [x], with spirantization and devoicing (e.g. [axˈnostiko] but [ak~ɡ̊~ɡ~ɣˈne]). In this dialectal area, orthographic *c* can be realized as the fricative [θ] before /t/, undergoing spirantization, devoicing, and place assimilation (e.g. [ˈdiθto] (*dicto*) 'I dictate', [aθtuˈaɾ] (*actuar*) 'to act').

Word-internal coda stops can also be deleted (e.g. *sé*[∅]*timo* (*séptimo*) 'seventh'; a[∅]*ción* (*acción*) 'action'). The stops /p, b, t, d/ can also acquire a velar point of articulation (e.g. [ˈpeksi] 'Pepsi'; [ˈpiksa] 'pizza') (see González 1991; Díaz-Campos 1999; Bongiovanni 2014), as in Venezuelan Spanish, although these pronunciations can also be heard in Peninsular Spanish. Coda deletion is very common in words containing orthographic *x* ([ks]) followed by an onset consonant in nonaspirating Peninsular Spanish (e.g. *e*[s]*traño* (*extraño*) 'strange'; *e*[s]*celente (excelente)* 'excellent').

Complex codas involving a stop are also possible when followed by /s/, as in *o*[βs]*tinación* 'obstination' or *a*[ðs]*crito* (adscrito) 'assigned, appointed', usually pronounced as voiced approximants. These approximants can be further weakened in cases such as *a*[$_{\text{ð}}$s]*crito* or even deleted (see Navarro Tomás 1932). Word-internal complex codas made up of a coronal nasal /n/ plus /s/ are also allowed, but the nasal is usually deleted in less affected speech (e.g. [kostituˈθjon] (*constitución*) 'Constitution').

Despite the alleged gradient nature of these neutralization processes as described by Hualde (2005) and Navarro Tomás (1932), they are grounded on general phonological principles. If one takes the two end points of the gradient scale, on one end we find voiceless stops, usually found in emphatic speech. Devoicing of stops in coda position is a well-attested neutralization process in the world's languages. On the other end of the scale, the voiced approximant is the result of a process of spirantization (see the chapter "Spirantization and the Phonology of Spanish Voiced Obstruents"). Spirantization can be seen as a weakening process targeting stops syllabified in nonprominent syllabic positions, such as the coda, as a way to increase their sonority. Formally, this process can be interpreted as the left-to-right spreading of the feature [+continuant] of the vowel to its neighboring consonant in the rhyme. Whether the voice specification of the following onset plays a role in voicing or partially voicing the previous coda stop is an issue that is addressed in neither Navarro Tomás (1932) nor Hualde (2005), and it merits exploration in further studies.

I want to close this subsection by briefly outlining Hualde's (1989) neat description of final obstruent processes in Spanish. In word-internal syllable-final position, there is neutralization of both voice and continuancy (e.g. *di*[ɡ~k~ɣ~x]*no* (*digno*) 'worthy'; Hualde 1989: 35). Before a voiceless consonant, however, voiceless realizations are virtually mandatory (e.g. *a*[t~θ.k]*irir* (*adquirir*) 'to acquire'; Hualde 1989: 33, 35). In word-final position, there is only neutralization of voice, and never of continuancy. Therefore, a word like *inpu*[t] (*input*) 'input' cannot be pronounced as **inpu*[θ], the same way *pe*[θ] (*pez*) 'fish' cannot be pronounced as **pe*[t] (Hualde

1989: 35). Moreover, voice neutralization in word-final position is unidirectional: underlying voiced stops can undergo devoicing (after spirantization) (e.g. *se*[θ] (*sed*) 'thirst'; cf. *se*[ð]*iento* (*sediento*) 'thirsty'), but voiceless fricatives cannot undergo voicing (e.g. *lápi*[θ] (*lápiz*); cf. **lápi*[ð]; only velar voiceless stops can undergo voicing if also spirantized: /koɲak/ → [koˈɲak~ɣ~∅], Hualde 2005). Hence, in the underlying representation of morphemes, voiceless stops and fricatives can be postulated (e.g. *perdi*/θ/ → *perdi*[θ] 'partridge' and *perdi*[θ]*es* 'partridges'; *che*/f/ → *che*[f] 'chef' and *che*[f]*azo* 'chef.AUG'; *coña*/k/ → *coña*[k] 'cognac' and *coña*[k]*ito* 'cognac.DIM'), as well as voiced stops, which undergo spirantization and sometimes devoicing (e.g. *verda*/d/ → *verda*[ð~θ] 'truth' but *ver*[ð]*ades* 'truths'; *pu*/b/ → *pu*[f] 'pub' but *pu*[β]*s* 'pubs').

3.4.3. A case of phonological opacity involving voicing assimilation, spirantization, and devoicing

Martínez-Gil (1991) described an interesting colloquial variety of north-central Peninsular Spanish, which Morris (2002) analyzed in OT with local constraint conjunction. In this variety, voicing assimilation, spirantization, and devoicing interact in such a way that a parallel OT analysis with standard constraints cannot account for the facts. Contrastive voiced stops /b, d, ɡ/ are spirantized and also devoiced in coda position ([ɸ, θ, x]), as shown in (41).

(41) Spirantization and devoicing of underlying voiced stops (Morris 2002)

[aɸðiˈkaɾ]	*abdicar*	'to abdicate'
[aɸsoˈluto]	*absoluto*	'absolute'
[aθmiˈɾaɾ]	*admirar*	'to admire'
[aθxunˈtaɾ]	*adjuntar*	'to adjoin'
[ˈdixno]	*digno*	'worthy'
[ˈθixθax]	*zigzag*	'zigzag'

Voiceless stops followed by voiceless consonants faithfully surface as such, that is, with no spirantization (42).

(42) Faithful mapping of underlying voiceless stops (Morris 2002)

[ˈapto]	*apto*	'apt'
[eˈklipse]	*eclipse*	'eclipse'
[etˈθeteɾa]	*etcètera*	'et cetera'
[aktuˈaɾ]	*actuar*	'to act'
[ˈfɾak ˈt͡ʃiko]	*frac chico*	'small tuxedo'
[koˈɲak fɾanˈθes]	*coñac francès*	'French cognac'

However, the same voiceless stops spirantize, [ɸ, θ, x], when followed by a voiced consonant. The voiceless stops /p, t, k/ thus neutralize with the voiced stops /b, d, ɡ/ before voiced consonants in favor of [ɸ, θ, x], a case of structure-building neutralization (43).

(43) Spirantization of voiceless stops before voiced consonants (Morris 2002)

[ˈeθniko]	*étnico*	'ethnic'
[ˈriθmo]	*ritmo*	'rhythm'
[ˈfuθβol]	*fútbol*	'football'
[ˈfɾax ˈɣɾande]	*frac grande*	'big tuxedo'
[koˈɲax ˈmalo]	*coñac malo*	'bad cognac'

Morris (2002) assumes that in this variety there is a process of partial voicing assimilation. A partially assimilated coda obstruent is achieved by spreading the Laryngeal node of the following onset consonant to the stop coda without delinking the original Laryngeal specification of the coda. In the serial rule derivation in (44), voicing assimilation partially assimilates all coda stops to the voicing specification of the following consonant. Both /adxuntaɾ/ and /ritmo/, with opposite underlying voicing specifications, become a partially assimilated coda with respect to [voice]; the intermediate representations are ad^{t}xuntaɾ and rit^{d}mo. The next rule, spirantization, targets only stops that are voiced or partially voiced. This is why spirantization equally targets /admiɾaɾ/, and the intermediate representations <ad^{t}xuntaɾ> and <rit^{d}mo>, with some degree of voicing, but not <apto>, to which voicing assimilation applies vacuously. The third rule, devoicing, gets rid of all [+voice] specifications, and therefore all coda stops surface as voiceless fricatives except for [apto]. If voicing assimilation were total instead of partial, an input like /adxuntaɾ/ would devoice due to voicing assimilation, giving the intermediate representation <atxuntaɾ>, no spirantization could target the voiceless stop <t>, and therefore the derivation would wrongly predict *[atxunˈtaɾ] as the final output form.

(44) Serial rule derivation (based on Morris 2002)

input	/admiɾaɾ/	/adxuntaɾ/	/apto/	/ritmo/
voicing assimilation		ad^{t}xuntaɾ		rit^{d}mo
spirantization	aðmiɾaɾ	að^{θ}xuntaɾ		riθ^{ð}mo
devoicing	aθmiɾaɾ	aθxuntaɾ		riθmo
output	[aθmiˈɾaɾ]	[aθxunˈtaɾ]	[ˈapto]	[ˈriθmo]

This is a case of counterbleeding opacity (Bakovic 2011), a situation in which a phonological generalization overapplies, in the sense that the structural context that makes a phonological process applicable is wiped out by the application of a subsequent rule. Spirantization always applies before voiced consonants, as in [aθmiˈɾaɾ] and [ˈriθmo]. Before voiceless consonants, however, it does not apply, as in [ˈapto]. The opaque output form is [aθxunˈtaɾ], in which spirantization overapplies. In a rule-based derivational framework, this form is explained by ordering spirantization, which crucially depends on partial voicing assimilation, before devoicing. In fact, if voicing assimilation were considered a categorical process in this serial analysis, then contradictory rule orderings would be needed for different inputs.

In OT, an output-oriented theory with no access to intermediate representations, phonological opacity constitutes an important challenge. As illustrated in (45), OT cannot select the actual opaque output [aθxunˈtaɾ] and wrongly selects instead the transparent candidate [atxunˈtaɾ]. This is so because candidate (45a), the wrongly selected candidate, satisfies all the markedness constraints that the actual output (45b) also satisfies, but it does so by violating one faithfulness constraint fewer; the extra violation of Ident-[continuant] by the actual output form (45b) seems gratuitous. The definitions of the three markedness constraints used in (45) appear in (46). Candidates in the following OT tableaux are final output forms with no partial voicing assimilation.

(45) OT wrongly selects the transparent candidate *[atxuntaɾ]

/adxuntaɾ/	Agr-[vc]/stop	*VcdStp/Coda	*VcdObs/Coda	Id-[vc]	Id-[cont]
☞ a. atxuntaɾ				*	
:(b. aθxuntaɾ				*	*
c. aðxuntaɾ			*		
d. adxuntaɾ	*	*	*		

(46) Markedness constraints

Agree-[voice]/stop (based on Morris 2002):
Assign one violation mark for every stop in the output that does not agree in voicing with the following consonant (it triggers stop voicing assimilation).
*VcdStp/Coda:
Assign one violation mark for every voiced stop in coda position (it triggers voiced stop spirantization).
*VcdObs/Coda:
Assign one violation mark for every voiced obstruent in coda position (it triggers obstruent coda devoicing).

During the past fifteen years, different versions of OT have been developed to account for phonological opacity. In this chapter, we will analyze these data within one such version, McCarthy's (2007) OT with Candidate Chains (OT-CC). In OT-CC, candidates are evaluated in parallel, but they consist of chains that link the first member of the chain, which is always the fully faithful parse of the input, to the terminal of the chain, which corresponds to the final output, through intermediate representations. Every change from one form in a candidate chain to the adjacent form must be gradual (every change must introduce one change at a time), and harmonically improving (every change must conform with the language-particular constraint hierarchy). A gradual change is defined in terms of one violation of a faithfulness constraint. The conditions on gradualness and harmonic improvement restrict candidates to a finite set, instead of the infinite candidate set that automatically derives from parallel OT. Opacity in OT-CC emerges as an optimal solution to satisfy a constraint called Precedence(A, B), where A and B correspond to faithfulness constraints; this constraint forces a particular ordering between these two faithfulness violations between consecutive members of a candidate chain. Precedence(A, B) constraints thus have the effect of simulating rule ordering.

In (47) we present the set of constraint rankings necessary to derive the three operations involved in the opaque pattern described so far: stop voicing assimilation, devoicing, and spirantization. The set of gradual and harmonically improving chains that derives from the rankings established in (47) are illustrated in (48).

(47) Constraint rankings

Agree-[voice]/stop >> Ident-[voice] (stop voicing assimilation)
*VoicedObstruent/Coda >> Ident-[voice] (devoicing)
*VoicedStop/Coda >> Ident-[continuant] (spirantization)

(48) Possible gradual and harmonically improving chains

Because of Agree-[voice]/stop >> Ident-[voice]:
< . . . d.C[–vc], t.C[–vc] . . . >
< . . . t.C[+vc], d.C[+vc] . . . >
Because of *VoicedObstruent/Coda >> Ident-[voice]:
< . . . d.C, t.C. . . >
< . . . ð.C, θ.C. . . >
Because of *VoicedStop/Coda >> Ident-[continuant]:
< . . . d.C, ð.C. . . >

A candidate chain like *< . . . t.C[–vc], d.C[–vc] . . . >, for instance, cannot be generated because, although it is gradual, it is not harmonically improving; coda voicing violates top-ranked *VoicedObstruent/Coda and also Ident-[voice]. The chain *< . . . t.C, θ.C. . . > is also impossible to generate because spirantization of a voiceless stop adds a gratuitous violation of Ident-[continuant] with no improvement in markedness. Another impossible chain is, for instance, *< . . . t.C[+vc], ð.C[+vc] . . . >, in this case because it violates gradualness; two operations have been applied at once, voicing and spirantization.

The precedence constraint that will be crucial in the analysis is Precedence(Ident-[continuant],Ident-[voice]), defined in (49). This precedence constraint penalizes candidate chains in which Ident-[voice] is violated and this violation is not preceded by a violation of Ident-[continuant].

(49) Precedence(Ident-[continuant],Ident-[voice])

Assign one violation mark for every violation of Ident-[voice] that is not preceded by a violation of Ident-[continuant].

Once the rankings and potential candidate chains have been presented, the analysis follows easily. In OT-CC, markedness constraints evaluate only the final form of the chain, and faithfulness constraints assess each successive step within the chain. Consider the input /admiɾaɾ/. Candidate (50c), in which only devoicing has applied, violates both Agree-[voice]/stop and Precedence(Ident-[continuant],Ident-[voice]), because the violation of Ident-[voice] is not preceded by a violation of Ident-[continuant]. Candidates (50d) and (50e) violate *VoicedObstruent/Coda, and candidate (50e) also violates *VoicedStop/Coda. Both candidates (50a) and (50b) share the same terminal form in the chain, but only candidate (50a) satisfies Precedence(Ident-[continuant],Ident-[voice]), because in candidate (50b) devoicing does not follow spirantization. In this tableau, the only observable ranking argument is *VoicedObstruent/Coda >> Ident-[voice].

(50) Tableau for /admiɾaɾ/ → [aθmiˈɾaɾ]

/admiɾaɾ/	Agr-[vc]/stop	*VcdObstr/C	*VcdSt/C	Prec(Id-[cont], Id-[vc])	Id-[vc]	Id-[cont]
☞ a. <d.m,ð.m,θ.m>					*	*
b. <d.m,t.m,θ.m>				*W	*	*
c. <d.m,t.m>	*W			*W	*	L
d. <d.m,ð.m>		*W			L	*
e. <d.m>		*W	*W		L	L

The activity of the precedence constraint is relevant for an input like /adxuntaɾ/, which opaquely maps onto [aθxunˈtaɾ], with overapplication of spirantization. The fully faithful candidate (51d) in (51) violates all three undominated markedness constraints. Candidate (51c), the transparent candidate with only devoicing, fatally violates the precedence constraint, because devoicing is not preceded by spirantization. Candidate (51b), with only spirantization, is ruled out because it violates *VoicedObstruent/Coda, and therefore candidate (51a), with first spirantization and then devoicing, is selected as the most harmonic candidate. The precedence constraint thus dominates Ident-[continuant].

(51) Tableau for /adxuntaɾ/ → [aθxunˈtaɾ]

/adxuntaɾ/	Agr-[vc]/stop	*VcdObstr/C	*VcdSt/C	Prec(Id-[cont], Id-[vc])	Id-[vc]	Id-[cont]
☞ a. <d.x,ð.x,θ.x>					*	*
b. <d.x,ð.x>		*W				*
c. <d.x,t.x>				*W	*	L
d. <d.x>	*W	*W	*W		L	L

For an input like /ritmo/, a crucial ranking is discovered: Agree-[voice]/stop >> Precedence(Ident-[continuant],Ident-[voice]) (52). The winning candidate violates the precedence constraint because voicing is not preceded by spirantization, but this is the only way to satisfy Agree-[voice]/stop, the markedness constraint against stops that do not assimilate in voicing, violated by candidate (52d).

(52) Tableau for /ritmo/ → [ˈriθmo]

/ritmo/	Agr-[vc]/st	*VcdObstr/C	*VcdSt/C	Prec(Id-[cont],Id-[vc])	Id-[vc]	Id-[cont]
☞ a. <t.m,d.m,ð.m, θ.m>				*	*	*
b. <t.m,d.m,ð.m>		*W		*	*	*
c. <t.m,d.m>		*W	*W	*	*	L
d. <t.m>	*W			L	L	L

Finally, the input /apto/ faithfully maps onto [apto], with no spirantization. With such an input, there is no possible candidate chain but the one that contains only a fully faithful parse of the input: <apto>. A chain like <p.t,ɸ.t. . . > is not harmonically improving because spirantization targets only voiced stops. Another illegal chain is <p.t, b.t. . . > because coda voicing is never harmonically improving given the assumed set of universal constraints in OT.

4. Conclusions

In this chapter, we have reviewed the notions of contrast and neutralization in OT as implemented by positional faithfulness and Dispersion Theory, and we have surveyed some relevant neutralization processes in Spanish. An intricate case of phonological opacity present in some varieties of north-central Peninsular Spanish in which devoicing opaquely interacts with both spirantization of voiced stops and stop voicing assimilation has also been analyzed in OT-CC. Besides the descriptive side of the chapter, we hope to have offered a comprehensive look at how OT can deal with phonemic contrast, contrast neutralization, and also phonological opacity.

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2

Spirantization and the phonology of Spanish voiced obstruents

Fernando Martínez-Gil

1. Introduction

In standard varieties of Spanish, the voiced-obstruent phonemes /b, d, g/ exhibit two sets of allophonic realizations in complementary distribution: in some environments, they surface as stops [b, d, g]; in the complementary set of environments, they are realized as spirants [β, ð, ɣ] or as the corresponding approximants [β̞, ð̞, ɣ̞] (with possible intermediate realizations reflecting various degrees of constriction; cf. Martínez Celdrán 1991, 2004; Quilis 1999, 2000: 221–224; Piñeros 2002; Hualde 2005: 141–143; Colina, forthcoming), a lenition process commonly known as *spirantization*. For convenience, the cover symbols [β, ð, ɣ] will be used in this chapter to represent any of the [+continuant] allophonic variants. An essentially identical surface distribution is found at the palatal place of articulation, but here (not unexpectedly, given the high markedness of palatal stops) the complementary distribution is between a plosive, implemented phonetically as either a mid-palatal affricate [$ɟ^{ʝ}$] (sometimes transcribed as [ɟ͡ʝ]), a mid-palatal stop [ɟ], or an alveopalatal affricate [ǰ], depending on the particular dialect; a mid-palatal continuant [ʝ̞] occurs elsewhere.

For dialectal variation of the voiced palatal obstruent, cf. Alonso 1967; Navarro Tomás 1977: 129–131; Saciuk 1980; Lipski 1989; Harris and Kaisse 1999; Díaz-Campos and Morgan 2002; Hualde 2005: 165ff., Real Academia Española (henceforth, *RAE*) 2011: 175ff., Scarpace et al. 2015; Campos-Astorkiza 2018: 170–171, among others). All the preceding realizations are represented by *ll*, *y*, and *hi* in standard Spanish orthography: *lleno* [ˈ$ɟ^{ʝ}$eno] ‘full’, *calle* [ˈkaʝ̞e] ‘street’, *yema* [ˈ$ɟ^{ʝ}$ema] ‘yolk’, *mayo* [ˈmaʝ̞o] ‘May’, *hielo* [ˈ$ɟ^{ʝ}$elo] ‘ice’, etc. Some dialects (sometimes referred to as *ieísta* dialects in Zampaulo forthcoming) lack the voiced palatal obstruent and have instead the palatal glide [j].

The phonological characterization of Spanish voiced obstruents has been undoubtedly among the most intensely debated theoretical topics of Spanish phonology during the past few decades, and the data have been analyzed from almost every conceivable theoretical persuasion, especially within the generative theoretical framework. The debate has centered around two primary issues: (a) the phonological nature of the underlying segments and (b) the formal mechanisms required to provide an adequate account of the observed surface allophonic distribution.

Among the consonants of the phonemic inventory of Spanish, voiced obstruents are among the most phonologically active class. That is, underlying voiced obstruents of Spanish can be affected by at least the following seven distinct phonological processes (see also González, this volume).

With the exception of spirantization, the remainder of the processes in question usually occur in colloquial speech. As is typical in this style, they are highly variable and conditioned by factors that are both linguistic and extralinguistic (stylistic, dialectal, sociolinguistic, or any combination thereof) in nature. Here and in subsequent examples, syllable boundaries are indicated by periods in phonetic transcriptions whenever deemed relevant for the sake of clarity.

1) *Spirantization* (the main topic of this chapter): it occurs in postvocalic position as the most frequent environment: *nube* [ˈnu.ße] 'fog', *piedra* [ˈpje.ðɾa] 'stone, rock', *rayo*[ˈra.ɟo] 'beam', *lago* [ˈla.ɣo] 'lake' (for references, see §2).
2) *Voicing assimilation* to a following voiceless obstruent: *obtener* [oɸ.te.ˈneɾ] 'to obtain', *absurdo* [aɸ.ˈsuɾ.ðo] 'absurd', *subsidio* [suɸ.ˈsi.ðjo] 'subsidy', *obsesión* [oɸ.se.ˈsjon] 'obsession', *adquirir* [aθ.ki.ˈɾiɾ] 'to acquire', *adjuntar* [aθ.xũn̪.ˈtaɾ] 'to enclose', *Agfa* [ˈax.fa] (name). As pointed out by Navarro Tomás (1977: 83–84, 86–87, 97, 138–140), voicing assimilation can be partial: *absurdo* [aßɸ.ˈsuɾ.ðo], *adquirir* [aðθ.ki.ˈɾiɾ], *Agfa* [ˈaɣ^{x}.fa] (for further discussion on complete and partial assimilation of underlying voiced stops, see also Malmberg 1965: 43ff.; Cressey 1978: 74–75; Lozano 1979; Martínez Martín 1983: 129ff.; Quilis 1999: 205–206, 2000: 191; Martínez-Gil 1991, 2003; Morris 1998, ch. 3; Lewis 2001; Hualde 1989: 32–33, 2005: 148; RAE 2011: 140; Campos-Astorkiza 2012, 2015, 2018; González, this volume). In addition, voiced spirants may be derived in colloquial speech by voicing assimilation of voiceless stops to a following voiced consonant, most commonly a nasal: *hipnósis* [iß.ˈno.sis] 'hypnosis', *apnea* [ˈaß.ne.a] 'apnea', *ritmo* [ˈrið.mo] 'rhythm', *étnico* [ˈeð.ni.ko] 'ethnic', *hallazgo* (*z* = /θ/) [a.ˈɟað.ɣo] 'finding', *juzgar* [xuð.ˈɣaɾ] 'to judge', *acné* [aɣ.ˈne] 'acne', *McDonalds* [maɣ.ˈðo.nals] (name), etc. (cf. Hualde 1989, 2005: 146). Assimilation of a voiceless stop to a following voiced consonant can also be partial: *hipnosis* [iɸ^{ß}.ˈno.sis] 'hypnosis', *ritmo* [ˈriθ^{ð}.mo] 'rhythm', etc. (Martínez-Gil 2003). Voicing assimilation and spirantization contribute in part to the general process of neutralization of voicing and continuant features in Spanish coda obstruents (Quilis 1999: 204–205). In certain dialects (e.g., the Canary Islands, Panama, Chile, coastal Ecuador and Peru), voiceless stops may emerge as voiced ones in colloquial speech, but fail to spirantize: *zapato* [sa.ˈba.do] 'shoe', *siete* [ˈsje.de] 'seven', *cochino* [koˈɟʲi.no] 'swine, pig', *época* [ˈe.bo.ga] 'epoch' (Trujillo 1981; Oftedal 1985, ch. 7; Dorta and Herrera Santana 1993; Quilis 1999: 222–224; Lewis 2001; Hualde 2005: 143, 164; RAE 2011: 139; Campos Astorquiza 2018). The failure of underlying voiced stops to spirantize when they become voiced can be readily interpreted as a way of rendering the underlying distinction between voiceless and voiced stops as a stop vs. spirant contrast in surface representations (Hualde 2005: 143). In yet other dialects (including central and southern Spain, as well as Caribbean Spanish), such voicing occurs in combination with spirantization, thereby effectively wiping out the underlying distinction between voiced and voiceless stops: *zapatero* [sa.ßa.ˈte.ɾo] 'shoemaker', *pata* [ˈpa.ða], 'leg (of an animal)', *caracol* [ka.ɾa.ˈɣol] 'snail' (RAE 2011: 139).

I have been unable to find any recent experimental work that deals explicitly with the assimilation, whether partial or total, of Spanish underlying voiced stops to a following voiceless consonant.

3) *Devoicing* (combined with spirantization in some dialects) in syllable-final position, both within words and word-finally: *abnegar* [aɸ.ne.ˈɣaɾ] 'to renounce, abnegate', s*ubyugar* [suɸ.ɟu.ˈɣaɾ] 'to subdue, subjugate', *advertir* [aθ.ßeɾ.ˈtiɾ] 'to notice', *admitir* [aθ.mi.ˈtiɾ] 'to admit',

dogma [ˈdox.ma] ‘dogma’, *ignorar* [ix.no.ˈɾaɾ] ‘to ignore’, *club* [ˈkluɸ] ‘club’, *ciudad* [θju.ˈðaθ] ‘city’, etc. In other varieties, voiced-obstruent devoicing produces voiceless stops: *abnegar* [ap.ne.ˈɣaɾ], *advertir* [at.ßeɾ.ˈtiɾ], *ignorar* [ik.no.ˈɾaɾ], etc. (for devoicing in a variety of Spanish dialects, see Flórez 1951: 140ff.; Amado Alonso 1945; Navarro Tomás 1977: 101, 103; Canfield 1981: 67; Martínez Martín 1983: 130ff.; Becerra 1985: 183–189; Hualde 1989: 34–37; 2005: 19–20, 146–148; Martínez-Gil 1991, 2003; Mascaró 1995: 286–287; Antón 1998; González 2006a, 2006b; RAE 2011: 139–140; Campos-Astorkiza 2012, 2018, among others). In the dialects that exhibit voiced-obstruent devoicing, the result cannot be distinguished from assimilation to a following voiceless obstruent, since both processes produce an identical result. For example, the surface realization [aθ.ki.ˈɾiɾ] (for *adquirir* ‘to acquire’) can be derived either by voicing assimilation, by devoicing, or by the concurrent application of both (Hualde 1989: 33–34). In some Central Peninsular varieties (e.g., Madrid and surrounding areas), devoicing is accompanied by *coronalization* of /b, g/ to [θ]: *obtener* [oθ.te.ˈneɾ] ‘to obtain’, *dignidad* [diθ.ni.ˈðaθ] ‘dignity’ (Quilis 1965; Martínez Martín 1983: 132ff., 189ff.; Gibson 2010: 64; Molina Martos 2010; Hualde and Eager 2016).

4) *Gemination* by means of total assimilation, especially of /b, g/, to a following consonant: *submarino* [sum.ma.ˈɾi.no] ‘submarine’, *subterráneo* [sut.te.ˈra.ne.o] ‘underground’, *obtener* [ot.te.ˈneɾ] ‘to obtain’, *ignorar* [in.no.ˈɾaɾ] ‘to ignore’, *digno* [ˈdin.no] ‘deserving, worthy of’ (Henríquez Ureña 1938: 346–347, 1940: 346; Flórez 1951: 164; López Morales 1971: 130; Zamora and Guitart 1982: 109; Oftedal 1985: 57, 75, 97; García Martínez 1986: 99; D’Introno et al. 1995: 262ff.; Narbona et al. 2003: 188–189, among others). A special type of gemination, well attested in both Havana and Santo Domingo Spanish, arises by total assimilation of a liquid /l, r/ to a following oral stop, resulting in a geminate stop: *curva* [ˈkub.ba] ‘curve’, *falda* [ˈfad.d]a ‘skirt’, *ver lluvia* [ˈbeɟ.ˈɟu.ßja] ‘to see rain’, *algo* [ˈag.go] ‘something’ (Henriquez Ureña 1940: 148; López Morales 1971: 134; Guitart 1980, 2004; Zamora and Guitart 1982: 127–128; Harris 1985; Lipski 1994: 67; Hualde 2005: 108, 145; Santana Cepero 2006; Martínez-Gil 2012: 124–125).
5) *Velarization/glottalization*, often combined with *devoicing*, of /b/ (and, less commonly, also /d/) into [k]/[ʔ], respectively. It occurs mainly in Caribbean and Andean Spanish: *observar* [ok.seɾ.ˈßaɾ]/[oʔ.seɾ.ˈßaɾ] ‘to observe’, *abdomen* [ak.ˈdo.mẽ]/[aʔ.ˈdo.mẽ] ‘abdomen’, *admirar* [ak.mi.ˈɾaɾ]/[aʔ.mi.ˈɾaɾ] ‘to admire’, *advertir* [ak.ßeɾˈtiɾ]/[aʔ.ßeɾˈtiɾ], etc. (Henríquez Ureña 1940: 140; Chela Flores 1980; Canfield 1981: 11, 65; Guitart 1976: 23–26, 48; 1978, 1980, 1981; Zamora and Guitart 1982: 113–114; Obediente 1998; Hualde 2005: 146; Brown 2006; Moreno-Fernández 2011: 63; RAE 2011: 143–144, among others).
6) *Vocalization*, both in coda position (*observar* [ow.seɾˈßaɾ] ‘to observe’, *admirar* [aj.mi.ˈraɾ] ‘to admire’, *magnífico* [maj.ˈni.fi.ko]/ [maw.ˈni.fi.ko] ‘fantastic’) and before a tautosyllabic liquid in a complex onset (*pobre* [ˈpow.ɾe] ‘poor’, *diablo* [ˈdjaw.lo] ‘devil’, *ladrón* [laj.ˈɾon] ‘thief’, *lágrimas* [ˈlaj.ɾi.mas]/[ˈlaw.ɾi.mas] ‘tears’, *regla* [ˈrej.la]/[ˈrew.la] ‘rule(r)’). This vocalization pattern has been observed Chilean Spanish, as well as some other American Spanish varieties (Lenz 1940: 147ff.; Flórez 1951: 140; Navarro Tomás 1948: 60; Malmberg 1965: 30, 36–37; Oroz 1966: 139–144; Hooper 1976: 216; Martínez-Gil 1997; Piñeros 2001; Lipski 2011; RAE 2011: 138).
7) *Deletion*. Deletion of /b/ is common before another /b/ and before a tautosyllabic /s/: *subvención* [su.ßeṇ.ˈθjón] ‘subsidy’, *substancia* [sus.ˈtaṇ.θja] ‘substance’, *obstruir* [os.ˈtrwiɾ], *abstemio* [as.ˈte.mjo] ‘abstemious’. Deletion of /d/, on the other hand, occurs frequently in intervocalic position in Peninsular Spanish and in certain American varieties, in

the past participle *-ado* ending of 1st conjugation verbs (*conta<u>d</u>o* [kon̪.ˈta.o] 'counted', *compra<u>d</u>o* [kom.ˈpɾa.o] 'bought', etc.), and also in frequently occurring nouns ending in *-ado*, such as *la<u>d</u>o* [ˈla.o] 'side', *pesca<u>d</u>o* [pesˈka.o] 'fish'. In Andalusian Spanish and many American varieties, /d/ deletes variably in intervocalic position (*pe<u>d</u>azo* [pe.ˈa.so] 'piece, bit', *merca<u>d</u>o* [meɾ.ˈka.o] 'market', *comi<u>d</u>a* [ko.ˈmi.a] 'food', etc.). Deletion of /g/ occurs frequently before a nasal in colloquial speech: *digno* [ˈdi.no] 'worthy', *ignorante* [i.no.ˈɾãn̪.te] 'ignorant'. Word-final deletion of /d/ is also very common in colloquial speech: *ciuda<u>d</u>* [θju.ˈða] 'city, town', *verda<u>d</u>* [beɾ.ˈða] 'truth' (studies that describe voiced-obstruent deletion include Flórez 1951: 139ff; Oroz 1966: 145–149; Hooper 1976: 216; D'Introno and Sosa 1979; Canfield 1981: 11, 67; Martínez Martín 1983: 178ff.; Becerra 1985: 122–133; Bybee 2001: 148–153; Lipski 2011; Narbona et al. 2003: 196–197; Hualde 2005: 19–22, 29, 147; Obediente 2005: 299; González 2006b, 2009; Moreno-Fernández 2011: 64–65; RAE 2011: 142–143, 146–148; Díaz-Campos 2014: 24–25, among others).

This chapter has two primary goals. The first is to review a wide array of data, from both standard Spanish varieties and nonstandard dialects often left out in most influential accounts. In doing so, a number of issues, both theoretical and empirical, will be addressed that bear directly on the allophonic distribution of Spanish voiced obstruents but that either have not been adequately addressed in previous phonological analyses or have been overlooked altogether, in spite of their relevance for advancing our understanding of the phonological behavior of voiced obstruents. The second objective is to present an analysis of the allophonic distribution of voiced obstruents within the framework of *Optimality Theory* (OT) that appeals to the interaction of markedness and markedness constraints, the most basic formal mechanism of standard OT (cf. McCarthy 2002; Prince and Smolensky 2004 [1993]). A primary goal of this analysis is to be more comprehensive than other available OT accounts in terms of empirical coverage, and at the same time provide a principled solution to some of the shortcomings that haunted earlier approaches.

In this chapter I follow the spirit of Mascaró's (1984) proposal and interpret the allophonic distribution of Spanish voiced obstruents as a process of progressive assimilation of either value of the feature [cont(inuant)] to a preceding segment, framed in the Optimality theoretical model. In particular, my analysis invokes two basic markedness constraints, which often conflict with each other: Agree-[cont], which demands agreement between a voiced obstruent and a preceding segment's specification for the feature [cont], and VoiObs-[−cont], which favors the unmarked status of voiced stops over voiced continuants. In turn, these two markedness constraints dominate Ident-[cont], a faithfulness constraint that requires that the output specification for the feature [cont] be identical to that of the input. The core facts of the allophonic distribution of underlying voiced obstruents in standard Spanish varieties are shown to follow directly from the ranking Agree-[cont] >> VoiObs-[−cont] >> Ident-[cont], independently of whether underlying stops or spirants are assumed, in compliance with the familiar OT principle known as the *Richness of the Base*. Finally, with the addition of some additional constraints, as well as the permutation of the proposed constraint ranking, following the key OT notion of *factorial typology*, the present analysis will be extended to cover some of the basic patterns of stylistic and dialectal variation described in the preceding paragraphs; in particular, those in which spirantization interacts with other phonological phenomena in the language, including devoicing, gemination, velarization/glottalization, and voicing assimilation.

2. Spirantization in standard and dialectal Spanish

2.1. The data: spirantization in standard varieties

Consider the underlying obstruent system of most contemporary standard Spanish varieties in (1):

(1) Underlying system of Spanish obstruents

		labial	*dental*	*alveolar*	*palatal*	*velar*
Stops	voiceless	p	t			k
	voiced	b	d		ɟ	g
Affricates	voiceless				č	
	voiced					
Fricatives	voiceless	f	(θ)	s		x
	voiced					

The characterization of the voiced obstruents as underlying stops in (1) is a working hypothesis adopted in this chapter, shown to be strongly supported by the facts about Spanish complex-onset phonotactics discussed later. However, in line with the *Richness of the Base* postulate in OT, it will become apparent that the analysis proposed in this chapter generates the observed stop ~ spirant surface distribution of voiced obstruents independently of whether stops, fricatives, or underspecified (archiphonemic) segments are assumed at the underlying level.

In their comprehensive and extremely detailed study of Spanish palatal consonants, Harris and Kaisse (1999) have argued that *all* surface manifestations of palatal voiced obstruents are the result of a fortition process that turns the underlying front glide /j/ into a voiced palatal obstruent when located in absolute syllable-initial position (cf. also Hualde 1997, 2004). While this analysis is well motivated when applied to a number of well-known cases involving front glide ~ palatal obstruent morphophonemic alternations (e.g., *re*[j] 'king' ~ *re.*[ʝ]*es* 'kings'), it becomes problematic for lexical items with no alternations, unless one invokes the so-called free-ride principle (cf. Cole and Hualde 2011) to account for nonalternating occurrences of surface [ɟʝ]/[ʝ]/. A more natural alternative in such cases would be to postulate an underlying stop /ɟ/.

Given the lack of any known evidence guiding language learners in Spanish to postulate an underlying glide when no alternations of glide ~ palatal consonant occur, I assume that the underlying segment is a palatal plosive /ɟ/. This assumption is guided by the overriding consideration that as far as the spirantization phenomenon is concerned, /ɟ/ exhibits the same phonological behavior as the other voiced stops /b, d, g/. The fact that the palatal voiced obstruent in syllable-initial position is more commonly realized as an affricate [ɟʝ] at the phonetic level is not unexpected, given the well-known difficulty of producing a complete oral closure at the palatal point of articulation. Another consideration would be the potential symmetry within the phonemic inventory of Spanish plosives: if the underlying stop /ɟ/ is posited, it would be the palatal counterpart of /b, d, g/.

In standard varieties of contemporary Spanish, voiced obstruents are found in complementary distribution, both within words and across word boundaries. As illustrated in (2), the *plosive* allophones occur (a) in word-initial position after a pause (i.e., in absolute phrase-initial position), as in (2a); and (b) after homorganic sonorants, namely, nasals and laterals, as in (2b–c) (nasals in Spanish are always homorganic to a following consonant, whereas laterals are homorganic only to a following coronal consonant; note further that in Spanish /ɟ/ does not occur after a liquid within words):

For data on spirantization, see Malmberg (1965: 51ff.) and Navarro Tomás (1977: 79–80, 84–87, 98–103, 129–131, 138–142). Further data and formal analyses of the process can be found in Harris (1969: 38–40, 1984), Cressey (1978: 67ff.), Lozano (1979), Torreblanca (1980), Mascaró (1984), Amastae (1986), Martínez-Gil (1991, 1997, 2003, 2012), Widdison (1997), Piñeros (2002), Hualde (1991: 99–106, 2005: 111–112, 141–144), González (2002, 2003, ch. 4, 2006a, 2006b), Eddington (2011), Colina (forthcoming), and references therein.

(2) Voiced obstruents surface as plosives

a. Word-initially after a pause:

‖ [b]ámonos	'let's go!'
‖ [d]ecídete	'make up your mind!'
‖ [ɟʲ]ámame	'call me!'
‖ [g]anaremos	'we will win'

b. After nasals:

within words		*across words*	
a[mb]os	'both'	so[m b]onitos	'they are pretty-MASC.'
cua[n̪d]o	'when'	cie[n̪ d]ías	'a hundred days'
co[ñɟʲ]uge	'spouse'	está[ñ ɟʲ]enos	'they are full'
fa[ŋg]o	'mud'	ha[ŋ g]anado	'they have won'

c. After a lateral:

within words		*across words*	
ca[l̪d]o	'broth'	mie[l̪ d]e abejas	'bee honey'
sue[l̪d]o	'salary'	crue[l̪ d]ictador	'cruel dictator'
		mi[ʎ ɟʲ]aves	'a thousand keys'
		a[ʎ ɟʲ]egar	'upon arriving'

Elsewhere, voiced obstruents are realized phonetically as the *continuants* [ß, ð, ʝ, ɣ] (or their corresponding approximants), as illustrated in (3), namely, (a) after vocoids (i.e., vowels and glides) (3a); (b) after any consonant other than a homorganic sonorant (3b); and (c) for the non-coronal voiced obstruents /b, g/ after a heterorganic lateral (3c) (the sequences /-jɟ-/, /-lɟ-/, and /-ɾɟ-/ do not occur word-internally in Spanish):

(3) Voiced obstruents surface as *continuants* [ß, ð, ʝ, ɣ] elsewhere

a. After vocoids:

within words		*across words*	
lo[ß]o	'wolf'	ese [ß]ino	'that wine'
co[ð]o	'elbow'	tarea [ð]ifícil	'difficult task'
ca[ʝ]e	'street'	compro [ʝ]eso	'I buy plaster'
la[ɣ]o	'lake'	tiene [ɣ]racia	'it is funny'
va[jß]én	'to and fro'	mu[j ß]ueno	'very good'
de[wð]a	'debt'	re[j ð]anés	'Danish king'
a[wʝ]ido	'howl, wail'	ho[j ʝ]ueve	'today it rains'
arra[jɣ]ar	'to establish'	ha[j ɣ]atos	'there are cats'

b. After continuant consonants:

ár[β]ol	'tree'	mar [β]asto	'vast sea'
per[ð]er	'to lose'	color [ð]istinto	'different color'
		comer [ʝ]ogur	'to eat yogurt'
car[ɣ]a	'load'	marcar [ɣ]oles	'to score goals'
des[β]iar	'to deflect'	más [β]arato	'cheaper'
des[ʝ]elo	'thaw, melting'	otras [ʝ]aves	'other keys'
des[ð]e	'from, since'	tres [ð]isparos	'three gunshots'
mus[ɣ]o	'moss'	das [ɣ]racias	'you thank'

c. For noncoronal voiced obstruents also after non-homorganic laterals:

ol[β]idar	'to forget'	papel [β]erde	'green paper'
		el [ʝ]avero	'the keychain'
al[ɣ]a	'seaweed'	leal [ɣ]errero	'loyal warrior'

The stop ~ spirant distribution frequently gives rise to phonological alternations whenever a voiced obstruent is morpheme-initial at the lexical level, depending on the [cont] value of the final segment of a preceding prefix (4a), or word-initial at the phrase level (4b):

(4) Stop ~ continuant alternations

a. Within words:

com-[b]atir	'to combat'	vs.	de-[β]atir	'to debate'
in-[d]ucir	'to induct'	vs.	re-[ð]ucir	'to reduce'
in- [ɟʝ]ección	'injection'	vs.	de-[ʝ]ección	'dejection'
in-[g]resar	'to enter'	vs.	re-[ɣ]resar	'to return'

b. Across words:

un [b]aso	'a glass'	vs.	este [β]aso	'this glass'
un [d]ía	'one day'	vs.	este [ð]ía	'this day'
un [ɟʝ]ate	'one yacht'	vs.	este [ʝ]ate	'this yacht'
un [g]ato	'one cat'	vs.	este [ɣ]ato	'this cat'

Voiced spirants also surface in syllable-final position before another voiced consonant located in the onset of the following syllable, including sonorants (5a) and voiced obstruents (5b):

(5)

a.		b.	
a[β].negado	'self-sacrificing'	a[β.ð]omen	'abdomen'
su[β].lunar	'sublunar	a[β.ð]icar	'to abdicate'
a[ð].mirar	'to admire'	su[β.ʝ]acente	'underlying'
a[ð].misión	'admission'	a[ð.β]verso	'adverse'
i[ɣ].norar	'to ignore'	ru[ɣ.β]y	'rugby'
ma[ɣ].ma	'magma'	su[β.ɣ]lotal	'subglottal'
ma[ɣ].no	'great, famous'	amíg[ɣ.ð]alas	'tonsils'

2.2. Previous approaches to spirantization

The most influential generative accounts of the spirantization process to date fall into four main types, classified on an approximate chronological basis:

I) *Classical* (*segmental*, *linear*) generative accounts: (1) voiced obstruents are stops at the underlying level; the continuant allophones arise by *spirantization* (abbreviated as *Spir* hereafter), implemented as assimilation of [+cont] from a preceding segment (Harris 1969; Cressey 1978); (2) voiced obstruents are underlying spirants; they undergo a *fortition* (*Fort*) process and become stops in the appropriate environments (Hammond 1976; Macken 1980; Danesi 1982).

II) *Autosegmental* analyses (1980s and early 1990s): voiced obstruents are unspecified underlyingly for the feature [cont] (a.k.a. the *archiphonemic/underspecification hypothesis* since Lozano 1979); their surface realization as either stops or spirants is the result of one of five general mechanisms: (a) the continuant allophones are created by a Spir process, resulting from the progressive assimilation of [+cont] from the preceding segment; the stop allophones arise as a consequence of a universal markedness principle that assigns [−cont] by default (e.g., Harris 1984, 1985; cf. also Goldsmith 1981; Amastae 1986, 1989, 1995; Martínez-Gil 1991, 2012; Palmada 1997); (b) the stop allophones arise from a Fort process, involving progressive assimilation of [−cont] from a preceding homorganic segment; the spirant allophones are created by a (language-specific) default assignment of the value [+cont] (Hualde 1989, 1991; cf. also Nemer 1984; Barlow 2003); (c) both set of allophonic realizations, spirants and stops, are the result of Spir and Fort, respectively, by progressive assimilation of a preceding segment's [cont] specification (Mascaró 1984; cf. also Mascaró 1991); (d) the feature [continuant] is assigned to voiced obstruents as a feature-filling rule; it fails to apply to homorganic clusters, because they already share the feature [−cont] Branstine (1991); and (e) Spir is a syllable-contact phenomenon, where the feature [+cont] is assigned by a rule sensitive to a minimal sonority distance between the voiced obstruent and the preceding segment (Carreira 1998).

III) *Optimality Theoretic* analyses. Most available OT accounts of the stop ~ spirant distribution of Spanish voiced obstruents have shied away, at least in spirit, from the notion of progressive assimilation prevalent in previous autosegmental treatments. They include, in chronological order: (1) Baković (1997): voiced obstruents are underlying approximants; they are mapped as stops in absolute initial position and after homorganic nasals and laterals in compliance with StrongOnset, a Fort-inducing markedness constraint interacting with feature geometry and other constraints; 2) Martínez-Gil (1997, 2003): voiced obstruents are stops at the underlying level. A Spir-inducing constraint requires that they agree with a the preceding segment for the value of the feature [cont]; 3) Carreira (1998): the surface stop ~ spirant distribution is determined by the feature geometry in conjunction with markedness constraints that prohibit homorganic sequences of non-continuant sonorant plus continuant voiced obstruent; the spirant allophones are enforced by a Voice-Cont constraint demanding that [+voice] segments be [+cont], itself outranked by markedness constraints requiring that nasals and laterals be [−cont]; (4) Morris (1998, 2002): voiced obstruents are underlying stops; they are mapped as spirants by a lenition constraint *[−cont] ("no stops") conjoined with License-[voice], and interacting with other (conjoined) constraints; 5) Piñeros (2002): voiced obstruents are stops underlyingly; spirants arise by a the domination of Lazy, a effort-minimization constraint assigned to the phonetic component, over identity constraints that require faithfulness to the [−cont] input, thereby compelling lenited allophones in the appropriate environments; 6) González (2006a): the stop ~ spirant allophonic variants emerge in the interaction of faithfulness constraints requiring input-output identity and phonetically grounded markedness constraints disfavoring surface segments that are difficult in articulatory, acoustic or perceptual terms; and 7) Colina (forthcoming): Spir arises by the combination of effort reduction constrains and underlying underspecification: voiced obstruents are unspecified for the feature [cont] in underlying forms, and remain so in the phonological component, where they contribute to minimizing articulatory effort, and become specified as either [−cont] or [+cont] upon entering the phonetic level, a position similar to that adopted in Mascaró (1991).

IV) *Phonetic/experimental studies*. The allophonic realization of voiced obstruents has also been the subject of a significant amount of phonetic (experimental) studies in the past two decades or so, including Martínez Celdrán (1991, 2004), Romero (1995), Cole et al. (1999), Soler and Romero (1999), Quilis (2000), Ortega-Llebaria (2004), Carrasco (2008), Hualde et al. (2011), Hualde et al. (2011), and Carrasco et al. (2012), among others.

2.3. Issues in the phonological characterization of voiced obstruents in standard Spanish

At least eight predominant issues can be identified that bear directly on the underlying nature and type of the formal mechanisms that are used to account for the allophonic distribution of Spanish voiced obstruents. They are briefly enumerated in (6):

(6)
a. The homorganicity/heterorganicity condition
b. The phrase-initial position problem
c. The postlateral problem
d. Voiced obstruents and complex-onset phonotactics
e. Voiced obstruents in slow and deliberate speech styles
f Spir, Fort, or both?
g. Assimilation or lenition?
h. The postnuclear issue in dialectal data

2.3.1. The homorganicity/heterorganicity condition

In several influential generative analyses of Spanish voiced obstruents, the rule that derives the stop allophones crucially appeals to the condition that they be homorganic with a preceding noncontinuant sonorant (Cressey 1978; Hualde 1989, 1991; Carreira 1998), as shown in the relevant portion of the rule formulations proposed by these authors (the homorganicity condition is circled for visual convenience). The example in (7) reflects a *heterorganicity* condition imposed on the Spir rule (based on Harris 1969: 40; the condition is contained in the angled brackets, requiring that a voiced obstruent be *heterorganic* with a following coronal consonant):

(7) The Spir rule in Harris (1969: 40)

$$\begin{bmatrix}-\text{son}\\ +\text{voice}\end{bmatrix} \rightarrow \begin{bmatrix}+\text{cont}\\ -\text{strid}\end{bmatrix} \Big/ \left\{\begin{matrix}[-\text{son}]\\ [+\text{cont}]\\ <[-\alpha\text{cor}]>\end{matrix}\right\} (\#) \begin{bmatrix}\underline{\qquad}\\ <\alpha\text{cor}>\end{bmatrix}$$

("Voiced obstruents become non-strident continuants after obstruents, after continuant segments, and after heterorganic coronals.")

Cressey (1978) proposes the following simplification of Harris's analysis whereby the homorganicity condition is extended to all the place of articulation features (abbreviated as *PA*):

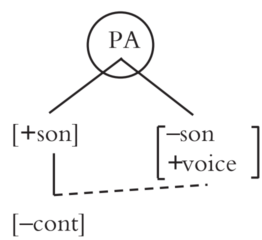
(8) Cressey's Spir rule (adapted from Cressey (1978: 73)

$$\begin{bmatrix}-\text{son}\\ +\text{voice}\end{bmatrix} \rightarrow [\alpha\text{cont}] \;/\; \alpha\left\{\begin{matrix}\| \\ \begin{bmatrix}-\text{cont}\\ \beta\text{PA}\end{bmatrix}\end{matrix}\right\}\begin{bmatrix}\overline{}\\ \beta\text{PA}\end{bmatrix}$$

("Voiced obstruents become [−cont] in phrase-initial position (i.e., after a pause), and after *homorganic* non-continuants, and [+cont] elsewhere.")

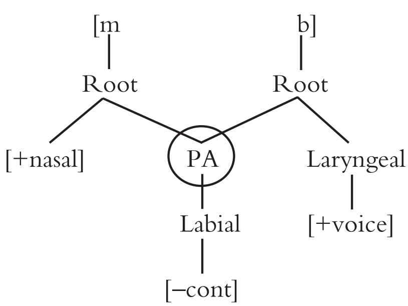
In the Fort analysis proposed in Hualde (1989, 1991: 99ff.), [−cont] spreads from a preceding homorganic sonorant:

(9)



Carreira's Fort configuration is shown in (10), as in *a*[mb]*os* (this author assumes, following Padgett 1994, 1995, that [cont] is Place-dependent):

(10)



Mascaró (1991) points out, however, that when speakers produce heterorganic clusters, in formal, careful, or moderately slow styles, voiced obstruents surface as stops after heterorganic nasals, thereby yielding sequences such as [md], [ŋb], [ŋd], etc., illustrated in (11) (some of the examples are from Mascaró 1991: 171):

(11)	parki[ŋ b]arato	'cheap parking'	(cf. *parki[ŋ β]arato)
	tande[m b]onito	'pretty tandem'	(cf. *tande[m β]onito)
	go[ŋ d]e plata	'silver gong'	(cf. *go[ŋ ð]e plata)
	ping po[ŋ d]anés	'Danish Ping-Pong'	(cf. *ping po[ŋ d]anés)
	álbu[m d]e fotos	'photo album'	(cf. *álbu[m ð]e fotos)
	Vietna[n̪ d]el norte	'North Vietnam'	(cf. *Vietna[m ð]el norte)
	parki[ŋ ɟʲ]eno	'filled parking'	(cf. *parki[ŋ ʝ]eno)
	ping po[ŋ ɟʲ]amativo	'flashy Ping-Pong'	(cf. *ping po[ŋ ʝ]amativo)
	Isla[m g]errero	'bellicose Islam'	(cf. *Isla[m ɣ]errero)
	tande[m g]rande	'big tandem'	(cf. *tande[m ɣ]rande)
	ultimátu[m g]rosero	'rude ultimatum'	(cf. *ultimátu[m ɣ]rosero)

Such data suggest that homorganicity cannot be taken as either a necessary or a sufficient structural condition for predicting the distribution of the stop allophones of Spanish voiced obstruents.

2.3.2. The phrase-initial position problem

The fact that voiced obstruents are consistently realized as stops when located phrase-initially has produced a bewildering assortment of solutions:

a) In a Spir analysis, the mapping of underlying stops to surface forms is direct, and so nothing else needs to be said about phrase-initial position (e.g., Harris 1969; Cressey 1978).
b) Spir combined with underspecification requires a default (redundancy) rule that specifies voiced obstruents as stops in the *elsewhere* environments, including phrase-initially (e.g., Harris 1984).
c) In a Fort type of account, some special mechanism is needed to derive the stop allophones in word-initial position, whether by means of a language-particular default rule (Hualde 1989, 1991) or a high ranking of some set of Fort-inducing markedness constraints barring voiced spirants in general (González 2006a). Alternatively, by positing two independent input levels, the phrase level and the word level, the Fort-inducing constraints are assigned an undominated status at the phrase level (Baković 1997).
d) Phrase-initial position is explicitly given the same status as a preceding stop consonant, under the assumption that "the resting position of the articulators implies the closure of the vocal tract" (Piñeros 2002: 398).
e) A solution to the phrase-initial problem is not explicitly addressed (e.g., Palmada 1997; Carreira 1998; Martínez-Gil 1991, 1997; Morris 1998, 2002).

In the proposal advanced here, phrase-initial stops follow directly and without any stipulations from the domination of the markedness constraint VoiObs-[−cont], disfavoring spirants over Ident-[−cont], a result similar to Harris's (1984) assignment of [−cont] by default.

2.3.3. The postlateral problem

The discrepant behavior in postlateral position has proven to be one of the most recalcitrant challenges faced by all available phonological analyses of Spanish voiced obstruents. Thus, as shown earlier (cf. (2c) and (3c)), while the coronals /d, ɟ/ are realized as plosives after laterals, their noncoronal counterparts /b, g/ surface as spirants in precisely the same environment. Such behavior, as Mascaró (1991: 175) points out, leads to an impasse if one adopts a solution that does not include some sort of homorganic condition, because in a purely phonological account /l/ must be either [+cont] or [−cont].

The postlateral problem is solved by Harris (1984, 1985) by assuming that a lateral's [+cont] specification is prevented from spreading to a following homorganic /d/ by geminate inalterability, on the grounds that a homorganic cluster forms a subsegmental geminate (cf. also Kenstowicz 1994: 488). This solution is inadequate, since it is unclear how the shared place of articulation in the [l̪d] sequence would prevent the spreading of [+cont] from the lateral onto a following /d/ (laterals are specified as [+cont] in Harris's analysis). Geminate inalterability effects typically emerge when the structural description of a rule refers to timing slots in the prosodic skeleton (Hayes 1986), which is clearly not the configuration proposed in Harris's (1984) Spir rule. In Fort analyses, on the other hand, the postlateral problem does not arise, since the stop allophones in this environment can be derived, whether by means of rules or constraints, from the homorganic status of the cluster. The present analysis proposes a solution to the postlateral problem in the form of a markedness constraint grounded on the articulatory properties of laterals.

2.3.4. Voiced obstruents and complex-onset phonotactics

Phonotactic conditions placed on the syllabification of biconsonantal onsets in Spanish can be shown to provide a hitherto largely unexplored, but arguably significant insight about the underlying nature of voiced obstruents, strongly suggesting that they are in fact *stops* at the underlying level. As illustrated in (12), in core (i.e., lexical) syllabification, well-formed bisegmental onsets in Spanish are restricted to the combination of an underlying oral stop (voiceless or voiced), or /f/, followed by a liquid (C_1 and C_2 refer to the first and second members of the complex onset, respectively):

(12) Allowed and excluded Spanish complex onsets (excluded onsets are highlighted with shading)

	C_1	C_2	Examples:
✓	b	r	*bro.ma* 'joke', *li.bro* 'book', *miem.bro* 'member'
✓	b	l	*blan.co* 'white', *do.ble* 'double', *em.ble.ma* 'emblem'
✓	p	r	*pra.do* 'meadow', *le. pra* 'leprosy', *com.pra* 'purchase'
✓	p	l	*pla.to* 'plate', *so.plar* 'to blow', *am.plio* 'wide'
✓	f	r	*fru.to* 'fruit', *su.frir* 'to suffer', *co.fre* 'coffer'
✓	f	l	*fla.co* 'thin', *a.fli.gir* 'to afflict', *in.flar* 'to inflate'
✓	d	r	*dro.ga* 'drug', *cua.dro* 'frame', *al.men.dra* 'almond'
*	d	l	
✓	t	r	*tru.co* 'trick', *cua.tro* 'four', *den.tro* 'inside'
(*)	t	l	(cf. *atlas* [ˈað.las]/[ˈa.tlas] 'atlas', *atleta* [að.ˈle.ta]/[a.ˈtle.ta] 'athlete', etc.)
✓	g	r	*gra.to* 'pleasant', *ti.gre* 'tiger', *Hun.grí.a* 'Hungary'
✓	g	l	*glo.ria* 'glory', *si.glo* 'century', *in.glés* 'English'
✓	k	r	*cre.ma* 'cream', *lu.cro* 'profit', *es.cri.bir* 'to write'
✓	k	l	*cla.ro* 'clear', *bu.cle* 'curl', *an.cla* 'anchor'

As in many languages, dental stop-lateral sequences in Spanish are excluded: /dl/ onsets are systematically disallowed; /tl/ is marginal at best, and it is parsed heterosyllabically in some Spanish dialects (although not in others, as in the well-known case of Mexican Spanish; Harris 1983:

32, 139; Hualde 2005: 74). Any combination of an underlying fricative or affricate plus a liquid is systematically excluded, as shown schematically in (13).

(13) Systematically excluded biconsonantal onsets in Spanish

C_1	C_2	C_1	C_2
* s	r	* č	l
* s	l	* ɟ	r
* θ	r	* ɟ	l
* θ	l	* x	r
* č	r	* x	l

As discussed by Martínez-Gil (2001), the case of /f/ is special, for typological reasons: no language apparently exhibits a labiodental stop, and thus a potential phonemic contrast with a labiodental fricative appears to be universally excluded; it follows that the feature [cont(inuant)] is universally noncontrastive for labiodental consonants, and thus it should be uniformly absent in underlying representations.

These facts point at a robust generalization, labeled the *Complex Onset Generalization* (*COG*) in Martínez-Gil (2001): well-formed complex onsets in Spanish core syllabification consist of a liquid preceded by either an oral stop or an underlying obstruent that crucially lacks a [+cont] specification. Fricatives, except /f/, are excluded because they are specified as [+cont], and so are affricates, which comprise a sequentially ordered [−cont, +cont] contour; cf. Steriade 1982; Sagey 1986; Lombardi 1991). If the voiced obstruents are either considered spirants/approximants underlyingly or assumed as underspecified in underlying forms for the feature [cont], as claimed by many available analyses, the COG cannot possibly be formulated in a meaningful way, since (a) it would be impossible to refer to the seemingly arbitrary sets {p, t, k} and {ß, ð, ɣ}, or, alternatively, {p, t, k} and {[ß̞, ð̞, ɣ̞]}, or {p, t, k} and {B, D, G}, as a natural phonological class (uppercase characters are commonly used to transcribe underspecified voiced obstruents); and (b) there would be no apparent explanation as to why fricatives, as well as approximants such as /ɾ, l, j, w/, are strictly prohibited as the first member of a complex onset, but {ß, ð, ɣ} or {ß̞, ð̞, ɣ̞} would be allowed.

Notice that {ß, ð, ɣ} are in fact found as the first member of complex onsets at the postlexical stratum, the domain in which Spir becomes active. This is an interesting paradox discussed in Martínez-Gil (1997; see also Piñeros 2001); the solution proposed in Martínez-Gil (1997) is that a minimal sonority distance constraint on complex onset clusters is active in core syllabification (lexical level), but turned off in the postlexical component, where Spir takes place. The exception is found in varieties of Chilean Spanish, where the scope of such a constraint has been extended to the phrase level, and as a consequence the first member of the complex onset is shifted onto the coda of the preceding syllable, where it undergoes the vocalization process briefly described in §1.

If the COG truly reflects a linguistically significant generalization about Spanish syllable phonotactics, one is led to conclude that voiced obstruents are noncontinuants at the underlying level. The upshot, then, is that analyses that postulate underlying spirants, underlying approximants, or underlying segments underspecified for the feature [cont] are fundamentally misguided, and thus should be abandoned.

2.3.5. Voiced obstruents in slow and deliberate speech styles

A factor rarely discussed in available analyses of Spanish voiced obstruents is the effect of *speech tempo* on allophonic realization. Perhaps the only exception is the influential study of Spanish phonology within the classical (linear) framework by Cressey (1978). This author points out that when speech tempo is slowed down, Spanish voiced obstruents are invariably realized as stops, independently of previous environment: "[T]he occlusive allophone *occurs in all environments in a slow speech style*" (1978: 71, [my emphasis, FM-G]). According to Cressey, it follows inevitably that Spanish voiced obstruents must be characterized as underlying stops: "The pronunciation which surfaces most frequently in the slower, more monitored speech style is considered basic, and the other allophone is treated as a modification of the basic pronunciation. This general practice seems correct to me, and thus I accept the [+occlusive] [i.e., [−cont]; FM-G] allophones as basic" (1978: 71–72).

Cressey's assessment, however, crucially depends on how a "slow speech style" is defined. Certainly, the stop allophones inevitably emerge whenever speech tempo is drastically slowed down, up to a halting type of speech, where words, and even syllables, are subject to emphatic enunciation. One could argue that in such conditions pauses would be artificially introduced, thereby re-creating the postpausal effect found in the phrase-initial environment. According to the intuitions of some native speakers I have consulted, as well as my own, Spir does take place in slow-tempo or deliberate styles in *natural* connected speech.

The stop-favoring effect that formal styles exert on the phonetic realization of voiced obstruents appears to be minimal, as illustrated in Quilis's (1964) spectrographic study of poetic enjambment, where informants were asked to read a poem into a microphone, arguably an extremely formal stylistic context. And yet Quilis's instrumental analysis shows that voiced obstruents in the Spir contexts were realized overwhelmingly as spirants by his informants. Stop realizations did occur in the experiment, but in a significantly lower number than spirants. These facts appear to suggest that speech tempo is not a preeminent factor in the stop ~ spirant allophonic distribution of voiced obstruents in Spanish.

2.3.6. SPIR, FORT, or both?

The argument discussed earlier regarding Spanish complex-onset phonotactics suggests that Fort approaches that assume underlying spirants/approximants are inadequate, and thus should be discarded. The question that logically arises, then, is: does the surface distribution of voiced obstruents arise from Spir alone, or does it involve the combined effect of both Spir and Fort? In this chapter I propose that both spirants and stops emerge as the consequence of a constraint whose effect closely mirrors progressive assimilation, whereby the voiced obstruent adopts whatever value of the feature [cont] is specified in the preceding segment, as first suggested in Mascaró (1984).

It should be emphasized that in the context of the constraint-based proposal put forth in this chapter, the Fort portion of progressive assimilation is intended to be understood simply as a requirement that a voiced obstruent may not disagree with the [−cont] specification of a preceding segment. If voiced obstruents are noncontinuants at the underlying level, as argued in this chapter, then progressive voicing assimilation after noncontinuant segments simply applies vacuously, since it does not alter the [−cont] feature already specified at the underlying level. Thus, the relationship between the stricture of a given segment and the stop ~ spirant/approximant surface realization of a following voiced obstruent is straightforward in a proposal that combines the notions of both Spir and Fort, implemented as progressive assimilation of the preceding segment's [cont] specification, as advocated in Mascaró (1984), and adhered to in this chapter. Of course, implicit in this proposal is that homorganicity is neither a sufficient nor a necessary condition for Fort, contrary to the claims of some previous analyses (e.g., Hualde 1989, 1991), and is instead a merely accidental one.

On the other hand, the Spir-only approach makes an implicit, but counterintuitive claim that the systematic occurrence of stop allophones after noncontinuant consonants is fortuitous, independently of whether one assumes underlying stops (e.g., Harris 1969) or underspecified voiced obstruents in which the [−cont] specification is assigned by default (Harris 1984). In either analysis the systematic occurrence of voiced stops after homorganic nasals and laterals has no significant phonological connection with the presence of a preceding noncontinuant segment.

2.3.7. Assimilation or lenition?

Much has been debated in the literature on how lenition processes such as Spir are to be adequately characterized. With regard to the allophonic realization of Spanish voiced obstruents, the issue quite generally has been framed as to whether it involves a case of progressive assimilation, captured by spreading of the feature [cont] specified on a preceding segment (as in the autosegmental analyses of Harris 1984, 1985; or Mascaró 1984), or rather a case of consonantal lenition/weakening, conceived broadly as a reduction of articulatory effort, favored by the relative lack of stricture of a preceding segment, as in Piñeros (2002) or Colina (forthcoming).

To a certain extent, the assimilation vs. lenition dichotomy is terminological, not substantive. Assimilation can unambiguously defined as taking place when one (or both) of two relatively dissimilar segments become more similar, where "more similar" can be directly quantified as involving a higher degree of feature agreement. In contrast, it is much more difficult to quantify in a precise manner the notions of "lenition" and "effort reduction." The reason is that it is generally defined as an increase in sonority, broadly construed as a decrease in articulatory constriction and an increase in acoustic and perceptual prominence, often combined with considerations of universal markedness. Articulatory effort is certainly related to notions such as consonantal "degree of stricture," "markedness," "relative phonological complexity," and so on. Attempts to separate articulatory effort from the structural complexity of phonological segments (Piñeros 2002: 394) are, in my opinion, largely misguided. The very idea of universal "markedness" is partially based on relative articulatory effort. Thus, clicks require much more complex articulatory gestures than do plain stops, and thus they are more marked. Paradoxically, however, some highly marked segments demonstrably involve less articulatory effort. Colina (forthcoming, §1), for example, characterizes Spir as a reaction to "the need to avoid the marked configuration represented by a combination of voicing and maximal stricture found in voiced stops." And yet the spirants/approximants that result from the Spir process in Spanish are undoubtedly more marked crosslinguistically than their stop counterparts [b, d, g], although they are characterized as involving less articulatory effort.

Most (if not all) types of assimilations could possibly be construed as lenition, in the sense that they result in a decrease of articulatory effort. On the other hand, there are assimilatory types that, while resulting in effort reduction, arguably entail a certain degree of fortition/strengthening as well as increased markedness. A typical case is the palatalization of oral stops before a palatal segment, most commonly a high vowel or a front glide, which involves a reduction of articulatory complexity by eliminating one of two contiguous articulatory gestures, but the resulting palatal (frequently, an affricate [ʤ] or [ʧ]) can hardly be characterized as a "weaker" consonant than the source stop; in fact, from an articulatory point of view there is no doubt that affricates are more complex than stops. In sum, while palatalizing assimilation is inherently effort reducing, it cannot be categorized as a lenition process, nor has it in my knowledge ever been construed in this manner in traditional accounts.

The traditional notion of phonological "weakening" of consonants is directly related to an increase in relative sonority, measured in terms of the Universal Sonority Hierarchy in (14) (where digits represent sonority indexes), or the version proposed by Harris (1989a, 1989b) for Spanish in (15), a language that, according to this author, ignores sonority distinctions based on voicing among obstruents, as well as the lateral vs. rhotic distinction between liquids): obstruents of lowest sonority are universally the least marked, and, vice versa, the more sonorous the obstruent, the higher its markedness.

(14) The Universal Sonority Hierarchy (Clements 1990)

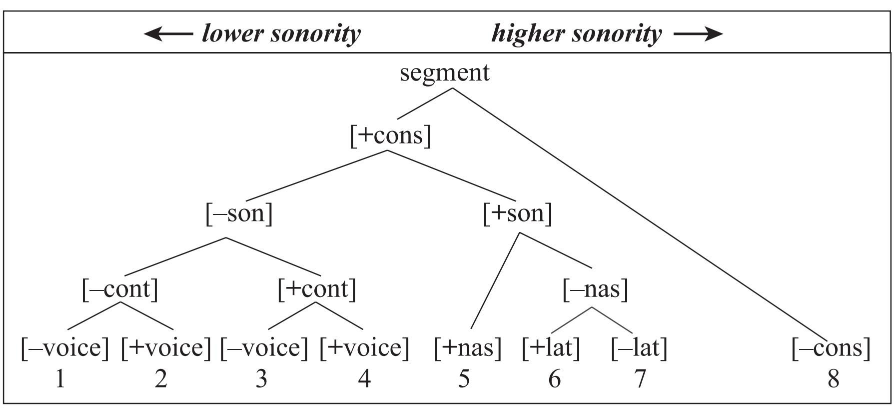
← *lower sonority*			*higher sonority* →			
obstruents			sonorants			
voiceless stops	voiced stops	voiceless fricatives	voiced fricatives	nasals	liquids	
					laterals	rhotics
p, t, k	b, d, g	f, s, θ, x	ß, ð, ɣ, z	m, n, ñ	l	r
1	2	3	4	5	6	7

(15) The Spanish version of the Sonority Hierarchy (Harris 1989a, 1989b)

← *lower sonority*		*higher sonority* →	
obstruents		sonorants	
stops	fricatives	nasals	liquids
p, t, k, b, d, g	f, s, θ, x	m, n, ñ	l, r
1	2	3	4

The sonority indexes in the Universal Sonority Hierarchy can be naturally derived from the relative sonority contribution of the various distinctive features and distinctive feature classes, as shown in (16) (Levin 1985; Blevins 1995):

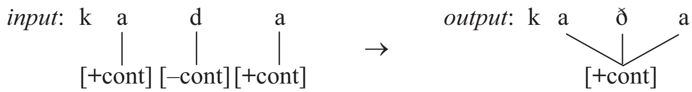
(16) The Universal Sonority Scale



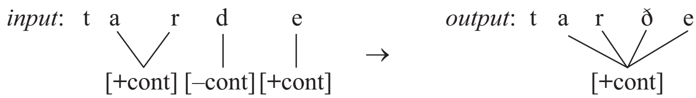
While relative sonority is not always inversely proportional to articulatory effort, the featural change from underlying [−cont] to surface [+cont] involved in Spir effectively captures the traditional notion of "weakening" as a phonological process loosely defined as involving a decrease of supraglottal constriction in consonantal articulation. As can be seen in (16), the feature [cont] establishes a major sonority division between the two major classes of obstruents: stops and continuants.

The weakening process brought about by Spir is formally reflected in the readjustments of the autosegmental associations of the feature [cont] involved in Spir, often combined with voicing assimilation, whose outcome is a drastic simplification of gestural coordination, as illustrated in the input-output pairs in (17) representative of the Spanish data discussed in §1, where (17a–d) illustrate Spir alone, and (17e–g) capture the interaction of Spir and voicing assimilation:

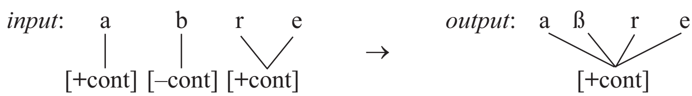
(17) a. The input is an intervocalic voiced stop, as in *cada* 'each':



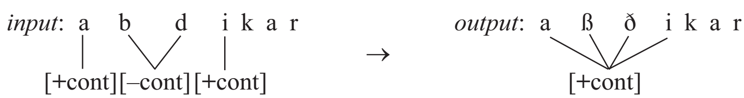
b. The input is an intervocalic liquid + voiced stop sequence, as in *tarde* 'late':



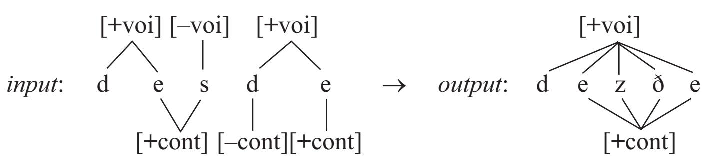
c. The input is an intervocalic voiced stop + liquid sequence as in *abre* '(s)he opens':



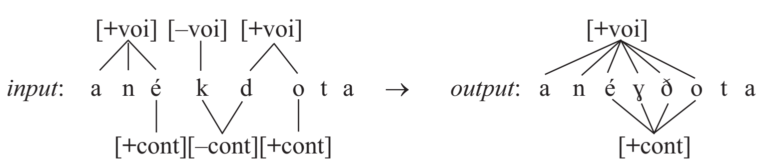
d. The input is an intervocalic sequence of two voiced stops, as in *abdicar* 'to abdicate':



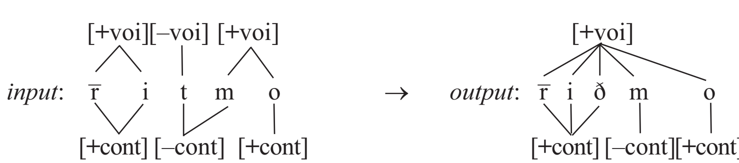
e. The input is an intervocalic voiceless fricative + voiced sequence, as in *de*/sd/*e* → *de*[zð]*e* 'since, from':



f. The input is an intervocalic voiceless stop + voiced stop sequence, as in *ané*/kd/*ota* → *ané*[ɣð]*ota* 'anecdote':



g. The input is an intervocalic voiceless stop + nasal sequence, as in *ri*/t/*mo* → *ri*[ð]*mo* 'rhythm':



Namely, both SPIR, analyzed as an assimilatory process, and voicing assimilation can be formally accounted for as a minimization of articulatory effort, illustrated in (17) by the readjustments in the autosegmental configuration, without the need to resort to an effort-reducing LAZY family of constraints. When we compare the autosegmental input representations with their corresponding outputs, it becomes evident that the input is formally more complex, because it involves either a series of alternating shifts in stricture (oral opening and closure) within the span of the given sequence (17a–d) or a resetting of either stricture or both laryngeal and stricture gestures (17e–g), whereas such complexity is greatly diminished in the corresponding outputs.

2.3.8. The postnuclear issue in dialectal data

In many American Spanish dialects (including nonstandard varieties in Argentina, Colombia, Costa Rica, Cuba, El Salvador, Honduras, Mexico (state of Jalisco), Nicaragua, and Panama), spirants are found after nuclear vowels, just as in standard dialects. However, after nonnuclear segments (glides and consonants), voiced obstruents surface as stops, as illustrated in (18):

(18) a. After glides:

standard	*dialectal*	
va[jß]én	va[jb]én	'oscillation'
cu[jð]dar	cu[jd]ar	'to look after'
tra[jɣ]o	tra[jg]o	'I bring'
de[wð]a	de[wd]a	'debt'
a[wð]az	a[wd]az	'audacious'
ca[wð]al	ca[wd]al	'flow'
a[wɣ]urio	a[wg]urio	'omen'

b. After a consonant:

standard	*dialectal*	
ár[ß]ol	ár[b]ol	'tree'
ol[ß]idar	ol[b]idar	'to forget'
res[ß]alo	res[b]alo	'I slide'
ar[ð]e	ar[d]e	'it burns'
car[ɣ]a	car[g]a	'load'
al[ɣ]a	al[g]a	'seaweed'
ras[ɣ]ar	ras[g]ar	'to tear'

The sources for the data in (18) include Albor (1951), Flórez (1951, 1965), Lacayo (1954), Canfield (1960, 1962, 1981: 34–36), Malmberg (1965), Resnick (1975, 1976), Sabino and Perisinotto (1975), Hammond (1976), Montes Giraldo (1982, 1995), Zamora and Guitart (1982), Becerra (1985), Amastae (1986, 1989, 1995), Moreno de Alba (1988), Lipski (1994), Carreira (1998), Vaquero de Ramírez (1996), Widdison (1997), Quilis (1999: 221), Carrasco et al. (2012), Martínez-Gil (2012), Hualde and Chitoran (2016), and Colina (forthcoming). SPIR-blocking is subject to dialectal variability regarding the contexts illustrated in (18). Thus, while in some varieties (e.g., Costa Rican Spanish) spirants occur most often after consonants and, to a lesser extent, after glides (Fernández 1982; Carrasco 2008; Carrasco et al. 2012), in other dialects stops are found mainly after consonants (Amastae 1989; Lipski 1994: 210, 271). And in yet other varieties (e.g., in Panamanian Spanish) spirants occur after vowels, glides, liquids, and the laryngeal fricative [h] (derived by aspiration of syllable-final /s/) (Alvarado de Ricord 1971) (see Colina forthcoming for further details).

The postnuclear-only type of SPIR illustrated in (1) presents a significant challenge for some analyses of SPIR. Indeed, it poses seemingly intractable problems to FORT analyses, for obvious reasons: (a) in a [−cont]-spreading type of autosegmental approach, such as Hualde's (1989, 1991), the stop allophones in (13) cannot possibly be derived by spreading the [cont] value from the preceding segment, since it is a [+cont] sonorant in most instances. In addition, the preceding segment generally fails to meet a required homorganicity condition for FORT to apply, since it does not share place features with the following voiced obstruent; and (b) in approaches that appeal to the Aperture Theory, as in Baković (1997) or González (2006a), the necessary distinction between a Spir-triggering nuclear vowel and a Spir-blocking glide cannot be attained, since in terms of relative aperture vowels and glides in this theory share the same A_{max} aperture specification, and it has been well established for over three decades now that the phonological distinction between vowels and glides is based exclusively on syllabic affiliation: nuclear vs. nonnuclear (Levin 1985).

Amastae (1986) proposes the ingenious solution in (19) to the postnuclear position problem, by assuming an ambisyllabification rule (19a) in the dialects in question, which incorporates a voiced obstruent into the coda of the preceding open syllable while it is still attached to the onset of the following one. This rule is ordered before, and thus feeds, Spir (cf. 19b):

(19) The *ambisyllabicity-based* Spir hypothesis (based on Amastae 1986)

a. Ambisyllabicity: b. Spir:

This analysis, however, suffers from a basic shortcoming in that no independent evidence has ever been put forth that otherwise supports ambisyllabification in contemporary Spanish.

The data in (18) point to a crucial restriction placed on Spir in the Spanish varieties under discussion: the process applies only after a nuclear vowel, but not after a closed syllable. Assuming that Spanish is sensitive to syllable weight (not an uncontroversial proposal in the literature on the topic by any means), the difference between standard dialects and those illustrated in (18) can easily be captured by the distinction between light and heavy syllables. The generalization that arises in (18) is that Spir in these varieties applies when the preceding syllable is *light* but not if the preceding syllable is *heavy*, in contrast with standard Spanish, for which the light ~ heavy distinction does not come into play as a factor conditioning Spir. We may conceptualize the difference between the standard and the dialectal varieties of Spanish under consideration by postulating that in the latter, but not in the former, heavy syllables block Spir. In short, in these varieties, Spir is triggered by a preceding nuclear vowel, the members of a class of segments whose articulation involves the lowest constriction level (or, alternatively, the highest sonority), whereas the process is blocked by preceding segments, such as glides and consonants, with a higher constriction (lower sonority) than nuclear vowels. The nuclear-vowel condition in Spir-blocking dialects will be incorporated into the OT account of (18) presented in §3.3.

3. An OT account of Spir

This section addresses two previous accounts of Spir that place this process in the phonetic component and offers an OT account of Spir in both standard Spanish varieties and dialectal data in which Spir is blocked after heavy syllables.

3.1. Preliminaries: arguments against a phonetic approach to Spir

Few phonological process in Spanish have been the subject of so many theoretical studies as Spir. Space limits prevent us from carrying out a full-fledged critique of such a vast literature. Instead, I will briefly discuss the feasibility of two recent OT accounts that stand out among the variety of available analyses because they advance a *phonetic* rather than a phonological approach to Spir: Piñeros (2002) and Colina (forthcoming). A phonetic treatment of Spir in the Iberian languages was first advocated by Mascaró (1991), who states: "I will reach two conclusions: at the descriptive level, that the distribution is governed by phonetic factors, and w.r.t. [with respect to; FM-G] the theory of phonology, that, consequently, Iberian spirantization cases do not constitute arguments for a spreading treatment of [continuant]" (168).

A Spir process similar, although not identical, to that of Spanish is also found in other Iberian languages, including Galician, Catalan, and Basque.

A convincing rebuttal of Mascaró's phonetic hypothesis, however, was subsequently advanced by Palmada (1997), who shows that phonological processes apply to the output of Spir, thus providing compelling reasons in favor of a *phonological* solution to Iberian Spir.

Piñeros (2002) follows the work of Kirschner (2001b) on phonetically based OT and attempts to capture the gradient nature of Spir by resorting to the effort-reducing constraint Lazy, assigned to the phonetic component. We may refer to it as the *Effort Reduction Hypothesis* (or *ERH* for short). As a consequence of the domination of Lazy over faithfulness to the input's [−cont] specification, underlying /b, d, g/ are realized as continuants with a variable degree of articulatory constriction, as an effect of the contribution of the different effort thresholds required to produce a voiced stop in the context of a preceding segment. Since major phonological classes, subclasses, and even individual segments have different effort thresholds, a reduction in the effort to produce voiced stops in the transition from a preceding segment with a low effort threshold results in continuants with variable stricture, ranging from regular fricatives to approximants. Essentially, the effort to produce a voiced stop is higher when the articulatory effort to produce a preceding segment is low, as in the case of vocoids, approximants, and continuant segments in general, and vice versa; the role of Spir is precisely to lessen that effort in voiced obstruents. One notable shortcoming of the ERH is that it disregards the OT tenet of *Freedom of Analysis*, since the alternative of underlying continuants as a potential input is not considered.

The main goal of Colina (forthcoming), on the other hand, is to account for the distribution of the stop and spirant allophones in standard varieties, as well as the dialectal variability found in both the phonetic realization of the spirant allophones and the phonological environments that favor Spir. Colina's proposal is that voiced obstruents are underspecified in both underlying representations and the output of the phonological component; their specification as [−cont] or [+cont] takes place in the process of phonetic implementation. I will label this approach the *Underspecification Hypothesis* (*UH*). The notion of effort reduction in the UH is said to be attained from a combination of underspecification at the phonological level (i.e., the absence of a lexically contrastive value for the feature [cont]) and the domination of effort-reducing constraints that penalize segmental markedness over faithfulness to the feature [cont], whose effect is to minimize the relatively high amount of effort in the laryngeal and occlusion gestures involved in voiced stops, a result avoided by generating continuants in the appropriate environments.

A widely held assumption since the outset of generative linguistics is that phonology and phonetics constitute two distinct components of the grammar, with very different properties. Most important for our discussion is the widely held assumption that phonological phenomena are categorical. As far as distinctive features are concerned, this means that for any given contrastive segment or class of segments, they bear a plus or minus specification at the underlying level. Even distinctive features that some authors hold to be monovalent still fall squarely within the categorical type, in that they either bear or do not bear the relevant specification; in contrast, the phonetic implementation of phonological structure is inherently variable and gradient (see Keating 1990, 1996; Cohn 1998, 2006; Cohn and Huffman 2014; Fanselow et al. 2006; Kingston 2007; and references therein). I will not discuss here the arguments advanced in the literature for phonetically based accounts over strictly phonological ones, or for the integration of gradient representations into phonological analyses (see Kirschner 2001a, 2001b, 2004; Hayes et al. 2004; Cohn 2011; Ernestus 2011 for further details). Instead, I will focus specifically on the shortcomings of an approach to Spir that assigns effort-reducing constraints to the phonetic component, as in the ERH and UH accounts.

There are two compelling reasons to reject such phonetically based approaches. First, in the ERH and, to some extent, also the UH, the phonetic markedness constraints are evaluated against distinctly categorical counterparts, such as Ident-[cont], a faithfulness constraint that requires surface voiced obstruents to maintain the input [cont] specification. The second involves the existence of phonological processes that affect voiced obstruents, often interacting with Spir, an adequate characterization of which can be achieved only by invoking binary distinctive features such as [voice], [consonantal], [sonorant], and so on. These processes, briefly discussed with corresponding references in §1, and listed in the following, include voicing assimilation, voicing, devoicing, total assimilation (gemination), velarization plus devoicing, and vocalization:

a) *Voicing assimilation* (e.g., *absurdo* [aɸˈsuɾðo] 'absurd', *adquirir* [aθkiˈɾiɾ] 'to acquire'). Here, the mapping /b/ → [ɸ] requires the combined action of Spir with a categorical change in voicing: [+voice] → [−voice].
b) *Voicing* but no Spir. In some Spanish varieties, including those spoken in the Canary Islands, voiceless stops become voiced intervocalically but frequently fail to undergo Spir (Oftedal 1985: 67ff.): *escapa* [ehˈkaba] '(s)he escapes', *escopeta* [ehkoˈbeda] 'shotgun', *típico* [ˈtibigo] 'typical'. The simplest way to account for this phenomenon is to assume that some contrast-preservation constraint (see Łubowicz 2012) eschews the neutralization of an underlying distinction between voiceless and voiced oral stops /p, t, k/ ~ /b, d, g/, which is then manifested as a voiced stop ~ voiced continuant distinction in phonetic representations. It is an inescapable fact that phonemic contrasts are categorical by definition.
c) *Devoicing*. As described in §1, there are Spanish dialects in which voiced obstruents undergo both devoicing and Spir in syllable-final position. In other varieties the devoiced obstruent fails to spirantize and thus surfaces as a voiceless stop: *club* [ˈklup] 'club', *absurdo* [apˈsuɾðo] 'absurd', *pared* [paˈɾet] 'wall', *ignorar* [iknoˈɾaɾ] 'to ignore', etc. Devoicing is a categorical process since it changes the value of the feature [voice]. The mapping of /b, d, g/ onto [p, t, k] is straightforward assuming underlying voiced stops, but it is not clear how to obtain such a mapping from input /B, D, G/ under the UH.

With the exception of some loanwords like *cadmio* 'cadmium', the occurrence of syllable-final /d/ word-internally in Spanish is restricted to the learned prefix *ad-*, as in *adverso* 'adverse', *admitir* 'to admit', etc. Word-final /g/, on the other hand, can be found only in a handful of foreign loans, such as *iceberg*, *ping-pong*, *gong*, etc.

d) *Total assimilation* (gemination), especially before stops, oral or nasal: *obtuso* [otˈtuso] 'obtuse', *abdicar* [addiˈkaɾ] 'to abdicate', *dogma* [domma], *ignorante* [innoˈɾan̪te] 'ignorant'. The changes in [voice], [sonorant], and place features involved in total assimilation are categorical, and thus the resulting geminates must be derived in the phonological component. In addition, in certain Caribbean varieties total assimilation targets syllable-final liquids, and the result is a voiced geminate stop, not a geminate spirant: *curva* [ˈkubba] ‘curve’, *falda* [ˈfadda] ‘skirt’, *algo* [ˈaggo] ‘something’. The emergence of geminate voiced stops instead of spirants can be easily explained in terms of markedness: the former are less marked and thus favored over the latter, which is more marked (see Martínez-Gil 2012, and §4.1). Total assimilation of liquids to a following voiced obstruent is categorical, given the change in [sonorant] and place features, and it follows directly from the assumption that the liquid totally assimilates to a following underlying voiced stop, but this is not the case under a UH, nor is it clear how both gemination processes would be analyzed under an ERH.

e) *Vocalization*. In some varieties of American Spanish, syllable-final obstruents are vocalized to either [j] or [w], depending on the place features of the source obstruent: *observar* [owserˈβaɾ] ‘to observe’, *admirable* [ajmiˈɾaβle] ‘admirable’, *dogma* [ˈdojma]/[ˈdowma] ‘dogma’. In dialects of Chilean Spanish, vocalization also affects a voiced obstruent followed by a liquid in a complex onset cluster: *pobre* [ˈpowɾe] ‘poor’, *ladrón* [lajˈɾon] ‘thief’, *regla* [ˈrejla]/ [ˈrewla] ‘rule’. As argued in Martínez-Gil (1997), the simplest explanation for vocalization in such cases is the following. As mentioned earlier, there is a minimal sonority distance restriction on Spanish complex onsets. In standard dialects this constraint is enforced in core syllabification, but it is no longer active at the phrasal level, the domain of Spir. However, in the Chilean dialects under discussion, the minimal sonority distance has been extended also to the postlexical phonology, where Spir turns a voiced stop into a spirant, in violation of the minimal sonority distance. Consequently, the onset cluster is no longer allowed, and the spirant is shifted to the coda of the preceding syllable, where it undergoes vocalization. Here, too, the change in consonantal features involved in vocalization is a categorical one, and thus it must take place in the (postlexical) phonology, not in phonetic detail.

f) *Velar shift* and *devoicing* in American Spanish dialects: *observar* [okserˈβaɾ] ‘to observe’, *admirar* [akmiˈɾaɾ] ‘to admire’, etc. Here, the place features of a labial or coronal voiced obstruent are shifted to velar, and it concomitantly becomes voiceless. This process is just one more example of contrastive (i.e., categorical) features being altered, and thus its domain must be the phonological component, not the level of phonetic implementation.

In view of such data, it is unclear how the processes and interactions voiced obstruents are subject to in dialectal data can possibly originate at the level of phonetic implementation, and thus any attempt to circumscribe Spir to the phonetic component becomes highly precarious. Furthermore, it seems unlikely that the generalizations that arise from such processes and interactions can be adequately captured in both the ERH and the UH approaches.

A number of additional issues arise specifically in the UH. The effort-reduction strategy claimed to be involved in Spir is achieved by proposing that voiced obstruents are unspecified for the feature [cont] (let us label it [Ucont]), and that this lack of specification persists as optimal in the output of the phonological component, a result crucially ensured by Dep-[cont], a constraint that prohibits the insertion of (plus or minus) [cont] specifications. Lack of specification, according to the UH, captures effort reduction. The [±cont] values are claimed to be assigned in phonetic detail, depending on the surrounding context (although no explicit details are provided on how such a mechanism is implemented), subject to gradient phonetic implementation. A fundamental problem for this approach is that the evident *phonological* connection between the surface [cont] value of a voiced obstruent and that of a preceding segment is not captured, with the implication that it is a mere accident. In addition, it is difficult to interpret, for obvious articulatory reasons, the alleged “gradient” nature of the stop allophones created in phonetic implementation in both absolute word-initial position and after noncontinuant segments: a stop is implemented with a complete blockage of the airstream. If this blockage is not complete, then it is a continuant. There is no possibility of a "gradient stop." Finally, the UH leads to a seemingly peculiar characterization of the most basic level of phonological analysis: phonemic contrast. If voiced obstruents are indeed [Ucont], the question naturally arises as to how the phonemic opposition between voiceless and voiced stops in Spanish is to be described, or how they are even learned in language acquisition, since they must now be characterized as a contrast between voiceless stops and [Ucont]; cf. /p/ ~ /b/ (*peso* [ˈpeso] 'weight' ~ *beso* [ˈbeso] 'kiss', *ropa* [ˈropa] 'clothes' ~ *roba* [ˈroβa] '(s)he steals'), /t/ ~ /d/ (*tía* [ˈtia] 'aunt' ~ *día* [ˈdia] 'day', *bota* [ˈbota] 'boot' ~ *boda* [ˈboða] 'wedding'), and /k/ ~ /g/ (*casa* [ˈkasa] 'house' ~ *gasa* [ˈgasa] 'gauze', *vaca* [ˈbaka] 'cow' ~ *vaga* [ˈbaɣa] 'lazy-FEM.'). Such an analysis is likely to be considered unacceptable to many (if not most) phonologists of Spanish. To make matters worse, the voiceless stop ~ voiced stop contrast is actually realized phonetically in many minimal pairs, such as *trompa* [ˈtɾompa] 'trunk (of an elephant') ~ *tromba* [ˈtɾomba] 'water spout', *cuanto* [ˈkwan̪to] 'how much' ~ *cuando* [ˈkwan̪do] 'when', *falta* [ˈfal̪ta] 'fault' ~ *falda* [ˈfal̪da] 'skirt', *manca* [ˈmaŋka] 'one-handed-FEM.' ~ *manga* [ˈmaŋga] 'sleeve', etc.

3.2. An OT approach to Spir in standard Spanish varieties

This section presents a phonological account of SPIR in standard dialects of Spanish. I assume, following earlier remarks on complex-onset phonotactics, that voiced obstruents are stops at the underlying level, although this assumption will not be critical to my analysis. SPIR is viewed as the particular instantiation of a general requirement that voiced obstruents in Spanish agree with a preceding segment for the feature [cont]. In order to comply with this constraint, voiced obstruents adopt the feature [+cont] in the phonological component; the gradient and variable stricture values of [+cont] are attributed here to phonetic implementation. When the preceding segment is [−cont], the agreement constraint is satisfied vacuously, and, as a consequence, the underlying [−cont] specification surfaces. A markedness constraint against voiced spirants favors the stop realization in word-initial position after a pause, since no preceding segment is available. Finally, the postlateral problem is resolved by subordination of the [cont] agreement requirement to a grounded constraint that captures the observation that laterals are [−cont] at the coronal place of articulation, and [+cont] at the labial and dorsal places of articulation.

One of the most fundamental tenets of OT is that both underlying contrasts and phonological phenomena arise primarily in the resolution of conflicts between two major types of universal constraints: those that demand input-output faithfulness and those that penalize marked configurations. Faithfulness constraints demand that the input (the underlying structure) be fully realized in the output of the phonological component, and, conversely, they disfavor outputs that contain structures absent in underlying forms. Markedness constraints disfavor certain structural configurations present in the input. Phonological phenomena arise in the resolution of the conflict between the two types of constraints according to a ranking hierarchy particular to each language or dialect of a language. Two central tenets of OT are relevant for a constraint-based approach to the allophonic distribution of Spanish voiced obstruents:

A) *Richness of the Base* (*ROTB*)*:* the input of phonological representations is a free combination of linguistic primitives. There are no formal devices capable of imposing restrictions on inputs. Analyses in which the predictable properties of the output are simply stipulated in underlying forms, and then transferred to surface forms, are inadmissible. Thus, contrary to the UH, the ROTB proscribes the underspecification of underlying representations.

B) *Lexicon Optimization* (*LO*)*:* this is a procedure that guides learners in the task of determining underlying forms during language acquisition, and it essentially states, "Choose the underlying representation that yields the optimal mapping between input and output" (i.e., the one that violates the least number of constraints). Thus, all other things being equal, the optimal input form will be one that either does not deviate or deviates minimally from the observed phonetic output.

There are two critical consequences of ROTB and LO for an OT analysis of the stop ~ spirant allophonic distribution of Spanish voiced obstruents: (1) this distribution must follow directly (and exclusively) from the interaction of faithfulness and markedness constraints, evaluated on potential surface forms (the candidates), as required by ROTB, not from the phonologist's particular assumption about the value of [continuant] in underlying representations, such as underspecified representations, nor from the assumption that inputs are specified as stops or, alternatively, as spirants/approximants, as in some in OT accounts; and (2), in compliance with LO, underlying forms unspecified for continuancy cannot conceivably be posited by learners acquiring Spanish, on the grounds that surface forms are always fully specified. Furthermore, given the long-standing generative assumption that a segment unspecified for [cont] is not distinct from either [+cont] or [−cont], since otherwise a ternary distinction would be created, it does not make sense to include candidates with unspecified voiced obstruents in an OT type of constraint evaluation.

The relative markedness of obstruents is reflected in the universal scale in (20), which essentially reflects the status of this class of segments in the Universal Sonority Scale (16) discussed earlier. As shown by the boxed portion of the scale, within the class of nonstrident voiced obstruents, stops are less marked than continuants (Trubetzkoy 1969; Greenberg 1978; Maddieson 1984; Clements 1990: 296; Pulleyblank 1997; Hayes and Steriade 2004; de Lacy 2006; " >" = "more marked than").

(20) Universal markedness scale for nonstrident obstruents
$\boxed{\text{Voiced fricatives > voiced stops}}$ > voiceless fricatives > voiceless stops

The OT analysis of the stop ~ spirant distribution of Spanish voiced obstruents proposed in this chapter draws in part from some of the ideas advanced in earlier analyses, especially in those of Harris (1984) and Mascaró (1984, 1991); its main ingredients are the constraints (21)–(24):

(21) *VoiObs*-[−cont]: Assign a violation for every nonstrident voiced obstruent not specified as [−cont] (nonstrident voiced continuants are universally more marked than voiced stops).

(22) *Agree*-[cont]: Assign a violation for every voiced obstruent that does not agree for the feature [cont] with a preceding segment.

(23) *Ident*-[cont]: Assign a violation for every segment in the output that differs in the value of the feature [cont] from its corresponding input.

(24) *Lat*-[−cont]@*Cor*: Laterals are [−cont] at the coronal place of articulation, and [+continuant] at any other place of articulation.

The markedness scale in (20) is the basis for the "default" status of voiced stops in comparison with their voiced spirant counterparts. The relevance of this constraint for candidate evaluation is limited to instances in which a preceding segment is absent, namely, when voiced obstruents are in absolute word-initial position. *Agree*-[cont] is equivalent to progressive assimilation of the feature [cont], but unlike assimilation by autosegmental spreading in rule-based theories, its main role is to ensure that a voiced obstruent does not disagree with the [cont] value of a preceding segment. The faithfulness constraint (23) penalizes the lack of input-output identity for the feature [cont]. Finally, constraint (24) is phonetically grounded on the observation that laterals are articulated with a simultaneous closure of the airstream at the center of the vocal tract, and a release of air through one or both sides of the mouth (Ladefoged and Maddieson 1996: 182–203; Ladefoged and Johnson 2011: 15, 178–180). Mascaró (1991: 174–176) cogently describes this property in reference to Iberian Spir as follows:

> A careful examination of the execution of a sequence like [ld] shows that the articulatory correlates of [+cont] airflow through an open vocal tract hold true for all the vocal tract, except for its central part. In this area, the airflow is interrupted by the contact of the front part of the tongue blade and the teeth. Lowering of the back of the tongue blade allows the air to escape around the central closure, behind the cheek and the teeth. A phonological solution imposes /l/ to be either [+continuant] or [−continuant], but phonetically, the correlates for this feature are not equally distributed along the vocal tract. For /l/ there is airflow from the glottis to the lips, but the dento-palato-alveolar region is excluded. . . . Spirantization is correlated with existence of airflow during the production of the preceding segment. But, crucially, this airflow has to be registered at the place of the preceding segment itself. In other words, [d] is a stop because at *its* place of articulation, i.e., the dental region, there is no airflow during the articulation of [l]. . . . On the other hand, [ß] and [ɣ] are spirants because at *its* place of articulation, i.e., the labial and velar regions, respectively, there is airflow during the articulation of [l]. (emphases in the original; FM-G)

The proposed constraint ranking for (21)–(24) in standard Spanish varieties is given in (25):

(25) Constraint ranking: Lat-[−cont]@Cor >> Agree-[cont] >> VoiObs-[−cont] >> Ident-[cont]

I will now demonstrate that the proposed constraints and constraint ranking adequately derive the standard Spanish stop ~ spirant allophonic distribution of underlying voiced obstruents in (2)–(5) in a straightforward manner, independently of whether underlying stops or spirants are assumed, in compliance with the ROTB tenet in OT.

In general, in the proposed analysis faithfulness to input [cont] is consistently sacrificed in order to satisfy the higher-ranked markedness constraints Agree-[cont] and VoiObs-[−cont]. My account of the standard Spanish data in (2)–(5) is illustrated with likely candidates in the pairs of tableaux in (26)–(32), representative of the various environments that determine the stop ~ spirant distribution. In each pair the first tableau assumes an input *stop*, and the second an input *spirant*. As shown in (26)–(27), Agree-[cont] is irrelevant in the evaluation of candidates with a voiced obstruent in phrase-initial position, and so the selection of voiced stops as optimal is effectively compelled by the domination of VoiObs-[−cont] over Ident-[cont].

(26) Voiced stops in phrase-initial position, assuming underlying *stops*
/b/ámonos → [b]ámonos 'let's go!' (cf. (2a))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. [b]ámonos			
b. [ß]ámonos		*!	*

(27) Voiced stops in phrase-initial position, assuming underlying *spirants*
/ß/ámonos → [b]ámonos 'let's go!' (cf. (2a))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. [b]ámonos			*
b. [ß]ámonos		*!	

The proposed constraint-based analysis essentially relies on the simplest and most straightforward possible mechanism in OT: in accordance with the ranking in (25), the interaction between the dominant markedness constraints Agree-[cont] and VoiObs-[−cont] over the subordinate input-output faithfulness constraint Ident-[cont] correctly accounts for all the remaining data, namely, cases in which voiced obstruents are neither phrase-initial nor in postlateral position; namely, after vocoids, as in the tableaux pair (28)–(29); after continuant consonants, as in (30)–(31); after homorganic nasals, as in (32)–(33); and after heterorganic nasals, as in (34)–(35). Here again, the evaluation proceeds in pairs: the first tableau assumes underlying stops, and the second underlying spirants. In tableaux where the autosegmental affiliation between a voiced obstruent and the feature [cont] is shown, the abbreviation [c] will be used for [cont]. Because the constraint Lat-[−cont]@Cor is relevant only when a voiced obstruent is preceded by a lateral, it will be shown only in the tableaux illustrating the evaluation of candidates in such sequences in tableaux (36)–(39).

(28) Voiced spirants after vocoids, assuming underlying *stops*
lo/b/o → lo[ß]o 'wolf' (cf. (3a))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. l[o ß]o [+c]		*	*
b. l[o b]o [+c][–c]	*!		

(29) Voiced spirants after vocoids, assuming underlying *spirants*
lo/ß/o → lo[ß]o 'wolf' (cf. (3a))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. l[o ß]o [+c]		*	
b. l[o b]o [+c] [–c]	*!		*

(30) Voiced spirants after continuant consonants, assuming underlying *stops*
ár/b/ol → ár.[b]ol 'tree' (cf. (3b))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. á[r ß]ol [+c]		*	*
b. á[r b]ol | | [+c] [–c]	*!		

(31) Voiced spirants after continuant consonants, assuming underlying *spirants*
ár/ß/ol → ár.[b]ol 'tree' (cf. (3b))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. á[r ß]ol [+c]		*	
b. á[r b]ol | | [+c] [–c]	*!		*

(32) Voiced stops after homorganic nasals, assuming underlying *stops*
am/b/os → am[b]os 'both' (cf. (2b))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. a[m b]os [–c]			
b. a[m ß]os | | [–c] [+c]	*!	*	*

(33) Voiced stops after homorganic nasals, assuming underlying *spirants*
am/ß/os → am[b]os 'both' (cf. (2b))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. a[m b]os [–c]			*
b. a[m ß]os | | [–c] [+c]	*!	*	

(34) Voiced stops after heterorganic nasals, assuming underlying *stops*
álbu/m d/*e fotos* → *álbu*[m d]*e fotos* 'photo album' (cf. (11))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. álbu[m d]e fotos [–c]			
b. álbu[m ð]e fotos [–c] [+c]	*!	*	*

(35) Voiced stops after heterorganic nasals, assuming underlying *spirants*
álbu/m ð/*e fotos* → *álbu*[m d]*e fotos* 'photo album' (cf. (11))

Candidates	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. álbu[m d]e fotos [–c]			*
b. álbu[m ð]e fotos [–c] [+c]	*!	*	

Tableaux (36)–(37) illustrate the selection of stops after homorganic laterals; (38)–(39) show how spirants are optimal after heterorganic laterals.

(36) Voiced stops after a homorganic lateral, assuming underlying *stops*
cal/d/o → cal[d]o 'broth' (cf. (2c))

Candidates	Lat-[−cont]@Cor	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. ca[l d]o [–c]				
b. ca[l ð]o [–c] [+c]		*!	*	*
c. ca[l ð]o [+c]	*!		*	*

(37) Voiced stops after a homorganic lateral (cf. (2c)), assuming underlying *spirants*
cal/ð/o → cal[d]o 'broth'

Candidates	Lat-[−cont]@Cor	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. ca[l d]o [–c]				*
b. ca[l ð]o [–c] [+c]		*!	*	
c. ca[l ð]o [+c]	*!		*	

(38) Voiced spirants after non-homorganic laterals, assuming underlying *stops*
ol/b/idar → ol[ß]idar 'to forget' (cf. (3c))

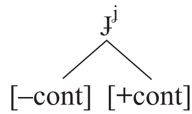
Candidates	Lat-[−cont]@Cor	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. o[l ß]idar [+c]			*	*
b. o[l b]idar [–c][–c]		*!		
c. o[l b]idar [–c]	*!			

(39) Voiced spirants after non-homorganic laterals, assuming underlying *spirants*
ol/ß/idar → ol[ß]idar 'to forget' (cf. (3c))

Candidates	Lat-[−cont]@Cor	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. o[l ß]idar [+c]			*	
b. o[l b]idar [+c] [–c]		*!		*
c. o[l b]idar [+c]	*!			*

The question that immediately arises now is: how does the present analysis derive the allophonic realizations of the affricate [ɟʲ]? In order to address this issue, we only need to consider the structural representation of affricates as contour segments, i.e., a configuration that contains a temporally ordered sequence of [−cont, +cont] specifications, as in depicted in (40) (cf. Steriade 1982; Sagey 1986; Lombardi 1991):

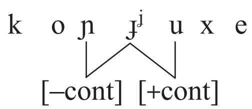
(40) Autosegmental representation of an affricate



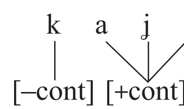
In compliance with AGREE-[cont], the affricate's initial [−cont] phase will be shared with the preceding nasal, as in *cónɣuge* [ˈkoɲɟʲuxe] 'spouse' (41a) (cf. (2b)), whereas in the SPIR context only the affricate's [+cont] value can be realized, and now it shares this specification with the preceding continuant, as in *ca<u>ll</u>e* [ˈkaʝe] 'street' (41b) (cf. (3a)):

(41) The two surface realizations of the affricate vs. the spirant

a. An *affricate* as in *cónɣuge* 'spouse':



b. A *spirant*, as in *ca<u>ll</u>e* 'street':



As already indicated in §1, palatal stops are highly marked across languages. There is a well-documented universal preference for affricates over stops at the palatal point of articulation (Maddieson 1984, ch. 2; Ladefoged and Maddieson 1996, ch. 3). We can integrate this markedness universal in the form of a constraint that disfavors palatal stops, which we can conveniently dub *PAL-STOP. As shown in (42), assuming the input is a voiced palatal stop, the mapping /ɟ/ → [ɟʲ] will be selected as optimal if *PAL-STOP dominates the other relevant constraints in the hierarchy, thereby ensuring that a candidate with the voiced palatal affricate [ɟʲ] (42a) wins over alternatives that contain either a voiced palatal stop [ɟ] (42b) or a voiced palatal spirant [ʝ] (42c).

(42) Voiced affricates after homorganic nasals, assuming underlying *stops*
có/ɲɟ/uge (*cónyuge*)→ có[ɲɟʲ]uge 'spouse' (cf. (2b))

Candidates	*PAL-STOP	AGREE-[cont]	VOIOBS-[−cont]	IDENT-[cont]
☞ a. có[ɲ ɟʲ]uge [–c] [+c]				*
b. có[ɲ ɟ]uge [–c]	*!			
c. có[ɲ ʝ]uge [–c][+c]		*!	*	*

The surface realization of input /ɟ/ as a voiced palatal spirant [ʝ] as optimal in the context of a preceding continuant segment is illustrated in (43):

(43) Voiced spirants after continuant segments, assuming underlying *stops*
ca/ɟ/e (*calle*)→ ca[ʝ]e 'street' (cf. (3a))

Candidates	*Pal-Stop	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]
☞ a. c [a ʝ]e [+c]			*	*
b. c [a ɟ]e [+c] [–c]	*!	*		*
c. c[a ɟ^{j} e] [+c] [–c] [+c]		*!		*

Although this is not shown in (42)–(43), the reader can easily verify that the same affricate output after a homorganic nasal, and a spirant after a continuant segment, respectively, are obtained if we instead assume an input spirant /ʝ/.

3.3. Blocking of Spir after a nonnuclear segment in dialectal data

For those American Spanish varieties in which Spir takes place exclusively after light syllables (cf. (18)), we may appeal to constraint (44) as a convenient way of referring to whatever constraint(s) is responsible for the more limited version of Agree-[cont] in these varieties, namely, one requiring that a voiced obstruent agree for the feature [+cont] only in the context of a preceding nuclear vowel. The constraint ranking is otherwise identical to that proposed earlier for standard varieties, as shown in (45).

(44) Agree-[cont]-NucV: Assign a violation for every voiced obstruent that does not agree for the feature [cont] with a preceding nuclear vowel.

(45) Agree-[cont]-NucV >> VoiObs-[−cont] >> Ident-[cont]

Representative derivations of spirants in postnuclear position vs. stops after glides and consonants elsewhere are shown in tableaux (46)–(51). Observe the critical role played by VoiObs-[−cont] in deriving the stop allophones after nonnuclear segments, as in (48)–(51).

(46) Voiced spirants surface after vocoids, assuming underlying *stops*
lo/b/o → lo[ß]o 'wolf' (cf. (3a))

Candidates	Agree-[cont]-NucV	VoiObs-[−cont]	Ident-[cont]
☞ a. l[o ß]o [+c]		*	*
b. l[o b]o [+c] [–c]	*!		

(47) Voiced spirants after vocoids, assuming underlying *spirants*
lo/ß/o → lo[ß]o 'wolf' (cf. (3a))

Candidates	Agree-[cont]-NucV	VoiObs-[−cont]	Ident-[cont]
☞ a. l[o ß]o [+c]		*	
b. l[o b]o [+c] [–c]	*!		*

(48) Voiced stops after glides, assuming underlying *stops*
de/wd/a → de[w.d]a 'debt' (cf. (18a))

Candidates	Agree-[cont]-NucV	VoiObs-[−cont]	Ident-[cont]
☞ a. de[w.d]a			
b. de[w.ð]a		*!	*

(49) Voiced stops after glides, assuming underlying *spirants*
de/wð/a → de[w.d]a 'debt' (cf. (18a))

Candidates	Agree-[cont]-NucV	VoiObs-[−cont]	Ident-[cont]
☞ a. de[w.d]a			*
b. de[w.ð]a		*!	

(50) Voiced stops after consonants, assuming underlying *stops*
ár/b/ol → ár.[b]ol 'tree' (cf. (18b))

Candidates	Agree-[cont]-NucV	VoiObs-[−cont]	Ident-[cont]
☞ a. ár.[b]ol			
b. ár.[ß]ol		*!	*

(51) Voiced stops after consonants, assuming underlying *spirants*
ár/ß/ol → ár.[b]ol 'tree' (cf. (18b))

Candidates	Agree-[cont]-NucV	VoiObs-[−cont]	Ident-[cont]
☞ a. ár.[b]ol			
b. ár.[ß]ol		*!	*

4. Other issues related to the phonology of voiced obstruents

This section provides an analysis for five of the phonological processes discussed in §1, in which voiced obstruents are involved in one way or another, namely, two types of total assimilation, three types of devoicing, and the way Spir interacts with voicing assimilation in relatively fast and informal colloquial registers. Voiced-obstruent deletion cannot be addressed here due to space restrictions. For an OT account of coda voiced-obstruent vocalization, the reader is referred to Martínez-Gil (1997) and Piñeros (2002).

4.1. Total assimilation of liquids to voiced obstruents in colloquial Caribbean Spanish

In some Spanish dialects, liquids undergo complete assimilation to a following consonant, including in the Spir environments, both inside words and across word boundaries. Crucially, when the following consonant is a voiced obstruent, the resulting geminate is invariably realized as a *stop*, never as a spirant. The examples from Havana Spanish in (52) illustrate a more formal/careful style vs. a colloquial, less monitored one (see Guitart 1976, 1978, 1980, 2004; Harris 1984, 1985). A similar phenomenon is reported in Flórez (1951: 204, 226) for dialectal Colombian Spanish.

(52) Liquid assimilation in Havana Spanish ([ḍḍ] = a retroflex dental geminate)

a. Within words:

		formal	*informal*	
curva	'curve'	cu[r ß]a	cu[bb]a	(not *cu[ßß]a)
olvidé	'I forgot'	o[l ß]idé	o[bb]idé	(not *o[ßß]idé)
arde	'it burns'	a[rð]e	a[ḍḍ]e	(not *a[ðð]e)
gordo	'fat'	go[rð]o	go[ḍḍ]o	(not *go[ðð]o)
amargo	'bitter'	ama[rɣ]o	ama[gg]o	(not *ama[ɣɣ]o)
pulga	'flea'	pu[lɣ]a	pu[gg]a	(not *pu[ɣɣ]a)

b. Across word boundaries:

ser bobo	'to be stupid'	se[r ß]obo	se[b b]obo	(not *se[ß ß]obo)
él besa	'he kisses'	é[l ß]esa	é[b b]esa	(not *é[ß ß]esa)
ser dos	'to be two'	se[r ð]os	se[ḍ ḍ]os	(not *se[ð ð]os)
ver lluvia	'to see rain'	ve[r ɟ]uvia	ve[r ɟ]uvia	(not *ve[ɟ ɟ]uvia)
ver gatos	'to see cats'	ve[rɣ]atos	ve[g g]atos	(not *ve[ɣɣ]atos)
el gato	'the cat'	e[l ɣ]ato	e[g g]ato	(not *e[ɣ ɣ]ato)

Harris (1985) analyzes the failure of the Havana Spanish geminates to undergo Spir as a geminate inalterability effect (see also Kenstowicz 1994: 423–424); namely, Spir is allegedly blocked because the second half of the geminate fails to meet the rule's structural description. For this explanation to work, it crucially requires, arbitrarily, that liquid assimilation be extrinsically ordered before Spir; the opposite order wrongly predicts that, e.g., underlying /kurba/ (*curva*) would become [kurßa] (by Spir) and then *[kußßa] (by liquid assimilation).

There is, however, a substantive alternative explanation for the emergence of geminate stops in colloquial Havana Spanish. It is a well-established fact that among the obstruents geminate voiced fricatives such as [👌👌], [ðð], and [ɣɣ] are the most marked (Thurgood 1993; Kirschner 2001a; Podesva 2002; Kawahara 2007). In general, voiced geminate fricatives are highly disfavored across languages due to the difficulty of maintaining the long turbulent airflow in the vocal tract needed for producing a geminate fricative while simultaneously increasing subglottal air pressure, necessary to initiate vocal fold vibration (O'Hala 1983; Kirschner 2001a, 2002b; Hayes and Steriade 2004). The most likely reason that the geminates created by liquid assimilation in Havana Spanish fail to be affected by Spir is the avoidance of highly marked geminate voiced spirants; the less-marked geminate stops are favored instead (Martínez-Gil 2012). From an OT perspective, this insight has a straightforward implementation: assuming an undominated ranking of the markedness constraint banning voiced spirant geminates, in combination with a high-enough ranking of faithfulness to input [voice], **cu*[ßß]*a* will always be less optimal than its competitor *cu*[bb]*a*.

The data on liquid assimilation in colloquial Havana Spanish can be made to follow directly from the domination of two markedness constraints over the three basic constraints and the constraint ranking already proposed for standard Spanish: (a) AGREE-F (53), which requires that liquids agree in all features with a following consonant; and (b) NO-GEM & VOIOBS-[−cont] (54), a local constraint conjunction that disfavors spirant geminates. Following the standard convention on the interpretation of constraint conjunction, locally conjoined constraints are violated if and only if both constraints are violated. Finally, the undominated positional faithfulness IDENT-F-ONS (55) demands input-output identity of all features, thus preventing any unfaithful mapping of a consonant located in the syllabic onset (Beckman 1997, 1999; Lombardi 1995, 1999, 2001; Smith 2004, 2005), effectively enforcing regressive rather than progressive assimilation: *cur.va* 'curve' becomes [ˈkub.ba], not *[ˈkur.ra], and *pul.ga* 'flea' becomes [ˈpug.ga] rather than *[pul.la].

(53) AGREE-F: Assign a violation for every liquid that does not agree in all features with a following voiced obstruent.

(54) NO-GEM & VOIOBS-[−cont]:
Fricative geminates are disallowed.

(55) IDENT-F-ONS: Assign a violation for every onset consonant whose input features do not have correspondents in the output.

Total assimilation of liquids to a following voiced obstruent in colloquial Havana Spanish follows from the constraint ranking in (56):

(56) Constraint ranking:
IDENT-F-ONS >> AGREE-F >> NO-GEM & VOIOBS-[−cont] >> AGREE-[cont] >>
VOIOBS-[−cont] >> IDENT-[cont]

The interaction of these constraints and the constraint ranking for the total assimilation of liquids to a following voiced obstruent is illustrated in tableaux (57)–(58). As shown, the high ranking of both IDENT-F-ONS and AGREE-F is critical in eliminating candidates such as (57b–d)/(58b–d), in which any of the onset consonant features of the input have been altered in the output.

(57) Total assimilation of liquids to a following voiced obstruent in colloquial Havana Spanish, assuming underlying *stops*
cur./b/a → cu[b.b]a 'curve' (cf. (52a))

Candidates	IDENT-F-ONS	AGREE-F	NOGEM & VOIOBS-[−cont]	AGREE-[cont]	VOIOBS-[−cont]	IDENT-[cont]
☞ a. cu[b.b]a				*		
b. cu[ß.ß]a	*!		*		*	*
c. cu[ɾ.ß]a	*!	*			*	*
d. cu[ɾ.ɾ]a	*!					

(58) Total assimilation of liquids to a following voiced obstruent in colloquial Havana Spanish, assuming underlying *spirants*
cur./ß/a → cu[b.b]a 'curve' (cf. (52a))

Candidates	IDENT-F-ONS	AGREE-F	NOGEM & VOIOBS-[−cont]	AGREE-[cont]	VOIOBS-[−cont]	IDENT-[cont]
☞ a. cu[b.b]a				*		*
b. cu[ß.ß]a			*!		*	
c. cu[ɾ.ß]a	*!	*			*	*
d. cu[ɾ.ɾ]a	*!					

4.2. Total assimilation of coda voiced obstruents to a following noncontinuant consonant

We have already mentioned, with some illustrative examples (see §1 and §3.1), that in many varieties of colloquial Spanish, voiced obstruents undergo complete assimilation to a following noncontinuant consonant. The failure of voiced obstruents to completely assimilate to continuant consonants appears to respond to a similar motivation to that already discussed for Havana Spanish: the process is forestalled because the resulting continuant geminates are highly marked. The derivation of geminates by complete assimilation of a voiced obstruent to a following noncontinuant consonants is enforced by the undominated constraint AGREE-F, whose target in this instance is voiced obstruent-noncontinuant sequences. Tableaux (59)–(60) illustrate, with the evaluation of some likely candidates, the complete assimilation of /b/ to a following /t/, as in *o<u>b.t</u>e.ner* [ot.te.ˈneɾ] 'to obtain':

(59) Total assimilation of a voiced obstruent to a following noncontinuant consonant in colloquial Spanish, assuming underlying *stops*
o/bt/ener → o[t.t]e.ner

Candidates	IDENT-F-ONS	AGREE-F	NOGEM & VOIOBS-[−cont]	AGREE-[cont]	VOIOBS-[−cont]	IDENT-[cont]
☞ a. o[t.t]e.ner						
b. o[b.t]ener		*!		*		
c. o[ß.t]ener		*!			*	*
d. o[b.b]ener	*!			*		
e. o[ß.ß]ener	*!		*		*	**

(60) Total assimilation of a voiced obstruent to a following noncontinuant consonant in colloquial Spanish, assuming underlying *spirants*
o/ßt/ener → o[t.t]e.ner

Candidates	IDENT-F-ONS	AGREE-F	NOGEM & VOIOBS-[−cont]	AGREE-[cont]	VOIOBS-[−cont]	IDENT-[cont]
☞ a. o[t.t]e.ner				*		
b. o[b.t]ener		*!		*		*
c. o[ß.t]ener		*!			*	
d. o[b.b]ener	*!			*		*
e. o[ß.ß]ener	*!		*		*	**

4.3. Devoicing of syllable-final voiced obstruents

Earlier in this chapter we discussed two types of syllable-final voiced-obstruent devoicing in certain varieties of Spanish (see also Martínez-Gil 1991, 2003; Morris 2002; Gonzalez 2002, 2003, 2006a, 2006b, 2009; and references therein).

The first type produces a voiceless stop, both word-internally (*a<u>d</u>verso* [atˈbeɾso] 'adverse') and in word-final position (*pare<u>d</u>* [paˈɾet] 'wall'). This pattern of devoicing provides an intractable type of empirical evidence against analyses of Spir that postulate either underlying spirants or voiced obstruents unspecified for [cont], given that a mapping of underlying voiced stops onto surface voiceless stops is the simplest and most direct hypothesis with regard to the LO principle. As an illustrative example, the mapping of *pare<u>d</u>* 'wall' into [paˈɾet] is enforced by the domination of *VoiCoda (61), a constraint that militates against voiced obstruents in coda position (see Kager 1999: 14; Lombardi 2001; McCarthy 2008: 67–68, among others). Obviously, in these varieties Ident-[voice] (62), requiring input-output faithfulness for the feature [voice], must be subordinate to the other relevant constraints, since it is violated in devoicing. The ranking of the pertinent constraints for this type of devoicing is as in (63):

(61) *VoiCoda: Assign a violation for every voiced obstruent in coda position.

(62) Ident-[voice]: Assign a violation for every segment in the output that differs in the value of the feature [voice] from its corresponding input.

(63) Constraint ranking:
*VoiCoda >> Agree-[cont] >> VoiObs-[−cont] >> Ident-[cont], Ident-[voice]

As shown in (64), candidates with a final voiced obstruent (64c–d) are immediately ruled out because they violate undominated *VoiCoda, hence leaving in play the two competing candidates with a voiceless obstruent (64a) and (64b). The decision is left to Ident-[cont], which selects the more faithful candidate, one with a voiceless stop (64a), over its competitor with a voiceless spirant (64b). (As is customary in OT, the absence of crucial ranking between two or more constraints, as in the case of Ident-[cont] and Ident-[voice] in (64), is indicated in the tableau by a broken line.)

(64) Devoicing of voiced stops in coda position, assuming underlying *stops*
pare/d/ → pare[t] 'wall'

Candidates	*VoiCoda	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]	Ident-[voice]
☞ a. pare[t]					*
b. pare[θ]				*!	*
c. pare[d]	*!	*			
d. pare[ð]	*!		*	*	*

There is a clear advantage in postulating underlying stops for this first type of devoicing, in that only such an assumption can formally capture the process in a simple and straightforward manner, as suggested earlier. The alternative of positing input spirants will inevitably produce the incorrect result, a voiceless spirant, as shown in tableau (65) (where the sad face points to the observed output form, and the symbol "💣" signals the illegitimate winner).

(65) Devoicing of voiced stops in coda position, assuming underlying *spirants*
pare/ð/ → pare[t] 'wall'

Candidates	*VoiCoda	Agree-[cont]	VoiObs-[−cont]	Ident-[cont]	Ident-[voice]
☹ a. pare[t]				*!	*
💣 b. pare[θ]					*
b. pare[d]	*!	*		*	
c. pare[ð]	*!		*		*

It becomes apparent that the problem at hand has immediate implications for the ROTB principle mentioned earlier, which requires that "[a]ll generalizations about the inventory of elements permitted in surface structure must be derived from markedness/faithfulness interactions, which control the faithful and unfaithful mappings that preserve or merge contrasts present in the base" (McCarthy 2002: 70). As a consequence of ROTB, surface realizations of a given input must be derived from a language's constraint hierarchy, not particular assumptions about the content of the input (McCarthy 2002: 77). It would seem that the data from the first type of devoicing present a serious challenge to ROTB, since the proposed constraints and constraint ranking are unable to derive an output voiceless stop from an input voiced spirant. Devoicing emerges in the interaction of the highly ranked *VoiCoda with the identity constraints that demand input-output faithfulness of [cont] and [voice], but as we have seen, such interaction is unable to render the observed type of devoicing if input spirants are surmised. One might attempt to solve the problem by appealing to a basic markedness constraint on phonological classes, Obs[−cont], a general version ofVoiObs-[−cont] grounded on the observation that, among obstruents, fricatives are universally more marked than stops. Notice that any input-output mapping change of the feature [cont] in *onset* obstruents would be averted by undominated Ident-[cont]-Ons. The domination of Obs[−cont] over the two identity constraints would yield the correct output, as shown in tableau (66):

(66) Devoicing of voiced stops in coda position, assuming underlying *spirants*
pare/ð/ → pare[t] 'wall'

Candidates	*VoiCoda	Agree-[cont]	Obs[−cont]	Ident-[cont]	Ident-[voice]
☞ a. pare[t]				*	*
b. pare[θ]			*!		*
c. pare[d]	*!	*		*	
d. pare[ð]	*!		*		*

This solution, however, does not work, because it predicts that all coda obstruents will surface as stops in the varieties under discussion, which is not at all the case: coda /s/ (and also /θ/ in some dialects) does not become a stop in surface forms. One can only conclude, then, that for the first type of devoicing data, the ROTB does not crucially control the input-output mapping, since the desired results can arise only under the assumption of a particular type of input, voiced stops, which, as we have seen earlier, is independently motivated by the facts on complex-onset phonotactics. The devoicing of input voiced obstruents to output stops, however, is ostensibly controlled by LO since, all other things being equal, an input-output mapping such as /d/ → /t/ will always be more faithful than the alternative /ð → /t/. As will be apparent in §4.4, the same situation arises in the analysis of devoicing plus velar shift in American Spanish dialects.

The second type of devoicing of syllable-final voiced obstruents, found in northern and central Iberian Spanish, interacts with Spir in that the result is a voiceless spirant (see §1). Here, too, the process occurs in both word-internal position (*admitir* [aθ.mi.ˈtiɾ] ‘to admit’) and word-finally (*pared* [paˈɾeθ] ‘wall’). If we just invoke the constraints and constraint ranking necessary to account for the first type of devoicing, we immediately face an impasse: a candidate with a syllable-final voiceless stop will always prevail over one with a voiceless spirant, since the mapping /pared/ → *[paˈɾet] violates only Ident-[voice] and thus wins over the observed /pared/ → [paˈɾeθ], which violates both Ident-[voice] and Ident-[cont]. Exactly the opposite result is obtained if one assumes underlying spirants: the observed mapping /pared/ → [paˈɾeθ] violates only Ident-[voice] and thus beats the incorrect one, /pareð/ → *[paˈɾet], which violates both Ident-[voice] and Ident-[cont]. This is precisely one of the problematic effects that arises in the interaction of Spir and voicing/devoicing discussed in Martínez-Gil (2003). In that work I propose a constraint that comes into play in this second type of devoicing, the Spanish Coda Condition (67), which favors voiceless fricatives over voiceless stops in syllable-final position:

(67) CodaCond: Assign a violation for every oral stop in coda position.

(68) Constraint ranking:
*VoiCoda >> Agree-[cont] >> VoiObs-[−cont] >> CodaCond >> Ident-[voice], Ident-[cont]

The CodaCond (67) is well grounded on coda phonotactics in the vernacular Spanish lexicon: within the class of obstruents, only the underlying coronal anterior fricative /s/ (and in Iberian Spanish also /θ/) is allowed. As mentioned earlier, /d/ occurs word-internally only in the learned prefix *ad-* ‘to, toward’; prefixal /-d/ has been lost in the vernacular version *a-* (cf. learned *ad-vertir* ‘to notice, warn’, *ad-juntar* ‘to attach’ vs. vernacular *a-parecer* ‘to appear’, *a-saltar* ‘to assault’, etc.). Word-final /-d/, however, does occur in the vernacular lexicon. However, the fact that it is generally lost in colloquial Spanish, just like the other oral stops (*ciudad* [θjuˈða] ‘city’, *salud* [saˈlu] ‘health’, *pared* [paˈɾe] ‘wall’, etc.), can easily be construed as a CodaCond effect.

Historically, the loss of syllable-final /-d/ is well attested in the transition from earlier to later stages of Old Spanish: *vendgar* > *vengar* ‘to avenge’, *sedmana* > *semana* ‘week’, *adtor* > *azor* ‘goshawk’, *qued* > *que* ‘what/that’, *matod* > *mató* ‘(s)he killed’. The alternative of inserting an epenthetic vowel to allow the syllabification of /d/ word-finally is also well documented: *promed* > *promete* ‘(s)he promises’, *pud* > *pude* ‘I could’, *pued* > *puede* ‘(s)he can’, *veniad* > *venía* ‘(s)he was coming’ (see Menéndez Pidal 1968; Lapesa 1951; Catalán 1971; Freixas 2001). In other instances, coda-/d/-avoiding changes took place, such as the affrication of /d/ into /d^z/ (> /ts/, later deaffricated to /s/ or /θ/, spelled *z*), as in *judgar* > *juzgar* ‘to judge’ or, more frequently, the metathesis of word-medial coda /d/ and a following sonorant consonant: *cadnado* > *candado* ‘lock’, *lidmo* > *lindo* ‘pretty’, **riedna* > *rienda* ‘reins, restraint’, *espadla* > *espalda* ‘back’, *cabidlo* > *cabildo* ‘chapter, town council’, *tidle* > *tilde* ‘tilde, accent mark’, etc. (Holt 2004).

The inclusion of the CodaCond in the evaluation of candidates yields the desired outcome in that a voiceless spirant is selected as optimal over a voiceless stop, as shown in tableaux (69)–(70):

(69) Devoicing and Spir of voiced stops in coda position, assuming underlying *stops*
pare/d/ → pare[θ] ‘wall’

Candidates	*VoiCoda	Agree-[cont]	VoiObs-[−cont]	CodaCond	Ident-[cont]	Ident-[voice]
☞ a. pare[θ]					*	*
b. pare[t]				*!		*
c. pare[d]	*!	*				
d. pare[ð]	*!		*		*	

(70) Devoicing and Spir of voiced stops in coda position, assuming underlying *spirants*
pare/ð/ → pare[θ] 'wall'

Candidates	*VoiCoda	Agree-[cont]	VoiObs-[−cont]	CodaCond	Ident-[cont]	Ident-[voice]
☞ a. pare[θ]						*
b. pare[t]				*!	*	*
c. pare[d]	*!	*			*	
d. pare[ð]	*!		*			

4.4. Devoicing and velar shift in dialectal American Spanish

As mentioned previously, in varieties of American Spanish we find a third type of syllable-final voiced-obstruent devoicing, which carries a concomitant shift in place of articulation from labial or coronal to velar (as also indicated, a variant of this pattern is a glottal stop [ʔ], but I will not include it in the present discussion): *abnegado* [akneˈɣaðo] 'self-sacrificing', *absurdo* [akˈsuɾðo] 'absurd', *submarino* [sukmaˈɾino] 'submarine', *admirable* [ak.mi.ˈɾable] 'admirable', *adverso* [akˈbeɾso] 'adverse', etc. Here we need to consider two additional constraints: (71), requiring that coda obstruents have a velar place of articulation, and (71), demanding input-output identity of place of articulation features. The constraint ranking is given in (73), where constraints irrelevant for the evaluation of candidates in this particular instance have been left out:

(71) CodaObs-Vel: Assign a violation for every obstruent in the output that does not have a velar place of articulation.

(72) Ident-Pl: Assign a violation for every segment in the output that differs in the value of place features from its corresponding input.

(73) Constraint ranking:
*VoiCoda, CodaObs-Vel >> Ident-[cont], Ident-[voice], Ident-Pl

CodaObs-Vel is used here as a cover name for the constraint(s) responsible for enforcing velar as the default place of articulation for stops, which would also include nasal stops, since nasal velarization is also well documented in these varieties. Here again, an undominated positional constraint would protect onset obstruents from undergoing a velar shift, and so it would apply only to coda stops. Thus, for dialects that exhibit (velar) place shift, it is apparent that the familiar universal markedness harmony scale for place of articulation, Labial, Dorsal > Coronal (">" = "more marked than") (see Crowhurst 2011; Rice 2011), has been reranked as Dorsal > Coronal, Labial. There are alternative ways of enforcing the default coda velar place in these varieties, such as licensing constraints on coda place, or the conjunction of NoCoda & Place $_{\text{Lab, Cor}}$, but I will not take on the issue any further in this chapter.

(74) Devoicing of voiced stops in coda position, assuming underlying *stops*
a/b/negado → a[k]negado 'self-sacrificing'

Candidates	*VoiCoda	CodaObs-Vel	Ident-[cont]	Ident-[voice]	Ident-Pl
☞ a. a[k]negado				*	*
b. a[x]negado			*!	*	*
c. a[p]negado		*!		*	
d. a[ɸ] negado		*!	*	*	
e. a[b]negado	*!	*			
f. a[ß]negado	*!	*	*		

As illustrated in (75), devoicing and velar shift of coda voiced obstruents raises the same problem as the first type of devoicing in §4.3 in that it can be derived only if we assume underlying stops. If underlying spirants are posited instead, the wrong result emerges: candidates (75a) and (75b) tie in all other constraints, with the exception of Ident-[cont], a constraint satisfied by the candidate with a voiceless velar spirant (75b) but violated by the observed surface form with a voiceless velar stop (75a); thus, again, the wrong candidate would be erroneously selected. The considerations adduced regarding ROTB and LO for the first type of devoicing in §4.3 would naturally apply here as well.

(75) Devoicing of voiced stops in coda position, assuming underlying *spirants*
a/ß/negado → a[k]negado 'self-sacrificing'

Candidates	*VoiCoda	CodaObs-Vel	Ident-[cont]	Ident-[voice]	Ident-Pl
☹ a. a[k]negado			*!	*	*
💣 b. a[x]negado				*	*
c. a[p]negado		*!			
d. a[ɸ]negado		*!			
e. a[b]negado	*!	*			
f. a[ß]negado	*!	*	*		

4.5. The interaction of Spir and voicing assimilation

As shown in (76), in most varieties of colloquial Spanish, voicing assimilation and Spir may interact; the interaction is typically bound by stylistic factors. In relatively informal, fast-tempo styles, when a voiceless stop assimilates in voicing to a following voiced consonant (a nasal or a voiced obstruent located in the onset of the following syllable), the process feeds Spir, as illustrated in (76a), thereby deriving new voiced spirants from underlying voiceless stops (cf. Harris 1984: 150; Martínez-Gil 1991, 2003). By contrast, in more formal and deliberate styles, voicing assimilation may be suppressed altogether, and the first member of the cluster preserves its underlying voicing and continuant values. Crucially, in both styles, when the second member is a voiced obstruent, it takes whatever value of [cont] is borne by the preceding consonant (cf. (76b)):

(76) a. Underlying voiceless stop + nasal sequences:

formal	*informal*	
ri[t].mo	ri[ð].mo	'rhythm'
hi[p].nosis	hi[ß].nosis	'hypnosis
Vie[t].nam	Vie[ð].nam	'Vietnam'
é[t].nico	é[ð].nico	'ethnic'
té[k].nica	té[ɣ].ni.ka	'technique

b. Underlying voiceless stop + voiced obstruent sequences:

fú[t.b]ol	fú[ð.ß]ol	'football'
ané[k.d]ota	ané[ɣ.ð]ota	'anecdote'
po[p. d]e los 80	po[ß. ð]e los 80	'80s pop (music)'
ra[p. g]rosero	ra[ß. ɣ]rosero	'rude rap'
boico[t. g]lobal	boico[ð. ɣ]lobal	'global boycott'
Ma[k.d]onald's	Ma[ɣ.ð]onald's	'McDonald's'
ro[k. d]uro	ro[ɣ. ð]uro	'hard rock'

The informal colloquial speech data in (76) are often left out of phonological analysis of Spanish voiced obstruents, although one can argue that it provides additional motivation and support for the presumption that the observed allophonic distribution derives from a process of progressive assimilation of the feature [cont]. As shown later, such stylistic variation can be readily incorporated into the OT account proposed here by means of additional constraints and constraint reranking.

In order to account for the interaction of SPIR and voicing assimilation in (76), an additional constraint needs to be considered, AGREE-[voice] (77), which compels voicing assimilation. This constraint must be ranked over both VOIOBS-[−cont] and IDENT-[voice] (78), the faithfulness constraint that requires input-output identity for the feature [voice]. AGREE-[voice], however, is not crucially ranked with respect to AGREE-[cont].

(77) AGREE-[voice]: Assign a violation for every voiced obstruent that does not agree with a following onset consonant for the feature [voice].

(78) IDENT-[voice]: Assign a violation for every segment in the output that differs from its corresponding input for the value of the feature [voice].

The constraint ranking for the informal/fast-tempo style is shown in (79):

(79) AGREE-[cont], AGREE-[voice] >> VOIOBS-[−cont] >> IDENT-[cont], IDENT-[voice]

Tableau (80) illustrates the interaction of voicing assimilation, enforced by AGREE-[voice], and SPIR, compelled by the AGREE-[cont] constraint, in heterosyllabic voiceless stop-nasal sequences in informal style, resulting in the mapping of syllable-final underlying voiceless stops onto surface voiced spirants. The interaction of AGREE-[voice] and SPIR in voiceless-voiced stop sequences for the informal-style data in (76) is illustrated in tableaux (81)–(82):

(80) Input voiceless stop + nasal sequences: *informal* style
ri/t/mo → ri[ð].mo 'rhythm' (cf. (76a))

Candidates	AGREE-[cont]	AGREE-[voice]	VOIOBS-[−cont]	IDENT-[voice]	IDENT-[cont]
☞ a. ri[ð].mo			*	*	*
b. ri[t].mo		*!			
c. ri[θ].mo		*!			*
d. ri[d].mo	*!			*	

(81) Input voiceless stop + voiced obstruent sequences: *informal* style, assuming underlying *stops*
fú/tb/ol → fú[ð.ß]ol 'football' (cf. (76b))

Candidates	AGREE-[cont]	AGREE-[voice]	VOIOBS-[−cont]	IDENT-[voice]	IDENT-[cont]
☞ a. fú[ð.ß]ol			**	*	**
b. fú[t.b]ol		*!			
c. fú[t.ß]ol	*!	*	*		*
d. fú[d.ß]ol	**!		*	*	
e. fú[d.b]ol	*!			*	
f. fú[ð.b]ol	*!		*	*	*

(82) Input voiceless stop + voiced obstruent sequences: *informal* style, assuming underlying *spirants*
fú/tß/ol → fú[ð.ß]ol 'football' (cf. (76b))

Candidates	AGREE-[cont]	AGREE-[voice]	VOIOBS-[−cont]	IDENT-[voice]	IDENT-[cont]
☞ a. fú[ð.ß]ol			**	*	*
b. fú[t.b]ol		*!			*
c. fú[t.ß]ol	*!	*	*		
d. fú[d.ß]ol	**!		*	*	
e. fú[d.b]ol	*!			*	*
f. fú[ð.b]ol	*!		*	*	*

Voicing assimilation may be suppressed in formal/deliberate styles, as in the *formal* style in (76). Here the first member preserves its underlying voicing and continuant values; accordingly, the following voiced obstruent surfaces as a stop. I analyze representative examples of the *formal*-style outputs in (83)–(84) as arising from constraint reranking, in line with the tenet of factorial typology. The constraint ranking in (83) is a permutation of the constraint ranking in (79), one in which IDENT-[voice] is promoted to an undominated rank, while AGREE-[voice] is demoted to the lowest rank, thereby yielding the formal/deliberate-style forms in (76). The evaluation of likely candidates for representative examples is shown in tableaux (84)–(86):

(83) Constraint ranking for *formal* styles in (76):
IDENT-[voice], AGREE-[cont] >> IDENT-[cont] >> VOIOBS-[−cont], AGREE-[voice]

(84) Input voiceless stop-nasal sequences: *formal* style
ri/t/mo → ri[t].mo 'rhythm' (cf. (76a))

Candidates	IDENT-[voice]	AGREE-[cont]	IDENT-[cont]	VOIOBS-[−cont]	AGREE-[voice]
☞ a. ri[t].mo					*
b. ri[θ].mo			*!		*
c. ri[d].mo	*!	*			
d. ri[ð].mo	*!		*	*	

(85) Input voiceless stop-voiced obstruent sequences: *formal* style, assuming underlying *stops*
fú/tb/ol → fú[t.b]ol 'football' (cf. (76a))

Candidates	IDENT-[voice]	AGREE-[cont]	IDENT-[cont]	VOIOBS-[−cont]	AGREE-[voice]
☞ a. fú[t.b]ol					*
b. fú[t.ß]ol		*!	*	*	*
c. fú[d.b]ol	*!	*			
d. fú[d.ß]ol	*!	**	*	*	
e. fú[ð.ß]ol	*!		**	**	
f. fú[ð.b]ol	*!	*	*	*	

(86) Underlying voiceless stop + voiced obstruent sequences: *formal* style, assuming underlying *spirants*
fú/tß/ol → fú[t.b]ol 'football' (cf. (76b))

Candidates	Ident-[voice]	Agree-[cont]	Ident-[cont]	VoiObs-[−cont]	Agree-[voice]
☞ a. fú[t.b]ol			*		*
b. fú[t.ß]ol		*!		*	*
c. fú[d.b]ol	*!	*	*		
d. fú[d.ß]ol	*!	**		*	
e. fú[ð.ß]ol	*!		*	**	
f. fú[ð.b]ol	*!	*	**	*	

As the reader can easily verify, the constraints and constraint ranking established for the voicing assimilation facts in (76) would also account for the emergence of partially voiced stops, as in pairs like *ri*[$\theta^{ð}$]*.mo* ~ *ri*[t^{d}]*.mo*, or *fú*[$\theta^{β}$]*ol* ~ *fú*[t^{b}]*ol*, etc. In autosegmental terms, such partially voiced stops form a [−voice] [+voice] contour similar to that of an affricate, and thus they simultaneously satisfy faithfulness to the input for both feature values; the evaluation would thus proceed much as in (84)–(86), except that now the winning candidates would satisfy both Ident-[voice] and Ident-[cont] (for further details on this analysis, see Martínez-Gil 2003).

4. Conclusion

This chapter offers a review of a number of formal approaches put forth in the past to explain the allophonic distribution of Spanish voiced obstruents, and offers an Optimality Theoretic account that relies on two basic markedness constraints: one requires that voiced obstruents agree with a preceding segment for the value of the feature [continuant] and is crucially ranked over a second constraint that favors stops over spirants among voiced obstruents. In turn, the domination of these two constraints over an identity of input [cont] is shown to derive the basic facts of the allophonic distribution of voiced obstruents in standard Spanish varieties.

By taking into consideration other relevant constraints and constraint (re)ranking, it is shown that this account has significant advantages over competing OT approaches, in that is it able to incorporate, with minimal additional machinery, a comprehensive corpus of stylistic and dialectal variation not contemplated in previous accounts, while essentially maintaining the basic formal mechanisms used for the analysis of standard Spanish data.

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3
Consonant assimilation

Carolina González

1. Introduction

Consonant assimilation occurs when a consonant becomes more similar to a nearby or adjacent segment, be it consonantal or vocalic. Take, for example, the data in (1), which exemplifies nasal place assimilation in Spanish (Navarro Tomás 1918; Quilis 1993). The syllable-final nasal in the preposition 'en' *in*, realized as an alveolar nasal [n] in isolation or before a vowel (1a), is pronounced as bilabial [m] before a bilabial consonant (1b), and as velar [ŋ] before a velar consonant (1c). In addition, the word-internal codas in 'Andalucía' and 'Valencia', which occur before a dental and interdental consonant, respectively, are realized with the same place of articulation as the following consonant (1a, b).

(1)	a.	en Andalucía	/en andaluθia/	[e.naṇ̪.da.lu.ˈθi.a]	*in Andalucia*
	b.	en Valencia	/en balenθia/	[em.ba.ˈlen̟.θja]	*in Valencia*
	c.	en Cataluña	/en kataluɲa/	[eŋ.ka.ta.ˈlu.ɲa]	*in Catalonia*

All transcriptions in this chapter are given the International Phonetic Alphabet (IPA). Note that /d, t/ are dental in Spanish. Unless noted, examples are conveyed in Castilian (North-Central Peninsular) Spanish (for transcription conventions, see Martínez-Celdrán et al. 2003; Campos-Astorkiza 2012; Hualde 2014). In (1a) resyllabification applies across words (see Colina, this volume, and Hualde, this volume).

Consonant assimilation in Spanish is local, within and across word boundaries, since the target of assimilation and its trigger are immediately adjacent. Nonlocal, or 'at-a-distance', assimilation, where the trigger and the target are phonetically separated by one or more segments, is, however, attested for vowels in Spanish (Jiménez and Lloret, this volume).

Nasal place assimilation is anticipatory (regressive), since the 'target' (the segment undergoing assimilation) becomes more similar to the following segment (the 'trigger'). Anticipatory assimilation is more prevalent in Spanish than perseveratory (progressive) assimilation, where the trigger precedes the target. This is also the case cross-linguistically (Gordon 2017: 124). Spirantization, which involves assimilation of the feature [continuant], is the main example of perseveratory consonant assimilation in Spanish. Compare, for example, 'vino' [ˈbi.no] *wine* vs. 'el vino' [el. ˈβ̞i.no] *the wine*. In the second example, 'v' is realized as an approximant because the preceding sound is [+continuant] (see also Martínez-Gil, this volume). When both anticipatory and perseveratory assimilation apply, mutual or reciprocal assimilation arises, as in 'un vino' [um.ˈbi.no] *a (glass of) wine*. In this case, the nasal assimilates in place to the following consonant, which agrees in continuancy with the preceding nasal.

Consonant assimilation in Spanish can be *partial*, as in (1), or *total*, depending on whether some or all segmental characteristics are assimilated. Total assimilation is also known as *gemination*. One example is 'mismo' /mismo/ *same*, realized in some Spanish dialects as [ˈmĩm.mo] (D'Introno et al. 1995: 291). While total assimilation in Spanish is anticipatory and can be triggered only by an adjacent consonant, partial assimilation can be perseverative and may be triggered by consonants (as in 1), vocoids, or both. For example, /k ɡ x/ are palatalized before front vocoids in Chilean Spanish (cf. 'reloj' [re.ˈlox] *watch* with 'relojes' [re.ˈlo.çes] *watches*; Silva-Fuenzalida 1953: 161; see also section 1.3). In addition, spirantization is triggered by both vowels and consonants (Martínez-Gil, this volume).

Section 2 previews the main types of consonant assimilation in Spanish. Section 3 examines some critical issues arising from the consideration of assimilatory processes in Spanish. Section 4 provides a case study of velar palatalization in Chilean Spanish, and section 5 summarizes the main points of this chapter and provides some directions for further investigation.

2. Main types of consonant assimilation in Spanish

Four main types of consonant assimilation can be considered for Spanish: (i) place assimilation, (ii) voice assimilation, (iii) manner assimilation, and (iv) gemination. The first three types involve partial assimilation, while the last entails total assimilation.

Place assimilation is the most commonly attested type of assimilation in Spanish, and cross-linguistically as well (Gordon 2017: 127, 128). Place assimilation targeting sonorants, such as nasal place assimilation, and lateral place assimilation, whereby a coda lateral assimilates in place to the following onset, appear to be common across Spanish dialects. On the other hand, place assimilation phenomena targeting obstruents are associated with specific dialects. This is the case for velar palatalization in Chilean Spanish, whereby velar obstruents /k ɡ x/ are realized as palatal before a front vocoid, and for coda interdentalization of /p t k/, as in 'actor' [aθ.ˈtoɾ], reported in North-Central Peninsular Spanish. Place assimilation is described in detail in section 2.1.

Voicing assimilation, second only to place assimilation in frequency cross-linguistically (Gordon 2017: 127, 128), refers to a change in consonantal voicing due to the influence of a nearby segment. One example is the word 'isla' *island*, pronounced in many Spanish dialects as [ˈiz.la]. Voicing assimilation in Spanish can be triggered by voiced consonants and vowels. A more detailed description of voicing assimilation in Spanish is provided in section 2.2.

Typologically, gemination and manner assimilation appear to be relatively rare, particularly the latter (Gordon 2017). The main type of manner assimilation in Spanish is spirantization, which is perseveratory and involves the feature [continuant], as already mentioned. Martínez-Gil (this volume) provides a detailed examination of spirantization in Spanish. We indicate additional examples of manner assimilation phenomena reported for Spanish in the literature in section 2.3.

Last but not least, gemination, or the total assimilation of a coda consonant to the following onset, as in 'carne' [ˈkan.ne] *meat*, is widespread in several dialectal areas, including Caribbean and Andalusian Spanish. Gemination has aroused much interest in Spanish phonology and has recently been documented in detail for additional dialectal areas, including Murcian Spanish. More information on gemination in Spanish dialects is given in section 2.4.

2.1. Place assimilation

Place assimilation in Spanish can target both sonorants and obstruents. Within the first group we have nasal place assimilation (previewed in (1)) and lateral place assimilation. The examples in (2, 3) illustrate nasal place assimilation across all places of articulation, across and within words, respectively. As mentioned earlier, nasal place assimilation interacts with spirantization (Navarro Tomás 1996: 110; Harris 1969; Hooper 1972; Cressey 1978, among others).

(2)	a.	en Andalucía	/en andaluθia/	[e.nan̪.da.lu.ˈθi.a]	*in Andalucia*
	b.	en Bilbao	/en bilbao/	[em.bil.ˈ β̞ao̯]	*in Bilbao*
	c.	en Finisterre	/en finistere/	[eɱ.fi.nis.ˈte.re]	*in Finisterre*
	d.	en Zaragoza	/en θaɾaɡoθa/	[en̟.θa.ɾa.ˈɣ̞o.θa]	*in Saragossa*
	e.	en Toledo	/en toledo/	[en̪.to.ˈle.ð̞o]	*in Toledo*
	f.	en Sevilla	/en sebiʝa/	[en.se.ˈβ̞i.ʝa]	*in Seville*
	g.	en Lleida	/en ɟeida/	[enʲ.ˈɟej.ð̞a]	*in Lleida*
	h.	en Cataluña	/en kataluɲa/	[eŋ.ka.ta.ˈlu.ɲa]	*in Catalonia*

Note that before a palatal consonant, as in (2g), /n/ tends to be realized as a palatalized nasal [nʲ] rather than as a fully palatal nasal [ɲ], unless it precedes a palatal nasal, as in 'un ñame' *a yam* (Quilis 1993: 229–230; Hualde 2014: 173).

(3)	a.	mana	/mana/	[ˈma.na]	*it flows*
	b.	envidia	/enbidia/	[em.ˈbi.ð̞ja]	*jealousy*
	c.	menfis	/menfis/	[ˈmeɱ.fis]	*Memphis*
	d.	manzana	/manθana/	[man̟.ˈθa.na]	*apple*
	e.	manta	/manta/	[ˈman̪.ta]	*blanket*
	f.	mansa	/mansa/	[ˈman.sa]	*docile-FEM.*
	g.	mancha	/mantʃa/	[ˈmanʲ.tʃa]	*stain*
	h.	manga	/manɡa/	[ˈmaŋ.ɡa]	*sleeve*

An exception to nasal place assimilation within words is when /m/ immediately precedes /n/, as in 'alumno' [a.ˈlum.no] *student* (Hualde 2014: 172).

Kochetov and Colantoni (2011) find that nasal place assimilation in Argentinian and Cuban Spanish is categorical except before fricatives, and that it goes hand in hand with stricture (manner) assimilation (see also section 2.3; cf. Honorof 1999 for Peninsular Spanish).

Coda laterals assimilate in place of articulation to a following coronal consonant (i.e. interdental, dental, or (pre)palatal; 4, 5) (Navarro Tomás 1996; Alarcos Llorach 1950; Quilis 1981, among others). Lateral place assimilation blocks spirantization before /d/ (cf. 5e with 5b).

(4)	a.	ala	/ala/	[ˈa.la]	*wing*
	b.	alma	/alma/	[ˈal.ma]	*soul*
	c.	elfa	/elfa/	[ˈel.fa]	*elf-FEM.*
	d.	falsa	/falsa/	[ˈfal.sa]	*fake*
	e.	alza	/alθa/	[ˈal̟.θa]	*raise!*
	f.	alta	/alta/	[ˈal̪.ta]	*tall-FEM.*
	g.	colcha	/koltʃa/	[ˈkolʲ.tʃa]	*quilt*
	h.	alcohol	/alkool/	[al.ˈkol]	*alcohol*

(5)	a.	el amor	/el amoɾ/	[e.la.ˈmoɾ]	*the love*
	b.	el valor	/el baloɾ/	[el. β̞a.ˈloɾ]	*the courage*
	c.	el furor	/el fuɾoɾ/	[el.fu.ˈɾoɾ]	*the fury*
	d.	el celo	/el θelo/	[el̟.ˈθe.lo]	*the zeal*
	e.	el dolor	/el doloɾ/	[el̪.do.ˈloɾ]	*the pain*
	f.	el sabor	/el saboɾ/	[el.sa.ˈ β̞oɾ]	*the taste*
	g.	el llanto	/el ɟanto/	[elʲ.ˈɟan̪.to]	*the weeping*
	h.	el calor	/el kaloɾ/	[el.ka.ˈloɾ]	*the heat*

Note that before a palatal consonant, as in (4g, 5g), /l/ tends to be realized as palatalized [lʲ] rather than as a fully palatal [ʎ] (Quilis 1993: 310–311; cf. Hualde 2014: 178).

As mentioned in the introduction, velar obstruents /k ɡ x/ in Chilean Spanish are palatalized before front vocoids (6) (Lenz 1940; Silva-Fuenzalida 1953; Oroz 1966). For /ɡ/, palatalization interacts with spirantization, resulting in [ɟ] after nasal or pause and [ʝ] elsewhere (Morales Pettorino 2003: 52). Velar palatalization is reportedly attested in areas of Colombia, Peru, Mexico, and Spain as well (Zamora Vicente 1967: 389; Greet Cotton and Sharp 1988: 286; RAE 2011). Unusually in Spanish, velar palatalization involves onset targets and vocalic triggers. For details, see section 4.

(6)	a.	quiso	/**k**iso/	[ˈ**c**i.so]	*(s)he wanted*
	b.	corto	/**k**oɾto/	[ˈ**k**oɾ.to]	*short*
	c.	higuera	/i**ɡ**eɾa/	[i.ˈ**ʝ**e.ɾa]	*fig tree*
	d.	gafa	/**ɡ**afa/	[ˈ**ɡ**a.fa]	*glasses*
	e.	gente	/**x**ente/	[ˈ**ç**en.te]	*people*
	f.	jota	/**x**ota/	[ˈ**x**o.ta]	*jay*

Palatalization of onset nasals is found in Asturias and Castilla-León Spanish. In Puerto Rico, Ecuador, Chile, Argentina, Colombia, the Philippines, and areas of Mexico, nasal palatalization appears to be assimilatory since it is triggered by diphthongs beginning with [i̯], as in 'nieto' [ˈɲe.to] *nephew*, 'Antonio' [an̪.ˈto.ɲo] (Quilis 1993: 242–243; Córdova 1996; RAE 2011: 243, among others). A similar phenomenon is attested for the sequence [li] followed by vowel in various Spanish dialects, including Judeo Spanish and dialects spoken in areas of Mexico and in Equatorial Guinea (Quilis 1993: 325 and references therein).

Interdentalization of /p t k/ in North-Central Peninsular Spanish might also be assimilatory. These obstruents, especially /k/, are realized by some speakers as [θ] before all voiceless stops (7) (Navarro Tomás 1996; D'Introno et al. 1995: 264; Quilis 1964). Some authors suggest that hypercorrection or orthographic influence are behind interdentalization (Lapesa 1981; Hualde 2014). However, González (2008) argues that place assimilation is involved, concurrently with manner dissimilation (cf. Antón 1994; Martínez-Gil 1999 for nonassimilatory approaches). Word-internally, coda /p t k/ can only be followed by coronal consonants /θ t s n/. Evidence from online misspelling shows that interdentalization of /k/ is more frequent before /t/, and rare before /s/, where deletion tends to take place. In addition, word-final /k/ tends to be either pronounced faithfully or deleted.

(7)	a.	óptico	/optiko/	[ˈoθ.ti.ko]	*optical*
	b.	étnico	/etniko/	[ˈeθ.ni.ko]	*ethnic*
	c.	adicto	/adikto/	[a.ˈð̞iθ.to]	*addict*

Interdentalization appears to be more pervasive in some areas of North-Central Spain (Asturias, Burgos) than in the Basque country (Martínez Martín 1983; Antón 1994, 1998; Barbero and González 2015). Ongoing research suggests that in Basque-speaking areas, total assimilation (gemination) is a more frequent outcome, at least for coda /k/ (section 2.4).

Finally, in Bolivian Spanish /s/ becomes labiodental before /f/ in words such as 'resbaloso' *slippery* or 'desvelo' *sleeplessness* (Coello Vila 1996). In addition, labialization of /f/ to [ɸ] appears to be assimilatory in Caribbean Spanish, since it occurs more frequently before [u̯e], as in 'fue' *s/he went* or 'fuego' *fire* (Vaquero 1996; RAE 2011: 187). Similarly, dorsalization of /f/, resulting in [h], [x], or [ħ], appears to be assimilatory in Venezuelan Spanish and other dialects, since it occurs before /u/ and/or all back vowels: 'perfumar' [peɾ.hu.ˈmaɾ] *to perfume* (Quilis 1993: 282–283; RAE 2011: 189).

2.2. Voicing assimilation

As already mentioned, voicing assimilation in Spanish can be triggered by both voiced consonants and vowels. We will discuss each case in turn.

In some dialects maintaining /s/ in the coda, as in Mexico and parts of Spain, coda fricatives /f (θ) s x/ assimilate in voicing to a following voiced consonant, within and across words (8, 9) (Navarro Tomás 1996; see also Harris 1969; Hooper 1972; Hualde 1989b; cf. Torreblanca 1978; Martínez-Gil 1991, 2003; Campos-Astorkiza 2014, in press, among others).

(8)	a.	afgana	/afɡana/	[av.ˈɣ̞a.na]	*Afghan*-FEM.
	b.	jazmín	/xaθmin/	[xað.ˈmin]	*jasmine*
	c.	muesli	/muesli/	[ˈmwez.li]	*muesli*
	d.	musgo	/musɡo/	[ˈmuz.ɣ̞o]	*moss*

(9)	a.	las gardenias	/las ɡaɾdenias/	[laz. ˈɡaɾ.ð̞e.njas]	*the gardenias*
	b.	las rosas	/las rosas/	[laz. ˈro.sas]	*the roses*

Voicing assimilation is extremely rare for coda /f/ (8a), because few Spanish words have /f/ in this position. In addition, it does not apply to coda /x/, also relatively rare in Spanish (Hualde 2014: 156; see also section 2.2). Note that voicing assimilation interacts with spirantization in (8a, d).

Voicing assimilation can target noncontinuant obstruents as well. In some Spanish dialects, coda stops optionally assimilate in voicing to the following onset (Hualde 1989a; Martínez-Gil 1991, 1999; Morris 2002a; RAE 2011: 148). In Castilian Spanish, coda stop voicing assimilation interacts with spirantization (10a, c) and, in some cases, with coda fricativization (cf. 10b, d) (for more details, see Martínez-Gil 1991, 1999, 2003; González 2002).

(10)	a.	admirar	/admiɾaɾ/	[að̞.mi.ˈɾaɾ]	*to admire*
	b.	adquirir	/adkiɾiɾ/	[aθ.ki.ˈɾiɾ]	*to acquire*
	c.	acne	/akne/	[aɣ̞.ˈne]	*acne*
	d.	actor	/aktoɾ/	[ak.ˈtoɾ]	*actor*

A similar voicing assimilation process is attested in Venezuelan Spanish, where voicing assimilation interacts with velarization: 'absoluto' [ak.so.ˈlu.to] *absolute*; 'étnico' [ˈeɡ.ni.ko] *ethnic* (RAE 2011: 143).

As mentioned earlier, voicing assimilation can also be triggered by vowels in Spanish. Word-final /s/ assimilates in voicing to a following vowel in Ecuadorian Spanish (Lipski 1994: 248; Bradley 2005; Colina 2009a; Chappell 2011). In Istanbul Judeo-Spanish, both /s/ and /ʃ/ undergo this type of assimilation (Bradley 2007; Hualde and Saul 2011, among others). In Catalan Spanish, /s/ is typically voiced between vowels (García Mouton 1994), and in Canary Islands and Puerto Rican Spanish, /s/ and /f/ undergo voicing in this context (Torreblanca 1986; Torreira and Ernestus 2012).

Note that unlike for fricatives, which are phonologically voiceless in Spanish, voicing assimilation targets both voiced and voiceless stops in this language and can result in voiced/voiceless outcomes.

Onset voiceless stops are realized as voiced in several Spanish dialects (Torreblanca 1976; Marrero Aguiar 1988; Quilis 1993: 222–223; Vaquero 1996; RAE 2011: 138–139, among others). This is generally understood as consonantal weakening rather than assimilation.

2.3. Manner assimilation

Aside from spirantization (Martínez-Gil, this volume), manner assimilation is rather infrequent in Spanish. One example is the realization of coda /s/ as the fricative rhotic [ɹ̝] before a trill (11) (Navarro Tomás 1996: 107, 156; D'Introno et al. 1995: 290).

(11)	a.	Israel	/israel/	[iɹ̝.ra.ˈel]	*Israel*
	b.	las reinas	/las reinas/	[laɹ̝.ˈrej.nas]	*the queens*

As discussed in section 2.2, coda fricatives can assimilate in voicing to a following voiced consonant. Before a trill, however, voicing assimilation goes in tandem with /s/ rhoticization.

/s/ can alternatively be realized as a trill: [ir.ra.ˈel], [lar.ˈrej.nas] (D'Introno et al. 1995: 290), which would be an instance of total assimilation (section 2.4). Deletion of /s/ in this context is also common (Hualde 2014: 155).

As noted in section 2.1, Kochetov and Colantoni (2011) report that nasal place assimilation in Cuban and Argentinian Spanish is accompanied by stricture ('manner') assimilation. This raises the question of whether manner/stricture assimilation is involved, and underreported, in other place assimilation phenomena in Spanish.

2.4. Gemination

Phonological geminates do not exist in Spanish, except for a few learned words such as 'perenne' *perennial* or 'obvio' *obvious* (Hualde 2014; cf. Baker 2004). However, they can arise via complete assimilation of a coda to the following onset. For example, in Murcian Spanish all codas except for /m n/ assimilate to the following onset, within and across words (12, 13) (Monroy and Hernández-Campoy 2015: 230, 231).

(12)	a.	aptitud	[at.ti.ˈtuð]	*aptitude*
	b.	atmosfera	[æm.ˈmɔf.fe.ɾa]	*atmosphere*
	c.	absurdo	[as.ˈsuɾ.ðo]	*absurd*

(13)	a.	los pies	[lɔp.ˈpje]	*the feet*
	b.	las manos	[læm.ˈmæ.nɔ]	*the hands*
	c.	los vasos	[lɔb.ˈbæ.sɔ]	*the glasses*

In Murcian Spanish, /a e o/ are reportedly realized as open [æ ɛ ɔ] when the coda is not pronounced (12b, 13a–c) (Monroy and Hernández-Campoy 2015: 233, 235). It is unclear from the source whether this is categorical; in (13a) the last vowel is transcribed as closed [e]. In addition, vowel harmony takes place when coda /s/ indicates person or plurality, as in (13c) (Monroy and Hernández-Campoy 2015: 235 and references therein).

In many dialects, including Caribbean, Andalusian, and New Mexican Spanish, gemination targets /s/ before a consonant (see, for example, RAE 2011: 200). Focusing on Andalusian Spanish, complete assimilation of /s/ to the following onset may arise regardless of the following consonant (14). In addition, if the following onset is a voiceless stop, complete assimilation with preaspiration may result (14a). If the onset is a sonorant, partial devoicing can take place (14b). Finally, if the onset is a voiced obstruent, a geminated voiceless fricative results (14c) (Alarcos 1958; Hualde 1989a, 1989b; Gerfen 2001, 2002; among others).

(14)	a.	visto	[ˈbit.to]	[ˈbiʰt.to]	*seen*
	b.	abismo	[a.ˈβ̞im.mo]	[a.ˈβ̞im̥.mo]	*abyss*
	c.	rasgo	[ˈraɡ.ɡo]	[ˈrax.xo]	*feature*

Postaspiration is also attested in some Andalusian varieties. For details, see Torreira (2012).

Gemination also targets liquids in coda position in Caribbean Spanish (Guitart 1976, 1980; Harris 1985; Núñez-Cedeño 1994; Martínez-Gil 2012) and in parts of Panama, Colombia, and Chile (RAE 2011: 230). Gemination of coda /ɾ/ is also attested in Chilean Spanish and other dialectal areas, particularly with a coda nasal or stop: 'actor' [at.ˈtoɾ] *actor*, 'un médico' [um.ˈme.ð̞i.ko] *a doctor* (Oroz 1966; Quilis 1993; D'Introno et al. 1995; RAE 2011: 256). In addition, total assimilation might be more pervasive than previously thought in some variants of North-Central Peninsular Spanish (Martínez-Gil 2017, p.c.). In an ongoing acoustic study on coda /k/ in Basque Spanish, González (2015) reports geminated outcomes in 23% of tokens analyzed for eight speakers of this dialect; most occur before [t] (cf. 23% deletion, 11% interdentalization, 30% [k], and 13% other realizations).

3. Critical issues

As shown in the previous section, consonant assimilation is pervasive and multifaceted in Spanish, with a number of voicing, place, and manner assimilation phenomena attested in several dialects. This section discusses a number of empirical and theoretical issues that stand out regarding these phenomena.

3.1. Empirical issues

One issue that arises when we examine consonant assimilation in Spanish is the extent to which it is categorical. This is important for descriptive reasons, and also has implications for its theoretical analysis.

Like other phonological phenomena—such as weakening or strengthening—consonant assimilation is grounded in phonetics, with articulatory, perceptual, and aerodynamic factors leading or contributing to it (Jun 1995, 2004). Articulatory factors are prevalent; speech segments are typically coarticulated in running speech, frequently resulting in or causing assimilation to nearby sounds. Coarticulation is obvious when we isolate the first gesture of 'curo' /ˈkuɾo/ *I heal*, which has lip rounding. Compare with 'quita' /ˈkita/ *take off (IMP.)*, where /k/ is pronounced with lip spreading. This shows that /k/ is typically coarticulated with the following vowel (expressed in narrow transcription with /k/ labialization in 'curo' [ˈkʷu.ɾo] and fronting in 'quita' [ˈkʲi.ta]). Coarticulation underpins various types of consonantal assimilatory phenomena in Spanish, most notably velar palatalization. But coarticulation is by nature phonetic and gradient, whereas velar palatalization and other assimilatory phenomena are phonological and (quasi-)categorical.

Perception is another important factor leading to or contributing to consonant assimilation, particularly when directionality asymmetries are observed (Gordon 2017: 123). It is well known that velars are likely to be perceived as palatals before front vowels and glides, which contributes to palatalization phenomena across languages (Guion 1998; see also Zampaulo, this volume). Perception also plays a role in assimilatory processes that have codas as targets, since it is harder to accurately perceive voicing and place cues in this position (Quilis 1993: 363). Assimilation to the following onset is one possible outcome, together with neutralization, deletion, or weakening. Last but not least, aerodynamics is relevant in cases such as voicing assimilation, which affects all coda fricatives except for /x/. Aerodynamic reasons can explain this apparent exception: voicing is least conducive for velar obstruents cross-linguistically, since their constriction is too close to the larynx to allow for sustained voicing. Aerodynamics can also impact whether a phenomenon is categorical or gradient, as shown by Kochetov and Colantoni (2011) for nasal place assimilation.

One case of assimilation that appears to be partial and/or gradient is fricative voicing assimilation (Harris 1969; see also section 2.2). Navarro Tomás (1996: 95, 108) observed that a slow, strong, or emphatic articulation blocks voicing for coda /s θ/. More recently, Campos-Astorkiza (2014) provides acoustic evidence that in North-Central Peninsular Spanish, voicing assimilation is gradient and sensitive to prosody, since it is more likely within words than in higher prosodic domains.

It is also important to note which assimilatory phenomena are optional rather than obligatory, and which are relatively more prevalent. Practically all types of consonant assimilation discussed in this chapter appear to be optional, excepting perhaps gemination in Andalusian or Caribbean Spanish. This issue is particularly relevant when several types of assimilation can apply in the same context, as with coda stops in Peninsular Spanish, which optionally interdentalize, assimilate in voicing, or completely assimilate to the following onset.

Gradience and optionality need to be investigated further in many of the phenomena previewed in section 1. Another, more specific empirical issue to investigate further is whether fricatives and stops do indeed undergo voicing assimilation in similar dialectal areas. Whereas coda fricatives undergo voicing assimilation, which is gradient (or gemination in certain dialects, such as Caribbean or Andalucian Spanish), several assimilatory outcomes are possible for coda stops, including not only voicing assimilation but also interdentalization and gemination. Voicing assimilation can also interact with coda devoicing and spirantization, which 'conspire' to realize coda voiced stops as voiceless fricatives in Castilian Spanish (Martínez-Gil 1999; González 2002; Morris 2002a). Detailed acoustic investigation of both coda fricatives and voiced and voiceless stops in a given dialectal area is needed to clarify whether voicing assimilation targets both types of obstruents in similar ways, and how voicing assimilation interacts with other phenomena.

Interdentalization of coda voiceless stops and gemination also remain to be explored in more detail. Ongoing research by the present author suggests that interdentalization might not be as common in Basque-speaking areas as in other areas of Northern and Central Spain. Gemination also appears to be more extended than otherwise thought; more acoustic and articulatory evidence is needed, especially in dialects other than Andalusian or Caribbean Spanish.

3.2. Theoretical issues

Modeling assimilation proved challenging under rule-based, linear generative approaches, particularly for nasal place assimilation (Harris 1969; Cressey 1978; Núñez Cedeño 1980), since the *Sound Pattern of English (SPE)* formalism could not capture it simply (see, for example, Hooper 1972). Autosegmental approaches could capture assimilation more effectively through the delinking and spreading of different nodes comprising isolated features (e.g. 'voice') or feature nodes (such as 'place') (Hualde 1989b; Martínez-Gil 1991; Núñez Cedeño 2014). They could also capture partial assimilation outcomes, via double linked specifications such as [+voice], [−voice] for partial (de)voicing.

The most influential phonological framework since the 1990s, Optimality Theory (OT; McCarthy and Prince 1993a, 1993b; Prince and Smolensky 1993), is based on language-specific rankings of universal constraints. The prevailing way to capture assimilation in OT revolves around the interaction of faithfulness constraints (typically Identity; McCarthy and Prince 1995) with Agreement (Agree) constraints (Lombardi 1999, 2001). The latter enforce similar feature specifications between segments. In consonant assimilation, Agree outranks Identity (Ident). Because Agree constraints are nondirectional, Ident constraints relevant to the trigger outrank Agree (see Piñeros 2006 and section 4 for examples).

One example is provided in (15), focusing on voicing assimilation. The ranking Ident-Onset [voice] >> Agree [voice] >> Ident [voice] selects candidate (b) as the winner, since it violates only the lower-ranked Ident [voice]. Faithful candidate (a) fails because [s] disagrees in voicing with the adjacent consonant, leading to a violation of higher-ranked Agree [voice]. Candidate (c) achieves voicing agreement by changing the onset input specification, violating top-ranked Ident-Onset [voice].

(15) /isla/ → [ˈiz.la] 'island'

Candidates	Ident-Onset [voice]	Agree [voice]	Ident [voice]
a. is.la		*!	
☞ b. iz.la			*
c. is.l̥a	*!		*

Agree constraints are not phonetically grounded. They can be understood as expressing a coarticulation imperative (González 2014), but since assimilation can also be grounded in perception and aerodynamics, their lack of phonetic grounding might be an advantage. They are nondirectional and generally 'blind' to feature binarity (but see section 4). However, assimilation is asymmetrical cross-linguistically, and certain assimilations are seldom attested (Bateman 2007; Zsiga 2011). Future work should explore whether Agree constraints are ideal to capture assimilation.

One of the most important issues in the theoretical analysis of assimilation is how to best account for variation—and whether both grammatical and nongrammatical variation should be incorporated in phonological models (Coetzee 2016). One way in which variation can be accounted for in OT is having two (or more) constraints ranked similarly. This can result in a 'tie' between optimal candidates. Another option is constraint reranking in related grammars, which may correlate with different degrees of formality, tempo, or other factors that underlie different phonological realizations. Examples of both will feature in the case study in the next section. In addition, during the past two decades there has been an increase in empirical studies of consonant assimilation, and an improved understanding of the typology of assimilatory phenomena. From approaches with Lazy constraints (Kirchner 1998; Baker 2004) and gestural

OT (Bradley 2014a, 2014b) to stochastic OT (Boersma 1997; Boersma and Hayes 2001), Max-Ent models (Hayes and Wilson 2008), and (noisy) Harmonic Grammar (Pater 2009; Coetzee 2016), OT continues to provide promising avenues of investigation to incorporate variation in consonant assimilation.

In Harmonic Grammar, constraint weighting replaces constraint ranking, with a Harmony score calculated for each candidate according to its constraint violations and the weights of those constraints. See Pater (2009) and Coetzee (2016) for details.

4. Case study: velar palatalization in Chilean Spanish

This section will focus on the analysis of velar palatalization in Chilean Spanish, introduced in section 2.1. Velar palatalization is common cross-linguistically (Bateman 2007; Gordon 2017). In Spanish, velar obstruents are slightly fronted before front vocoids across dialects (Navarro Tomás 1996), as in the word 'quita' [kʲi.ta] *take off* mentioned in section 3.1. We will refer to this general coarticulatory tendency as 'velar fronting'. In contrast, however, velar obstruents /k ɡ x/ are (pre) palatal before front vocoids in Chilean Spanish (Lenz 1940; Oroz 1966). We will refer to this phenomenon as 'velar palatalization'. For /ɡ/, the allophone [ɟ] occurs after a nasal or pause, and the allophone [ʝ] elsewhere.

(16)	a.	<u>qu</u>iso	/ˈ**k**iso/	[ˈ**c**i.so]	*wanted (3rd person sg.)*
	b.	page usted	/ˈpa**ɡ**e usˈted/	[ˈpa.**ʝ**eu̯s.ˈte]	*you (formal) pay*
	c.	<u>g</u>ente	/ˈ**x**ente/	[ˈ**ç**en̪.te]	*people*

Available studies on this phenomenon from the past forty years suggest that velar palatalization in Chilean Spanish can be considered (quasi-)categorical. Rabanales (1980: 447, 448) lists palatalization of velar obstruents as a phenomenon common in all areas of Chile, regardless of formality or educational level; Tapia and Valdivieso (1997: 136) also consider it a general phenomenon in Chile. On the other hand, while Wagner (1996: 227) states that velar palatalization is almost categorical at lower sociocultural levels, but optional otherwise, Flores (2016) reports that velar palatalization is prevalent across the upper and middle classes and concludes that velar palatalization has gained ground and acquired overt prestige in Chile since the 1990s.

A theoretical account of this phenomenon, couched in OT, is given in González (2014), which compares synchronic velar palatalization in Chilean Spanish with diachronic palatalization (for more information on the latter, see Baker and Holt, this volume, and Zampaulo, this volume). The remainder of this section draws from this analysis. It shows that a general, coarticulatory tendency to front back consonants, and a (quasi-)categorical assimilatory phenomenon to fully palatalize them, can be captured in a related manner with Agree constraints in OT.

The analysis assumes that vowels are dorsal (Sagey 1986), therefore specified as [±back], as are velar and palatal consonants. It also proposes that vowels and dorsal consonants are specified for [±front]. Thus, /a, o, u/ are [−front, +back], and /e, i/ are [+front, −back]. Fronted and palatal consonants articulated in the hard palate are [−back], with the former being [−front] and the latter [+front]. On the other hand, velars are [+back, −front].

Following Calabrese (2005), velar fronting is captured through the involvement of [−back]. It is proposed that velar palatalization involves the feature [+front]. Both fronting and palatalization can be captured through the interaction of Ident and Agree. Because vocoids are triggers and consonants are targets, two types of Ident constraints are proposed, based on Telfer (2006).

(17) Ident-C: 'Preserve the feature values of consonants.'
Corresponding [+consonantal] input and output segments have the same features.

(18) IDENT-V: 'Preserve the feature values of vocoids.'
Corresponding [−consonantal] input and output segments have the same features.

These constraints interact with AGREE [−back] and AGREE [+front]. The formulation of these constraints singles out ± feature specifications, which captures velar palatalization in Spanish and avoids generating consonant retraction of palatals.

(19) AGREE [−back]: 'If a segment is [−back], adjacent segments are [−back].'
That is, *[−back] [+back], *[+back] [−back]

(20) AGREE [+front]: 'If a segment is [+front], adjacent segments are [+front].'
That is, *[−front] [+front], *[+front] [−front]

The ranking IDENT-V >> AGREE [−back] >> IDENT-C >> AGREE [+front] captures velar fronting, common in most Spanish dialects, as shown in (21). Note that candidate (b), with a fronted velar, is optimal since it violates low-ranked constraints, unlike candidates (a), (c), and (d). Note that (d) achieves agreement through a double violation of IDENT-V (since the vowel has changed its input specification in backness and fronting).

(21) /xente/ → [ˈxʲen̪.te] *people*

Candidates		IDENT-V	AGREE [−back]	IDENT-C	AGREE [+front]
	a. ˈxen̪.te		*!		*
☞	b. ˈxʲen̪.te			*	*
	c. ˈçen̪.te			**!	
	d. ˈxon̪.te	*!*			

If IDENT-C is demoted below AGREE [+front], and there is no crucial ranking between both agreement constraints, velar palatalization arises, as shown in (22). The winning candidate (c) is realized with full palatalization of the input velar, violating IDENT-C. In comparison, candidates (a, b) violate higher-ranked agreement constraints, while (d) loses on a double violation of IDENT-V. The tableau in (23) shows the evaluation for the word /ɡala/, where palatalization does not apply. In this case, faithful candidate (a) is selected as the winner; unlike its competitors, it does not violate any constraints in the evaluation.

(22) /xente/ → [ˈçen̪.te] *people*

Candidates		IDENT-V	AGREE [−back]	AGREE [+front]	IDENT-C
	a. xen̪.te		*(!)	*(!)	
	b. xʲen̪.te			*!	*
☞	c. çen̪.te				**
	d. xon̪.te	*!*			

(23) /ɡala/ → [ˈɡa.la] *gala*

Candidates		IDENT-V	AGREE [−back]	AGREE [+front]	IDENT-C
☞	a. ɡa.la				
	b. ɡʲa.la		*!		*
	c. ɟa.la		*(!)	*(!)	**
	d. ɡo.la	*!			

Finally, the ranking IDENT-V, IDENT-C >> AGREE [+front], AGREE [−back] would capture instances of velar faithfulness, since both faithfulness constraints would rank over both agreement constraints. It is an empirical question whether there are Spanish dialects where velars display no fronting whatsoever before fronted vowels.

The related rankings in (21, 22) represent similar, but nonidentical grammars in various Spanish dialects. With some additions, these basic rankings can account for the development of palatals diachronically in Hispano-Romance, which went through a fronting phase before fully palatalizing (for details, see González 2014).

This approach involves specification of features in the formulation of AGREE constraints, which accounts for some of the asymmetrical nature of this type of assimilation; more investigation is needed on whether specification is needed to account for other phenomena. In addition, it depends on specifying dorsal consonants, and vowels, with [±front]. More investigation is needed on the relevance of [±front] in other areas of Spanish phonology.

One possible alternative analysis without recurring to the feature [front], suggested by Martínez-Gil (p.c.), considers palatalized velars as having both a consonantal and a vocalic place of articulation. The latter would correspond to a secondary, fronted place of articulation. The ranking AGREE [back] >> DEP-V-PLACE >> IDENT [back] would capture fully palatalized outcomes in Chilean Spanish in this analysis.

5. Conclusion

The goal of this chapter was to provide a comprehensive overview of consonant assimilation in Spanish. The preview offered in section 1 shows that consonant assimilation in Spanish is generally anticipatory and tends to involve coda targets and onset triggers. This is not surprising since a large body of research shows that codas are weaker in many ways than onsets and more prone to undergoing phonological changes. Consonant assimilation in Spanish targets both sonorants and obstruents, albeit in different ways. Most cases of consonant assimilation in Spanish involve place, followed by voicing, the most common features that assimilate between adjacent consonants cross-linguistically. Spirantization (see Martínez-Gil, this volume) is also unusual in that it involves assimilation of manner (more specifically, continuancy). Finally, while some types of assimilatory phenomena are pervasive across Spanish dialects (such as nasal and lateral place assimilation), some appear to be specific to certain dialects (such as interdentalization).

Although much work has been conducted on certain types of consonantal assimilatory phenomena in Spanish, such as voicing or nasal place assimilation, more research is needed regarding less investigated cases, such as interdentalization or gemination. In addition, a better understanding of gradience and optionality in Spanish consonant assimilation phenomena will contribute greatly to the refinement and/or development of current theoretical models in phonology.

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4
Vowel harmony

Jesús Jiménez and Maria-Rosa Lloret

1. Introduction

Vowel harmony refers to the phonological phenomenon that requires vowels in certain morphological or prosodic domains to agree in specific phonological features. For example, in the most common pattern of Eastern Andalusian Spanish, a final vowel that is lax due to the aspiration or complete loss of word-final *-s* causes a stressed nonhigh vowel to become lax as well (lax vowels are more open than their tense counterparts), as in *nenes* /nenes/: [ˈnɛnɛ] 'boys' (cf. *nene* /nene/: [ˈnene] 'boy'). The segment that originates the harmony is called *the trigger* (e.g., the final unstressed vowel in [ˈnɛnɛ]); the segment that undergoes harmony is called *the target* (e.g., the stressed vowel in [ˈnɛnɛ]); and the transmitted feature is *the harmonizing feature* (e.g., "lax" in [ˈnɛnɛ]).

From the point of view of articulation, harmony may result in gestural simplification, because it minimizes differences in the production of agreeing segments. From the point of view of perceptibility, the harmonizing features become more perceptible, since they extend to other segments and thus turn out to be more salient acoustically. The cost of harmony is that certain phonological input features are overridden by the transmitted features. Empirical data provide a notable diversity of harmony patterns that phonological theories try to accommodate. This chapter presents different types of vowel harmony within and across varieties of Spanish, and discusses related theoretical issues focusing on the characteristics of the trigger and the target as well as the domain of harmony. The discussion is organized as follows. First, we describe the harmony patterns that have been reported for some varieties located in the southeast area of peninsular Spanish (§2). In §3 we highlight the theoretical concerns that these data raise. In §4 we carry out an OT analysis of the prototypical vowel harmony systems described within the prominence-based licensing approach developed by Walker (2005, 2011). In §5 we extend the typology to other Iberian Romance varieties displaying vowel harmony, which include data from some Cantabrian Spanish varieties (the other Spanish dialect that shows vowel harmony) as well as data from varieties of Asturian and Catalan. Finally, in §6 we present the conclusions.

2. Data from southern peninsular Spanish

Spanish has a five-vowel inventory (i.e., /a, e, i, o, u/), traditionally described as showing a tendency to be realized with tenser (more closed) allophones in open syllables and with laxer (more open) allophones in closed syllables (Navarro Tomás 1982). The strong restrictions that general Spanish has on word-final codas (only fricatives, nasals, and liquids, all of them coronal, and in certain varieties /h/, are allowed) sometimes lead to the weakening or complete loss of final consonants; this, especially in the latter case, may be compensated by opening the preceding vowel in some varieties (Navarro Tomás 1938), thus accentuating the differences between tense and lax vowels up to the point of creating new surface lexical and morphological contrasts: e.g., *ve* [ˈbe] 's/he sees' vs. *vez* [ˈbɛ] 'time (occasion)'; *ve* [ˈbe] 's/he sees' vs. *ves* [ˈbɛ] 'you-SING. see'. In Eastern Andalusian (EA) Spanish (spoken in the provinces of Almería, Granada, Córdoba, and Jaén) and in Murcian Spanish (spoken in the neighboring region of Murcia), the lax character of the rightmost vowel can extend to the preceding syllables, giving rise to a process of vowel harmony (*nenes* [ˈnɛnɛ], *comes* [ˈkɔmɛ] 'you-SING. eat'), which is the focus of this chapter.

The process of vowel harmony in EA Spanish has been studied for many years, dating back as far as Navarro Tomás (1938, 1939). Other relevant classical studies are Rodríguez-Castellano and Palacio (1948), Alonso et al. (1950), Alvar (1955a, 1955b, 1996a), Salvador (1957, 1977), Alarcos Llorach (1958, 1983), Llorente Maldonado de Guevara (1962), Mondéjar (1970, 1979, 1991), Contreras Jurado (1975–1976), Hooper (1976), Gómez Asencio (1977), Moya Corral (1979), Zubizarreta (1979), López Morales (1984), Llisterri and Poch (1986), Martínez Melgar (1986, 1994), Sanders (1994, 1998), and Hualde and Sanders (1995). More recent studies, sometimes focusing only on analytic aspects of the process, include Jiménez and Lloret (2007), Lloret and Jiménez (2009, 2018), Carlson (2012), Soriano (2012), Herrero de Haro (2016a, 2016b, 2017b, 2017c, 2018, 2019a), Henriksen (2017), Lloret (2018), Neumann and Kanwit (2018) and, specifically for the Murcia region, Hernández-Campoy and Trudgill (2002). (See Herrero de Haro 2017a for an in-depth revision of the literature on EA.)

The contrast between tense and lax vowels is typically captured with the common practice of using the [ATR] feature, though, as is well known (see, e.g., Rice 1999), there is no exact correlation for all languages between the quality of vowels and the advanced/retracted tongue root position. The tense (more closed) version of each vowel is considered to be [+ATR], while the lax (more open) version is considered to be [−ATR] (1).

(1)

	Coronal		Labial	
[+ATR]	i		u	High
[−ATR]	ɪ		ʊ	
[+ATR]	e		o	
[−ATR]	ɛ		ɔ	
[+ATR]		a		Low
[−ATR]		a̞		

Navarro Tomás (1939), Alonso et al. (1950), Salvador (1957), Gómez Asencio (1977), Mondéjar (1979), Alarcos Llorach (1983), Hernández-Campoy and Trudgill (2002), and Soriano (2012), among others, consider the difference between the tense and lax counterparts of high vowels significant enough to be taken into account. Salvador (1977: 12) excludes the laxing of final /u/, except for educated speakers. Other authors (e.g., Rodriguez-Castellano and Palacio 1948; Zubizarreta 1979; Llisterri and Poch 1986; Sanders 1994, 1998; Henriksen 2017; Rincón 2018) do not consider the difference to be significant for high vowels. Experimental studies in general favor the former view (see, e.g., Martínez Melgar 1986, 1994; Herrero de Haro 2018, 2019b), though some variation may be found across varieties.

A characteristic that southern peninsular Spanish varieties with vowel harmony share is the fact that [−ATR] harmony proceeds leftwards, usually from a weak position (i.e., the final unstressed vowel) to a strong position (e.g., the stressed vowel). The scope of vowel harmony, though, shows noteworthy divergences within and across varieties, which fall into two main patterns: one that imposes phonological requirements and another that additionally places specific morphological conditions. Throughout this chapter, the phonologically conditioned vowel harmony will be illustrated with data from Granada (as presented in Jiménez and Lloret 2007, 2018; Lloret and Jiménez 2009; Lloret 2018, based mainly on data from Alonso et al. 1950; Sanders 1994) and Murcia (as described in Hernández-Campoy and Trudgill 2002), and the morphologically conditioned vowel harmony with data from Jaén (as described in Soriano 2012).

2.1. Phonologically conditioned patterns

In the EA variety spoken in Granada, -/s/ and -/h/ (in the few words that present a final <j> in Spanish, as in *reloj* 'watch') typically delete (a short aspiration is also a possible alternative in emphatic pronunciations), irrespective of their morphological filiation; concomitantly, any contiguous preceding vowel opens (and /a/ further fronts, represented as [æ̣]): e.g., *ves* [ˈbɛ$^{(h)}$] 'you-SING. see', *vas* [ˈbæ̣$^{(h)}$] 'you-SING. go', *mis* [ˈmɪ$^{(h)}$] 'my.PL.', *reloj* [reˈlɔ$^{(h)}$] 'watch'. Word-final coronal liquids (-/l/, -/ɾ/) can also delete (or weaken) along with the opening of the preceding vowel; however, while the opening of the vowel is quite systematic before fricatives, it is variable before liquids and is usually described as a low-level phonetic effect that produces a lesser degree of opening than in the fricative context, as shown in the examples with the diacritic indicating a lowered vowel: e.g., *girasol* [hiɾaˈso$^{(l)}$] ~ [hiɾaˈsọ$^{(l)}$] 'sunflower', *cantor* [kanˈtọ$^{(ɾ)}$] 'singer-MASC.'. Word-final nasals are always maintained while all other word-final consonants systematically delete, but in none of these contexts is the preceding vowel open: e.g., *melón* [meˈloŋ] 'melon' vs. *tarot* [taˈɾo] 'tarot', *anorak* [anoˈɾa] 'anorak'.

Final vowels that are open (i.e., [−ATR]) due to the loss (or weakening) of a word-final fricative in nonoxytones cause obligatorily stressed nonhigh vowels, and optionally pretonic and posttonic nonhigh vowels within the prosodic word (clitics included), to become [−ATR] (2a–c). In oxytones, pretonic nonhigh vowels may also take the [−ATR] feature from the last vowel (2d). The opening can affect nonfinal low vowels as well, but the process seems to be less regular (see Henriksen 2017). On the other hand, high vowels, stressed or not, are not targeted by vowel harmony, as the words *libros* and *muchos* in (2a) show; they act as *neutral* vowels. Nonetheless, they do not interrupt the spreading of the harmonizing feature in this variety; they are thus *transparent* to harmony, up to the point of allowing discontinuous [−ATR] vowel strings: see, for instance, *molinos* in (2b) or *cómicos*, *económicos*, and *consíguelos* in (2c). Finally, words such as *ídolos* and *consíguelos* in (2c) illustrate another pattern: in proparoxytones with a stressed high vowel, posttonic mid vowels may agree with the opening of the last vowel even though the stressed vowel remains closed: e.g., [ˈiðɔlɔ$^{(h)}$].

(2) Interaction between opening in the rightmost vowel and vowel harmony in Granada EA (induced by word-final coronal fricatives and -/h/)

a. Two-syllable paroxytones: final opening, with obligatory spreading to the stressed (except if it is high)

nenes	'boys'	[ˈnɛnɛ$^{(h)}$]
asas	'handles'	[ˈa̹sæ$^{(h)}$]
libros	'books'	[ˈlißɾɔ$^{(h)}$]
muchos	'many-MASC.'	[ˈmuʃɔ$^{(h)}$]
jueves	'Thursday'	[ˈhwɛßɛ$^{(h)}$]
Burgos	'Burgos (city name)'	[ˈbuɾɣɔ$^{(h)}$]

b. Three-syllable or larger paroxytones: final opening, with obligatory spreading to the stressed (except if it is high) and optional spreading to the pretonic (except if they are high)

comemos	'we eat'	[koˈmɛmɔ$^{(h)}$] ~ [kɔˈmɛmɔ$^{(h)}$]
abetos	'firs'	[aˈßɛtɔ$^{(h)}$] ~ [a̹ˈßɛtɔ$^{(h)}$]
molinos	'mills'	[moˈlinɔ$^{(h)}$] ~ [mɔˈlinɔ$^{(h)}$]
monederos	'purses'	[moneˈðɛɾɔ$^{(h)}$] ~ [mɔnɛˈðɛɾɔ$^{(h)}$]
horrorosos	'horrifying-MASC.PL.'	[oroˈɾɔsɔ$^{(h)}$] ~ [ɔrɔˈɾɔsɔ$^{(h)}$]

c. Proparoxytones: final opening, with obligatory spreading to the stressed (except if it is high) and optional spreading to the posttonic and the pretonic (except if they are high)

tréboles	'clovers'	[ˈtɾɛßolɛ$^{(h)}$] ~ [ˈtɾɛßɔlɛ$^{(h)}$]
cómicos	'comic-MASC.PL.'	[ˈkɔmikɔ$^{(h)}$]
ídolos	'idols'	[ˈiðolɔ$^{(h)}$] ~ [ˈiðɔlɔ$^{(h)}$]
económicos	'economic-MASC.PL.'	[ekoˈnɔmikɔ$^{(h)}$] ~ [ɛkɔˈnɔmikɔ$^{(h)}$]
recógelos	'gather them-MASC.'	[reˈkɔhelɔ$^{(h)}$] ~ [reˈkɔhɛlɔ$^{(h)}$] ~ [rɛˈkɔhɛlɔ$^{(h)}$]
consíguelos	'get them-MASC.'	[konˈsiɣelɔ$^{(h)}$] ~ [konˈsiɣɛlɔ$^{(h)}$] ~ [kɔnˈsiɣɛlɔ$^{(h)}$]

d. Oxytones: final opening, with optional spreading to the pretonic (except if they are high)

coméis	'you-PL. eat'	[koˈmɛj$^{(h)}$] ~ [kɔˈmɛj$^{(h)}$]
revés	'other side'	[reˈßɛ$^{(h)}$] ~ [rɛˈßɛ$^{(h)}$]

The variability encountered in (2) in cases with pretonic and posttonic vowels gives rise to three different patterns according to the domain in which harmony applies, which are illustrated with the words *rocógelos* and *consíguelos* in (3): minimal extension, in which only stressed nonhigh vowels harmonize (pattern *a*, (3a)); medium extension, in which all nonhigh vowels of the main foot harmonize (pattern *b*, (3b)); and maximal extension, in which all nonhigh vowels of the prosodic word harmonize (pattern *c*, (3c)). Here it is important to stress that if the pretonic vowels harmonize, the posttonic vowels harmonize as well (as in [rɛˈkɔhɛlɔ$^{(h)}$], [kɔnˈsiɣɛlɔ$^{(h)}$]), but not the other way around (*[rɛˈkɔhelɔ$^{(h)}$], *[kɔnˈsiɣelɔ$^{(h)}$]).

(3) Domains

	a. Pattern *a*	b. Pattern *b*	c. Pattern *c*
	Minimal extension	Medium extension	Maximal extension
recógelos	[reˈkɔhelɔ$^{(h)}$]	[reˈkɔhɛlɔ$^{(h)}$]	[rɛˈkɔhɛlɔ$^{(h)}$]
consíguelos	[konˈsiɣelɔ$^{(h)}$]	[konˈsiɣɛlɔ$^{(h)}$]	[kɔnˈsiɣɛlɔ$^{(h)}$]

In the Murcian variety, all word-final consonants except nasals delete and concomitantly induce the opening of a nonhigh preceding vowel (and /a/ further fronts); the resulting [−ATR] final vowel, stressed or not, causes all the preceding nonhigh vowels to become [−ATR] in the domain of the prosodic word (clitics included), as the examples in (4) illustrate.

(4) Interaction between vowel harmony and opening in the rightmost vowel in Murcia (induced by all word-final consonants, except for nasals)

a. Words with a final fricative

nenes	'boys'	[ˈnɛnɛ]
asas	'handles'	[ˈæ̞sæ̞]
comemos	'we eat'	[kɔˈmɛmɔ]
abetos	'firs'	[æ̞ˈβɛtɔ]
monederos	'purses'	[mɔnɛˈðɛɾɔ]
horrorosos	'horrifying-MASC.PL.'	[ɔrɔˈɾɔsɔ]
tréboles	'clovers'	[ˈtɾɛβɔlɛ]
recógelos	'gather them-MASC.'	[rɛˈkɔxɛlɔ]
coméis	'you-PL. eat'	[kɔˈmɛj]

b. Words with other final consonants

comer	'to eat'	[kɔˈmɛ]
destrozar	'to smash'	[dɛttɾɔˈθæ̞]
clavel	'carnation'	[klæ̞ˈβɛ]
coñac	'cognac'	[kɔˈɲæ̞]

In Murcian, high vowels do not participate in the harmonic process at all (they are neutral to harmony). On the one hand, final high vowels neither become open as an effect of word-final consonant loss nor trigger the opening of preceding nonhigh vowels (5a). On the other, in words with final nonhigh vowels, the presence of high vowels in any position blocks harmony further left, as illustrated by *molinos* or *cómicos* in (5b). Hence, high vowels are *opaque* to harmony and, consequently, discontinuous [ATR] domains do not arise from vowel harmony; note that the last two examples in (5b) do not constitute an instance of a discontinuous [−ATR] domain, since the opening of the initial vowels is related to the next coda consonant and not to the final vowel.

(5) Interaction between high vowels and opening in the rightmost vowel in Murcia (induced by all word-final consonants, except for nasals)

a. Words with a final high vowel

tesis	'thesis'	[ˈtesi]
yogur	'yogurt'	[ʒoˈɣu]

b. Words with a final nonhigh vowel

libros	'books'	[ˈliβɾɔ]
muchos	'many-MASC.PL.'	[ˈmut͡ʃɔ]
molinos	'mills'	[moˈlinɔ]
cómicos	'comic-MASC.PL.'	[ˈkomikɔ]
ídolos	'idols'	[ˈiðɔlɔ]
consíguelos	'get them-MASC.PL.'	[konˈsiɣɛlɔ]
capacitar	'to enable'	[kapaθiˈtæ̞]
hospitalizar	'to hospitalize'	[ɔppitaliˈθæ̞]
extintor	'fire extinguisher'	[ɛttinˈtɔ]

2.2. Morphologically conditioned patterns

In Jaén EA any final nonnasal consonant can be deleted, producing an opening effect on the previous vowel (and the fronting of /a/): e.g., *ves* [ˈbɛ], *vas* [ˈbæ̞], *reloj* [reˈlɔ]; *girasol* [xiɾaˈsol] ~ [xiɾaˈsɔ], *cantor* [kanˈtoɾ] ~ [kanˈtɔ]; *tarot* [taˈɾɔ], *anorak* [anoˈɾæ̞]. From the set of final lax vowels, only those related to the loss of the infinitive mark -/ɾ/ or to the loss of (part of) an inflectional suffix containing -/s/ (namely, the plural nominal marker -/s/ or -/es/, the second person singular verb suffix -/s/, and the final sibilant of the first and second person plural verb suffixes, -/mos/ and -/is/, respectively) yield harmony (6). In words with one of these suffixes, harmony takes over all the syllables in the prosodic word (clitics included), as in *coméis* [kɔˈmɛj], even for nonfinal high vowels, as in *muchos* [ˈmʊʃɔ] (6a). Contrariwise, nonlisted endings do not trigger harmony, as in *jueves* [ˈhweßɛ] (6b).

(6) Interaction between vowel harmony and opening in the rightmost vowel in Jaén EA

a. /s/&/ɾ/ ⊆ suffix (-/s/, -/es/, -/mos/, -/is/; -/ɾ/): final opening, with spreading to all vowels

coméis	'you-PL. eat'	[kɔˈmɛj]
nenes	'boys'	[ˈnɛnɛ]
asas	'handles'	[ˈæ̞sæ̞]
muchos	'many-MASC.'	[ˈmʊʃɔ]
comemos	'we eat'	[kɔˈmɛmɔ]
abetos	'firs'	[æ̞ˈßɛtɔ]
molinos	'mills'	[mɔˈlɪnɔ]
monederos	'purses'	[mɔnɛˈðɛɾɔ]
horrorosos	'horrifying-MASC.PL.'	[ɔrɔˈɾɔsɔ]
tréboles	'clovers'	[ˈtɾɛßɔlɛ]
cómicos	'comic-MASC.PL.'	[ˈkɔmɪkɔ]
recógelos	'gather them-MASC.'	[rɛˈkɔhɛlɔ]
comer	'to eat'	[kɔˈmɛ]
destrozar	'to smash'	[dɛʰttɾɔˈθæ̞]

b. /s/&/ɾ/ ⊄ suffix (-/s/, -/es/, -/mos/, -/is/; -/ɾ/): final opening, without further spreading

revés	'other side'	[reˈßɛ]
jueves	'Thursday'	[ˈhweßɛ]
Burgos	'Burgos (city name)'	[ˈbuɾɣɔ]
extintor	'fire extinguisher'	[eʰttinˈtɔ]
yogur	'yogurt'	[ʒoˈɣʊ]

2.3. Summary

For the sake of comparison, (7) sums up the variation documented in the harmony systems of the varieties under study according to the quality of the vowel and its position in the word.

(7)	Input	Output			
		Pretonic	Tonic	Posttonic	Final (tonic or a-tonic)
Granada	/e/ /o/ /a/ /i/ /u/	e ~ ɛ o ~ ɔ a ~ a̹ i u	ˈɛ ˈɔ ˈa̹ ˈi ˈu	e ~ ɛ o ~ ɔ a ~ a̹ i u	ɛ ɔ æ̹ ɪ ʊ
Jaén	/e/ /o/ /a/ /i/ /u/	ɛ ɔ æ̹ ɪ ʊ	ˈɛ ˈɔ ˈæ̹ ˈɪ ˈʊ	ɛ ɔ æ̹ ɪ ʊ	ɛ ɔ æ̹ ɪ ʊ
Murcia	/e/ /o/ /a/ /i/ /u/	ɛ ɔ æ̹ i u	ˈɛ ˈɔ ˈæ̹ ˈi ˈu	ɛ ɔ æ̹ i u	ɛ ɔ æ̹ i u

As can be seen, in all the reported patterns the harmonizing feature is [−ATR], which is generated by the loss (or weakening) of certain word-final consonants. However, while the [−ATR] feature that enhances harmony emerges in Granada from the loss (or weakening) of the fricatives (-/s/ and -/h/), and in Murcia from the loss of any nonnasal consonant, in Jaén it emerges only from the loss of -/s/ and -/ɾ/ of certain inflectional suffixes (see (8)).

(8)	Conditionings on the -C that concomitantly opens the rightmost vowel	
	Phonologically conditioned vowel harmony	Morphologically conditioned vowel harmony
Granada	any -/s/ or -/h/	
Jaén		-/s/ (from the inflectional suffixes -/s/, -/es/, -/mos/, -/is/) and -/ɾ/ (from the infinitive suffix)
Murcia	any nonnasal -C	

Another point of discrepancy across varieties is the behavior of high vowels: in Jaén, high vowels behave just like any other vowel with regard to harmony; in Murcia, high vowels never become [−ATR] and block harmony; in Granada, final high vowels preceding word-final fricatives may open, but the [−ATR] feature is not harmonically transmitted to nonfinal high vowels, even though they do not block harmony. In other words, with regard to the targets of harmony, Granada and Murcia harmonies point at nonhigh vowels, while Jaén harmony targets all vowels; as for the blockers of harmony, Granada and Jaén show none (though in Granada high vowels are neutral transparent vowels), whereas in Murcia high vowels are neutral opaque vowels (see (9)).

(9)	Conditionings on the possible triggers and targets of vowel harmony		
	Affected ([−ATR]) rightmost vowels	Harmonized vowels	Blocker
Granada	all vowels	all nonhigh vowels	none
Jaén	all vowels	all vowels	none
Murcia	all nonhigh vowels	all nonhigh vowels	high vowels

The directionality of harmony is the same for all patterns: from the final vowel leftwards. They also coincide in affecting the stressed vowel as a norm (though high vowels are unaffected in Granada and Murcia), but they diverge in the treatment of pretonic and posttonic vowels: in Granada, harmony can target the stressed vowel, the stress foot (and hence posttonic vowels are affected), or the whole prosodic word (and hence pretonic vowels are affected as well); in Murcia and Jaén, harmony targets the whole prosodic word, though in Murcia the transmission is interrupted by the presence of high vowels. Here (10) summarizes the domains of vowel harmony, ignoring sequences with neutral high vowels.

(10)	Domains of vowel harmony (without high vowels)			
	Pretonic	Tonic	Posttonic	Final (trigger)
Granada	variable	obligatory	variable	obligatory
Jaén	obligatory	obligatory	obligatory	obligatory
Murcia	obligatory	obligatory	obligatory	obligatory

3. Theoretical concerns

The vowel harmony patterns attested for southern peninsular Spanish raise several theoretical concerns, some of which are specific to Spanish while others have to do with the grounding of harmony.

To begin with, the emergence of lax vowels, which are the triggers of harmony, originated a debate on their phonemic status in Spanish. Some authors argued that new grammatical contrasts created by the lax vowels under the loss of the suffix -/s/ (11) favor the recognition of new phonemes, and therefore proposed a split system (/a, a̹, e, ɛ, i, ɪ, o, ɔ, u, ʊ/), known as *des-do-bla-mien-to vocálico* ('vowel doubling' or 'vowel splitting') in the Hispanic literature (e.g., Navarro Tomás 1938, 1939; Alarcos Llorach 1949; Alonso et al. 1950; Alvar 1955a; Salvador 1957, 1977; Gómez Asencio 1977; and, for the Murcian variety, Hernández-Campoy and Trudgill 2002).

(11)	a.	va	's/he goes'	[ˈba]	b.	vas	'you-SING. go'	[ˈbæ̹]
		ve	's/he sees'	[ˈbe]		ves	'you-SING. see'	[ˈbɛ]
		mi	'my.SING'	[mi]		mis	'my-PL.'	[mɪ] ([mi] in Murcia)
		lo	'him'	[lo]		los	'them-MASC.'	[lɔ]
		tu	'your.SING.'	[tu]		tus	'your-PL.'	[tʊ] ([tu] in Murcia)

As Herrero de Haro (2017a: 319) notes, one should distinguish between *vowel doubling*, which implies the acceptance of new lax phonemes, and mere *vowel system doubling*, which does not necessarily entail the addition of new phonemes but just the emergence of new allophones derived from the basic five-vowel system (see Alarcos Llorach 1958, 1983; Mondéjar 1979; Cerdà 1992). Recall that, as we already noted, some authors defend incomplete split systems, usually without the lax version of the two high vowels (as in Murcian).

The vowel doubling view, with the final lax vowels as the only exponent of some morphological information (i.e., with alleged underlying contrasts such as /nene/ 'boy' vs. /nenɛ/ 'boys'), has been challenged by a variety of claims from the synchronic perspective. First, the harmonic systems under study are favored, but not determined, by the fact that vowel quality is the only exponent of a grammatical contrast, since it may affect not only words where -/s/ is the exclusive representative of an inflectional suffix (*nenes* [ˈnɛnɛ], *comes* [ˈkɔmɛ]) but also cases where -/s/ is just part of an inflectional suffix (*vemos* [ˈbɛmɔ] 'we see', *coméis* [kɔˈmɛj], *meses* [ˈmɛsɛ] 'months'). Additionally, the process can also affect endings that are dubiously inflectional (*jueves* [ˈhwɛβɛ], *lejos* [ˈlɛhɔ] 'far') and cases where the fricative is part of the stem (*revés* [rɛˈβɛ]). Second, the selection of the -/es/ plural allomorph in nouns (*meses* [ˈmɛsɛ]) and the morphophonological alternations it generates (*mes* [ˈmɛ] 'month', *mesecito* [meseˈsito] 'month-DIM.') provide further evidence for the presence of an input consonant, even if it is realized as an aspirate in some varieties (*me*[h]*ecito*). Third, diphthong formation across words is blocked when the first vowel is affected by the laxing process, which is another reminder of the presence of an input word-final consonant (*clavel**es y** tomates* [ɛ.i] 'carnations and tomatoes' vs. *tomat**e y** clavel* [ej] 'tomato and carnation'). One last claim, already pointed out by Alarcos Llorach (1958, 1983), connects the realizations of internal codas with those of word-final codas: in southern peninsular Spanish, word-internal /s/-codas typically undergo aspiration or deletion, or trigger gemination of the following consonant (with possible retention of the aspiration) (*casco* [ˈkahko], [ˈkako], [ˈkakko], [ˈka^{h}kko] 'helmet'), and the same outcomes arise when an undisputed word-final /s/ comes in contact with a consonant (*mes completo* [mɛ$^{(h)}$kkomˈpleto] 'full month'). Given that varieties displaying word-final opening also present similar results in the contact of plural forms and the following word (*los cascos* [lɔ$^{(h)}$kˈka̹$^{(h)}$kkɔ$^{(h)}$] 'the helmets'), it is reasonable to assume that the plural morph is a fricative consonant as well. All in all, the data indicate that a simple five-vowel phonemic set, with underlying final consonants, is sufficient to account for the laxing of vowels, even for cases in which the opening is the only trace of a grammatical contrast.

Another issue of debate is the source of [−ATR] induced by consonant loss (or weakening). Fricatives (contrary to stops) and liquids (contrary to nasals) share a more open gesture in the oral tract, which presumably may induce the opening of the contiguous vowel. Along these lines, Jiménez and Lloret (2007) and Lloret and Jiménez (2009), building on data from Granada, propose that [−ATR] emerges from local assimilation, as a cue preservation of the laryngeal specification [spread glottis] that fricatives have (Vaux 1998; Gerfen 2002), based on the fact that [spread glottis] contributes to the raising of the first formant in vowels (i.e., to their opening) and that opening guarantees sufficient perceptual salience of this feature (Gordon and Ladefoged 2001: 400). Likewise, the further fronting of an adjacent /a/ is seen as a way to preserve the place feature [coronal] of the lost consonant (Hualde and Sanders 1995), though it can also be understood as a strategy to reinforce the contrast between the plain low vowel ([a]) and its lax, more open counterpart ([æ̹]). The data from Jaén and Murcia, though, challenge this phonetically grounded interpretation, since the deletion of any word-final nonnasal consonant (including stops) causes the opening effect. Hence, further investigation of the link between articulation and acoustics is needed to capture plausible phonetic reasons for the emergence of [−ATR] as a trace of consonant loss (or weakening) in the resulting word-final open syllable.

In the traditional Hispanic view, the opening of vowels is usually considered an aspiration-dependent phenomenon: "la espiración glotal característica de [h] (realización de /s/), antes de perderse totalmente, deja como recuerdo o la abertura de la vocal o la infección sobre la consonante [siguiente]" [the glottal aspiration (which is the realization of /s/), before being completely lost, leaves as a reminder either the opening of the vowel or the infection of the [following] consonant]

(Alarcos Llorach 1958: 197; our translation). Hualde and Sanders (1995) instead propose that the weakening of final consonants in EA just triggers the reinforcement of a prior phonetic difference between close vowels in final open syllables and open vowels in final closed syllables, since the same kind of vocalic contrast is well attested in other Spanish and Romance varieties that do not aspirate /s/.

See along these lines Henriksen (2017: 122)

Though the phonological interpretation of vowel doubling and the phonetic grounding for the source of [−ATR] have attracted considerable interest among scholars, these issues are peripheral to the core discussion on vowel harmony, and we will not pursue them here. What is relevant for our purposes is that in these systems [−ATR] serves as a marked value that enhances harmony as a means to maximize its salience. That is the reason why harmony takes place from a weak position (the final unstressed syllable) to a strong position (the stressed syllable, the foot, or the whole prosodic word). The existence of patterns with discontinuous [ATR] sequences, as in *tréboles* [ˈtɾɛ$_{-\text{ATR}}$βo$_{+\text{ATR}}$lɛ$_{-\text{ATR}}^{(h)}$] in Granada, gives support to the view that southern peninsular Spanish vowel harmony is primarily perceptually based, though articulation is also favored in nondiscontinuous sequences, as in *tréboles* [ˈtɾɛ$_{-\text{ATR}}$βɔ$_{-\text{ATR}}$lɛ$_{-\text{ATR}}^{(h)}$] (Lloret 2007). It is important to highlight at this point that theories grounded on the articulatory benefits of harmony, that is, on the attempt to minimize the resetting of articulators—especially Gestural Uniformity (e.g., Pulleyblank 2002), but also Optimal Domains Theory (Cole and Kisseberth 1994) and Span Theory (McCarthy 2004)—can correctly account for cases in which a uniform [−ATR] span is created, as in Jaén and Murcia and in certain patterns of Granada. Indeed, a simple instruction banning [+ATR] specifications before a final [−ATR] vowel would generally induce the transmission of [−ATR] to the left, as in [ˈtɾɛβɔlɛ$^{(h)}$]. However, this approach runs into problems when dealing with cases presenting discontinuous domains (e.g., [ˈtɾɛβolɛ$^{(h)}$] in Granada), in which vowel harmony gives rise to nonhomogeneous articulatory sequences. The alternative approach to these issues is perceptually based (e.g., Boersma 1998): harmony results from languages attempting to attach features to maximally perceptible positions. This perceptual interpretation, already present in the Optimal Domains Theory (Cole and Kisseberth 1994) and Span Theory (McCarthy 2004), has been refined in the prominence-based licensing approach to vowel harmony put forward by Walker (2005, 2011) and will be the basis of our analysis in §4. In this view, featurally discontinuous strings such as [ˈtɾɛβolɛ$^{(h)}$], albeit not optimal, are not troublesome at all, since the harmonic transmission of [−ATR] to the stressed syllable makes this feature perceptually more salient.

In an articulatory-based analysis, transparent intervening high vowels (as in *cómicos* [ˈkɔmikɔ$^{(h)}$]) could be handled by assuming that these segments are underspecified for the harmonic [ATR] feature. Note, however, that final high vowels that are contiguous to -/s/ undergo opening in Granada and Jaén (e.g., *mis* [mɪ] ‘my.PL.’, *tus* [tʊ] ‘your.PL.’) and thus presumably are able to acquire the [−ATR] feature. As for posttonic mid vowels that may not be affected by harmony (as in [ˈtɾɛβolɛ$^{(h)}$]), underspecification is not a plausible explanation; prominence relations, though, could still justify why within the metrical foot they may remain unaffected, since the posttonic syllable is the weakest position within the foot: Hualde (1989), for instance, explains this configuration as an instance of percolation of the harmonizing feature to the head of the prosodic foot only. In our view, both perceptual and articulatory factors contribute to vowel harmony, but the summation of all the data suggests that the primary motivation for spreading is perceptual.

Finally, southern peninsular Spanish harmony also contributes to the debate on how the harmonizing features are transmitted. In the common view, harmony is seen as a long-distance assimilation process that spreads a feature from vowel to vowel. But this interpretation is incompatible with discontinuous sequences, in which harmony is most likely achieved through operations of feature copying (which can skip a segment) rather than through feature spreading (see discussion in §4).

4. OT prominence-based licensing approach to southern peninsular Spanish vowel harmony

In this section we provide an OT prominence-based licensing analysis (Walker 2005, 2011; Jiménez and Lloret 2007, 2018; Lloret and Jiménez 2009; Lloret 2018) of the three vowel harmony systems under discussion, focusing on how the harmonizing [−ATR] feature of final vowels extends further left. As already stated, they are licensing-driven systems because harmony targets prominent positions and thus serves to improve the perception of the [−ATR] value, singled out because its initial host is usually a weak segment, i.e., a final unstressed vowel. The spreading of [−ATR] seeks to satisfy the constraint License(−ATR, S-Pos) (cf. the general constraint License(F, S-Pos): "Feature [F] is licensed by association to strong position S"; Walker 2005: 941), which in the harmonies under study minimally targets the stressed syllable; that is, it demands that the harmonizing feature is linked to that syllable. On the other hand, the faithfulness constraint Ident(ATR) (cf. Ident(F): "Correspondent segments have identical values for the feature F"; McCarthy and Prince 1999: 294) enforces the maintenance of the input [ATR] value in all vowels. The basic ranking that allows [−ATR] vowels to be derived from harmony is License(−ATR, S-Pos) >> Ident(ATR), as illustrated in (12): candidate (12b) is preferred over (12a) because [−ATR] is realized on the stressed vowel at the expense of incurring an additional faithfulness violation. All the following analyses concentrate on harmony and thus take into account only candidates with the final vowel already opened as a remnant of the word-final consonant (either lost or weakened). Note, however, that this trace allows candidates to satisfy a faithfulness constraint, not included in the tableaux, against the total loss of the final consonant (such as Max-IO: "Every segment of the input has a correspondent in the output"; see McCarthy and Prince 1999: 225). We assume, in line with Walker (2011: 178–179), that the satisfaction of Max-IO is achieved through a coalescence process between the final consonant and the preceding vowel, as the subscripts in candidates (12a–b) indicate. For the sake of completeness, though, in (12) we also consider the possibility that [−ATR] is only realized on the stressed vowel to satisfy the licensing requirement, as in candidate (12c) [ˈnɛ_2ne_1]; this mapping, in which the output exponent of the lost final consonant attaches only to the stressed vowel, is ruled out by the action of Right-Anchor(I-O) ("An element at the right periphery of I[nput] has a correspondent at the right periphery of O[output]"; McCarthy and Prince 1999: 295) at the top of the ranking. (In all the rankings proposed throughout this chapter, constraints for which the data do not impose a rank ordering have been placed as high as possible, following the constraint demotion algorithm; see Tesar and Smolensky 1994.)

(12)

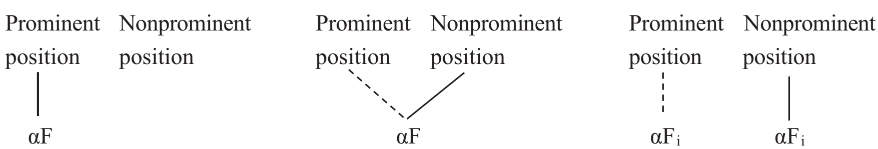
/nen$\text{e}_1$$\text{s}_2$/	Right-Anchor(I-O)	License(−ATR, S-Pos)	Ident(ATR)
a. ˈnenɛ_{12}		*!	*
☞ b. ˈnɛ_2nɛ_{12}			**
c. ˈnɛ_2ne_1	*!		*

Variation in the patterns due to the scope of harmony (i.e., the harmony domains and its blockers) as well as to restrictions in the combination of certain features (to prevent, e.g., high vowels from opening) is discussed in the following sections.

4.1. Phonologically conditioned vowel harmony: Murcia and Granada

In Murcia, vowel harmony affects nonhigh vowels in the domain of the prosodic word, as in *monederos* [mɔnɛˈðɛrɔ] and *tréboles* [ˈtrɛβɔlɛ]. Since the general domain of harmony is the whole prosodic word, the active licensing constraint that enhances harmony targets all vowels; it is an instance of the maximal licensing constraint License([F], ∀V), posited by Walker (2011: 246) to account for unbounded harmony, according to which a [F] ([−ATR] in our case) must be licensed by association with all syllables in a prosodic word. High vowels are never affected by the opening, whether they are the rightmost vowel next to the lost consonant (e.g., *tesis* [ˈtesi]) or one of the targets of harmony (e.g., *ídolos* [ˈiðɔlɔ]), and they additionally block the transmission of [−ATR] further left (e.g., *cómicos* [ˈkomikɔ], *molinos* [moˈlinɔ], *consíguelos* [konˈsiɣɛlɔ]). The prohibition on opening high vowels can be seen as a limitation imposed by the feature co-occurrence constraint *High/−ATR (cf. RTR/HIGH Condition: "If [−ATR] then not [+high]," in Archangeli and Pulleyblank 1994: 176), which must be ranked above the maximal licensing constraint (and also above the aforementioned Max-IO constraint, which demands the maintenance of some trace of the final consonant). The high vowels' interruption of the spreading can be seen as a ban against ill-formed gapped, discontinuous configurations (Archangeli and Pulleyblank 1994: 357). To accommodate this prohibition, we use the devices provided by the license theory. In this approach Walker (2011: 7), following Steriade (1995), defines three configurations that can satisfy the general licensing constraint License(−ATR, S-Pos): (*a*) when [F] is contained wholly within a strong position (*direct licensing*, as in (13a)); (*b*) when [F] originally appears in a weak position but spreads to a strong adjacent position (*indirect licensing*, as in (13b)), and (*c*) when [F] originally appears in a weak position but is duplicated, through feature copying, in a strong nonadjacent position (*identity licensing*, as in (13c)); feature copying is considered the only available configuration when the target is not adjacent to the trigger.

(13) a. Direct licensing b. Indirect licensing c. Identity licensing



Under licensing, spreading is a local operation in Gen: it can give rise only to local assimilations, limited to adjacent targets, as in indirect licensing (13b). Nonlocal assimilations, which operate at a distance over unaffected intervening segments, are instead achieved via feature copying, that is, through duplication of the feature in the prominent position, as in identity licensing (13c). For instance, to produce a discontinuous [−ATR] string such as [ˈkɔ$_{-ATR}$mi$_{+ATR}$kɔ$_{-ATR}$] or [ˈtɾɛ$_{-ATR}$βo$_{+ATR}$lɛ$_{-ATR}$], the [−ATR] feature of the last vowel must have a duplicant feature in the stressed syllable. Although that configuration satisfies License(−ATR, S-Pos), it violates the markedness constraint against any duplicated feature, *Duplicate(F) (Walker 2011: 54). Local assimilation via indirect licensing, whenever possible, is preferred to feature copying because it does not entail any *Duplicate(F) violation. In Murcia, the ranking of *Duplicate(F) above the licensing constraint License(−ATR, ∀V) guarantees the exclusion of long-distance harmonies that skip high vowels. (For a discussion of the viability of assimilation via segmental linking or via segmental correspondence, see, among others, Walker 2000; Hansson 2001; Rose and Walker 2004; McCarthy 2007.)

Similar markedness constraints that have been used in the OT literature to discard gapped configurations are *Gap (Pulleyblank 1996; Ní Chiosáin and Padgett 2001; Walker 1998, 2005), Proximity (Rose and Walker 2004), Locality (Walker 2010: 172), and *Skip(X) (Kimper 2012: 303). Some authors resort instead to faithfulness constraints such as IO-Integrity (Krämer 2003: 93) or O-Contiguity (Jiménez and Lloret 2007; Lloret and Jiménez 2009: 314).

The final ranking at work for Murcia is presented in (14). Tableaux (15) and (16) illustrate that, in words without high vowels, the [−ATR] feature of the final vowel is spread, via indirect licensing, to all the syllables in the word, so that a [−ATR] homogeneous string is generated. Instead, high vowels are never targeted by vowel harmony, due to *High/−ATR, as the example in (17) shows.

(14) Ranking for Murcia: maximal licensing (all nonhigh vowels harmonize; high vowels are opaque):
*High/−ATR, *Duplicate(F) >> License(−ATR, ∀V) >> Ident(ATR)

(15)

/tɾeboles/	*High/−ATR	*Dupl	License(−ATR, ∀V)	Ident(ATR)
a. ˈtɾeβolɛ			**!	*
b. ˈtɾɛβolɛ		*!	*	**
☞ c. ˈtɾɛβɔlɛ				***

(16)

/monedeɾos/	*High/−ATR	*Dupl	License(−ATR, ∀V)	Ident(ATR)
a. moneˈðeɾɔ			***!	*
b. moneˈðɛɾɔ			**!	**
c. monɛˈðɛɾɔ			*!	***
☞ d. mɔnɛˈðɛɾɔ				****

(17)

/mut͡ʃos/	*High/−ATR	*Dupl	License(−ATR, ∀V)	Ident(ATR)
☞ a. ˈmut͡ʃɔ			*	*
b. ˈmʊt͡ʃɔ	*!			**

The blocking of vowel harmony over an unaffected intervening high vowel is illustrated in tableaux (18) and (19) with the behavior of two proparoxytones displaying a different combination of high and nonhigh vowels in the tonic and posttonic positions. When the penult syllable contains a nonhigh vowel, as in (18), License(−ATR, ∀V) can drive the harmonization of this vowel, even though the stressed high vowel remains unchanged. However, when the intervening penult contains a high vowel, as in (19), it blocks the spreading altogether, so that both the penult and the antepenult are unaffected. In both tableaux the propagation of [−ATR] across high vowels (candidates (18d) and (19b)) is discarded because it should be achieved through feature copying and that configuration is prohibited by *Duplicate(F). In sum, in words containing a high vowel, the [−ATR] feature of the last vowel extends leftwards to all available targets until the first high vowel is reached.

(18)

/konˈsiɡelos/	*High/−ATR	*Dupl	License(−ATR, ∀V)	Ident(ATR)
a. konˈsiɣelɔ			***!	*
☞ b. konˈsiɣɛlɔ			**	**
c. konˈsɪɣɛlɔ	*!		*	***
d. kɔnˈsiɣɛlɔ		*!	*	***

(19)

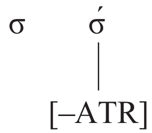
/komikos/			*High/−ATR	*Dupl	License(−ATR, ∀V)	Ident(ATR)
☞	a.	ˈkomikɔ			**	*
	b.	ˈkɔmikɔ		*!	*	**
	c.	ˈkɔmɪkɔ	*!			***

The data from Granada EA pose two additional challenges to the general schema of licensing. First, high vowels, which are also unaffected by harmony though they open as an effect of word-final consonant loss (or weakening), are transparent to harmony. Second, three different domains of harmony have been reported: a minimal extension domain targeting a nonhigh stressed vowel, a medium extension domain targeting the main foot, and a maximal extension domain targeting the whole prosodic word (see (3)). From now on, the examples for Granada will illustrate the analysis with loss of the word-final fricative, which is the least marked outcome and the common norm in all EA varieties (see, e.g., García Marcos 1990, who reports 69% cases of deletion, 30% cases of aspiration, and 1% cases of maintenance of the sibilant for Granada. On the formalization of the variation for the case of word-final aspiration in Spanish, see Lloret 2014 and references therein).

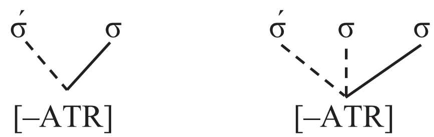
As for the behavior of high vowels, the ranking of *High/−ATR above the relevant licensing constraints overrules, as in Murcia, the harmonic opening of high vowels (e.g., *muchos* [ˈmuʃɔ]). Note, however, that since in Granada rightmost high vowels that are adjacent to a final deleted (or weakened) consonant are opened (e.g., *tesis* [ˈtɛsɪ]), *High/−ATR must be ranked below the constraint Max-IO, responsible for leaving a [−ATR] trace of the final consonant on the preceding vowel (contrary to the topmost position that it occupies in the Murcia ranking).

The fact that intervening transparent high vowels do not interrupt harmony (as in *cómicos* [ˈkɔmikɔ]) runs again into the debate of how harmonizing features are extended. According to the three configurations that can satisfy License(−ATR, S-Pos) presented in (13), in Granada harmony, oxytones that do not obligatorily compel harmony because the [−ATR] feature of the final vowel is already realized in a strong position (i.e., the final stressed vowel, as in *revés* [reˈßɛ]) are an instance of direct licensing (20). However, if [−ATR] is associated to an unstressed position, it seeks to target a vowel in a strong position (i.e., the stressed vowel), as in *nenes* [ˈnɛnɛ], which shows an instance of indirect licensing (21a). In cases where the stressed vowel is followed by a transparent penult high vowel, as in [ˈkɔmikɔ], [−ATR] also targets the stressed vowel, giving rise to an identity licensing configuration (23a). Medial posttonic (nonhigh) vowels may optionally undergo harmony: if they do, the span of [−ATR] vowels fits into the indirect licensing scheme, as in *tréboles* [ˈtɾɛßɔlɛ] (21b); if they do not, the resulting configuration follows the identity licensing pattern instead, as in [ˈtɾɛßolɛ] (23b). Pretonic vowels may also harmonize: again, if the result is a homogeneous [−ATR] span, the configuration fits indirect licensing, as in *momentos* [mɔˈmɛntɔ] (22a) or *revés* [rɛˈßɛ] (22b), as it does in paroxytones if [−ATR] spreads only to the stressed vowel, as in *momentos* [moˈmɛntɔ] (22c); but if an intervening transparent high vowel occurs, identity licensing emerges, as in *molinos* [mɔˈlinɔ] (24). All identity licensing schemes in (23) and (24) serve to allow structures in which two vowels interact at a distance across a nonintervening segment. The admissibility of discontinuous configurations in Granada shows that *Duplicate(F) has a lower position in the hierarchy than in Murcia, where only continuous [−ATR] spans are allowed.

(20) Patterns without [−ATR] spreading: direct licensing
/rebes/: [reˈßɛ]

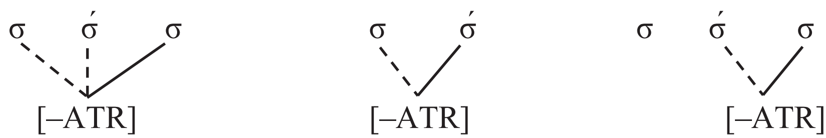


(21) Patterns with continuous [−ATR] domains, without pretonic vowels: indirect licensing
a. /nenes/: [ˈnɛnɛ] b. /tɾeboles/: [ˈtɾɛßɔlɛ]



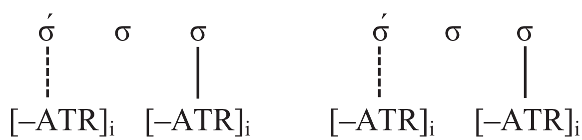
(22) Patterns with continuous [−ATR] domains, with pretonic vowels: indirect licensing

a. /momentos/: [mɔˈmɛntɔ] b. /rebes/: [rɛˈßɛ] c. /momentos/: [moˈmɛntɔ]

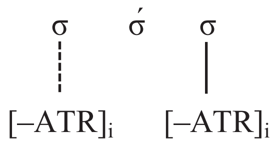


(23) Patterns with discontinuous [−ATR] domains, without pretonic vowels: identity licensing

a. /komikos/: [ˈkɔmikɔ] b. /tɾeboles/: [ˈtɾɛßolɛ]



(24) Patterns with discontinuous [−ATR] domains, with pretonic vowels: identity licensing
/molinos/: [mɔˈlinɔ]



In the maximal extension pattern of Granada (pattern *c* in (3)), the ranking in (25), with the demotion of *Duplicate(F) with respect to Murcia (cf. (14)), is enough to obtain the grammatical results. As in Murcia, in candidates with nonhigh vowels, harmony operates to the fullest possible extent within the word (see (26) and (27)).

(25) Ranking for pattern *c* (provisional): maximal licensing (all nonhigh vowels harmonize):
*High/−ATR >> License(−ATR, ∀V) >> *Duplicate(F), Ident(ATR)

(26)

/treboles/	*HIGH/−ATR	LICENSE(−ATR, ∀V)	*DUPL	IDENT(ATR)
a. ˈtreβolɛ		**!		*
b. ˈtrɛβolɛ		*!	*	**
☞ c. ˈtrɛβɔlɛ				***

(27)

/monederos/	*HIGH/−ATR	LICENSE(−ATR, ∀V)	*DUPL	IDENT(ATR)
a. moneˈðerɔ		***!		*
b. moneˈðɛrɔ		**!		**
c. monɛˈðɛrɔ		*!		***
☞ d. mɔnɛˈðɛrɔ				****

In words with high vowels, *HIGH/−ATR rules out candidates with harmony targeting them, as shown in (28b) and (29c). The low position of *DUPLICATE(F) in the ranking, though, renders possible candidates in which the high vowels are skipped by harmony, that is, candidates with nonlocal harmony (see (28d) and (29b)).

(28)

/konsigelos/	*HIGH/−ATR	LICENSE(−ATR, ∀V)	*DUPL	IDENT(ATR)
a. konˈsiɣelɔ		***!		*
b. konˈsɪɣelɔ	*!	**	*	**
c. konˈsiɣɛlɔ		**!		**
☞ d. kɔnˈsiɣɛlɔ		*	*	***

(29)

/komikos/	*HIGH/−ATR	LICENSE(−ATR, ∀V)	*DUPL	IDENT(ATR)
a. ˈkomikɔ		**!		*
☞ b. ˈkɔmikɔ		*	*	**
c. ˈkɔmɪkɔ	*!			***

The medium extension pattern of Granada (pattern *b* in (3)) poses a further challenge to the analysis, because in proparoxytones with a stressed high vowel and pretonic and posttonic nonhigh vowels (as in *consíguelos*), the posttonic nonhigh vowel harmonizes, although the stressed high vowel and the pretonic nonhigh vowel do not ([konˈsiɣɛlɔ])—a configuration that has usually gone unnoticed in previous work. In line with Jiménez and Lloret (2007, 2018) and Lloret and Jiménez (2009), we propose that the different extension patterns found in Granada vowel harmony reveal the scalar nature of licensing requirements: (*a*) *minimal licensing* requires only that [F] is licensed in *a* minimally strong position (whose trigger in Granada EA harmony is LICENSE(−ATR, σ́), according to which [−ATR] must be licensed by association with the stressed syllable of a prosodic word); (*b*) *medium licensing* demands that [F] is licensed in a *stronger* position (whose trigger in Granada EA is LICENSE(−ATR, Foot), according to which [−ATR] must be licensed by association with the main foot of the prosodic word); and (*c*) *maximal licensing* requires that [F] is licensed in *all* available positions in the prosodic word (which in Granada EA is brought by LICENSE(−ATR, ∀V)). Hence, in our view, maximal licensing is not independent from prominence (as Walker 2011 assumes) but is another instance of prominence-based licensing systems where the harmonizing feature seeks to target all the positions in a higher prosodic constituent. The three proposed licensing constraints are progressive (i.e., they are in an implicational relation), because the stressed vowel is part of the main foot, and the main foot is contained in the prosodic word; thus, if minimal licensing is violated, so are medium and maximal licensings, and if medium licensing is violated, so is maximal licensing, but not the other way around. As we will see at the end of this section, these implications neatly fit the attested and unattested patterns in Granada.

The relevant partial ranking common to all Granada EA patterns is *High/−ATR >> License(−ATR, σ́) >> Ident(ATR). In the pattern with maximal licensing, already analyzed in (26)–(29), the ranking of all the licensing constraints at the same point of the hierarchy, below *High/−ATR and above *Duplicate(F) and Ident(ATR), ensures maximal spreading (30). We do not repeat the tableaux here because, due to the implicational nature of the proposed licensing constraints, no change arises in the selection of the optimal candidates, and the same holds for the ranking for Murcia proposed in (14).

(30) Ranking for pattern *c* (final): maximal licensing (all nonhigh vowels harmonize):
*High/−ATR >> License(−ATR, σ́), License(−ATR, Foot), License(−ATR, ∀V)
>> *Duplicate(F), Ident(ATR)

In the medium licensing pattern (pattern *b* in (3)), not only does the presence of a posttonic high vowel not block harmony of the stressed nonhigh vowel (as in [ˈkɔmikɔ]; see (35)), but the presence of a nonharmonic stressed vowel does not impede posttonic nonhigh vowels from harmonizing (as in [konˈsiɣɛlɔ]; see (34)). These results are obtained by ranking License(−ATR, σ́) and License(−ATR, Foot) together, crucially above *Duplicate(F) and Ident(ATR) and with License(−ATR, ∀V) at the bottom of the hierarchy (31). With this ranking, all available targets belonging to the main foot are harmonized, and posttonic high vowels can be skipped via identity licensing, as illustrated in (32)–(35) (see especially (35b)).

(31) Ranking for pattern *b*: medium licensing (stressed nonhigh vowels and posttonic nonhigh vowels harmonize; pretonic vowels do not harmonize):
*High/−ATR >> License(−ATR, σ́), License(−ATR, Foot) >> *Duplicate(F),
Ident(ATR) >> License(−ATR, ∀V)

(32)

/tɾeboles/	*High/ −ATR	License (−ATR, σ́)	License (−ATR, Ft)	*Dupl	Ident (ATR)	License (−ATR, ∀V)
a. ˈtɾeßolɛ		*!	**!		*	**
b. ˈtɾɛßolɛ			*!	*	**	*
☞ c. ˈtɾɛßɔlɛ					***	

(33)

/monedeɾos/	*High/ −ATR	License (−ATR, σ́)	License (−ATR, Ft)	*Dupl	Ident (ATR)	License (−ATR, ∀V)
a. moneˈðeɾɔ		*!	*!		*	***
☞ b. moneˈðɛɾɔ					**	**
c. monɛˈðɛɾɔ					***!	*
d. mɔnɛˈðɛɾɔ					****!	

(34)

/konsigelos/	*HIGH/ −ATR	LICENSE (−ATR, σ́)	LICENSE (−ATR, Ft)	*DUPL	IDENT (ATR)	LICENSE (−ATR, ∀V)
a. konˈsiɣelɔ		*	**!		*	***
b. konˈsɪɣelɔ	*!		*	*	**	**
☞ c. konˈsiɣɛlɔ		*	*		**	**
d. kɔnˈsiɣɛlɔ		*	*	*!	***!	*

(35)

/komikos/	*HIGH/ −ATR	LICENSE (−ATR, σ́)	LICENSE (−ATR, Ft)	*DUPL	IDENT (ATR)	LICENSE (−ATR, ∀V)
a. ˈkomikɔ		*!	**!		*	**
☞ b. ˈkɔmikɔ			*	*	**	*
c. ˈkɔmɪkɔ	*!				***	

Finally, in the minimal licensing pattern (pattern *a* in (3)), *DUPLICATE(F) and both the medium and maximal licensing constraints are ranked below IDENT(ATR) (36). As shown in tableaux (37)–(40), with this ranking the [−ATR] feature of the last vowel extends only up to stressed nonhigh vowels at the expense of creating nonhomogeneous configurations (see (37b) and (40b)).

(36) Ranking for pattern *a*: minimal licensing (only stressed nonhigh vowels harmonize):
*HIGH/−ATR >> LICENSE(−ATR, σ́) >> IDENT(ATR) >> *DUPLICATE(F), LICENSE(−ATR, Foot), LICENSE(−ATR, ∀V)

(37)

/tɾeboles/	*HIGH/ −ATR	LICENSE (−ATR, σ́)	IDENT (ATR)	*DUPL	LICENSE (−ATR, Ft)	LICENSE (−ATR, ∀V)
a. ˈtɾeβolɛ		*!	*		**	**
☞ b. ˈtɾɛβolɛ			**	*	*	*
c. ˈtɾɛβɔlɛ			***!			

(38)

/monedeɾos/	*HIGH/ −ATR	LICENSE (−ATR, σ́)	IDENT (ATR)	*DUPL	LICENSE (−ATR, Ft)	LICENSE (−ATR, ∀V)
a. moneˈðeɾɔ		*!	*		*	***
☞ b. moneˈðɛɾɔ			**			**
c. monɛˈðɛɾɔ			***!			*
d. mɔnɛˈðɛɾɔ			****!			

(39)

/konsigelos/	*HIGH/ −ATR	LICENSE (−ATR, σ́)	IDENT (ATR)	*DUPL	LICENSE (−ATR, Ft)	LICENSE (−ATR, ∀V)
☞ a. konˈsiɣelɔ		*	*		**	***
b. konˈsɪɣelɔ	*!		**	*	*	**
c. konˈsiɣɛlɔ		*	**!		*	**
d. kɔnˈsiɣɛlɔ		*	***!	*	*	*

(40)

/komikos/		*HIGH/ −ATR	LICENSE (−ATR, σ́)	IDENT (ATR)	*DUPL	LICENSE (−ATR, Ft)	LICENSE (−ATR, ∀V)
a.	ˈkomikɔ		*!	*		**	**
☞ b.	ˈkɔmikɔ			**	*	*	*
c.	ˈkɔmɪkɔ	*!		***			

The licensing approach developed here yields a typology of vowel harmony consistent with the Granada patterns under study, as illustrated in (41) with words displaying pretonic and posttonic vowels at the same time (i.e., *recógelos* and *consíguelos*): either all (nonhigh) vowels harmonize ((41a), maximal licensing), or harmony reaches all (nonhigh) vowels in the main foot ((41b), medium licensing), or just the stressed (nonhigh) vowel harmonizes ((41c), minimal licensing). Except when the posttonic is a high vowel (e.g., *económicos*, pronounced with maximal licensing: [ɛkɔˈnɔmikɔ]), utterances with harmonized pretonic vowels leaving the posttonic unaffected (41d) are neither attested nor expected. This is an important upshot of our analysis, since no reranking of the proposed constraints leads to the unattested pattern, which is a desirable consequence for factorial typology: indeed, to open pretonic vowels, LICENSE(−ATR, ∀V) must dominate IDENT(ATR), but the inverse ranking is necessary to prevent posttonic vowels from opening as well (see (41d)).

(41)

Inputs		/ɾekohelos/ /konsiɡelos/	**Rankings**	**Domain**
Possible outputs	a.	[rɛˈkɔhɛlɔ] [kɔnˈsiɣɛlɔ]	LICENSE(−ATR, σ́), LICENSE(−ATR, Foot), LICENSE(−ATR, ∀V) >> *DUPLICATE(F), IDENT(ATR)	Max.
	b.	[reˈkɔhɛlɔ] [koˈnsiɣɛlɔ]	LICENSE(−ATR, σ́), LICENSE(−ATR, Foot) >> *DUPLICATE(F), IDENT(ATR) >> LICENSE(−ATR, ∀V)	Med.
	c.	[reˈkɔhelɔ] [konˈsiɣelɔ]	LICENSE(−ATR, σ́) >> IDENT(ATR) >> *DUPLICATE(F), LICENSE(−ATR, Foot), LICENSE(−ATR, ∀V)	Min.
Impossible outputs	d.	[rɛˈkɔhelɔ] [kɔnˈsiɣelɔ]	**No ranking available:** Spreading to the pretonic ⇒ LICENSE(−ATR, ∀V) >> IDENT(ATR) Posttonic gap ⇒ IDENT(ATR) >> LICENSE(−ATR, ∀V)	—

In line with Kaplan's (2015) work, an analysis with a single licensing constraint, License(−ATR, ∀V), and positional faithfulness constraints restricted to relative metrical prominent positions (pretonic syllables being a stronger site than posttonic syllables) is also possible, as explored in Lloret (2018). In minimal licensing both pretonic and posttonic vowels would be protected, whereas in medium licensing just the pretonic (the more prominent) would. Even though the analysis works, it relies on the assumption that in nonmaximal patterns unstressed vowels are preserved over stressed ones, which goes against the usual expectations of positional faithfulness (Beckman 1998). We thus prefer to stick to our split version of License(−ATR, S-Pos), which is well suited to capturing the scalar nature of vowel harmony.

4.2. Morphologically conditioned vowel harmony: Jaén

As Soriano (2012) points out, in Jaén EA vowel harmony, leftward spreading of [−ATR] appears as a concomitant strategy to maximize certain morphological contrasts, since it takes over the whole prosodic word but is triggered only by a few inflectional suffixes (namely, -/s/ of the plural nominal suffix -/s/ or -/es/ or the verbal suffixes of second person singular -/s/, first person plural -/mos/, and second person plural -/is/, as well as the infinitive suffix -/ɾ/). Hence, some constraint referring to the morphosyntactic information contained in these suffixes is needed. Inflectional suffixes are considered less prominent than roots; they are thus well suited to raise prominence-based licensing issues.

To capture morpheme-specific licensing, we adopt Walker's (2011: 59–63) view based on the lexical indexation approach proposed in Pater (2009). We assume the following:

> The phonological exponence of a morpheme is the phonological material that is identified with that morpheme in an output. [. . .] [F]or a feature specification to qualify as the phonological exponence of a morpheme, it does not have to be that morpheme's sole phonological exponence [. . .]. The morpheme in question could also be identified with other phonological material in the output, but only the content specified in the constraint—here, F—is in the scope of licensing.
>
> (Walker 2011: 61)

In Jaén EA, the suffixes triggering vowel harmony are marked with a subscript "L". All of these morphemes, for independent phonetic reasons that affect all nonnasal final consonants, surface with deletion of the final consonant, with the concomitant effect of opening all the preceding adjacent vowels (and further fronting /a/). In this scenario, only lexically indexed suffixes propagate the [−ATR] traces of their lost exponents to the domain of the whole prosodic word, due to the role of License_L(−ATR, ∀V). The simplified ranking presented in (42) is sufficient to illustrate the analysis (we do not include *Duplicate(F) in the ranking, because, as we have demonstrated for Granada EA, in systems with maximal extension this constraint is low ranked and, therefore, not relevant for the discussion).

(42) Simplified ranking for Jaén EA:
License_L(−ATR, ∀V) >> *High/−ATR, Ident(ATR) >> License(−ATR, ∀V)

The morpheme-specific nature of the pattern captured by the ranking in (42) entails that only indexed morphemes compel harmony in the whole domain of the prosodic word, as illustrated in tableaux (43) and (44). In (43) the indexed constraint License_L(−ATR, ∀V) assigns violations to candidates in which the [−ATR] traces of the indexed morpheme do not spread to all the vowels of the prosodic word (43a–b). Note that in this variety the subordinate position of *High/−ATR in the ranking allows the spreading of [−ATR] with total disregard for the creation of [−ATR] high vowels (43c). In (44), instead, the presence of a final -/s/ that is not morphologically marked leaves License_L(−ATR, ∀V) without effect, so that the candidate (44a), with opening of the rightmost vowel but without any modifications in the stressed vowel, is selected. It is important to stress that the ability to induce vowel harmony is totally dependent on the marked affixes: the same root, for instance, *extintor* 'fire extinguisher', surfaces with only final opening in the singular but with overall harmony in the plural form: [e^{h}ttinˈtɔ] vs. [ɛ^{h}ttɪnˈtɔɾɛ].

(43)

/komikos$_L$/	LICENSE$_L$(−ATR, ∀V)	*HIGH/−ATR	IDENT (ATR)	LICENSE (−ATR, ∀V)
a. ˈkomikɔ	**!		*	**
b. ˈkomɪkɔ	*!	*	**	*
☞ c. ˈkɔmɪkɔ		*	***	

(44)

/burɡos/	LICENSE$_L$(−ATR, ∀V)	*HIGH/−ATR	IDENT (ATR)	LICENSE (−ATR, ∀V)
☞ a. ˈburɣɔ			*	
b. ˈbʊrɣɔ		*!	**!	

5. Vowel harmony in other Iberian Romance varieties

In the previous section, we showed that southern peninsular Spanish harmonic processes are well suited to the prominence-based licensing approach, because the features typically spread from a weak position to strong positions, sometimes permitting discontinuous configurations. This pattern of feature propagation from weak to strong positions is quite common among the Iberian Romance languages (for a typological survey, see Jiménez and Lloret 2011). In this section we present data from these other varieties without providing a formalized OT analysis but just highlighting the similarities and differences with the southern peninsular harmonic patterns previously analyzed.

To start with, in the central Asturian variety of Lena, the high unstressed vowel -/u/ of the masculine suffix triggers a raising of the preceding stressed vowels /e, o, a/ to [i, u, e], respectively, emphasizing in this way the contrast with the mid unstressed vowel -/o/ of the mass suffix, which does not induce any alteration in the root: e.g., [ˈfiu] vs. [ˈfeo] (see (45a–b); cf., on this issue, Neira Martínez 1955, 1983; Penny 1969; Hualde 1989, 1998; Dyck 1995; Walker 2005, 2011; Martínez-Gil 2006; Campos-Astorkiza 2009; Finley 2009). Height harmony does not apply when -/u/ is not an inflectional suffix, as in the adverb [aˈßaxu], or when it appears in words referring to objects that do not allow for the mass/count distinction, as in [ˈjelsu] (see (45c)). Lena harmony is also not triggered by the coronal vowel -/i/, which does not present a height contrastive distribution with -/e/ in inflectional suffixes: e.g., [ˈventi] (see (45d); cf. Campos-Astorkiza 2009, but see Hualde 1989). The central Asturian variety of Aller permits the spreading of height from a final front vowel -/i/ as well, but this is limited to verbal forms, which are the only ones displaying a contrast between final -/i/ and -/e/: for instance, [eˈßɾi] vs. [aˈßɾe] (see (46c–d)). Note that in western and eastern Asturian varieties, where there is no contrast between high and mid vowels in final position, there is no vowel harmony either: e.g., [ˈt͡ʃoßu] ‘wolf’, [ˈpet͡ʃu] ‘breast’ (cf. [ˈt͡sußu], [ˈpit͡ʃu] in Lena Asturian). Overall, Asturian varieties provide an instance of morphologically conditioned harmony triggered from a final weak position, since the set of endings that induce the spreading is defined by their morphological content, as in Jaén EA (cf. Campos-Astorkiza 2009 for an analysis along these lines).

(45) Height harmony in Lena Asturian

a.	feu	'ugly-MASC.SING.'	[ˈfiu]	b.	feo	'ugly-MASS'	[ˈfeo]
	tontu	'silly-MASC.SING.'	[ˈtuntu]		tonto	'silly-MASS'	[ˈtonto]
	santu	'saint-MASC.SING.'	[ˈsentu]		santo	'saint-MASS'	[ˈsanto]
c.	abaxu	'down'	[aˈßaxu]	d.	venti	'twenty'	[ˈbenti]
	yelsu	'plaster'	[ˈjelsu]		madre	'mother'	[ˈmaðɾi]

(46) Height harmony in Aller Asturian

a.	calderu	'cauldron'	[kalˈdiɾu]	b.	calderos	'cauldrons'	[kalˈdeɾos]
	fechu	'made-MASC.SING.'	[ˈfit͡ʃu]		fechos	'made-MASC.PL.'	[ˈfet͡ʃos]
c.	abri	'open-IMP.'	[ˈeßɾi]	d.	abre	'it opens'	[ˈaßɾe]
	corri	'run-IMP.'	[ˈkuri]		corre	's/he runs'	[ˈkore]

A fundamental source of variation found in the EA harmonic patterns is the scope of the harmonic domain, which in our analysis is accounted for through different licensing constraints. Similar scalar patterns in the harmonic domain are found in other peninsular dialects as well (on this issue, see especially Hualde 1989, which offers an autosegmental and metrical analysis of the northwestern varieties of Spain using, as in this chapter, a three-way scope distinction). Height harmony in Lena Asturian, for instance, targets only the stressed syllable (minimal licensing); gapped structures, with medial compatible segments unaffected, are allowed, as in [ˈpexaɾu] (see (47a)).

(47) Height harmony in Lena Asturian, with gapped configurations

a.	truébanu	'beehive'	[ˈtrwißanu]
	silicóticu	'silicotic-MASC.SING.'	[siliˈkutiku]
	páxaru	'bird-MASC.SING.'	[ˈpeʃaɾu]
b.	truébanos	'beehives'	[ˈtɾweßanos]
	slicóticos	'silicotic-MASC.PL.'	[siliˈkoticos]
	páxara	'bird-FEM.SING.'	[ˈpaʃaɾa]

Centralization harmony in Cantabrian (also known as Montañés), which also initiates from a final unstressed vowel, is an example of a weak-to-strong assimilation process illustrating harmonic domains beyond the stressed syllable. In Tudanca Montañés, a final high labial vowel is centralized (this vowel is described as centralized and as more open than [u]), and its [−ATR] feature extends up to the stressed syllable, including posttonic vowels (48a) (medium licensing) (centralized vowels are indicated, as in our sources, by capitalization; see Penny 1978; McCarthy 1984; Vago 1988; Hualde 1989, 1998; Dyck 1995; Walker 2005, 2011; Finley 2009). Centralization also applies when the last syllable contains an underlying high front vowel (48b). Final -/i/, however, neutralizes with -/e/ in a noncentralized vowel ranging from [ə] to [i]; hence, the underlying quality of high front vowels is visible only in its effects on the stressed syllable (cf. (48c)). In Pasiego Montañés, on the other hand, the centralization of -/u/ spreads to the whole prosodic word, clitics included (maximal licensing), as shown in (49a). Final -/i/, which neutralizes with final -/e/ in a schwa-type vowel, does not trigger centralization in this dialect (cf. (49b)); the contrast between -/i/ and -/e/, though, is maintained in forms with a stressed mid vowel due to height harmony from -/i/ (see (49b–c) and the description of this height harmony process below).

(48) Centralization in Cantabrian Spanish varieties: Tudanca Montañés

a.	[simˈpAtIkU]	‘nice-MASC.SING.’					
	[antiˈɣwIsImU]	‘very old-MASC.SING.’					
	[aˈka el ˈmEðIkU]	‘to the doctor’s’					
b.	/abɾi/	‘open-IMP.’	[ˈAßɾə]	c.	/abɾe/	‘it opens’	[ˈaßɾə]
	/meti/	‘put in-IMP.’	[ˈmEti]		/mete/	‘s/he puts in’	[ˈmeti]
	/komi/	‘eat-IMP.’	[ˈkOmə]		/kome/	‘s/he eats’	[ˈkomə]

(49) Centralization in Cantabrian Spanish varieties: Pasiego Montañés

a.	[sImˈpAtIkU]	‘nice-MASC.SING.’					
	[IskAlOfɾiˈAU]	‘shivering-MASC.SING.’					
	[kUn Il mAˈyIstɾU]	‘with the teacher’					
b.	/abɾi/	‘open-IMP.’	[ˈaßɾə]	c.	/abɾe/	‘it opens’	[ˈaßɾə]
	/bebi/	‘drink-IMP.’	[ˈbißə]		/bebe/	‘s/he drinks’	[ˈbeßə]
	/komi/	‘eat-IMP.’	[ˈkumə]		/kome/	‘s/he eats’	[ˈkomə]

The southern peninsular Spanish systems described have also shown that the interaction of harmony-driving constraints with other faithfulness and markedness constraints yields an additional variation regarding the internal configuration of the harmonic domains. For instance, a low position of *DUPLICATE(F) in the ranking ensures the acceptability of discontinuous representations, as shown by *tréboles* [ˈtɾɛßolɛ] in the Granada EA minimal harmonic pattern (see (37)). The same structure is also possible in Lena height harmony, as the form [ˈpeʃaɾu] in (47a) reveals: the high feature reaches the stressed low vowel, leaving the posttonic one unaffected. In both cases, modifying only the stressed vowel to satisfy minimal licensing serves to increase the saliency of the extended feature with a smaller amount of faithfulness violations.

The position of feature co-occurrence restrictions such as *HIGH/−ATR and their interaction with *DUPLICATE(F) also generate variation related to the configuration of the harmonic domains. In Granada EA vowel harmony, for example, high vowels are not affected by harmony (e.g., *muchos* [ˈmuʃɔ]), but they can be skipped, creating once again gapped domains (e.g., *cómicos* [ˈkɔmikɔ]). Similarly, in Pasiego Montañés, /e/ acts as a neutral transparent vowel with respect to centralization: it is not targeted by [−ATR] harmony but does not impede the process either, giving rise to discontinuous [ATR] strings, as in *cOnfesOnAriU* ‘confessional’ (see McCarthy 1984; Finley 2009).

The weak-to-strong spreading systems just presented differ from other peninsular varieties in which features propagate the other way around: that is, from strong to weak positions. For instance, in some Valencian Catalan varieties a word-final unstressed -/a/ becomes [ɛ] or [ɔ] when preceded by a stressed /ɛ/ or /ɔ/, respectively, thus spreading the place features [coronal] and [labial] from the stressed vowel (see (50a–b)). According to Jiménez (1998), the goal of this harmony is to improve the perceptibility of the marked mid-open vowels [ɛ, ɔ], which are typically limited to the stressed syllable (see also Walker 2005, 2011, and, for a phonetic analysis of the process, Herrero and Jiménez 2013; Jiménez and Herrero 2015). The spreading of the place features is blocked whenever an intervening posttonic nonlow vowel appears between the trigger and the target, as the words in (50c) exemplify.

(50) Place harmony in Valencian Catalan

a.	tela	‘cloth’	[ˈtɛlɛ]	b.	cosa	‘thing’	[ˈkɔzɔ]
	afecta	‘it affects’	[aˈfɛktɛ]		tova	‘soft-FEM.SING.’	[ˈtɔvɔ]
c.	còmica	‘comic-FEM.SING.’	[ˈkɔmika]				
	mèdica	‘medic-FEM.SING.’	[ˈmɛðika]				

Valencian vowel harmony usually affects only the posttonic syllable, a pattern that could be interpreted as a case of licensing targeting the main foot, similar to the medium extension pattern postulated for Granada EA (cf. Jiménez and Lloret 2011). A few southern Valencian varieties, though, allow the place features to extend to the whole prosodic word, as in southern peninsular Spanish maximal patterns: e.g. *afecta* [ɛˈfɛktɛ] (see Jiménez 1998).

With respect to the weak-to-strong and strong-to-weak dichotomy, height harmony in Cantabrian varieties falls into two different categories. In Tudanca Montañés, pretonic mid vowels raise to high if the stressed syllable contains a high vowel or a prevocalic glide; that is, in this variety the harmonized feature extends from a strong to a weak position (51). As the examples in (51c) show, the process is unbounded, being able to affect more than one pretonic mid vowel; however, it does not reach proclitic elements such as articles or prepositions.

(51) Height harmony in Tudanca Montañés

a.	cerilla	'match'	[θiˈɾiya]	b.	cera	'wax'	[ˈθeɾa]
	cocina	'kitchen'	[kuˈθina]		cocer	'to cook'	[koˈθeɾ]
c.	metería	'I would put in'	[mitiˈɾia]	d.	meter	'to put in'	[meˈteɾ]
	comería	'I would eat'	[kumiˈɾia]		comer	'to eat'	[koˈmeɾ]

Height harmony in Pasiego Montañés is a more complex phenomenon. As in some Asturian varieties, a final high vowel induces height harmony in the stressed syllable, but only mid vowels are targeted (52a). Additionally, as in Tudanca, pretonic mid vowels may raise when preceding a high vowel or a prevocalic glide in the stressed position (52c); pretonic vowel raising in Pasiego is unbounded, but, in contrast to Tudanca, the high feature spreads up to clitic forms (52e). In this variety, then, raising follows a twofold pattern: it can go from a weak unstressed final syllable to the stressed position and from this strong syllable to the weak pretonic positions. The main complexity of the pattern, though, arises because the process affecting the stressed syllable feeds the pretonic raising process, as the examples [rIˈðUndU] and [kUɾˈðIɾU] in (52a) illustrate. Note, finally, that in both patterns the spreading can apply through an intervening transparent low vowel, as in [ˈɡwIɾfAnU] (52a) or [pUl kAˈmInU] (52e).

(52) Height harmony in Pasiego Montañés

a.	güérfanu	'orphan-MASC.SING.'	[ˈɡwIɾfAnU]
	bebi	'drink-IMP.'	[ˈbißə]
	redondu	'round-MASC.SING.'	[rIˈðUndU]
	corderu	'lamb'	[kUɾˈðIɾU]
b.	güérfanos	'orphan-MASC.PL.'	[ˈɡweɾfanʊs]
	beber	'to drink'	[beˈßeɾ]
	redondos	'round-MASC.PL.'	[reˈðondʊs]
	corderos	'lambs'	[koɾˈðeɾʊs]
c.	cogería	'I would take'	[kuxiˈɾia]
	comería	'I would eat'	[kumiˈɾia]
d.	cogeré	'I will take'	[koxeˈɾe]
	comer	'to eat'	[koˈmeɾ]
e.	pol caminu	'by the road'	[pUl kAˈmInU]
	me lo dio	's/he gave it to me'	[mi lu ˈðjo]
f.	por la calle	'by the street'	[po la ˈkaʎe]
	me lo compró	's/he bought it for me'	[me lo komˈpɾo]

All the harmonic processes presented in this chapter share a common trait: a constraint favoring feature spreading (i.e., a constraint from the LICENSE(F, S-Pos) family) is in a high-ranked position in the hierarchy, crucially above IDENT(F). From that position, it drives harmony at the expense of altering the features of other input segments, with discontinuous configurations admitted (e.g., in Granada EA) or with only homogeneous strings (e.g., in Jaén EA and Murcia). Other plausible orderings produce alternative results in Spanish. The most radical option is that the constraints promoting vowel harmony appear below the faithfulness constraint protecting input vocalic specifications. This ordering would completely rule out the spreading of the harmonizing feature. Yet the final consonant might still open the adjacent vowel if the faithfulness constraint demanding retrieval of the lost consonant (i.e., MAX-IO) is in a high-enough position in the ranking. The opening of the last vowel without further spreading is found in Jaén EA in words without the listed suffixes (e.g., *Burgos* [ˈbuɾɣɔ]; see (44)) but is also the usual outcome in some western Andalusian and other Spanish varieties, e.g., Albacete and Ciudad Real: *nenes* [ˈnenɛ]. To complete the typology, if the faithfulness constraints targeting vocalic features were at the top of the ranking, the final consonant might even be deleted without leaving any mark of its loss, as happens in western Andalusian as well as in Canarian and Extremaduran varieties: *nenes* [ˈnene] (see Alvar 1996a, 1996b; Álvarez 1996).

6. Conclusion

In this chapter we have shown that the interaction of the licensing principles with other faithfulness and markedness constraints gives rise to a vast array of harmonic patterns, illustrating the way in which languages try to balance the need to preserve underlying information (phonological as well as morphological) and the requirements of structural simplicity. Our examination of the details of the triggers, targets, and scope of vowel harmony in southern peninsular Spanish leads us to conclude that, in the patterns reported, the compensation of word-final consonant loss with the opening of the rightmost vowel and further leftward spread is favored but not determined by a need to enhance grammatical distinctions. This is clear in the Murcian system, where, as highlighted by Hernández-Campoy and Trudgill (2002), the opening and harmonic effects due to the loss of any nonnasal word-final consonant fail to preserve many morphological and lexical distinctions (e.g., [pɾɛˈβɛ] is the outcome of *prevés* 'you-SING. foresee' and *prever* 'to foresee'; [sɔˈlæ̞] is the outcome of *solaz* 'solace' and *solar* 'building lot'). Likewise, the prohibition on opening high vowels can create homophonous pairs ([ˈbiθi] is the outcome of *bici* 'bike' and *bicis* 'bikes'; [oˈi] is the outcome of *oí* 'I heard', *oís* 'you-PL. hear', and *oír* 'to hear'). Additionally, even in the morphologically conditioned harmony of Jaén, there are morpheme triggers whose segmental material is not limited to the deleted consonant (i.e., the nominal plural suffix -/es/, the verbal first person plural suffix -/mos/, and the verbal second person plural suffix -/is/), and at the same time some grammatical distinctions may not be preserved in some words (e.g., [ɔˈɪ] is the outcome of *oís* and *oír* vs. [oˈi] *oí*).

To conclude, we highlight some directions for future work. First, it would be worth investigating the phonetics-phonology interaction responsible for the opening of the rightmost vowels and further fronting of /a/ under consonant loss or weakening. Additionally, since some studies on other languages claim that transparency is not a failure to participate in harmony but a failure to produce salient consequences of harmony on a specific class of segments (see, e.g., Gafos and Dye 2011), experimental work on the quality of high vowels in southern peninsular Spanish is a welcome addition to the debate. Finally, the intralinguistic variation encountered in the Granada EA system needs much more data to be able to attempt a quantitative-based variation approach to vowel harmony: the descriptions so far just mention an internal factor (i.e., phonological similarity) and two external factors (i.e., high speech rate and informal registers) that favor fully harmonized pronunciations.

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Part II
Suprasegmental phonology

5

Phonotactic constraints on syllable structure

Sonia Colina

1. Introduction

Phonotactic constraints are restrictions on the sequences of segments allowed in a particular language. They are generally stated in syllabic terms because they hold over syllables and syllabic components: for example, the ill-formedness of the hypothetical Spanish word **muersto* can only be explained as the result of an excessive number of segments in the rhyme (three being the maximum), given that /ue/ and /rs/ are by themselves licit strings (Harris 1983: 9–10; Colina 2012). In this chapter, I will assume the syllable structure in Figure 5.1.

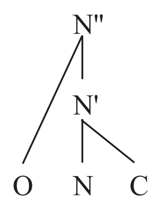

Figure 5.1 N-bar model of syllable structure

Figure 5.1 presents an N-bar model of syllable structure, selected for ease of presentation. I make no theoretical claims as to its superiority with respect to other possible representations, such as the moraic version of Figure 5.1, seen in Figure 5.2. In this mora-based representation of syllabic structure, the nucleus and the coda are dominated by a mora, and the onset, being nonmoraic, is attached directly to the syllable node (Figure 5.2).

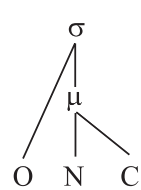

Figure 5.2 Moraic model of syllable structure

All syllables have a nucleus (N), which in Spanish must be vocalic. The onset (O) and coda (C) are optional, with a maximum of two segments in the onset and three in the coda (if the last one is /s/). In addition, segmental (feature) and sonority restrictions apply to specific segments and to segmental combinations within each syllabic constituent.

Phonotactics drive syllabification and the repair mechanisms that apply when illegal sequences arise through morpheme concatenation, borrowing, or other reasons. The focus of this article is on phonotactic constraints, rather than on syllable structure. Syllable structure will be referred to in connection with phonotactic constraints, as needed. Regarding its organization, the current chapter reviews general phonotactic facts of Spanish that apply over the syllabic level, i.e., the sonority contour in §2, followed by phonotactic restrictions that affect the segmental or featural level (§3). It also presents in further detail two related topics that have recently captured the attention of researchers, namely, the syllabic affiliation of prevocalic glides and the level of representation at which the sonority generalization on complex onsets applies (Complex Onset Condition; Martínez-Gil 1997, 2001; Colina 2009). Additionally, the chapter introduces the issue of dialectal variation in phonotactics and within-language variation in phonotactic restrictions.

2. Phonotactics and the sonority contour

A large number of phonotactic restrictions are driven by sonority, a complex notion that loosely described corresponds to perceptual prominence and/or degree of stricture.

Syllables exhibit a contour based on the universal sonority scale, according to which the syllable rises in sonority toward the nucleus, the sonority peak, and then decreases toward the coda (Sonority Sequencing Principle; Clements 1990). The rise tends to be maximal from the onset to the nucleus, and minimal in the transition from the nucleus to the coda. Phonotactic restrictions on segments and sequences of segments respond to the need to conform to this sonority contour.

The universal sonority scale consists of a hierarchy (1), where phonological classes are given a ranking by means of a relative sonority index:

(1)	Stops	< Fricatives	< Nasals	< Liquids	< Glides	< Vowels
	1	2	3	4	5	6

While the relative sonority of one phonological class versus another is universal (e.g., vowels are always more sonorous than glides, glides are more sonorous than liquids, etc.), the number of sonority-based classes in the sonority scale varies cross-linguistically. For Spanish, Harris (1989a, 1989b) proposes a sonority hierarchy with three sonority classes for consonants: obstruents, nasals, and liquids, while Martínez-Gil (2001) defends a subset of distinctions that separates obstruents into stops and fricatives on the basis of the phonotactics of onset clusters. More recently, Colina (2016) has argued that yet a finer distinction is needed to account for a Chilean dialect of Spanish in which obstruents in an onset cluster surface as coda glides, while /f/ remains unaffected (cf. §3.2 and Figure 5.3).

Sonority also plays a crucial role in the well-formedness of onset and coda clusters: generally, in Spanish two onset consonants must exhibit the maximal sonority distance possible among consonants (see discussion of the Complex Onset Condition in §3.2; see also Martínez-Gil 2001). For coda clusters, however, the ideal configuration does not present such a sharp contrast in sonority, with a preference for a more gradual decrease that often consists of a glide and a consonantal sonorant, or a consonantal sonorant and /s/: glide + sonorant, *veinte* [ˈbejn̪].te ‘twenty’; sonorant + /s/, *pers.pec.tive* ‘perspective’, *ins.taurar* ‘institute’, *sols.ticio* ‘solstice’; and less commonly a glide + obstruent *auxilio* [awk.ˈsi].*lio* ‘help’ or an obstruent + /s/, *abs.tener* ‘abstain’, *ads.cribir* ‘ascribe’. In the case of singleton codas, glides or sonorants are preferred over obstruents, again due to the tendency toward a more gradual decrease in sonority observed for postnuclear segments: *man.ta* ‘blanket’, *tren* ‘train’, *cal.do* ‘broth’, *pa.pel* ‘paper’, *peine* ‘comb’, *hay* ‘there is’, *muer. te* ‘death’, *mar* ‘sea’, *e.clip.se* ‘eclipse’, *stop* ‘stop’, *dog.ma* ‘dogma.’

3. Phonotactics and segmental features

In addition to the restrictions associated with the sonority contour of the syllable, phonotactic constraints often hold over specific segments and their featural makeup. In some cases, phonotactic restrictions are related to the affinity between a syllabic position and the sonority contribution made by a specific feature (e.g., the onset position favors more consonantal, less sonorous segments). In other instances, it is the affinity among the features themselves that explains phonotactic restrictions, such as the fact that coda nasals do not have their own point of articulation, or, in other words, that the nasal point of articulation is not licensed by the coda position. One common strategy to circumvent licensing restrictions on the coda (e.g., point of articulation for nasals and laterals, sonority and continuancy for obstruents) is to parse the potentially ill-formed feature through the following onset, resulting in well-known phenomena such as nasal/lateral assimilation and voice assimilation. Consequently, coda restrictions tend to refer to the surrounding segments and are formulated as phonotactic generalizations affecting more than one segment, such as “nasals in the coda have the same point of articulation as the following heterosyllabic consonant,” or “/s/ is [z] when followed by a voiced consonant” (cf. §3.3 and §3.4 for more on this topic).

3.1. Onsets

Almost all nonvocalic segments in the phonological inventory of Spanish can appear in the onset. Some restrictions apply to the allophonic realizations of a few phonemes, which, as already mentioned, are frequently explained as a result of the high sonority of the illegal allophone. For instance, rhotic taps do not occur in word-initial onset position; rather, the trill allophone is the only alternant that surfaces in this position, *caro* [ˈkaɾo] ‘expensive’, *carro* [ˈkaro] ‘cart’, but *roto* [ˈroto] *[ˈɾoto] ‘broken’. Since an onset tap appears in word-internal position, it must be concluded that this is not related entirely to the onset position but to the combined effect of onset and word-initial parsing, as they are both considered prominent locations that favor stronger, less sonorous segments.

Similar restrictions apply to onset glides, which in many dialects are banned from the onset. In these dialects, a nonsyllabic high vocoid exhibits nonconsonantal [j, w] and consonantal allophones [ʝ, gw] that alternate depending on syllabic position, i.e., nucleus or onset respectively. The consonantal allophones range from a fricative to a stop or affricate depending on variable degree of constriction [ʝ, c, tʃ, dʒ, gw]. Unlike what happens in the case of word-initial taps, the onset ban on glides also applies word-internally in intervocalic position.

(2)	a. perd-er	‘to lose’	perd-[ˈje]ron	‘they lost’
	b. com-er	‘to eat’	com-[ˈje]ron	‘they ate’
	c. cre-er	‘to believe’	cre-[ˈʝe]ron	‘they believed’
	d. o-ir	‘to smell’	o-[ˈʝe]ron	‘they smelled’
	(Colina 2010)			

It has been proposed that the exclusion of glides from the onset is motivated by the sonority of glides that are too sonorous for the onset in most Spanish dialects (Hualde 1989, 1991, 1997; Harris and Kaisse 1999; Colina 2009). Thus, the process in (2c–d) has been explained in a derivational model through a rule of *onset strengthening* or *glide consonantization* that turns a [−consonantal] segment into [+consonantal]. A nonderivational account highlights the affinity between the onset and a consonantal segment, thus the preference for consonantal allophones of the glides (Colina 2009): more specifically, the consonantization facts are explained as the violation of an IDENT faithfulness constraint imposed by the satisfaction of the highly ranked ONSET and *ONSET/glide, which require onsets and ban glides in the onset respectively; IDENT is violated because the [−consonantal] specification of the input does not match that of the output [+consonantal] (Colina 2009). It should be noted that derivational approaches, because of their serial nature, face an important dilemma: does the vocoid start in the nucleus and then move to the onset as a result of consonantization, or does it originate in the onset and then become a consonant (Hualde 1989; Martínez-Gil 2016)? It is clear that a parallel conceptualization of the problem that references phonotactics and the affinity between segmental sonority and syllabic position provides a better understanding of the phenomenon.

Although the sonority-based restriction on onset glides applies to most dialects of Spanish, onset glides occur in a few varieties of Spanish, such as Sonoran Spanish (spoken in Sonora, Mexico). This fact poses an interesting question regarding the phonotactics of complex onsets in this dialect (and others). If glides are acceptable as single onsets, are postconsonantal glides also in the onset, resulting in a complex onset cluster? In principle, this should be possible, as the sonority of the glide is higher than that of a liquid, thus improving on the sonority contour of an obstruent + liquid complex onset. To date, however, I am not aware of any study that provides empirical evidence connected with this issue. I will return to it in §4.

3.2. Complex onsets

Onset clusters in Spanish consist of a voiceless or voiced stop /p, t, k, b, d, g/ or /f/, as the first member of the cluster, and a liquid /l, r/ as the second. This generalization is known as the *Complex Onset Condition* (Harris 1983; Martínez-Gil 2001; Hualde 2005; Colina 2009, 2016, among many others). Some examples of well-formed onset clusters in word-initial and word-medial position are given in (3).

(3) Well-formed onset clusters

a. blanco	'white'	platicar	'to talk'
b. broma	'joke'	presión	'pressure'
c. adrelanina	'adrenaline'	atracar	'to hold up'
d. glotón	'glutton'	clavo	'nail'
e. inglés	'English'	aclarar	'clarify'
f. granada	'pomegranate'	cresta	'crest'
g. egresar	'to graduate'	increpar	'to reprimand'
h. fluido	'fluid'	frente	'front'
i. afligir	'to afflict'	sufrir	'to suffer'

Exceptions to this generalization include the coronals /t, d/. The cluster /dl/ is always ill formed, and /tl/ is acceptable only in some varieties, mostly under the influence of languages that have this sequence, like Nahuatl.

/tl/is a lateral alveolar affricate in Nahuatl. Examples of Nahuatl borrowings in Mexican Spanish are *Tlacuache* 'opposum' and *Tlaxcala* (place name).

These facts are generally attributed to co-occurrence restrictions on two adjacent coronals, and also on voice in the case of /dl/ (Harris 1983: 33). Varieties in which */tl/ is ill formed have a more restrictive filter that rules out a sequence of two [−continuant] and [+coronal] segments in the onset, irrespective of their voice specification.

It must be noted that the restrictions on /tl/ and /dl/ in onset clusters are frequent in many languages (Parker 2012: 151). More recently, phonetic evidence has shown that these clusters present issues of perceptibility; in particular, it is difficult to discriminate auditorily between /tl/ /dl/, on the one hand, and /kl/ /gl/, on the other (Flemming 2002, 2007).

As already mentioned, the relevant descriptive generalization for onset clusters in a majority of Spanish varieties is quite straightforward: complex clusters consist of an obstruent or /f/ (C1) and a liquid (C2). One issue that has remained unexplained until recently is why /f/ is well formed as the first member of the cluster, but no other fricative is. In other words, what does /f/ have in common with the stops? Martínez-Gil (2001) and later Colina (2016) argue that what these sounds have in common is the absence of the feature [+continuant] in their phonological representation, because they contain the opposite specification (i.e., [−continuant] in the case of voiceless stops) or have no specification at all (i.e., voiced stops and /f/). In this analysis, [+continuant] is the feature that contributes to sonority among consonants. Given the absence of [+continuant] in their representation, /p, t, k, b, d, g/ and /f/ possess, as a group, lower sonority than the rest of the obstruents. While it is uncontroversial that voiceless stops are [−continuant], the absence of [+continuant] in voiced stops and in /f/ needs to be justified. /f/ is argued to be underspecified for continuancy because it is the only labiodental obstruent (i.e., it does not contrast [−continuant] and [+continuant] and therefore is predictably [+continuant]). The underspecification of voiced obstruents is consistent with phonetic studies that show a great degree of variation in voiced obstruents with regard to aperture, ranging from an open approximant to a fricative (Cole et al. 1999; Ortega Llebaria 2004; Colantoni and Marinescu 2010; Eddington 2011; Simonet et al. 2012); and that there is a gradient distinction rather a than bimodal one (Carrasco et al. 2012). Gradient variation supports the view that voiced obstruents are underspecified at the output of the phonology because they are realized variably and gradiently in the phonetic component, depending on the adjacent segments (Colina 2016, 2020).

Unless word-initial or postnasal, voiced obstruents are realized as approximants, thus violating the Complex Onset Condition at least on the surface. This raises the question of the point of application of the phonotactic restrictions on onset clusters. Martínez-Gil (2001), under a derivational framework, proposes that the Complex Onset Condition is operative at the level of the underlying representation, where the voiced obstruents would be stops, at least in some analyses (Harris 1969). Such a proposal does not offer a definitive solution, since it does not work for those analyses in which the stops are underlyingly approximants (Hammond 1976; Bakovic 1994; Barlow 2003). In addition, defining the Complex Onset Condition as a restriction on the input is problematic for nonserial, surface-true approaches such as Optimality Theory (OT) that prohibit restrictions on the form of the input. OT analyses (Martínez-Gil 1997; Colina 2009) argue that the condition, formulated as the Maximal Sonority Distance (MSD) ('Minimal' in Martínez-Gil 1997) constraint, is violated under domination by more highly ranked constraints that determine the realization of voiced obstruents as approximants. In a more recent proposal in which voiced obstruents are underspecified at the output of the phonology, Colina (2016) argues that phonotactic constraints apply to outputs, specifically at the output of phonology before entering the phonetic module, and thus the MSD is not violated. This is consistent with optimality-theoretic analyses in which constraints apply to outputs.

However, data from some Chilean dialects pose some potential problems for the account that says that the onset condition applies at the output of the phonology (Colina 2016). In these dialects, underlying oral stops are vocalized in a syllable coda, becoming glides, e.g., *ap.to a*[w].*to* 'apt', *ét.ni.co é*[j].*niko* 'ethnic', *ac.to a*[j].*to*, *a*[w].*to* 'act' (Lenz et al. 1940; Oroz 1966; Martínez-Gil 1997). Underlying voiced stops also undergo vocalization when followed by a tautosyllabic liquid in word-medial position (a–c), but not across words (d). Voiceless stops in onset clusters are not vocalized (e–g).

(4) Chilean vocalization

a.	po[w].re	*po.[β]re	'poor'
b.	ma[j].re	*ma.[ð]re	'mother'
c.	vi.na[j].re	*vi.na.[ɣ] re	'vinegar'
d.	la.[ðr]o.ga	*la [j].ro.ga	'the drug'
e.	le.[p]ra	*le[w].ra	'leprosy'
f.	le.[t]ra	*le[j].ra	'letter'
g.	sa.[k]ro	*sa[j].ro, *sa[w].ro	'holy'

Martínez-Gil (1997) convincingly shows that voiced obstruents vocalize and are subsequently parsed in the coda, in order to improve the sonority contour of the Complex Onset Condition, avoiding an approximant as the first member of the cluster. This explains why only voiced (not voiceless) onset obstruents vocalize, namely, because voiceless obstruents do not have an approximant allophone that compromises the sonority rise of the onset cluster. In other words, since voiceless stops do not have approximant allophones, they do not vocalize in an onset cluster (only in the coda). As seen in (d), vocalization does not take place across words in an effort to avoid misalignment of syllables and word boundaries.

The Chilean phenomenon presents an apparent obstacle for the analysis of complex onset phonotactics in Colina (2016) because, if voiced obstruents lack the feature [+continuant] at the output of the phonology, sonority restrictions (Complex Onset Condition) are not violated and therefore the prediction is that there would be no vocalization. The explanation for this apparent difficulty lies in the behavior of /f/ once again. Colina (2016) argues that /f/ patterns differently from the voiced obstruents in onset clusters, exhibiting no vocalization. This is evidence that in this dialect the feature that makes voiced obstruents more sonorous than /f/ is [+voice]. In other words, Chilean requires one additional sonority class that divides the least sonorous class of voiceless and voiced obstruents and /f/ (those without [+continuant] in their phonological representations) into two, [−voice] and [+voice] (Figure 5.3).

Obstruents			Sonorants	
p, t, k, [+voiceless, +labiodental]	b, d, g	s, h, x, tʃ, dʒ	m, n, ɲ, r	l, ɾ
1	2	3	4	5

Figure 5.3 Sonority scale for some varieties of Chilean Spanish
Source: Colina (2016: 131).

With a sonority scale like the one in Figure 5.3, the Complex Onset Condition for these Chilean dialects allows only segments in classes 1 and 5 (e.g. voiceless stops and /f/, as well as [l], [ɾ]). At first glance, the scale may appear problematic, because /f/ is above the voiced stops. However, Figure 5.3 does not place a voiceless labiodental fricative over the voiced stops, but rather a voiceless obstruent that lacks a continuant specification and therefore cannot be considered a fricative at the point of application of the sonority generalization. Colina argues that it is reasonable to assume that language-specific adjustments to the scale will depend on the sound inventory of the language (including language-specific featural specifications) and point of application. Furthermore, it is to be expected that dialectal variation will affect sonority scales and other aspects of phonotactics as it does segmental phonology (see §4 for another example of dialectal variation in Spanish phonotactics).

Perhaps the best-known phonotactic restriction affecting Spanish onsets is the one that bans /s/ + obstruent clusters, *stop* *[stop]. Sonority offers a clear explanation for this, since /s/ does not provide enough of a sonority rise with respect to the following obstruent. Accounting for the repair mechanism selected (i.e., epenthesis) when this sequence arises, usually in loans, is not so straightforward. While the resulting heterosyllabic cluster, [es.ˈtop] is an improvement in terms of sonority, it is not quite as clear why this is preferred to deletion, [top]. A minimality requirement must be ruled out, since epenthesis applies across the board, regardless of the number of syllables in a word. Furthermore, the fact that other languages with the same restriction (e.g., Farsi) tend to repair the cluster in a similar way points toward the phonetic makeup of the segments involved. The acoustic saliency of /s/ is likely a factor in /s/ retention and the selection of epenthesis, rather than deletion, to repair the cluster. Moreover, as it will be seen in section 3.4 in connection with codas, /s/ is known to hold a special status in the coda as well, as an additional appendix permitted beyond coda restrictions. This generalization applies across languages, e.g., English *sixths*, with a three-segment coda + /s/.

3.3. Codas

As mentioned in §2, some coda phonotactics are related to sonority, such as the preference for sonorants over obstruents. Other phonotactic restrictions affecting the coda can be observed at the segmental and featural levels: for instance, in word-final position, most varieties of Spanish allow rhotics and also nasals and laterals with a neutralized point of articulation (usually coronal, but some varieties have velar or bilabial nasals instead); among sonorants, and among the obstruents, the coronals /d/ and /s/ are possible, *hotel*, *amar*, *camión*, *virtud*. /d/ can be realized as a voiced or voiceless continuant [ð] [θ] or a stop [d] [t] in some Peninsular varieties. Other obstruents are rare, e.g., /x/ and /t/: *reloj*, *cénit*.

There is a clear asymmetry between word-internal and word-final phonotactics as to the number of segments permitted in these positions, which is more restricted in the latter. In word-internal position, nasals and laterals exhibit additional allophones that are the result of assimilation to the point of articulation of the following segment, *ca*[m]*po*, *te*[ŋ]*go*, *ca*[l̪]*do*. Similarly, more obstruents are possible word-internally than in word-final position, often exhibiting neutralization of continuancy and voice contrasts, *o*[p/b/β/ɸ]*sesión*, *di*[k/g/x/ɣ]*no*, *é*[t/d/θ/ð]*nico*. One strong reason for the smaller numbers of word-final obstruents in the patrimonial lexicon has to do with the history of the Spanish language, which in its evolution from Latin repaired ill-formed word-final codas through epenthesis; a consequence of that process is that in present-day Spanish, word-final coda obstruents are generally followed by [e] - as in *nube*, *mate*, *toque* (Menéndez Pidal 1968). In contrast, in word-internal position, epenthesis was prevented so as not to break up a morpheme. Latin prefixes (which often ended in obstruents, e.g., *ob*, *ad*) are another factor contributing to higher numbers of obstruents in word-internal position in the patrimonial lexicon.

In general, restrictions on consonantal codas are due to the preference for CV syllables (i.e., the dispreferred or marked status of codas), also understood by some as the preference for consonants to be aligned with the left edge of the syllable, and vowels with the right edge (Piñeros 2006). While deletion and epenthesis of complete segments are ways to create/favor unmarked CV syllables, less radical strategies include partial parsing or deletion of specific features in the phonological output, such as featural neutralization and parsing of features through other syllabic positions. Examples of these are voice assimilation in obstruents and place assimilation in sonorants, on the one hand, and continuancy and voice neutralization in obstruents, on the other, as seen in the examples in this section. Onset parsing of a coda feature, such as point of articulation (through a shared association line in an autosegmental representation), allows the licensing of said feature through the onset, preserving it and avoiding its presence in the coda. Neutralization of features means that a feature is unspecified at the output of the phonology and then realized in the phonetic component. This accounts for its gradient nature and variability, as can be observed with regard to the aperture (continuancy) of obstruents in the coda; for instance, *eclipse* can be realized in many varieties of Spanish as [e.ˈklib.se] [e.ˈkliβ.se] [e.ˈkliβ̞.se] with various degrees of aperture (i.e., stop, fricative, approximant).

The preceding phonotactic facts refer to features and syllabic position, but more specifically they relate to the affinity between specific natural classes and features. Notice, for instance, that obstruents retain their point of articulation, while their continuancy and voice specifications become noncontrastive. For sonorants (nasals and laterals), it is the point of articulation that becomes unspecified. This affinity is generally grounded in acoustics and the perceptibility of featural combinations.

3.4. Complex codas

Spanish allows coda clusters consisting of a consonant or glide plus /s/, e.g., *abstracto*, *biceps*, *vals*, *transporte*, *perspectiva*. As is well known, /s/ has a special status cross-linguistically as an appendix both in the coda and in the onset, being the only segment that can be attached at syllable edges often in apparent violation of the sonority contour.

Permissible clusters that do not have /s/ as the second member consist of a glide and a consonant, e.g., *auxilio* [awk.ˈsi.lio], *veinte* [ˈbejn̪.te]. Liquid + nasal clusters are not allowed, given that they are too close on the sonority scale. While the phenomena discussed in §3.3 with regard to codas (e.g., neutralization of obstruents, assimilation) are also operative in coda clusters, obstruents (other than /s/) are frequently deleted in coda clusters in casual speech, regardless of their position in the cluster, e.g., *auxilio* [aw.ˈsi.lio], *abstracto* [as.ˈtrak.to]. Thus, one can conclude that coda obstruent deletion is generally driven by sonority since the least sonorous element of the cluster is generally the one targeted for deletion. However, nasals are often deleted in a nasal + /s/ cluster, while liquids are more generally retained, *transporte* [tras.ˈpor.te], *vals* [bals], *perspectiva* [pers.pek.ˈti.βa]. It is reasonable to assume that some degree of nasality is preserved in the vowel in the first case (thus avoiding full deletion) and that the sibilant is once again maintained due to its acoustic saliency.

No geminates are permitted in Spanish. When they arise through morpheme concatenation (fake geminates), in Latinisms or other types of cultisms and borrowings, they are realized as singletons in casual speech, and only as two identical heterosyllabic segments in careful and formal speech, *innato* [in.ˈna.to] [i.ˈna.to] 'innate', *perenne* [pe.ˈren.ne] [pe.ˈre.ne] 'perennial'. In varieties with nasal velarization, the first nasal in a fake geminate is sometimes a velar [iŋ.ˈna.to] or a velar partially assimilated to the point of articulation of the following nasal [i ŋ͡n.ˈna.to].

3.5. Nuclei

Like their consonantal counterparts, vocalic geminates are not permissible in Spanish. This restriction applies when two identical vowels arise as the result of morpheme concatenation (the vowels tend to be reduced to one segment): *una amiga* [u.na.ˈmi.ɣa] 'a friend', as well as when there is a sequence of a glide and a vowel that differ only in syllabic status ([±vocalic]). In other words, the sequences *wu, *ji are ill formed (as well as *uw and *ij). The fact that the glides [w] and [j] cannot be in the same nucleus with the corresponding high vowel (Hualde 2014: 200) has been used to argue for the parsing of prevocalic glides in the onset in Spanish. In addition, Spanish does not allow long diphthongs, e.g., a diphthong made up of two fully syllabic vowels, i.e., CVV *[kie], [kje].

4. Case study: dialectal variation and onset phonotactics

In this section, I expand on recent and ongoing work on Chicano Spanish that is pertinent to the phonotactics of vocoid sequences and to dialectal variation in phonotactics (Martínez-Gil 2000; Bakovic 2006; Colina 2009; Martínez-Gil 2016). I consider onset glides in either intervocalic or postconsonantal position in onset-strengthening varieties like Peninsular Spanish and in non-onset-strengthening ones like Mexican Spanish from Sonora (henceforth Sonoran Spanish,).

It must be noted that Spanish varieties that ban high glides in intervocalic onset position (i.e., onset-strengthening varieties such as Peninsular Spanish) nonetheless allow them when they are the result of across-the-word resyllabification. In derivational terms, onset glides are ill formed lexically (5) but permitted postlexically (6). In (5a), the onset [j] in *leyes* *[ˈle.jes] is ill formed, but it is possible when it is the result of across-the-word resyllabification (6a). To further support this contrast between lexical and postlexical phonotactics of [j], compare the minimal pair in (5c) and (6b). As expected, onset [j] is possible when it is the result of postlexical resyllabification (6b); yet it is ill formed when it is in the onset of a lexical word (5c).

(5) Word level (lexical)

a.	ley	[lej]	'law'	leyes	[ˈle.ʝes] *[ˈle.jes]	'laws'
b.	hay	[aj]	'there is'	una	[ˈu.na]	'one'
c.	ayuna	[a.ˈʝu.na] *[a.ˈju.na]	'he/she fasts'			

(6) Across the word (postlexical)

a.	ley alguna	[ˈle.jal.ˈɣu.na]	'some law'
b.	hay una	[a.ˈju.na]	'there is one'

In casual speech, a sequence of two vowels within or across words surfaces as a glide + vowel or vice versa, as one of the vowels loses its mora and becomes a glide. This phenomenon, also known as vowel merger, is common to most varieties of Spanish; there is, however, variation in the target of gliding. While in Peninsular dialects it is the least sonorous vowel (regardless of its position in the sequence), Sonoran Spanish glides the first of the two vowels (8–9). In all varieties, two identical vowels are reduced to one (7). Sonoran Spanish vowel merger data are discussed now because they are pertinent to the discussion of the phonotactics of glides, and in particular of postconsonantal glides (i.e., prevocalic postconsonantal glides).

(7) Two identical vowels reduced to one
- a. lo odio [ˈlo.ðjo] 'hate-1SG it/him'
- b. mi hijo [ˈmi.ho] 'my son'

As already mentioned, in a sequence of two vowels, the first one loses its mora. Furthermore, if the first vowel is low, it is deleted (8).

(8) Low vowel deleted when followed by #V2

a.	la iglesia	[li.ˈɣle.sja]	'the church'
b.	paga Evita	[ˌpa.ɣe.ˈβita]	'Evita pays'
c.	casa humilde	[ˌka.su.ˈmilde]	'humble home'
d.	niña orgullosa	[ˌni.ɲoɾ.ɣu.ˈjosa]	'proud girl'

Cf. Peninsular: [laj.ˈɣle.sja] [ˌpa.ɣae̯.ˈβita] [ˌka.saw.ˈmilde] [ˌni.ɲao̯ɾ.ɣu.ˈɟosa]

If the first vowel is mid and the second disagrees only in height, only the high vowel surfaces. Martínez-Gil (2000, 2016) interprets this as the demorification and elevation of the mid vowel (G1 +V2), which is then deleted in contact with an identical high vowel (9).

(9) V1 is mid,V2 disagrees in height only: high vowel only

se hinca	[ˈsiŋ.ka]	'kneels'
como uvitas	[ˌko.mu.ˈβitas]	'like grapes-DIM.'

Cf. Peninsular: [ˈsejŋ.ka], [ˌko.mow.ˈβitas]

In all remaining cases, when the first vowel is high and the second vowel differs from it in a feature other than height, the first vowel surfaces as a high glide (10). The same happens when the first vowel is mid (11). The second vowel is never a glide in Sonoran Spanish.

(10) High V1 is a glide when followed by any vowel

mi última	[ˈmjul.tima]	'my last one-FEM.'
mi hebra	[ˈmje.βɾa]	'my thread'
mi obra	[ˈmjo.βɾa]	'my deed'
mi árbol	[ˈmjaɾ.βol]	'my tree'
tu hijo	[ˈtwi.ho]	'your son'
tu época	[ˈtwe.po.ka]	'your time'
su Homero	[swo.ˈme. ɾo]	'your Homer'
tu alma	[ˈtwal.ma]	'your soul'

Peninsular: same outputs

(11) Mid V1 is a high glide when followed by any V

me urge	[ˈmjuɾ.he]	'it is urgent to me'
pague ocho	[pa.ˈɣjo.tʃo]	'that s/he pay eight'
porque aveces	[ˌpoɾ.kja.ˈβe.ses]	'because sometimes'
tengo hipo	[teŋ.ˈgwi.po]	'I have the hiccups'
como Eva	[ko.ˈmwe.βa]	'like Eva'
lo habla	[ˈlwa.βla]	'speaks it'

(11) Mid V1 is a high glide when followed by any V
Peninsular: [ˈmewɾ.xe], [pa.ˈɣe̯o.tʃo], [ˌpoɾ.ke̯a.ˈβe.θes], [teŋ.ˈgoj.po], [ko.ˈmo̯e.βa], [ˈlo̯a.βla].

One phonotactic generalization to be drawn from the data in (9–11) is that mid glides are not allowed in Sonoran Spanish (Colina 2009), in contrast with other varieties like Peninsular Spanish that have both mid and high glides (this also suggests a preference for a complex nucleus over a complex onset). In other words, as seen in §3.5, like Peninsular Spanish, Sonoran Spanish does not have two syllabic vocoids in one syllable; yet, unlike Peninsular Spanish, mid vocoids can only be fully syllabic (i.e., vowels rather than glides). Martínez-Gil (2016) argues that the motivation behind this phenomenon and behind the selection of the first vocoid as the target of demorification is that the glides are parsed as a second member of the onset and therefore must be high. While Colina does not consider the complex onset option, Martínez-Gil does not mention sonority considerations (i.e., the preference for high glides over mid ones) as a possible factor driving glide selection in the nucleus. In sum, the relevant phonotactic issue is whether the dialectal differences respond to variation in onset parsing of the high vocoid or to a preference for or ban on some glides. Determining whether postconsonantal homosyllabic glides are parsed in the onset (vs. the nucleus) is important because onset parsing would suggest unreported cross-dialectal variation in the syllabic affiliation of prevocalic glides. Moreover, on a theoretical level, dialectal variation in the syllabic affiliation of prevocalic glides in Spanish (the finding that prevocalic glides can be parsed in the onset or in the nucleus, depending on the dialect) would bear out the predictions of an optimality-theoretic factorial typology in which constraint reranking predicts possible patterns of variation.

One piece of evidence presented by Martínez-Gil in favor of the onset parsing of glides is that glides must be in the onset because they undergo strengthening—a phenomenon that affects only this syllabic position. However, strengthening does not demonstrate that glides are in the onset, since glides never surface in the onset position in strengthening dialects, at least lexically; furthermore, the strengthening argument is framework specific, presupposing a derivational account in which a glide is first in the onset and then becomes an obstruent. Nonetheless, this particular argument is not needed to support Martínez-Gil's position, as the (non)acceptability of onset glides in glide-strengthening dialects such as Peninsular Spanish is not necessarily relevant for Sonoran Spanish. Phonotactics can reflect dialectal variation, like other phonological components, and that glides cannot be in the onset in Peninsular Spanish (within the word) does not imply that the facts are the same for Sonoran Spanish. In fact, as already mentioned, Sonoran Spanish does allow onset glides, minimally for singletons (Canfield 1981; Alvar 1996), and thus *creyendo* 'believing' is realized as [kre.ˈjen.do], with a glide instead of a fricative consonant. Although glides are parsed in the onset when no other onset is available (i.e., intervocalically), as in [kre.ˈjen.do], that does not necessarily entail that they will be parsed in the onset in a cluster, when there is an onset present (i.e., in postconsonantal, prevocalic position); yet it is reasonable to hypothesize that if glides are allowed in a single onset, they may also be well formed as the second member of an onset cluster, as they are the most sonorous single onset permitted in this variety (just as liquids are in Peninsular and other varieties with onset strengthening).

Colina et al. (2018) is an example of a recent study that sets out to test the preceding hypothesis empirically. The authors designed two sets of stimuli according to two (sub)hypotheses. The first relies on a well-known restriction on the Spanish rhyme, namely, that Spanish allows a maximum of three rhyme segments (Harris 1983). Thus, if a sequence of CGVGC (Consonant + Glide + Vowel + Glide + Consonant) is allowed (e.g., the third syllable in the nonce word *la.ca.puais.to*), the postconsonantal glide should be in the onset, because otherwise the rhyme would contain four segments and would be illicit. Stimuli in this group consisted of four-syllable nonce words that contained a postconsonantal high vocoid followed by a diphthong and a coda consonant (i.e., a four-segment rhyme or complex onset + three-segment rhyme). Four-syllable words were created to avoid a glide + vowel sequence too close to the beginning or end of the word, positions known to favor hiatuses in some dialects (Hualde 1999, 2005). The second set of stimuli was designed around the (sub)hypothesis that if the glide is in the onset, there should be onset co-occurrence restrictions; namely, only some combinations of consonant + glide should be possible as complex clusters. For instance, a palatal consonant + homorganic glide [j] (e.g., **ch*[j]*aba*) should be disallowed because their articulations are too similar. Oral data were collected from 10 speakers of Sonoran Mexican Spanish (with limited English proficiency) using two tasks: an oral recorded phrase reading (e.g., "Digo ___ porque sí") and an oral syllable division task. Stimuli in both tasks consisted of 23 nonce words (alongside 23 fillers) containing the relevant stimuli.

The participants' productions from the oral syllable division task were categorized as a triphthong in 45% of the data, a hiatus in 30%, or a simplification (eliding the prevocalic glide) in the remaining 25%. Thus, prevocalic glides were produced as part of the onset, at least some of the time. Duration and intensity (dB) values for the data from the oral recorded phrase were extracted and compared to those from prevocalic glides that were not preceded by a palatal consonant. Palatal + glide sequences showed longer durations. Glides preceded by a palatal consonant showed lower intensity values over the time course, suggesting a more consonant-like production.

Taken together, the data from the two tasks support the hypothesis that prevocalic glides can be produced as part of a complex onset in Sonoran Spanish. The syllable division task illustrates that this production is possible, though highly variable. The data from the phrase reading task suggest that co-occurrence restrictions apply to palatal consonant + homorganic glide [j] sequences, and a possible repair strategy is to lengthen the onset, resulting in longer durations and more consonant-like productions.

Empirical evidence of this type (in favor of the onset parsing of glides in Chicano Spanish) suggests the need for more studies on cross-dialectal variation in phonotactics, as having accurate dialectal data has implications for research on monolingual and bilingual acquisition and on acquisition errors (e.g., language learning, speech pathology, etc.), and advises caution about drawing generalizations based on phonological descriptions that could be inaccurate or inapplicable to all varieties and speakers. It is important to also consider the possibility that phonotactic variation can also exist depending on other syllabic conditions (cf. Colina and Simonet 2014 for Galician).

Galician is a language that does not have coda clusters but that allows /ns/ in the plural /mans/; Colina and Simonet (2014) argue that there is no epenthesis *[ˈmanes] because the nasal is a velar glide that can be parsed in the nucleus, rather than in its normal coda position, when required by higher-ranking constraints.

5. Conclusions

This chapter has presented a review of phonotactic constraints on Spanish syllable structure. The presentation was divided into two major types of constraints: first those that are driven by sonority, a factor that plays an important role in determining the sequencing of segments within syllabic constituents; and then those that refer to specific segments and their featural makeup, often reflecting the affinity or lack of it between a specific feature and a syllabic position. The discussion on the phonotactics of segments and features focused on the phonotactics of the onset, nucleus, and coda, both simple and complex, explaining that some phonological processes in Spanish (e.g., nasal assimilation, obstruent coda neutralization) are ultimately a consequence of segmental and featural phonotactics. In addition, this chapter summarizes recent work pertinent to dialectal variation in phonotactics, in connection with complex onsets in some varieties of Chilean Spanish and prevocalic postconsonantal glides in Sonoran Mexican Spanish. Arguments and preliminary experimental results are introduced regarding the proposal that glides could be part of a complex onset in this variety (instead of part of the nucleus, as in most varieties of Spanish).

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6
Glides and high vowels in Spanish

Ellen M. Kaisse

1. Introduction: what is a glide?

This chapter deals with the phonetics and phonology of glides in Spanish. It also treats their close relatives, the high vowels. As in many languages, a Spanish high vowel and a glide with the same place of articulation can be argued to be manifestations of a single underlying segment that shows up as a syllable peak in some environments but not in others. Spanish is particularly interesting because its high vowels, /i/ and /u/, have a wide variety of allophones, including not only the glides [j] and [w] but also a number of consonantal variants including fricatives, affricates and stops, like [ʝ] [ɟ], [ɣʷ] and [ɡʷ].

Here is a roadmap of the chapter. The remainder of this section explains what linguists mean by the term 'glide.' Section 2 talks about the phonetics of Spanish glides against a background of what is known about glides in the world's languages. Section 3 surveys the range of glides linguists encounter and situates the Spanish inventory in that context. Section 4 presents a detailed description of the allophones of Spanish glides—including the fricatives, affricates and stops—that make the surface distribution so rich and complex, and discusses variation across dialects. Because most of the explanation for the distribution of allophones lies in a segment's position in the syllable, sections 5 and 6 discuss Spanish syllabification in general and the complexities of the syllabification of high vowels and glides in particular, first in a derivational model and then in Optimality Theory. Section 7 investigates possible and impossible sequences of Spanish vowels and glides and introduces machinery to cope with the syllabification of sequences of high vowels. Section 8 deals with hiatus, the relatively unusual situation where sequences of adjacent vowels are realized on the surface, where one would normally have expected the high one to be realized as a glide. Section 9 is about sequences of vowels between words (and sometimes within them) that can be realized with glides in connected, casual or rapid speech. Section 10 summarizes the various sources of glides and their consonantal allophones.

Glides can be thought of as hybrid creatures. Articulatorily they are most like—indeed in some cases identical to—vowels. But phonologically they fill positions that usually belong to consonants—they do not form the peak of a syllable but instead function as onsets, codas and the nonsyllabic pieces of diphthongs.

To understand this hybridness, consider that the sounds of speech are made by adjusting the shape of the vocal tract. If the articulators are brought close together to make the noise of friction, or if they touch, the result is a consonant. All other sounds are made just by shaping the oral cavity without bringing any articulators very close. The result of simply shaping the oral cavity is a vowel or a glide, and the sounds made this way are known collectively as 'vocoids.' The distinctive feature that distinguishes vocoids from consonants is [consonantal]. [+consonantal] sounds are made with an obstruction at least as narrow as that of a fricative (Chomsky and Halle 1968).

Where do glides, such as the [j] and [w] of Spanish, fall in the consonant versus vowel dichotomy? Articulatorily they are just like vowels, which is why they fall into the class of vocoids—they are made without bringing the tongue close enough to the roof of the mouth to make a noise of friction. But syllabically they do not qualify as vowels, because vowels are syllable peaks, capable of forming a syllable all on their own: [i] is a syllable; [o] is a syllable. But the diphthongs [aj] and [ja] are each a single syllable, not two syllables, even though they contain two vocoids. Glides can form the nonsyllabic portion of a diphthong, as in [aj], or they can even fill the syllabic position normally reserved for a consonant, forming all or part of an onset (English [jɛt] 'yet,' [twɪn] 'twin'). In other words, glides are vocoids that, because of their position next to another vowel, do not form an independent syllable.

The term 'glide' originated in a period in the history of linguistics where the emphasis was on the surface realizations of sounds, while the concepts of underlying form and syllable structure were not developed in their modern forms. This has led to ongoing confusion between the phonetic existence of glides—which are exceedingly common in the world's languages—and the question of whether glides are underlying segments, ones that we would put in the consonant portion of a language's phonemic segment inventory. In most languages, glides are not underlyingly distinct from vowels; 'glide' is simply the name we give to [−consonantal] surface segments that are not the peaks of their syllables. Levi (2006, 2011) has gone a long way in clarifying how to think about glides in different languages. Most languages simply have one set of underlying vocoids that show up predictably as vowels in some positions but as glides when they are adjacent to another vowel. This willingness to yield the syllabic head position is especially true of high vocoids such as [i] and [u], which, after all, are more consonant-like simply because the tongue is raised close to the palate. In many languages, we find alternations in the realization of an underlying high vocoid depending on the sonority of surrounding segments. For instance, in Modern Greek, neuter nouns usually end in /-i/. When the plural affix /-a/ is present, the /i/ appears as a glide. If there is no affix present, as in the singular, /i/ appears as [i]. Similarly, in Spanish, the possessive pronoun /mi/ appears as [mi] when the next word begins with a consonant but is often realized as [mj] when the next word begins with a vowel:

(1)	a.	/peð+i/	[peˈði]	'foot-NEUT.SG'
	b.	/peð+i+a /	[peˈðja]	'foot-NEUT.PL'
	c.	/mi madre/	[miˈmaðre]	'my mother'
	d.	/mi amor/	[mjaˈmor]	'my love'

Levi refers to the surface glides, which are allophones of underlying vowels such as the Greek and Spanish /i/, as 'derived glides.' However, she shows that there are a few languages where the high vocoids do not alternate with vowels and do not act like underlying vowels. They act more like members of the consonant inventory of the language. These she terms 'phonemic glides.' In Turkish, for instance, there is an underlying glide /j/, which is a distinct phoneme from /i/, which also exists. The phonemic glide /j/ does not participate in vowel harmony like /i/ does but instead co-occurs with both front and back vowels. Also, unsyllabifiable clusters containing phonemic glides are subject to epenthesis, so that /mejl/ 'tendency' emerges as [mejil]. In a language with only a derived glide, this form would be underlying /meil/ and it would make no sense for it to undergo epenthesis of a third vocoid—it would be expected to emerge as [mejl]. By most tests, Spanish has only derived glides, and we will treat it that way in the bulk of this chapter. As we will see in section 8, Spanish does have exceptional high vocoids that are realized as [i] and [u] even next to other vowels, but although the terminology for distinguishing these from normal high vocoids has been confusing over the decades and has sometimes made use of the term 'phonemic glide,' the distinction is not what Levi means by phonemic versus derived glides.

2. The phonetics of glides

In the simplest, perhaps oversimplified case, glides are articulated in exactly the same way as the vowels they are related to; that is, the tongue and lips are in the same posture. The only consistent distinction cross-linguistically is the nonpeak position in the syllable, but this in itself does not constitute a phonetic difference, only a representational, phonological one. Some phonetic cues have been claimed to be associated with glides over the years, but none are straightforward or invariably true. Levi (2011), in a literature search covering around 100 years, found discussions of degree of constriction, duration and amplitude as correlates of the phonetic vowel/glide distinction. As far as constriction goes, one might presume that glides are reliably more constricted than their vowel counterparts, but phonetic investigations such as those of Straka (1964) found that this really varies from environment to environment and language to language. One reason for the variation is the tendency of glides to consonantalize in some languages—i.e. to bring the articulators closer together—when the glide lies in the onset of a syllable, taking the structural position of a consonant. The majority of Spanish dialects take this strengthening quite far, so that onset 'glides' do not exist on the surface—no vocoids are pronounced in onset position, only consonants. One finds consonantal allophones such as [ʝ] and [ɣʷ]. Another reason for the difference in constriction across and within languages may be indirectly related to the short duration of glides. Straka found that in the context [iji], the glide is more constricted than the vowels, but in [aja], is it less constricted than [i] would typically be in the same language. We can surmise that the tendency of glides to be rapidly articulated can prevent them from attaining a very high target in the low vowel context. There simply may not be time to get there.

Concerning duration, glides tend to have shorter formant transitions and shorter overall duration than their syllabic counterparts, and indeed some investigators (e.g. Catford 1977) claim that they need have no steady state whatsoever. Steady states are the hallmarks of vowels and of syllable peaks in general. Glides in some languages are apparently all about aiming for a target position but not about resting there for any appreciable amount of time. Perhaps they were dubbed 'glides' because early phoneticians perceived them to always be moving to or away from a target. For Spanish, Aguilar (1999) compares exceptional forms pronounced with two vowels in hiatus, such as [ˈpi.e] 'it cheeps (SBJV)' and [pi.ˈe] 'I cheeped' with the diphthongal [pje] 'foot,' and indeed finds that the duration of the group of vowel plus vowel is always longer than the otherwise articulatorily identical sequence of glide plus vowel, by about a third on average. Also, while the vowel-vowel sequence may show two steady states, the glide-vowel sequence shows no steady state for either component. Finally, the slopes of the formant transitions are steeper in vowel-vowel sequences than in diphthongs, indicating that the targets of the two hiatal vowels are farther apart and that less time is spent on those transitions. These results are consistent with those of the first modern acoustic studies of Spanish hiatuses and diphthongs (Borzone de Manrique 1976, 1979), which concentrate on formant transition rate, finding that diphthongs are characterized by gradual, slow transitions between the two vocoids while vowel-vowel sequences have more abrupt transitions. Perhaps because hiatal vowels spend less time on transitions, they have additional time to achieve steady states. (For a comprehensive overview of the phonetics of Spanish glides and vowels, see Aguilar 1997.)

As for amplitude, it has been claimed over the past 150 years that glides have less prominence than vowels do. Straka (1964) confirmed instrumentally that at least some glides have less airflow than vowels do. Again, if they are aiming for greater constriction, and if they do not have open steady states, which are acoustically more powerful, a tendency to have lower airflow and lower amplitude makes sense.

3. A brief survey of glides in Spanish and beyond

Cross-linguistically, high vowels are the most likely to have glide allophones; therefore, languages with [i] and [u] often also have their nonsyllabic counterparts [j] and [w] (also written [i̯], [u̯]) in the surface inventory of sounds. The tendency toward nonpeak status is related to the universal tendency for syllable peaks to be associated with the most sonorous segment in the local environment, and high vowels are less sonorous than mid or low vowels. Once a local peak is identified, a high vocoid may not be a good candidate for peakhood as well, since this would involve a marked string of adjacent syllables, the second having no onset, and a difficult-to-perceive vowel-vowel hiatus. ([pi.a] is often less ideal than [pja].) It is not a foregone conclusion that all the high vowels of a language will have nonsyllabic allophones, however. Modern Greek, for instance, has [j] from /i/ but does not have a surface [w] corresponding to its /u/.

Less common glides are also found in the world's languages. For instance, if a language has the front rounded vowel [y], it may well also have a front rounded glide [ɥ], as in French. Some languages also have central glides. British English has a central glide, typically transcribed as [ə̯] or occasionally as [ɐ̯], which is a reflex of an earlier /r/ that was weakened in the coda, as in [biə̯] 'beer.' A similar phenomenon is found in German. Some dialects of American English have centralizing diphthongs that arise from the 'breaking' of the monophthong [æ] to [æə̯], as in northeast American [bæə̯d] or [beə̯d] 'bad.'

Spanish has an unmarked and unremarkable inventory of five underlying vowels:

(2)
i					u
	e			o	
		a			

Since glides are usually simple, positionally predictable allophones of a language's vowels, there are at most five derived, phonetic glides Spanish could have. All dialects of Spanish have the most unmarked and expected glides, [j] and [w], the glide allophones of the vocoids /i/ and /u/.

Navarro Tomás (1965) uses two terms for the same phonetic entity: a semivowel ('semivocal') is a postvocalic glide, while a semi-consonant ('semiconsonante') is prevocalic, nonstrengthened glide.

Additionally, in casual speech, /e/ and /o/ may be realized with glide counterparts [e̯] and [o̯] in Peninsular Spanish (Hualde 2005). In Latin American dialects, these mid vowels often merge with /i/ and /u/ when they are glided and are realized as [j] and [w], especially when they are unstressed, as documented most recently by Martínez-Gil (2016) for Chicano and Colantoni and Hualde (2016) for Mexican and Argentinian dialects. The merger is stigmatized in Peninsular Spanish. So, cross-linguistically, Peninsular Spanish is noteworthy for the existence of a contrast between derived mid and high glides.

Another interesting part of the story in Spanish involves just how nonsyllabic vocoids are pronounced, particularly when they are syllable-initial, as they turn out to be in /io/ 'I' and /klaraboia/

'skylight.' In these cases, dialects differ in the phonetic realizations, but the majority 'strengthen' (consonantalize) the glides so that the articulators are in closer proximity than they would be for a high vowel and we get some degree of fricative noise or even affrication or stopping involving a complete occlusion of the vocal tract. A few dialects, such as Sonoran (Canfield 1981), apparently do not strengthen, and have the glides [j] and [w] even in syllable-initial position. But most Spanish stands out among languages in the easily audible and generally required degree of strengthening of its onset vocoids. This is especially true in Argentinian, which, as we shall see, has strident, voiceless [ʃ] for the onset allophone of the palatal vocoid where more familiar dialects have [ʝ]). In this required fortition, Spanish should be compared with languages like Slovak (Rubach 1998) and Korean (Yun 2004), which do not consonantalize glides in the onset or elsewhere. We will see in section 5 that many phenomena converge to show that Spanish vocoids opportunistically fill onsets when no underlyingly consonantal segment is available to do so. The same opportunistic filling of onsets occurs in Slovak (Rubach p.c., 1998) and Korean (Yun 2004), but because there is no obvious phonetic strengthening, one must rely heavily on phonological phenomena, with no phonetic cues to help one out. So Spanish has been helpful in allowing phonologists studying languages without fortition to nonetheless diagnose where glides are positioned in syllables.

4. Inventory of Spanish surface glides and their allophones

The various dialects of Spanish display a rich inventory of prepalatal, palatal and velar segments, all of which are allophones of underlying /i/ and /u/. These are summarized in table form in (3).

There are a number of ways to spell the sounds in question. For the palatals, we find <i>, <y>, <(h)iV>, or (in yeista dialects) <ll>, as in <tiempo> 'time,' <yéma> 'yolk,' <hiéna> 'hyena' and <llena> 'full.' For the velars, the choices are <hu> as in <hueso> 'bone,' and <u> as in <claustro> 'cloister' and <trueno> 'thunder.'

The glides [j, w] appear when a high vocoid is not syllable-initial and not itself a syllable peak. They are found either prevocalically ([ˈtjem.po] 'time,' [pwes] 'so') or postvocalically ([boj] 'I go,' [ˈklaws.tro] 'cloister') The palatal and velar fricatives [ʝ] and [ɣʷ] are the default consonantalized allophones of /i/ and /u/, found in many well-described dialects, such as standard Castilian and most Mexican varieties; [ʃ] (and its sociolinguistically distributed variant [ʒ]) appears as the default consonantalized version of /i/ in onsets in Argentinian Spanish. (See Harris and Kaisse 1999 and references therein for a richer bibliography.) The [−continuant] variants [ɟ] (many dialects), [ʧ, ʤ] (Argentinian) and [ɡʷ], which may be realized as affricates or as stops, usually appear after a nasal, though they are also sometimes found in prosodically strengthened environments, such as utterance-initially or before a stressed vowel (Lavoie 2001).

The symbol [y] is typically used by Hispanists for IPA [ʝ] or as a cover symbol for [ʝ] and [ɟ]. For a detailed articulatory description of the variants of the palatal glide in Castilian and Argentinian dialects, see Harris and Kaisse (1999) and references therein.

(3)		ʃ	ʒ	ʧ	ʤ	j	ʝ	ɟ	w	ɣʷ	ɡʷ
	+cons +cont	+ +	+ +	+ −	+ −	− +	+ +	+ −	− −	+ +	+ −
	+vc	−	+	−	+	+	+	+	+	+	+
	COR	yes	yes	yes	yes	no	yes	yes	no	no	no
	DOR	no	no	no	no	yes	yes	yes	yes	yes	yes
	high					+	+	+	+	+	+
	back					−	−	−	+	+	+

This table is adapted from Harris and Kaisse (1999) and presented for concreteness. Of course, many variants are available in different distinctive feature systems. In the system we adopt, the primary articulator of glides and vowels is DORSAL, and only dorsal segments are specified for the feature [high]. Articulatory studies of Spanish such as Quilis (1993) suggest that the fricative [ʝ] and its stop/affricate counterpart [ɟ] use both the rear of the blade and the front of the tongue body, hence their double specification as COR and DOR.

5. Syllable structure and the syllabic position of glides

We have several excellent and comprehensive treatments of Spanish syllable structure and how it is created, including Harris (1989) and Hualde (1991) in a derivational framework, and Colina (2009), which incorporates many of the insights of earlier analyses into an optimal-theoretic framework. While some disagreements persist, it can safely be said that there is a general consensus that accepts the major results of these studies. In what follows, I will largely use the derivational orientation in which the syllabification algorithms were developed, then explain briefly how an optimality-theoretic, constraint-based system captures the same insights.

Spanish syllables have the form:

(4) (O)-(S)-(G)-V-(G,C)-(s)
O = obstruent, S = sonorant consonant, G = glide, V = vowel, C = consonant,
s = the fricative [s]

(4) shows that the only absolute requirement is that there be a vowel forming the syllabic nucleus; the other segments are optional.

We are speaking now of the form of syllables derived by the core principles of syllabification that are carried out in the word-level ('lexical') phonology. Later, postlexical processes, discussed in section 9, can create less restricted syllable types, and the syllabic position of glides in those postlexical syllables may differ from those discussed in this section. In particular, Martínez-Gil (2016) argues that a postlexically glided vowel like the one in [mjamor], from [mi amor] 'my love,' is in the onset, not in the nucleus.

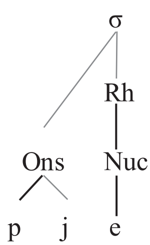
Consonants are absolutely prohibited from nuclear positions in Spanish. There are no syllabic consonants and no consonants in diphthongs. They are all parsed into onsets if they precede a vowel or into codas if they cannot be placed in an onset. In a derivational framework, one scans for a [−consonantal, −high] segment and builds a syllable over it. Up to two preceding consonants are placed in the onset of that syllable. Then any remaining, unaffiliated postvocalic high vocoid or consonant is placed in the coda.

The question for us is what happens to the high vocoids /i/ and /u/. They are acceptable but not ideal syllable peaks. In a word like /piso/ 'floor,' or /tu/ 'you,' /i/ and /u/ each represent the local sonority peak. They are surrounded by true consonants or nothing and therefore must form the nucleus of the syllable. However, in /ai/ 'there is,' /boniato/ 'sweet potato,' or /io/ 'I,' the high vocoid is adjacent to a more suitable, more sonorous vowel and therefore is not itself parsed as the syllable peak. Instead, it becomes a satellite of some sort—a coda in [aj], and, as we shall see, either an onglide lying in the nucleus in [bo.nja.to] or an onset in [ʝo].

Consider Spanish words like [pje] 'foot,' [meˈrjenda] 'snack' and [ˈbweno] 'good,' which have syllables containing glides. Where are the glides structurally? Do they form complex onsets with the preceding consonant, as in (5), or do they form ongliding diphthongs with the following vowel, as in (6)? We will adopt the position of Harris (1989) and Hualde (1991) and subsequent researchers such as Colina (2009) that (6) is the correct structure when a consonant precedes the glide. The consonant fills the onset position, and the glide shares the nucleus with the peak vowel.

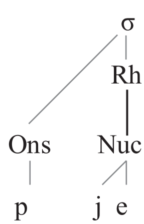
I adopt here a commonly used system where syllables branch into onset and rhyme constituents, following Harris (1983). The rhyme consists of an obligatory nucleus (the peak or head of the syllable) and an optional coda. The nucleus itself can be simple or complex. A complex nucleus is usually called a diphthong; it branches into a peak and a glide. The peak has a vertical line attaching it to the nucleus, while the satellite on- and offglides have a slanted line. In Spanish there probably are no true offgliding diphthongs, since a postvocalic glide fills the coda position. Alternative representations include N' structure (Blevins 1995, used by Colina, this volume), moraic structure (Hayes 1989, used by Martínez-Gil 2016), and variants of X-skeleton and CV skeleton structures.

(5)



incorrect structure for Spanish

(6)

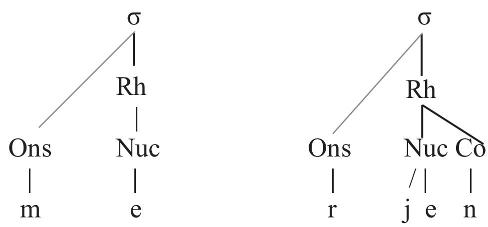


correct structure for Spanish

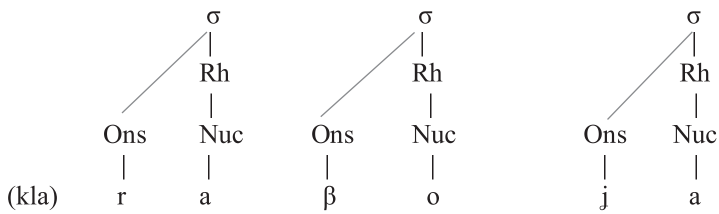
Because the question of onset versus nuclear glide position is structural, not phonetic, we can't simply listen to the pronunciation of the syllables in question and decide where the glide is. In some languages, the complex onset structure has support, while in others, such as Slovak (Rubach 1998), the complex nucleus structure has convincing phonological arguments behind it. Fortunately, Spanish gives us several converging arguments that indicate that (6), the complex nucleus structure, is the correct one. We will discuss those shortly.

The situation is actually a little more complicated, however. Several phenomena (reviewed later in this section and presented fully in Harris and Kaisse 1999) argue that a prevocalic glide actually *is* in the onset, but only if there is no other, less sonorous and therefore more appropriate segment to fill that onset. To put it another way, high vocoids that are local sonority peaks, as in /piso/ 'floor,' are parsed as nuclear heads. High vocoids that are the lowest sonority element compared to their immediate neighbors to the right and left, as in /**i**o/ 'I' and /klarabo**i**a/ 'skylight,' are parsed as simple onsets. High vocoids that lie between a consonant and a nonhigh vocoid, as in /p**i**e/ in (6) and /mer**i**enda/ 'snack' in (7), are parsed as onglides in the nucleus. So while the structure in (6), elaborated in (7) using the form [me.ˈrjen.da], is correct for a derived glide that has a consonant on its left and a vowel on its right (*CGV*), the structures in (8) and (9) are correct for the consonantalized glides preceded by a vowel (*VGV*) or by nothing (*GV*) as in [kla.ra.ˈbo.ʝa] and [ʝo]. Recall that the terminal symbols in the tree are [j], a true glide that merely shapes the vocal tract, and [ʝ], a voiced nonstrident palatal fricative, the consonantalized allophone of the glide, which appears in syllable-initial position.

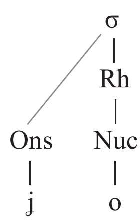
(7)



(8)

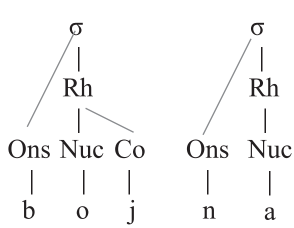


(9)



To summarize, high vocoids are accommodating. They will fill onsets if there is no better, less sonorant candidate to do so. They will act as syllable peaks if there is no better, more sonorant candidate. When they are sandwiched between a less sonorant and a more sonorant segment, they are parsed as onglides within a nucleus. Finally, when they are postvocalic and haven't been recruited into a syllable, they fill the coda slot, as in [ˈboj.na] 'beret.'

(10)



high vocoid in coda

We now review some of the arguments that Spanish phonologists have amassed for the differential placement of postconsonantal versus non-postconsonantal glides.

Spanish has a three-syllable stress window, with stress allowed to fall on the ultima, penult or antepenult. Spanish exhibits a cross-linguistically common pattern: if the penult is heavy, stress cannot fall on the antepenult. (This pattern has often been described using feet called moraic trochees. However, see Piñeros (2016) for a relatively iconoclastic treatment where Spanish stress is not sensitive to quantity.) A rhymal consonant, an offglide and an onglide (Harris 1983: 88) are all stress attractors in the penult and outlaw antepenultimate stress. There are words like [sa.la.ˈmaŋ.ka] 'Salamanca' and [be.ne.ˈswe.la] 'Venezuela,' but none like *[sa.ˈla.maŋ.ka] or *[be.ˈne.swe.la]. Work with many consultants by Harris (1983) and by Harris and Kaisse (1999) confirms that nonce words with *CGV* in the penult are judged ill-formed if they have antepenultimate stress. However, both nonce-word studies and existing lexical items confirm that a consonantalized glide in the penult, such as [ʝ], Argentinian [ʃ] or [ɣʷ], does not prevent antepenultimate stress—because, *ex hypothesi*, that glide allophone is syllable-initial. Thus, there are existing words like [ˈkon.ʝu.xe] 'spouse' and foreign place names like 'Iowa' [ˈa.ʝo.ɣʷa]; additionally, nonce words like [ˈta.ʝa.ma] are judged acceptable.

Another argument concerns the three-segment limit on rhymes established by Harris (1983: 15). There are forms like [ˈfwer.te] 'strong,' [ˈtrjuɱ.fo] 'triumph' and [ˈklaws.tro] 'cloister' whose first syllables contain the rhymes [wer], [juɱ] and [aws]; but there are no words like *[fwers.te], with the rhyme *[wers]. Word-initial or intervocalic glides do not count toward the three-syllable limit. There are no words like *[njuks], but the word [juks.ta.po.ˈner] 'to juxtapose' is well-formed because the [j] has been recruited to fill an onset that would otherwise be empty, leaving the well-formed rhyme [uks].

An additional argument for the position of postconsonantal glides as nuclear rather than onset segments comes from the process of diphthongization under stress (Harris 1985). Large numbers of lexically unpredictable mid vowels break into the diphthongs [we] and [je] when they are stressed, producing alternations. For instance, the verb stem /ne!g-/ 'deny' (with ! marking the diphthongizable vowel) appears as [neˈɣar] in the regularly finally stressed infinitive but as [ˈnjeɣo] in the 1 sg. present tense, which is regularly stressed on the penult. Similarly, /tro!n-/ 'thunder' shows imperfect [tronˈaβa] 'it was thundering' but present [ˈtrwena] 'it is thundering.' Syllabification precedes stress (because stress needs to know the location and weight of syllables), so the breaking vowel is in the nucleus when it receives stress and diphthongizes. It wouldn't make much sense for the newly produced glide to move from the nucleus, where it is born, to fill an already filled or already stuffed onset [n] or [tr]. Of course, if a vowel-initial stem undergoes diphthongization, the new glide is recruited as an onset, as in /e!r-/ 'wound,' with surface forms [eˈrir] 'to wound' and [ˈʝere] 'he wounds.'

In Kaisse (2016) I advance a new argument for the differential parsing of high vocoids that are the least sonorous segment compared to their adjacent neighbors (/i/ in /io/) versus those that are of intermediate sonority compared to their adjacent neighbors (/i/ in /pie/). Hualde (1989) shows that the prevocalic glides of Pasiego, a distant dialect or 'co-dialect' of Spanish spoken in northwestern Spain, trigger height harmony just as high syllabic [i] and [u] do, and that this makes sense only if the glides are in the nucleus, not in the onset. (Coda glides, not being in nucleus, do not trigger harmony.) Kaisse (2016) shows that underlying high vocoids do this only if they are in structures like (6) and (7). The prediction of (7) versus (8–9) is that absolute syllable-initial vocoids are parsed in the onset and should therefore not be expected to trigger vowel harmony, which works from nucleus to nucleus. And indeed they do not. The definite article /el/ shows a raised variant [il] in [il ˈmjɛw] 'the fear,' caused by the high glide [j] of [mjɛw]. But the same definite article has an unraised [e] in [el ˈʝelsu] 'the plaster' because the underlying vocoid /i/ that starts /ielsu/ has filled the onset and is therefore not an eligible trigger of vowel harmony.

Harris and Kaisse (1999) give a few more arguments for the differential syllabic positions of syllable-initial and postconsonantal glides, but the arguments summarized here should be sufficient to make the point.

The syllabification algorithm results in an interesting alternation in roots that end in a vowel plus a high vocoid, such as /uruguai/, /konboi/ and /lei/. I give examples from Argentinian because the phonetic distance between the allophones is so striking in that dialect. Most other dialects show [ɟ] where Argentinian has [ʃ] or, for older Argentinian speakers, [ʒ].

(11)	a.	u.ru.ˈɣwaj	'Uruguay'	u.ru.ˈɣwa.ʃ-o	'Uruguayan'
	b.	koɱ.ˈboj	'convoy'	koɱ.bo.ˈʃ-ar	'to convoy'
	c.	ˈlej	'law'	ˈle.ʃ-es	'laws'

There are also alternations in suffixes such as the imperfect /-i+V/ and gerund /-iendo/ when they follow a verb root ending in a consonant (/kres/ 'grow') versus a vowel (/kre/ 'believe'). I again show the Argentinian forms.

(12)	a.	kre.ˈs-je.ron	'they were growing'	kre-.ˈʃe.ron	'they were believing'
	b.	kre.ˈs-jendo	'growing'	kre-.ˈʃendo	'believing'

The sizable phonetic distance between the Argentinian [ʃ] (or [ʒ]) and [j] has led some modern phonologists such as Hualde (1997) to amass arguments that they do not belong to the same underlying phoneme and that Spanish has phonemic glides (see section 1). The question of how many phonemes are needed for the Spanish palatal consonants, glides and vowels was hotly debated in the 1950s by American structuralists and others, and is a central question that I believe is resolved in Harris and Kaisse (1999). It is tempting to posit two phonemes because of contrasts in Argentinian like [ˈʃerba] 'maté tea leaves' and [ˈɟerba] 'herb.' However, Harris and Kaisse show that the distinction does not require an additional consonantal phoneme. Rather, the exceedingly rare words with [ɟ] in the onset have the same underlyingly marked nuclear /i/ vocoid that we will encounter in section 8.

Now that we have a basic understanding of how Spanish glides are syllabified, we can get some insight into how Spanish and English differ in their placement of these segments, resulting in pitfalls for second language learners. English has a wide array of true offgliding diphthongs, such as [aj], [aw], [ej], [ow] and [oj], as in *mine*, *mound*, *main*, *moan* and *boy*. Spanish, on the other hand, does not have complex nuclei of the form VG. Rather, the G is simply filling the coda position, as argued by a glides' incompatibility with another coda consonant and their failure to trigger vowel harmony in northwestern co-dialects like Pasiego. In English many tests suggest that V+G are joined in a complex nucleus. For instance, vowels and diphthongs alternate as if they were both residents of a single nucleus with differing surface realizations (*divine*, *divinity*; *sane*, *sanity*). And native speakers of English tend to perceive diphthongs as indivisible units. In phonetics courses they must be explicitly guided toward recognizing what the nucleus of a diphthong is rather than transcribing it with a single letter. English-speaking choruses must be trained not to move immediately to the offglide when singing diphthongs on long notes. And the timing and syllabification of a postvocalic glide do not change under affixation of a vowel. The English words *coyer* ('more coy') and *Uruguayan* are syllabified [ˈkoj.ɚ] (not *[ˈko.jɚ]) and [jʊ.ɹə.ˈgwaj.ən] (not *[jʊ.ɹə.ˈgwa.jən]). Compare this to the productive alternations in Spanish, exemplified in (11), where coda glides alternate with strengthened onset consonants. These differences can give subtle cues to the native language of a speaker. Additionally, many nonnative speakers of Spanish are recognizable by their failure to strengthen onset vocoids, while, in turn, native speakers of Spanish find it difficult to suppress that strengthening, pronouncing initial and intervocalic [j] and [w] targets in a second language as [ɟ] and [ɣʷ].

6. Syllabification of vocoids in Optimality Theory

While the foundational work on Spanish syllabification was done in a derivational framework, it is easily translated into Optimality Theory, as shown most extensively in Colina (2009). I summarize the outline of a constraint set adapted from Colina (2009: 20–26) that gets high vocoids in the right syllabic position and ensures that in strengthening dialects, a high vocoid in the onset is realized as a consonant.

To begin with, we need the familiar constraint ONSET, which penalizes any syllable without an onset and, when ranked highly, will force high vocoids into onsets, where they may then strengthen.

Next, we have two exploded constraint families, (13) and (14), which penalize less sonorant segments in nuclei and favor less sonorant segments in onsets.

(13) *NUC/OBSTRUENT >> *NUC/NASAL >> *NUC/LIQUID >> *NUC/GLIDE >> *NUC/VOWEL

This constraint family ensures that the most sonorant available segment is chosen as a nucleus. In Spanish *NUC/obstruent, *NUC/nasal and *NUC/liquid are undominated, since Spanish has no syllabic consonants.

(14) *ONSET/VOWEL >> *ONSET/GLIDE >> *ONSET/LIQUID >> *ONSET/NASAL >> *ONSET/OBSTRUENT

The ranked constraint family in (14) will penalize vocoids in the onset and, when ranked with faithfulness constraints that militate against changing the underlying [−cons] feature of a segment, will allow for the surface allophones of the high vocoids. In nonstrengthening dialects such as Sonoran (Canfield 1981), IDENT/CONS is ranked between *ONSET/VOWEL and *ONSET/GLIDE so that glides do not harden in the onset. In most other dialects, IDENT/CONS is ranked between *ONSET/GLIDE and *ONSET/LIQUID so that it is worse to have a glide in the onset than to strengthen it to [ɟ] or [ʃ], realizing the feature [cons] unfaithfully.

7. Possible strings of vocoids and the syllabification of adjacent high vocoids

Spanish allows almost any combination of adjacent vocoids, which then form ongliding (GV) diphthongs or what look like offgliding ones (VG). (If we define a diphthong narrowly to mean two vocoids syllabified within the nucleus, Spanish does not have offgliding diphthongs; as noted earlier, the G in VG is generally agreed to be in the coda.)

(15)

	nucleus e	gloss	nucleus a	gloss	nucleus o	gloss	nucleus i	gloss	nucleus u	gloss
a. onglide w	pwes	‘so’	xwan	(name)	ˈkwo.(ta)	‘quota’	fwi	‘I was’	*fwu	—
b. onglide j	ˈsjem.(pre)	‘always’	(me).djan.(te)	‘through’	(i).ˈdjo.(ma)	‘language’	*fji	—	ˈbju.(da)	‘widow’
c. coda w	ew.ˈ(ro.pa)	‘Europe’	ˈkaw.(sa)	‘cause’	bow	‘trawler’	*fiw	—	*fuw	—
d. coda j	ˈpej.(ne)	‘comb’	aj	‘there is’	boj	‘I go’	*mij	—	muj	‘very’

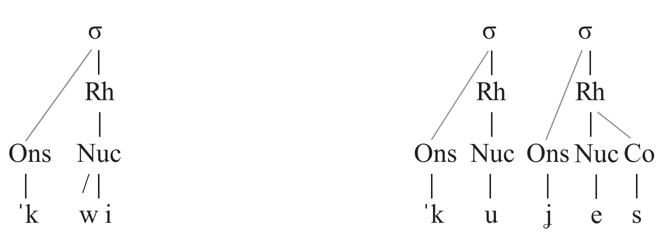
Notice that the last two columns contain gaps: [j] is not found before or after [i], and [w] is not found before or after [u]. This prohibition, discovered by Harris (1983: 17), can be stated as follows:

(16) Homorganic vocoids cannot co-occur in the rhyme of a syllable.

In section 5 we saw the basic processes that result in the glide realization of high vocoids when they are adjacent to a more sonorous vowel, /e/, a/ or /o/. In those cases the high vocoid defers to the nonhigh one and shows up as [j] or [w], whether it precedes ([bonjato]) or follows ([aj]) the more sonorous vowel. But what happens if we have two high vocoids in a row, as in /biuda/ 'widow' or /kuida/ 'care'? Harris (2000), based on data collected over several decades of research on Spanish high vocoids, shows that it is typically the rightmost vocoid that ends up as the syllable peak and the leftmost one that becomes a glide: [ˈbjuða], [ˈkwiða]. He accomplishes this in a derivational framework by having the syllabification algorithm work from right to left. (In Optimality Theory this directionality could be captured using Alignment constraints.) Consider /biuda/. Working from right to left, we identify the final /a/ as a nucleus and then attach /d/ as its onset. We now have the remaining string /biu/. Working from the right, we see that /u/ is at a syllabic plateau with the preceding /i/; they are both of the same sonority value, so we cannot choose between them by making the higher-sonority vocoid the head of the syllable. So we use the right-to-left procedure to project a nucleus from the rightmost candidate, /u/. The /i/ attaches in the normal way as an onglide in the nucleus, and the /b/ fills the onset slot. /kuida/ works exactly the same way—in this case resulting in syllabic [i] and onglide [w]. A more surprising case is the surname Ulloa, pronounced [uˈɟo.a], with an underlying representation (in yeista dialects) consisting of four successive vocoids: /uioa/. Why is this not pronounced [wi.ˈo.a]? Because we work from the right forming syllables. The final /a/ receives no onset because only high vocoids, not /o/, can be recruited as onsets or as onglides. The /o/ then projects its own syllable and grabs the preceding /i/ for its onset. This leaves the leftmost /u/ unsyllabified, and it becomes an onsetless syllable itself.

Harris (2000) was offered a rather spectacular alternation by a speaker of an Andean dialect in which the local guinea pig is called [kwi]. This pronunciation is unsurprising and stems from underlying /kui/ with, as usual, the rightmost high vocoid forming the syllable peak. When this root is suffixed with the vowel-initial plural morpheme /-es/, however, the outcome is [ˈku.ɟes]. The /u/ of /kui/ is syllabic in the plural but an onglide in the singular. The /i/ of /kui/ is a strengthened onset in the plural but a nucleus in the singular. Again, the pronunciation, while striking in its wholesale alternation, follows precisely from Harris's algorithm. In the plural, tracking from the end of the word leftward, we identify the /e/ of the affix as the first nucleus to be formed. The preceding /i/, being the only candidate for an onset to this syllable, is so attached. This leaves the preceding /u/ to form the next nucleus, with the /k/ as onset. In the singular /i/, the rightmost vocoid, must be the nucleus:

(17)



The few cases that do not appear to work properly under this right-to-left parse or in which speakers differ in their judgments will be explained by the presence of exceptional nuclear marking described in the next section. [muj] 'very' from /mui/ might have been expected to be pronounced *[mwi]. But we are about to see that a small set of words—exactly which ones differs from dialect to dialect and even speaker to speaker—have high vocoids that insist on being syllabic. [muj] results from a lexical entry with an obligatorily nuclear /u/.

8. The exceptional, nongliding high vowels

Speakers of many varieties of Spanish make a distinction between the normal, common high vocoids that surface as glides when they are next to another vocoid and the exceptional high vocoids that refuse to glide except in unguarded connected speech. These marked vocoids result in otherwise unexpected hiatus, where two vowels are pronounced next to each other. The distinction is noted as early as the 1918 edition of Navarro Tomás, and documented in many phonetic studies, such as Quilis (1993). Hualde (1999, 2005) makes the point that precisely which words have exceptional peaks is subject to both dialectal and idiolectal variation. In (18) the normal vocoids are labeled 'nonpeak,' and the exceptional ones 'peak.' Examples are from Harris and Kaisse (1999: 123).

		nonpeak		peak	
(18)	a.	bi.ˈsja.βa	's/he was vitiating'	ba.si.ˈa.βa	's/he was emptying'
	b	ˈbi.sja	's/he vitiates'	ba.ˈsi.a	's/he empties'
	c.	bo.ˈnja.to	'sweet potato'	di.ˈa.βlo	'devil'
	d.	ˈboj.na	'beret'	mo.ˈi.na	'annoyed'
	e.	ˈswa.βe	'smooth'	suˈa.βe	'Zouve' (French light infantry)
	f.	ˈkwi.ða	's/he cares'	u.ˈi.ða	'flight'

As can be seen in (18a) versus (18b), the distinction occurs either when the exceptional peak vocoid is unstressed or stressed. However, some dialects, such as standard Castilian and Argentinian, do not maintain the distinction postvocalically when the exceptional high vocoid is not stressed. They therefore have [pa.ˈis] 'country' with stressed, exceptional postsyllabic [i], but when a two-syllable affix is added, moving stress off the root, only [paj.ˈsa.no] is possible, not *[pa.i.ˈsa.no] (Harris and Kaisse (1999: 140) refer to this process as (obligatory) Post-V denuclearization).

There are many possible ways to represent the distinction between exceptional and normal high vocoids. In earlier work, such as Hualde (1991), the glide-able vocoids were identified as underlying glides, while the exceptional ones were identified as underlying high vowels. This distinction becomes hard to maintain in light of later work like Levi's on the rarity and requisite consonant-like behavior of underlying glides. Harris and Kaisse (1999) choose a less problematic method: they place a nuclear node above the nongliding high vowels in their lexical representation, adopting a version of the general method recommended in Blevins (1995) and still used in contemporary work such as Roca (2016).

(19) N
|
/u ida/ /kuida/

As a shorthand for the cumbersome three-line representation of (19), Harris and Kaisse recommend using a syllabification dot in the underlying form: /u.ida/ versus unmarked /kuida/. Either version of the representation ensures that when the syllabification algorithm comes to place these exceptional high vocoids in a syllable, they will already project N and a syllable σ, and will only show up as glides under the casual-speech, postlexical process that removes lexically constructed syllables, discussed in section 9. It is important to note that while words with exceptional peak vocoids have fast-speech variants where the exceptional syllabicity is lost, the nonexceptional words in the first column of (18) do not have possible pronunciations where the high vocoid is syllabic. It is not possible to pronounce [ˈkwida] or [biˈsjaba] as *[ku.ˈi.da] or *[bi.si.ˈa.ba].

Harris (1969: 122–124) and Hualde (1991: 478–479) also suggest that an underlying glide would solve the apparent stress assignment problem in a word like [ˈsaw.rjo] 'reptile'. This form is underlying /saurio/ in our current analysis, but Harris feared assigning stress to the /a/ violated the three-syllable window for Spanish stress, since it stressed the fourth vowel from the end. He therefore suggested that the underlying form had a /w/. However, more recent treatments, such as Harris and Kaisse (1999), argue that stress assignment is dependent on syllabification, and the syllabification of high vocoids looks at the sonority of the segments on both sides. Since /a/ is more sonorous than /u/, /saurio/ will be syllabified as [saw.rjo], and normal penultimate stress assignment results in the correct surface form.

Hualde (1999) provides detailed information about the distribution of exceptional, nongliding high vocoids in his dialect of Peninsular Spanish. Certain contexts favor hiatus. For instance, a morpheme boundary between vocoids often leads to their being syllabified into different syllables; the prefix /bi-/ and the suffixes /-oso/, /-al/ and /-ario/ are frequently involved in hiatus, as in [bi.ˈen.jo] 'biannual' and [bir.tu.ˈo.so] 'virtuous.' When one subtracts out the forms that have a morphological explanation, Hualde finds his dialect contains only about 50 nonverbs with exceptional hiatus. Within these forms, one can note certain tendencies, such as the likelihood of exceptional hiatus in initial syllables rather than noninitial ones, and the impossibility of hiatus when a velar precedes /u+V/, so that a form like *[e.ba. ku.ˈar] seems ill-formed to Hualde. This kind of intuition leads Hualde to the conclusion, now familiar to phonologists, that native speakers have knowledge about minor, statistical patterns in the lexicon.

9. Phrase-level (postlexical) loss of syllabicity of high vocoids

It is important to distinguish glides produced within words by lexical processes, like syllabification and diphthongization, from glides produced by postlexical processes that apply optionally within and between words, typically at faster rates and in more casual styles. These glides do not necessarily consonantalize when they move into the onset, and they do not contribute to the length or weight of a syllable.

Following most work in Spanish phonology of the past several decades, starting with Harris (1983), we'll adopt here a Lexical Phonology or 'stratal' approach to the interaction between phonology and morphology and syntax. There is a lexical (word-level) stratum and a postlexical (phrase-level) stratum. The initial pass of syllabification and stress occurs at the lexical level. As we have seen, this sometimes results in the assignment of high vocoids as the peak of a nucleus if they are a sonority peak (as in [ˈpiso]) or if they are exceptionally assigned a nuclear mark in the lexicon ([ba.si.ˈaβa, di.ˈa.βlo]). However, once words are put into phrases, additional processes can optionally remove the nuclear status of the high vocoid and allow it to be realized it as a glide. The processes desyllabifying vowels differ from speaker to speaker, and dialect to dialect, and vary by speech rate and style. Martínez-Gil (2016) shows examples from Chicano Spanish like (20a), where the third form shows a high vowel optionally realized as a glide if it is first in a sequence of vowels; (20b, c) are from Hualde (2005: 90), who is describing Peninsular dialects, where the high vocoid can also glide when it follows a vowel in the preceding word. Generally speaking, sequences of unstressed vowels have been found to be the most likely to undergo some sort of syllabic merger, including gliding.

(20)	a.	/kasi olbide/	ˈka.si.ol.βi.ˈðe	ˈka.sjol.βi.ˈðe	'I almost forgot'
	b.	/la union/	la.u.ˈnjon	law.ˈnjon	'the union'
	c.	/esta istoria/	ˈes.ta.is.ˈto.rja	ˈes.tajs.ˈto.rja	'this story'

The glides produced from postlexical gliding do not interact with the phonology in the way lexically derived glides do—for instance, they do not affect the weight of a syllable. Stress assignment is a lexical process, and it is therefore not to be expected that it would be sensitive to the postlexically derived glides. Moreover, glides that end up in syllable-initial position do not obligatorily strengthen: when [ˈaj] 'there is' is combined into a phrase with [ˈuna] 'one,' a possible outcome is [ˌa.ˈju.na] 'there is one,' though some speakers may optionally have [ˌa.ˈʝu.na]. The important distinction is that even in dialects where strengthening is obligatory in the lexicon, it is, at most, optional postlexically.

As we mentioned earlier, in connected, casual speech, unstressed /e/ and /o/ can also lose their syllabicity when next to another vowel, becoming [j] and [w] as well. (In Peninsular Spanish the high realization of the glide is stigmatized, and mid glides are preferred.) In some dialects, such as Chicano, even stressed mid vowels will become high glides (Martínez-Gil 2016). The process is postlexical—that is, it occurs between words as well as within them and has other typical postlexical characteristics such as gradience, optionality and stylistic dependence. In (21) we see the process occurring both word-internally and between words, with the mid vowel standing either before (as it must in Chicano) or after the triggering vowel. Examples (21a,b) are from Colantoni and Hualde (2016) on Mexican and Argentinian varieties, (21c) is from Martínez-Gil (2016), and (21d) is from Hualde (2005) on Peninsular Spanish.

(21)	a.	/teatro/	'theater'	[te.ˈa.tro]	[ˈtja.tro]
	b.	/kaera/	'will fall'	[ka.e.ˈra]	[kaj.ˈra]
	c.	/tengo amigos/	'I have friends'	[ˈteŋ.go.a.ˈmi.ɣos]	[ˈteŋ.gwa.ˈmi.ɣos]
	d.	/una ormiga/	'an ant'	[ˈu.na.or.ˈmi.ɣa]	[ˈu.nao̯r.ˈmi.ɣa]

Notice that in (21d) the desyllabification process has created a syllable [nao̯r] with a glide and a consonant other than [s] after the vowel, a syllable that lexical processes would not form but that is permitted postlexically. Navarro Tomás (1965) may be the first to remark on this expansion of syllable types. Spanish is not unusual here; it is often the case that postlexical resyllabification processes are more tolerant of expanded syllable types, and indeed all kinds of strings and segments that are not permitted in the lexical phonology.

Several authors (Roca 1986; Simonet 2005; Chitoran and Hualde 2007) have investigated the factors favoring desyllabification of those vocoids that are typically pronounced with hiatus in isolation or in careful speech. One factor that these authors have discovered is that the closer an unstressed hiatal vowel lies to the main phrasal stress of an utterance, the more likely it is to remain syllabic and the less likely it is to be realized as a glide. Thus, the word /pi.ano/, with a marked nuclear /i./, is frequently realized as [pi.ˈa.no] in the phrase *me compré un* ***piano*** 'I bought myself a piano' since the /i./ is right next to the phrasal stress (bolded), which falls on the stressed syllable of the last word of the utterance, in this case, the [a] of [pi.ˈa.no]. We are more likely to find the desyllabified variant [ˈpja.no] when the [i] is far from the end of the sentence and thus far from the phrasal stress, as in *me compré un piano de cola* ***carísimo*** 'I bought myself a very expensive grand piano.' Another factor, identified by Aguilar (1999), is the sociolinguistic context. Speakers conversing normally in a map task produced shorter, less syllabic vocoids than they did in a reading task.

10. Summary: sources of glides and their consonantalized allophones in Spanish

We have seen that Spanish has various sources of surface glides and their consonantalized palatal and velar allophones.

1) The predictable syllabification of an underlying high vocoid that is not a sonority peak but instead is next to another vocoid
2) Diphthongization of mid vowels under stress
3) Obligatory desyllabification of an exceptionally marked nuclear high vowel when it is unstressed and follows another vowel
4) Casual speech reduction (postlexical) of a high vowel between words
5) Casual speech reduction (postlexical) of a mid vowel either within or between words
6) Casual speech reduction of an exceptionally marked nuclear high vocoid that precedes another vowel

In all these cases, the nonpeak vocoid will fill the onset and (in most dialects) be consonantalized if it is a local sonority minimum—that is, if it is word-initial or lies between nonhigh vowels. However, as discussed in section 9, glides moved into onsets between words do not obligatorily strengthen, suggesting that consonantalization is a word-level, not a phrase-level process.

The largely allophonic distribution of high vowels, glides and corresponding consonants of Spanish can be confusing at first glance. But phonologists have made excellent progress in understanding how these sounds are distributed and how they alternate. The particular, rather intricate facts of Spanish have been useful to general phonologists in understanding the range of behaviors of high vocoids in human language, while our understanding of the phonology of many languages has, in turn, been useful in figuring out how Spanish vocoids work. This interplay between detailed knowledge of one language and broad knowledge of a number of languages is echoed in many other area of linguistic science and is one reason why language specialists benefit from studying general linguistics, while general linguists benefit from knowing a lot about one language.

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7
Syllable merger

José Ignacio Hualde

1. Introduction: lexical diphthongs and hiatuses

Syllabification in Spanish is relatively straightforward (Colina, this volume). Nevertheless, sequences involving high vocoids present certain complications for the analysis in some dialects (e.g. *en-vi-a-mos* 'we send' vs. *cam-bia-mos* 'we change'; see Kaisse, this volume), and there are some other contrasts in syllabification only partially derivable from considerations of morphological structure (e.g. *su-bli-me* vs. *sub-lin-gual*, *a-bier-to* 'open' vs. *ab-yec-to* 'abject'). In this chapter we will be concerned with only one such complication in Spanish syllabification: the phenomenon of postlexical syllable merger, which may result in a smaller syllable count in words and phrases than that expected from lexical syllabification rules. To give an example, a seven-syllable sentence such as *no iba a esquiar* /ˈno.ˈi.ba.a.es.ki.ˈar/ 'I was not going to ski' may be realized in three syllables by postlexical syllable merger [ˈnoi̯.βae̯s. ˈki̯ar].

For the transcription of consonants, I use a *yeísta* pronunciation with a distinction between /s/ and /θ/, which corresponds to the most common pronunciation in Peninsular Spanish nowadays. I chose this geographical variety for the transcriptions because it is the one that I am most familiar with.

Before considering syllable merger, we need to briefly review the syllabification of vowel sequences at the lexical level. In lexical or word-level syllabification, a sequence of two vowels in Spanish may constitute one of two syllabic configurations. The two vowels may create a hiatus, where each of the two vowels is the nucleus of a separate syllable, or they may form a diphthong with a single nucleus and a satellite. Diphthongs, in turn, can be either rising, if they rise in aperture, from a glide to a vowel (or from satellite to nucleus), or falling, if the glide is in second position (see, e.g., Hualde 2005: 77–86, for full exemplification). Hiatus and diphthong configurations are schematized in (1), where N stands for the syllable nucleus:

(1) Hiatus and diphthong

```
a.  Hiatus       N N
                 | |
                 V V              = V.V
b.  Diphthong    Rising diphthong       Falling diphthong
                 N                       N
                 | \                    /|
                 VV               = V̯V   VV              = VV̯
```

In lexical syllabification, most sequences containing an unstressed high vowel followed by a different vowel form rising diphthongs (e.g. *serio* [ˈse.ɾi̯o] 'serious, masc. sg.', *puesto* [ˈpu̯es.to] 'position', *italiano* [i.ta.ˈli̯a.no] 'Italian, masc. sg.'), and their mirror images form falling diphthongs (e.g. *boina* [ˈboi̯.na] 'beret', *pseudo* [ˈseu̯.ðo], *baile* [ˈbai̯.le] 'dance'). If both vowels are high but they are different (i.e. /iu/, /ui/), they are generally syllabified as a diphthong as well. In these sequences of two high vowels, the nucleus is normally in second position (e.g. *cuida* [ˈku̯i.ða] 's/he takes care', *viuda* [ˈbi̯u.ða] 'widow'); that is, these are rising diphthongs. An argument for this analysis is given by rhyming: *cuida* 's/he takes care' rhymes with *vida* 'life', and *viuda* 'widow' rhymes with *suda* 's/he sweats' (they are both different from *huida* [u.ˈi.ða] 'fleeing', which has a lexical hiatus; see section 5.3). A second argument is that, under emphasis, the second vowel is the one that is lengthened, the word *muy* 'very' being an exception. For the realization of syllable-initial glides, see Kaisse (this volume).

All other sequences not mentioned thus far are syllabified as hiatus. Hiatus sequences thus include

(a) all sequences where neither vowel is high (e.g. *tarea* [ta.ˈɾe.a] 'task', *faena* [fa.ˈe.na] 'work', *poetastro* [po.e.ˈtas.tɾo] 'bad poet', *beodo* [be.ˈo.ðo] 'drunk', *creemos* [kɾe.ˈe.mos] 'we believe', *loor* [lo.ˈor] 'praise', *azahar* [a.θa.ˈar] 'orange blossom');
(b) sequences where at least one of the two vowels is high and is stressed (e.g. *espía* [es.ˈpi.a] 'spy', *púa* [ˈpu.a] 'thorn', *país* [pa.ˈis] 'country', *laúd* [la.ˈuð] 'lute');
(c) sequences where both vowels are high and identical (e.g. *chiíta* [ʧi.ˈi.ta] 'Shiite', *duunviro* [du.um.ˈbi.ɾo] 'duumvir'); and
(d) analogically motivated as well as a few unmotivated exceptions to the diphthongization rule, with dialectal and idiolectal variation in this set of exceptions (e.g. *huida* [u.ˈi.ða] 'fleeing', *enviamos* [em.bi.ˈa.mos] 'we send', *liana* [li.ˈa.na] 'liana').

Sequences where a nonhigh vowel is flanked by two unstressed high vowels are usually syllabified in a single syllable, forming a triphthong (e.g. *buey* [ˈbu̯ei̯] 'ox', *cambiáis* [kam.ˈbi̯ai̯s] 'you-pl. change'), again with some variable lexical exceptions (e.g. *ampliáis* [am.pli.ˈai̯s] 'you-pl. widen').

The phenomenon with which we are concerned in this chapter, syllable merger, refers to the optional postlexical resyllabification in a single syllable of lexical hiatus sequences. That is, we have syllable merger when a sequence that constitutes two separate syllables or more by lexical syllabification is contracted into a single syllable. Syllable merger is also known as *hiatus resolution*. Merger may affect both the lexical hiatus sequences just reviewed and sequences of vowels arising across word boundaries in syntactic concatenation.

The remainder of this chapter is organized as follows: in section 2, I consider the types of evidence that may be used to determine the location of syllable boundaries in speech. In Spanish, syllable count in poetry and folk ballads and songs provides important evidence for syllable merger. This evidence is reviewed in section 3. Spanish speakers generally agree on what sequences of vowels may and may not merge in a single postlexical syllable-size unit, both in poetry and in everyday language. These sequences are reviewed in section 4. Not all sequences that may undergo merger do so with the same readiness, and in section, 5 I examine the factors that have been claimed to affect the likelihood of merger. In section 6, the phonetic results of syllable merger are considered (i.e. how vowel sequences that have been reduced to a single syllable are actually pronounced). Finally, section 7 offers a summary of the chapter.

2. Evidence for syllabification

The syllable may be understood as a domain of gestural coordination or motor planning. For instance, in V.CCV both consonants are strictly coordinated with each other and with the following vowel, whereas in VC.CV the timing of the two consonants is looser and only the second consonant is strictly coordinated with the second vowel (Browman and Goldstein 1988; Gafos 2002; Gafos et al. 2014; Goldstein et al. 2007). Acoustically, contrasts between tautosyllabic and heterosyllabic sequences may be reflected in the relative duration of different segments (Waals 1999 for Dutch; Prieto 2002 for Spanish; see also Fougeron 2007 for resyllabification across word boundaries in French).

Regarding sequences of vocoids, in a diphthong, the two vocalic gestures are more strictly coordinated than in a sequence in hiatus, with greater overlap, resulting in shorter duration of the high vocoid and of the entire sequence in diphthongs (Aguilar 1999). We may also use speakers' intuitions as evidence for the placement of syllable boundaries. Spanish speakers generally have clear intuitions about which words contain a diphthong and which contain a hiatus, although speakers vary in the strength of these intuitions in some cases (Hualde and Prieto 2002; Simonet 2005; Icardo Isasa and Hualde 2019).

Lexical syllabification, however, may be altered by postlexical syllable merger, both within words and across word boundaries. Clear evidence that syllable merger has not applied and two vowels in a sequence do not belong to the same syllable is obtained when a glottal stop or another consonantal segment or glide is inserted between the two vowels (Davidson and Erker 2014). These phenomena are not common in Spanish. On the other hand, the deletion of one of the vowels or the durational shortening of the sequence can be interpreted as evidence for articulatory fusion of the vowels into a single syllable (Aguilar 1999; Hualde et al. 2008).

As already mentioned, in Spanish, syllable count in folk ballads provides useful intuition-based evidence for syllable merger. We consider this evidence from scansion in the next section.

3. Syllable merger across word boundaries and within words in poetry: synaloepha and synaeresis

Optional syllable merger is an important device in the traditional poetic tradition of the Spanish language, including both learned poetry and folk ballads, allowing the poet to fit the same segmental string to more than one metrical pattern. This reflects options in the spoken language. That is, metrical conventions allowing for syllable merger reflect phenomena in spoken Spanish, where vowel sequences that would be heterosyllabic in careful pronunciation are often contracted into a single syllable. Arguably, the *romances* or folk ballads are a particularly interesting source of native speaker intuitions, since they have been transmitted through the oral tradition of the language over generations. The ultimate historical origin of most of the ballads mentioned in this section is unknown. Many were collected by Menéndez Pidal (1953) and other researchers from the oral tradition in the first decades of the 20th century.

One of the versions of the folk ballad known as *Romance del Conde Olinos*, for instance, starts with the following lines, and would be syllabified as indicated on the right (with phonemic spelling):

(2) *Romance del Conde Olinos*: syllable count

1	*Caminaba el Conde Olinos*	ka | mi | ˈna | bael | ˈkon | deo | ˈli | nos	= 8
2	*la mañana de San Juan*	la | ma | ˈɲa | na | de | san | ˈxuan	= 7 + 1
3	*a dar agua a su caballo*	a | da | ˈɾa | guaa | su | ka | ˈba | ʝo	= 8
4	*a las orillas del mar.*	a | la | ˈso | ɾi | ʝas | del | ˈmar	= 7 + 1
5	*Mientras el caballo bebe,*	mien | tra | ˈsel | ka | ˈba | ʝo | ˈbe | be	= 8
6	*canta un hermoso cantar.*	ˈkan | tau | ner | ˈmo | so | kan | ˈtar	= 7 + 1
7	*Las aves que iban volando*	la | ˈsa | bes | ˈkei | ban | bo | ˈlan | do	= 8
8	*se paraban a escuchar.*	se | pa | ˈɾa | ba | naes | ku | ˈʧar	= 7 + 1

'Count Olinos was walking, / in the morning of St John's Day, / to give water to his horse / by the seashore. / While the horse is drinking, / he is singing a beautiful song. / The birds that were flying by / stopped to listen.'

This ballad, like most Spanish folk ballads, was written (or was orally composed) in *octosílabos* (lines of seven syllables up to the last lexical stress), with vowel sequences that arise across word boundaries being merged into a single syllable in every instance in this fragment (lines 1, 3, 6, 7 and 8).

If the last word has penultimate stress, the line will have exactly eight syllables. If, on the other hand, the last word in the line has final stress, a silent beat is added to the count by convention: seven syllables + one silent beat. If the last word has antepenultimate stress, there must also be seven syllables up to the last stress, and the *octosílabo* measure is obtained by subtracting one from the total number of syllables (see, e.g., Quilis 1984: 27–33).

Some evidence for the phonological reality of syllable merger thus emerges from the shared intuitions of native speakers regarding what sequences of segments may or may not be considered to constitute a single syllable for the purpose of determining syllable count.

Traditionally, syllable merger across word boundaries is known as *synaloepha* (or *synalepha*) and is distinguished from *synaeresis* (or *syneresis*), which is the contraction of a vowel sequence within a word. An example of synaeresis would be the syllabification of the word *poeta* 'poet' in two syllables, [po.ˈe.ta] ◊ [ˈpo̯e.ta] or [ˈpu̯e.ta].

A less common phenomenon is the syllabification of a lexical diphthong as a hiatus in order to satisfy syllable-count constraints.

In the traditional metrical analysis of Spanish poetry, the phenomena of synaloepha and synaeresis receive the label *violenta* 'violent' when they require elimination or displacement of lexical stress. For instance, the following line from the *Romance del Conde Arnaldo* requires a violent synaeresis to produce the required syllable count:

(3) Example of violent synaeresis

*las velas tra**ía** de seda* las | ˈbe | las | tra | ia | de | ˈse | da = 8
'the sails, it had of silk'

As shown, the three-syllable word *traía* [tr.a.ˈi.a] 'it brought' must count as bisyllabic in this case, that is, [tra.i̯a], for the line to have eight syllables. This is obtained by the expedient of turning the lexically stressed high vowel into a glide and displacing or eliminating the lexical stress. We will return to this topic in section 6. At this point, we may note that stressed vowels receiving the last stress in the line cannot undergo synaeresis and become glides. In a hypothetical example like the one given in (4), synaeresis appears to be excluded:

(4) Example of impossible synaeresis

*de seda las velas tra**ía*** *de | ˈse | da | las | ˈbe | las | ˈtra | ia ~ tra | ˈia

Syllable merger that does not involve turning a lexically stressed vowel into a glide, on the other hand, can affect the last stress of the phrase or the line, as in the first two examples in (5), from the *Romance de doña Alda*. The third example in (5), from the same ballad, has been added to show the optionality of syllable merger:

(5) Synaeresis affecting the last stressed vowel in the phrase

*En París está doñ**a A**lda* en | pa | ˈɾi | ses | ˈta | do | ˈɲaal | da = 8
'Doña Alda is in Paris'
Doña Alda dormido se ha do | ˈɲaal | da | dor | ˈmi | do | ˈsea = 7 + 1
'Doña Alda has fallen asleep'
*si no era doñ**a A**lda* si | ˈno | ˈe | ra | ˈdo | ɲa | ˈal | da = 8
'except for doña Alda'

In this section I have introduced the notion of syllable merger, including the merger of word-internal vowel sequences that normally would be syllabified as heterosyllabic (or synaeresis) and the merger of sequences arising across word boundaries (or synaloepha).

All lexical hiatus sequences are not equally likely to undergo syllable merger, and the phonetic results of merger may also vary. Some of the issues that must be addressed when we consider syllable merger are the following:

a) Which vowel sequences may merge? How many vowels may merge into a single syllable?
b) What is the phonetic and phonological result of the merger?
c) What contextual and sociolinguistic conditions favor or disfavor syllable merger?

I will consider each of these three issues in the following sections.

4. Vowel sequences that may and may not undergo syllable merger

In principle, any two-vowel sequence arising either within a word or across word boundaries may be merged into a single syllable (Navarro Tomás 1977: 152), including all possible combinations of vowel height and quality, as exemplified in (6), with isolated lines from several ballads.

(6) Two-vowel sequences

	A. Identical vowels	
a–a	*en París esta doñ**a** **A**lda*	en|pa|ˈɾi|ses|ˈta|do|ˈɲaal|da
	‘Doña Alda is in Paris’	
e–e	*que era grande villanía*	ˈkee|ɾa|ˈgran|de|bi|ʝa|ˈni|a
	‘which was a great evil act’	
	B. Two nonhigh vowels	
a–e	*la luna estaba crecida*	la|ˈlu|naes|ˈta|ba|kre|ˈθi|da
	‘the moon was full’	
o–a	*yo te agradezc**o**, **A**benámar*	ˈʝo|tea|gra|ˈdeθ|koa|be|ˈna|mar
	‘I thank you, Abenamar’	
o–e	*el otr**o** **e**s Generalife*	e|ˈlo|ˈtroes|xe|ne|ɾa|lí|fe
	‘the other one is Generalife’	
e–a	*el moro que **a** mí me tiene*	el|ˈmo|ɾo|kea|ˈmi|me|ˈtie|ne
	‘the Moor who has me’	
	C. Nonhigh vowel + high vowel	
e–u	*porque soy hijo de **u**n moro*	por|ke|ˈsoi|ˈi|xo|deun|ˈmo|ɾo
	‘because I am the son of a Moor’	
a–u	*matómel**a** **u**n ballestero*	ma|ˈto|me|ˈlaun|ba|ʝes|ˈte|ɾo
	‘a crossbowman killed mine’	
	D. High vowel + nonhigh vowel	
i–a	*all**í** **ha**blaron sus doncellas*	a|ˈʝia|ˈbla|ɾon|sus|don|ˈθe|ʝas
	‘there her maidens spoke’	
i–e	***y** **e**stán los campos en flor*	ies|ˈtan|los|ˈkan|po|sen|ˈflor
	‘and the fields are blooming’	
o–i	*siendo yo niñ**o** **y** muchacho*	ˈsien|do|ˈʝo|ˈni|ɲoi|mu|ˈʧa|ʧo
	‘when I was a child and youngster’	
	E. High vowel + high vowel	
i–u	***y** **u**na cristiana cautiva*	ˈiu|na|kris|ˈtia|na|kau|ˈti|ba
	‘and a captive Christian woman’	

The syllable-internal vowel sequences created by the application of syllable merger may also include three or more vowels and thus go beyond those possible in lexical syllabification, as in the following example from a well-known Mexican folk song:

(7) Three-vowel sequences

1	*ya se secó el arbolito*	ˈʝa|se|se|ˈkoe|lar|bo|ˈli|to
2	*donde dorm**ía** **e**l pavo real*	don|de|dor|ˈmiael|ˈpa|bo|ˈrial
3	***y** **aho**ra dormirá en el suelo*	ˈiao|ɾa|dor|mi|ˈɾae|nel|ˈsuelo
4	*como cualquier animal*	ko|mo|kual|ˈkie|ɾa|ni|ˈmal

‘The little tree has dried up / where the peacock slept / and now it will sleep on the ground / like any other animal.’

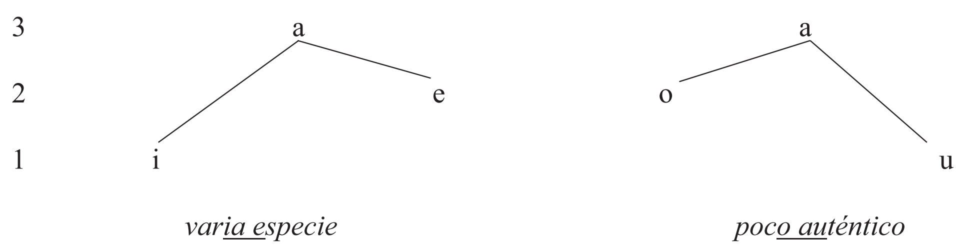
Notice, in particular, the three-vowel sequences /iae/ in line 2 and /iao/ in line 3, both of which are syllabified in a single syllable.

Unlike two-vowel sequences, not all three-vowel (or longer) sequences may be merged into a single syllable. The most important factor for determining which sequences of three or more vowels are reducible to a single syllable is vowel height or aperture; that is, whether each of the vowels is low, mid or high (Navarro Tomás 1977: 150–151). Equivalently to aperture, we may use the notion of sonority, as more open vowels are more sonorous than higher ones (Clements 1990; Hualde 1991, 2005: 93–94; Aguilar 2010: 32; Colina 2012). Sequences of three or more vowels reducible to a single syllable by merger may have one of four configurations:

a) a rise in aperture or sonority (i.e. from higher to lower vowel) as in /iea/ (*nadie hablaba* 'nobody was speaking'), including sonority plateaus, as in /ioe/ (*serio estudio* 'serious study') (rising-rising or rising-level sonority);
b) a fall in sonority, also including plateaus, as in /aeu/ (*para Eugenio* 'for Eugenio'), /aou/ (*nueva o usada* 'new or used'), /eoi/ (*que oigamos* 'that we listen') (falling-falling or level-falling sonority);
c) both a rise and a fall, as in /oau/ (*poco auténtico* 'not very authentic'), /iae/ (*varia especie* 'several types') and, with a "violent" contraction, *dormía el* in (7) (rising-falling sonority); or
d) a sonority plateau, whether or not the vowels are identical in the front/back dimension, as in /eoe/ (*escribe o escucha* 's/he writes or listens'), /ooe/ (*macho o hembra* 'male or female'), /eee/ (*cree en eso* 's/he believes in that') (level sonority).

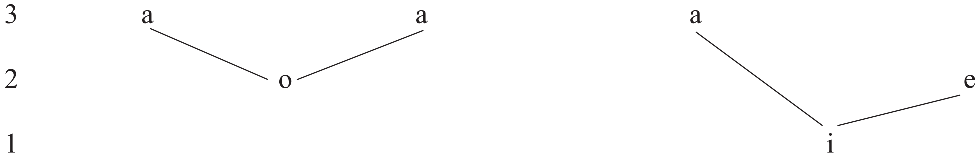
That is, three-vowel sequences reducible to a single syllable by syllable merger are those describable as containing a sonority curve with at most a rise to a sonority peak (from a less open to a more open vowel) and a fall. To illustrate, in the examples in (8), we assign a sonority value of 3 to the low vowels, a value of 2 to the mid vowels and a value of 1 to the high vowels:

(8) Examples of three-vowel sequences reducible to a single syllable



On the other hand, sequences like /eia/ (*une y ata* 'unites and ties'), /aoa/ (*una o ate* 'may unite or tie') and /aie/ (*canta y espera* 'sings and waits') contain two distinct sonority peaks, as sonority falls and rises again, as shown in (9), and consequently are not reducible to a single syllable:

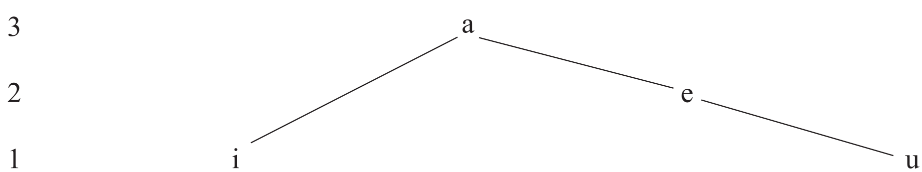
(9) Examples of three-vowel sequences not reducible to a single syllable



Thus, only three-vowel sequences involving a falling-rising sonority contour are unreducible to a single syllable. All other sequences of three vowels can be reduced to a single syllable by merger, subject to certain conditions that we will consider in the following section.

Even longer sequences, of four and five vowels, may be contracted if they respect the principle of containing a single sonority rise, as in /iaeu/ (*hacia Europa* 'toward Europe'), /ioau/ (*medio austero* 'half austere') and /iaaeu/ (*de Asia a Europa* 'from Asia to Europe'):

(10) Example of four-vowel sequence reducible to a single syllable



To sum up this section, if we consider the height of the vowels involved in a sequence, all sequences of two vowels, whether they are found in a single word or across word boundaries, are reducible to a single syllable by syllable merger. In addition, sequences of three, four and even five vowels can also be syllabified in a single syllable, as long as the sequence has an allowable sonority profile for a syllable.

The vowel sequences that can constitute a single syllable as a result of postlexical resyllabification can clearly be far more complex than the allowable tautosyllabic lexical sequences. Regarding the internal phonological structure of such sequences, the highest-sonority element may be taken as the nucleus of the resulting merged syllable, and any preceding and following vocalic elements as satellites. Nevertheless, in actual pronunciation these sequences may be reduced and blended to a considerable extent, so that the discrete phonological segments present in the input to syllable merger are often not identifiable in the output. For instance, in an example such as *nadie hablaba* 'nobody was speaking', a resyllabified sequence /iea/ is unlikely to have three segmentable vocoids in the spectrogram.

Besides sonority considerations, there are additional factors that may prevent or favor syllable merger. These will be considered in the next section.

5. Contexts that favor and disfavor syllable merger

As in other languages (see, e.g., Zsiga 1997 for Igbo; Baltazani 2006 for Greek), hiatus resolution is a variable phenomenon in Spanish. From Navarro Tomás's (1977) description and more recent work, we may identify several factors that affect the readiness with which sequences of vowels with permissible sonority profiles may undergo contraction. The factors mentioned in Navarro Tomás's analysis include speech rate, stress, whether the sequence is word internal or created across word boundaries and whether the two vowels are identical or different:

> En general, en lenguaje rápido, la reducción de los grupos vocálicos a una sola sílaba es más frecuente que en lenguaje lento; si las vocales no son acentuadas, su reducción, en igualdad de circunstancias, se produce más fácilmente que si alguna de ellas lleva acento; si son iguales, se contraen asimismo más fácilmente que si son diferentes, y si proceden del enlace de palabras distintas, mejor que si se hallan dentro de una misma palabra.
>
> [Translation: In general, in fast speech, the reduction of vowel groups to a single syllable is more frequent than in slow speech; if the vowels are not stressed, their reduction, other things being equal, is easier than if one of them bears the stress; if they are identical, they are also more easily contracted than if they are different; and if they arise from the linking of different words, better than if they are found inside the same word.]
>
> *(Navarro Tomás 1977: 148–149)*

Recent work has considered additional factors such as grammatical class, lexical and sequence frequency and consonantal environment, besides exploring dialectal differences. Here we will examine the evidence for the four factors mentioned by Navarro Tomás, as well as other possible factors affecting merger that have been considered by other authors.

5.1. Word boundaries

In the paragraph just quoted, Navarro Tomás states that other things being equal, syllable merger is more likely across word boundaries than within a single word. This claim, which appears to be based both on the author's intuition and on the relative frequency of synaloepha vs. synaeresis in the poetic tradition of the language, remains to be adequately tested, as most experimental research has tended to focus on only one of the two contexts. Thus, whereas studies such as Garrido (2008), Hernández (2009), Souza (2010) and Colantoni and Hualde (2016), among others, are exclusively concerned with word-internal sequences of nonhigh vowels and their resolution, Jenkins (1999), Aguilar (2005) and Hualde et al. (2008) examine only the realization of sequences of vowels across word boundaries.

In (11), I provide examples of the sequences /ee/ and /eo/ across word boundaries and word-internally with all possible combinations of stress patterns. For clarity, I indicate stress on all lexically stressed syllables in orthographic representations. Obviously, the pattern where both vowels receive lexical stress is possible only across word boundaries.

(11) Sequences of identical and nonidentical vowel across word boundaries and within words (U = unstressed vowel, S = stressed vowel)

		Across word boundaries		Word-internally	
a. Identical vowels					
U-U	e e	*puéde echár*	's/he can throw'	*creerán*	'they will believe'
U-S	e é	*cóme éso*	'eat that'	*leémos*	'we read'
S-U	é e	*quemé etápas*	'I burned stages'	*créeme*	'believe me'
S-S	é é	*quemé éso*	'I burned that'		
b. Different vowels					
U-U	e o	*puéde olér*	'it can smell'	*leopárdo*	'leopard'
U-S	e ó	*cóme ótro*	'eat another'	*beódo*	'drunk'
S-U	é o	*quemé hojítas*	'I burned little leaves'	*aséo*	'hygiene'
S-S	é ó	*quemé hóras*	'I burned hours'		

The claim would thus be that in a given dialect and style, controlling for vowel quality and for lexical and nuclear stress, within each pair on the same line in (11), the lefthand column sequence, which arises by syntactic concatenation, is more easily reduced to a single syllable than the identical word-internal sequence in the righthand column. Again, this remains to be empirically tested.

5.2. Lexical and nuclear stress

A second factor affecting syllable merger that Navarro Tomás mentions is stress: in sequences of two vowels, merger is easier or more frequent if both vowels are unstressed than if one or both of them bear lexical stress. If we consider again the examples in (11), the relevant comparison would be within each column, where the first example of each set (*puede echar* 's/he can throw', *puede oler* 's/he can smell') is expected to be more likely to undergo merger than the rest.

The effect of lexical stress on syllable merger has been tested in a number of corpus and experimental studies (e.g. Jenkins 1999; Aguilar 2005; Garrido 2008). In particular, Garrido (2008) finds a stress effect in word-internal sequences: in the varieties of Colombian and Mexican Spanish that she studies, a sequence like /ea/ is most likely to be reduced to a diphthong [i̯a] when it is found after the stress, as in *área* [ˈa.ɾi̯a], and least likely to be reduced when it is word-initial and the second vowel is stressed, as in *beata* [be.ˈa.ta] 'devout, fem. sg.'

Concerning lexical sequences with an unstressed high vowel that may be exceptionally pronounced as a hiatus in Peninsular Spanish, it has been noticed that proximity to the stress conditions their realization. In a sequence like /ia/, hiatus pronunciation is most likely to be found in words where the stress falls on the second vowel of the sequence, as in *diálogo* [di.ˈa.lo.ɣo] 'dialogue', *dual* [du.ˈal]; is less likely if the stress falls on the following syllable, as in *dialogo* [di.a.ˈlo.go] ~ [di̯a.ˈlo.ɣo] 'I dialogue', *dualismo* [du.a.ˈlis.mo] ~ [du̯a.ˈlis.mo]; and is dispreferred if the stress is further to the right, as in *dialogó* [di̯a.lo.ˈɣo] 's/he dialogued', *dualidad* [du̯a.li.ˈðað] 'duality' (Hualde 2005; Simonet 2005).

Distance from the stress has also been noted to affect the diphthong vs. hiatus pronunciation of sequences arising in compounds and words with prefixes (Hualde 2005: 82; Aguilar 2010: 36–37), regarding both sequences with an unstressed high vowel and sequences of two identical vowels, as illustrated in (12), with merger less likely if the stress falls on the initial vowel of the second member:

(12) Effect of distance from the stress

a Sequences with an unstressed high vowel
semi-abierto [se.mi̯a.ˈβi̯er.to] 'half open' vs.
semi-árido [se.mi.ˈa.ɾi.ðo] 'semi-arid'

b Sequences of identical vowels
porta-aviones (also spelled *portaviones*) [por.ta. ˈβi̯o.nes] 'aircraft carrier' vs.
porta-armas [por.ta.ˈar.mas] 'weapon carrier'

Alba (2006), based on data extracted from a corpus of conversational New Mexico/Colorado Spanish, reports the following hierarchy of sequences, from most likely to least likely to undergo contraction across word boundaries: U-U >> S-U >> U-S >> S-S. Whereas, in the corpus that he analyzes, 83% of all sequences of two unstressed vowels undergo merger, only 13% of sequences of two stressed vowels are merged. The difference between S-U (74% merged) and U-S (49%) is also quite considerable. The findings in Aguilar's (2005) study of read Peninsular Spanish are totally compatible with this hierarchy.

Regarding the effect of nuclear or main stress in the phrase, Navarro Tomás (1977: 170) states that, other things being equal, both synaloepha and synaeresis are less likely to occur in the last stressed position in the prosodic phrase (*grupo fónico*) than when the same sequence is found phrase-medially. That is, nuclear stress tends to block merger. However, Aguilar (2005) was not able to confirm this disfavoring effect of nuclear stress on the merger of sequences across word boundaries.

Navarro Tomás's statement seems correct regarding the possibility of violent synaeresis. It seems clear that, for instance, a word like *serían* [se.ˈɾi.an] can undergo violent synaeresis as [seɾi̯an] in a phrase such as *a lo mejor serían las tres* 'it must have been three o'clock, maybe', but not, with a different word order, in *las tres serían*, where the target word would receive nuclear stress. The difference between the two words in a minimal pair such as *seria* [ˈse. ɾi̯a] 'serious, fem. sg.' vs. *sería* [se. ˈɾi.a] 's/he would be' may even be lost under synaeresis in prenuclear position. That is, a sentence like *siempre una sería propuesta* 'one would always be proposed' may be realized as homophonous with *siempre una seria propuesta* 'always a serious proposal', with deaccentuation of the phrase-medial word *sería/seria*; but the contrast is robust in citation form or, more generally, under nuclear stress. Notice also that whereas the syntactic sequence of unstressed preposition plus unstressed article /a + el/ 'to the' is reduced to *al* even in the standard spelling, the contraction of *a él* 'to him', with a stressed pronoun, is impossible in phrase-final position, in a phrase like *se lo dije a él* 'I said it to him', *[se.lo.ˈði.xe.ˈal], *[se.lo.ˈði.xe.ˈae̯l], but not away from the nuclear stress: *a él se lo dije* [ˈae̯l. se. lo.ˈði.xe].

Navarro Tomás provides the following examples to illustrate the contrast, where synaeresis in the words *días* 'days', *paseo* 'walk' and *venían* 'they were coming' is normal in the lefthand phrases but would be strongly dispreferred with a different word order, as in the righthand column, where these words appear in phrase-final, nuclear position:

(13) Prenuclear vs. nuclear stress (examples from Navarro Tomás 1977: 170)

Prenuclear	vs.	Nuclear
cuatro d[i̯a]*s después*		*después de cuatro d*[ˈi.a]*s*
'four days later'		'after four days'
dio un pas[e̯o] *por la mañana*		*por la mañana dio un pas*[ˈe.o]
's/he took a walk in the morning'		'in the morning, s/he took a walk'
todos ven[i̯a]*n cansados*		*muy cansados ven*[ˈi.a]*n*
'they all came tired'		'very tired, they came'

Although Navarro Tomás (1977: 170–171) states that in examples like those in the lefthand column in (13), there is a displacement of the stress to the more open vowel in the sequence, it may be more accurate to conclude that what we actually have in most cases is application of a stress-removal process. In these examples of synaeresis, a lexically stressed vowel loses its lexical stress and is turned into a glide, allowing for the syllabification of both vowels as a single syllable. Stress removal may occur in prenuclear contexts but is impossible or at least strongly dispreferred in nuclear position.

Notice that the analysis of these examples as involving stress removal or deaccentuation is consistent with the deletion of nonfinal stresses—but not the last stress—in compounds, as in *limpiaparabrisas* [lim.pi̯a.pa.ɾa.ˈβri.sas] 'windshield wiper', with a single stressed syllable (see Hualde 2007). Compare, for instance, *María Rosa* [ma.ɾi̯a.ˈro.sa] with loss of the stress and synaeresis in the first member of the compound, vs. *Rosa María*, where contraction of the final sequence in a single syllable is not possible *[ˈro.sa.ma.ɾi̯a]. This view of violent synaeresis as usually involving loss of lexical stress in prenuclear position in the phrase is also consistent with the experimental finding that phrase-medial words (but not phrase-final words) may be realized with very reduced or no correlates of prosodic prominence (Torreira et al. 2014; see also Ortega-Llebaria and Prieto 2011). Nevertheless, in some cases, and especially phrase-initially, we may in fact have merger with retention of acoustic prominence over the merged sequence, as Navarro Tomás claims.

5.3. Vowel identity

Another factor affecting syllable merger mentioned by Navarro Tomás and illustrated in the examples in (11) concerns whether the two vowels in the sequence are identical or different. Navarro Tomás states that, other things being equal, identical vowels are more readily reduced to a single syllable than nonidentical vowels.

In the case of sequences across word boundaries, the merger of sequences of identical vowels has been described as a very common outcome in both Peninsular and Latin American varieties. Hutchinson (1974), for instance, describes systematic merger of sequences of identical vowels for South Texas Chicano Spanish, with data that have been the object of several later phonological analyses (Martínez-Gil 2000, 2016; Bakovic 2007; see also Garrido 2013: 342). Jenkins (1999: 11–12) also states that in the corpus of New Mexico Spanish that he examines, all sequences of two identical vowels at word boundaries are fused into one. For Peninsular Spanish, see Quilis (1993: 375).

Nevertheless, Aguilar (1999, 2010: 64), with reference to Peninsular Spanish, claims that the merger of two identical vowels is far from being obligatory and that its frequency of application is conditioned by factors such as speech rate and style (e.g. spontaneous vs. read speech), stress, the type of syntactic boundary between the two words (which may condition the placement of prosodic boundaries) and the speaker's intention to avoid potential ambiguity. For instance, she finds that the sequence of two identical unstressed vowels /a-a/ across a boundary was realized as a single vowel only in 68% of all cases in a corpus of informal speech, and in only 19% of the instances in a corpus of read speech. On the other hand, in his corpus of New Mexico Spanish, Alba (2006) reports merger of /a-a/ in 87% of instances across stress conditions. To the extent that these figures are representative, they point to the existence of dialectal differences in the extent to which hiatus is avoided in these sequences. Alba (2006) also suggests that, in addition to identical vowels merging more readily, the relative similarity between the two vowels may also be relevant, so that, for instance, /a-e/ may merge with greater frequency than /a-o/.

Regarding word-internal sequences, all sequences of identical vowels are heterosyllabic by lexical syllabification, as was mentioned in the introduction to this chapter. Their postlexical merger as a single vowel, in addition to being conditioned by stress (with merger more likely when both vowels are unstressed), seems to be lexically conditioned to a certain extent. Navarro Tomás (1977: 153–154) gives both pronunciations, with and without merger, as possible for words like *alcohol* [al.ˈkol] ~ [al.ko.ˈol] 'alcohol', *azahar* [aˈθar] ~ [a.θa.ˈar] 'orange blossom', *albahaca* [al.ˈβa.ka] ~ [al. βa.ˈa.ka] 'basil', but points out that the sequence of identical vowels is not reduced, in the variety he describes, in other words like *creencia* 'belief', *mohoso* 'moldy' and *loor* 'praise', always pronounced with a sequence of two vowels.

5.4. Speech rate

The remaining factor that Navarro Tomás identifies as affecting the readiness with which syllables may merge is speech rate: merger is more likely in fast than in slow speech. Concerning sequences across word boundaries, the effect of speech rate hardly needs commentary, since at slower rates words may be pronounced separately, or with more frequent prosodic boundaries between words, preventing coarticulation.

Regarding word-internal sequences, it should be noted that even lexical diphthongs may be realized as sequences of two vowels in very slow—perhaps unnaturally slow—or extra-careful speech. In this respect Spanish diphthongs are phonologically different from the diphthongizing vowels of English, such as /eɪ/ (as in *bait*) and /oʊ/ (as in *goat*), which can be characterized as containing an offglide, and also from the "true diphthongs" of this language, such as /aʊ/ (as in *house*), /aɪ/ (as in *bite*) and /ɔɪ/ (as in *toy*). As Roca (2016) argues, whereas English diphthongs are single phonological units, in Spanish these are separable sequences of two vowels. For this reason, this author claims that Spanish does not have "glides." Whereas in highly emphatic Spanish speech words like *veinte* and *causa* can be pronounced as [ˈbe.in.te] and [ˈka.u.sa], undoing the diphthong, such undoing of diphthongizing vowels or phonological diphthongs is not possible in English. The almost unconstrained nature of the sequences containing unstressed /i/ or /u/ that can form a diphthong in Spanish (compared to the restricted number of diphthongs in English) could be considered as evidence for this position.

5.5. Other factors

Besides the factors mentioned by Navarro Tomás and reviewed in the preceding four subsections, other factors have been tested for their possible effects on syllable merger in more recent experimental and corpus work. These factors include some related to lexical frequency or frequency of collocations, morphological category and consonantal environment.

5.5.1. Frequency-related factors

Alba (2006) finds that stress and vowel quality have the greatest effect on the probability of vowel merger, in agreement with work by other authors. However, he also identifies other relevant factors. In particular, previous mentioning of the word, the type of syntactic sequence (string class) and string frequency, among the additional factors that he tested, also had some effect on whether the vowel sequence was realized as heterosyllabic or as tautosyllabic.

The expectation that sequences arising in more frequent collocations of words (e.g. article + noun) are more likely to be contracted follows from certain theoretical perspectives. As a general principle affecting pronunciation, it has been proposed that lexical frequency or frequency of word collocation correlates with phonological reduction (Bybee 2001). As just mentioned, Alba (2006) found some support for this hypothesis.

In principle, higher frequency should also favor contraction of word-internal hiatus sequences. Souza (2010) conducted an experiment where educated speakers of Mexican Spanish performed a reading task in which they were asked to read aloud words differing in their lexical frequency at two speeds, normal and fast. Contrary to the hypothesis, the sequence /ea/, which has the main focus of the study, turned out not to be shorter in high frequency words.

5.5.2. Segmental context and syllable-structure factors

Aside from frequency, Souza (2010) also found that the fronting and raising of the first vowel of the word-internal sequence /ea/ (giving [i̯a]) is favored by the coronal consonant /d/, e.g. *ideal* [i.ˈði̯al].

Colantoni and Hualde (2016) considered four hypotheses on the merging of /ea/ as [i̯a] in a test of phonological acceptability in Argentine and Mexican Spanish: word minimality (diphthongization is dispreferred if the result would be a monosyllabic word, e.g. *leal* 'loyal'), proximity to stress (with the acceptability of diphthongization increasing with distance from the word stress, e.g., with accent marks added for clarity, *beatitúd* 'beatitude' > *beáta* 'devout, pious, fem. sg.'), onset type (clusters and palatals were predicted to disfavor diphthongization) and verb class (diphthongization more likely in first vs. second conjugation verbs, e.g. 1st conj. *peleamos*, *apeamos* > 2nd conj. *veamos*, *seamos*, *leamos*). The strongest support in their test on intuitions was received by the word minimality and verb class conditions.

Exceptional hiatuses in Peninsular Spanish have been claimed to be conditioned by morphological and phonological factors (Hualde 1999, 2005; Hualde and Chitoran 2003; Chitoran and Hualde 2007), including among the latter not only proximity to stress but also the position of the sequence with respect to the beginning of the word (an initiality condition).

5.5.3. Dialectal differences

An anti-hiatus tendency, with preference for the merger of vowel sequences, has been noted as being general in Spanish: "Nuestra pronunciación tiende, preferentemente, a convertir, siempre que es posible, todo conjunto de vocales en un grupo monosilábico" [Translation: Our pronunciation tends, preferably, whenever it is possible, to convert all sequences of vowels into a monosyllabic group] (Navarro Tomás 1977: 148). Aguilar (2005) describes heterosyllabification as formal, diphthongization as standard and deletion as informal. Although Navarro Tomás's description concerns (educated) Peninsular Spanish, it can be considered valid for Latin American Spanish taken as a whole as well. The only exception that has been pointed out concerns

Paraguayan Spanish, in contact with Guaraní, where there is a strong tendency to maintain hiatus sequences, with insertion of a glottal stop between the two vowels (Lipski 1994: 77–82).

Nevertheless, there are important differences in syllable merger across geographical and social varieties (see, e.g., Matluck 1995; Colantoni and Limanni 2010). These differences mostly affect the specific realization of merged sequences, e.g. whether /ea/ is realized as [i̯a] or [e̯a], rather than the conditions for merger. We address the topic of the phonetic realization of merged sequences and dialectal differences in this respect in the next section.

6. Phonetic results of merger

Heterosyllabic sequences of vowels are avoided in many languages. Provided that two or more vowels are merged in a single syllable, this merger may produce one of several phonetic outcomes, some being more frequent than others crosslinguistically (see Casali 1997). Jenkins (1999) classifies the resolution of vowel sequences across word boundaries in a corpus of New Mexico Spanish as hiatus, diphthong, deletion of the first vowel, deletion of the second vowel or coalescence. Aguilar (2005), in a controlled study of read speech in Peninsular Spanish, also distinguishes two types of mergers, reduction and deletion, in addition to the syllabification of the sequence as heterosyllabic. Hualde et al. (2008), also with Peninsular Spanish data, find evidence for two different strategies in the merger of the sequences /eo, ea, eo, oe/: temporal reduction of the first vowel and raising of this vowel.

The phonetic results of merger depend on the nature of the vowels involved, with some variation in certain cases. Sequences of two vowels across word boundaries that present the same segmental and stress configuration as those normally syllabified as diphthongs at the lexical level (i.e. those containing an unstressed high vowel) are usually reduced to a single syllable, giving rise to diphthongs that are phonetically indistinguishable from lexical diphthongs, as in the examples in (14), where other words with the same sequence forming a lexical diphthong are given for comparison (for clarity, stress is indicated on all words in the orthographic representation):

(14) Sequences across word boundaries and in word-internal diphthongs

/ai/	*hábla inglés* [ai̯]	's/he speaks English' (cf. *p*[ai̯]*saje* 'landscape')
/ei/	*sábe idiómas* [ei̯]	's/he knows languages' (cf. *p*[ei̯]*naba* 's/he combed')
/ia/	*míli absúrda* [i̯a]	'absurd military service' (cf. *ital*[ˈi̯a]*no* 'Italian')
/ie/	*péli estúpida* [i̯e]	'stupid movie' (cf. *ab*[ˈi̯e]*rto* 'open')
/au/	*téla usáda* [au̯]	'used cloth' (cf. *c*[au̯]*sar* 'to cause')
/eu/	*génte humána* [eu̯]	'humane people' (cf. [eu̯]*ropeo* 'European')
/ua/	*tríbu antígua* [u̯a]	'ancient tribe' (cf. *act*[u̯a]*lidad* 'present time')
/ue/	*espíritu enérgico* [u̯e]	'energetic spirit' (cf. *at*[ˈu̯e]*ndo* 'attire')

Sequences containing two vowels across word boundaries such as those in the examples in (14) can be indistinguishable from word-internal diphthongs. In fact, the two phrases in (15), one of which has a lexical diphthong /ia/ and the other a sequence /ia/ arising across word boundaries, seem to be completely homophonous, unless a somewhat unnatural prosodic break is introduced between the two words (Hualde et al. 2008):

(15) Word-internal diphthongs and identical sequences across word boundaries

está bailando	[estáβai̯ˈlando]	's/he is dancing'
estaba hilando	[estáβai̯ˈlando]	's/he was threading'

These facts correspond to Peninsular Spanish and may be different in other varieties. For South Texas Spanish, Hutchinson (1974) reports vowel deletion in sequences where a nonhigh vowel precedes a high vowel, e.g. *esta hija* [es.ˈti.xa] 'this daughter' (see also Martínez-Gil 2016 and Colina, this volume), and Jenkins (1999) also finds vowel deletion in these sequences in New Mexico Spanish.

Sequences of two identical vowels are readily reducible to the duration of a single vowel. There are, in fact, puns that rely on the homophony between the two phrases in (16):

(16) Sequences of identical vowels

está blando	'it is soft'
está hablando	's/he is speaking'

This durational reduction may also affect phonological sequences containing three distinct identical vowels (Monroy Casas 1980: 65) and may even include lexical diphthongs, giving rise to postlexical diphthongs and triphthongs from sequences of up to five phonological elements:

(17) Sequences of three identical vowels

*ib**a a A**mérica*	[ˈiβaˈmeɾika]	/aaa/ → [a]	's/he was going to America'
*ib**a a Au**stralia*	[ˈiβau̯sˈtrali̯a]	/aaau/ → [au̯]	's/he was going to Australia'
*de As**ia a Au**stralia*	[ˈde̯asi̯au̯sˈtrali̯a]	/iaaau/ → [i̯au̯]	'from Asia to Australia'
*cr**ee e**n unicornios*	[ˈkrenuniˈkorni̯os]	/eee/ → [e]	's/he believes in unicorns'

Reduction to the duration of a single vowel is not an obligatory phenomenon. As noted in section 5, it is more likely if both vowels are unstressed and if they are found across word boundaries. As also noted in section 4, within a word, it is common to maintain a longer duration in certain lexical items like *loor* 'praise', *alcohol*, etc., and there are even minimal pairs such as *azar* 'luck' vs. *azahar* 'orange blossom', which may be pronounced as either different or identical.

Finally, most variation in the realization of vowel merger concerns sequences of nonidentical nonhigh vowels, that is, the sequences /ea/, /eo/, /oa/, /oe/, /ae/, /ao/. A well-known phenomenon of dialectal variation is the raising of mid vowels in these word-internal sequences, rendering them identical to lexical diphthongs, as in *teatro* [ˈti̯a.tro] 'theater', *peon* [ˈpi̯on] 'worker', *Joaquín* [xu̯a. ˈkin], vs. the reduction of the first vowel without changing its quality, which is the solution that Navarro Tomás (1977: 67–68) describes for educated Peninsular Spanish, together with the realization of the sequence in hiatus, e.g. *teatro* [te.ˈa.tro] ~ [ˈte̯a.tro].

All three sequences [e.a], [e̯a] and [ia], are acoustically and perceptually different (for native speakers). In both diphthong sequences, the duration is considerably shorter than in the hiatus pronunciation. The difference between the two diphthongs has to do with the formant values toward the beginning of the diphthong, closer to those of [e] in one case and to those of [i] in the other.

Whereas the realization of these sequences as true diphthongs with high glides has been stigmatized as "rural" in Spain, in other areas they have greater acceptability. Colantoni and Hualde (2016) find that [i̯a] for /ea/ is considered more acceptable for educated speakers of Mexican Spanish than for speakers of Argentine Spanish with the same level of education. In Mexican Spanish, certain diphthongized forms have in fact been lexicalized, sometimes with a different meaning from that of the original word with two vowels in hiatus, e.g. *maistro* 'bricklayer' vs. *maestro* 'schoolteacher'; *cuete* 'firecracker' vs. *cohete* 'space rocket'.

Garrido (2007, 2008) finds differences in both production and language attitudes between speakers of Colombian and Mexican Spanish and also between Colombians from the

Caribbean and the Andean regions of the country regarding the production of forms like [pe.ˈli̯ar] for *pelear* 'to fight'.

One reason for the stigmatization of this type of realization in certain regions may be the potential for spelling mistakes and even changes in verbal conjugation, which may lead to hypercorrected forms such as *rumea* [ru.ˈme.a] 's/he ruminates' for standard *rumia* [ˈru.mi̯a] (infinitive *rumiar*), by analogy with, e.g., *humear* [uˈmi̯ar] 'to smoke, give out smoke', *humea* [uˈmea] 'it gives out smoke'.

Across word boundaries, vowel deletion appears to be a relatively common strategy when function words are involved, e.g. *la entrada* [lan.ˈtra.ða] 'the entry', *te aguanto* [ta.ˈɣu̯an.to] 'I support you', *la escuela* [las.ˈku̯e.la] 'the school'. In contrast, in word-internal sequences, vowel deletion is generally excluded. Thus, for instance, *ideal* [i.ðe.ˈal] may be realized as [i.ˈðe̯al] ~ [i.ˈði̯al], by syllable merger, but not as *[i.ˈðal]. There appear to be only a few lexical exceptions, like the word *real* 'real; royal; name of a coin', for which Navarro Tomás (1977: 78) describes [ˈral] as a possible "vulgar" pronunciation, besides [ˈre̯al] ~[ˈri̯al] and the unmerged pronunciation [re.ˈal].

The phonetic result of the merger of longer vowel sequences of nonidentical vowels has not been systematically studied. In principle, the same strategies of deletion and gliding are available. For instance, illustrating with some of the examples mentioned in section 4, it appears that the word-final vowel may be deleted in *nadie hablaba* /ie-a/ [i̯a], *hacia Europa* /ia-eu/ [i̯eu̯] (perhaps further reduced to [i̯u]), and that gliding of the word-final vowel may take place in *que oigamos* /e-oi/ [i̯oi̯], *poco auténtico* /o-au/ [u̯au̯]. This topic requires further work.

7. Summary

In this chapter I have examined the postlexical phenomenon of syllable merger in Spanish. This is a process by which vowel sequences in hiatus are grouped into a single syllable. I started the chapter by considering the evidence for syllable reduction in speech coming primarily from syllable count in poetry. In other sections, I analyzed the sequences that may undergo merger as well as the factors that favor and disfavor this process. As noted, the sonority profile of a given vowel sequence determines whether or not it can be realized in a single syllable. Some of the factors that affect the likelihood of merger were identified by Navarro Tomás. These include stress, whether the sequence is word-internal or found across word boundaries, whether the vowels are identical or different, and speech rate. More recent scholarship has identified additional factors, such as word frequency. Finally, recent work, which I have also reviewed, has been concerned with the phonetic realization of merged sequences and with dialectal differences in this respect. There have also been some recent phonological analyses of vowel merger in some Spanish varieties within Optimality Theory (Bakovic 2007; Martínez-Gil 2016), which have been cited, but not reviewed or compared, given the more descriptive focus of this chapter.

The empirical foundation of syllabification and syllable structure is notoriously difficult to apprehend. Whereas syllable count in poetry provides a reasonable basis for determining which types of vowel sequences Spanish speakers tend to consider or may accept as tautosyllabic, determining the phonetic nature of the resulting syllable nuclei is not always straightforward and appears to be subject to much dialectal variation. It is hoped that further work, including articulatory analysis, will shed light on some of the issues that are still open.

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8

Spanish verb and non-verb stress

Iggy Roca

1. Introduction

Word primary stress has been a central concern to Spanish phonological research for well over three decades now. Attention has chiefly leaned towards non-verbs (mainly nouns and adjectives: non-clitic pronouns, adverbs, conjunctions, prepositions, and interjections behave likewise), to the neglect of verbs. In this chapter I shall attempt to redress the balance by dealing with verbs first, in some depth, then proceeding to the examination of non-verbs.

Morphologically, the complexity balance tilts heavily on the side of verbs. Indeed, nouns (here a shorthand for all parts of speech but verbs) display a four-variant maximum each, respectively concerning the two grammatical genders M (inadequately commonly referred to as "**m**asculino" 'masculine') and F (inadequately commonly referred to as "**f**emenino" 'feminine'), e.g. M ***el*** *brujo* 'the sorcerer' vs. F ***la*** *bruja* 'the witch', in either the singular (ditto) or plural number (*lo**s** brujo**s*** vs. *la**s** bruja**s***).

The word "gender" here exclusively concerns syntactic agreement and is hence unrelated to contemporary extensions of the term into areas properly having to do with sex. Thus, in our *brujo* ~ *bruja* example the M (*el*) vs. F (*la*) grammatical genders do happen respectively to match a male and a female meaning: 'sorcerer' vs. 'witch'. This is not based, however, on general principle, but on piecemeal lexical determination: cf. in contrast *hijo* vs. *hija*, with *hija* indeed defining a female offspring ('daughter') but *hijo* (= 'offspring') sex-free, as in (Π= valid; * = invalid) Π*tengo cuatro hijos, dos de ellos niñas* 'I have four children, two of them girls' vs. **tengo cuatro hijas, dos de ellas niños* 'I have four daughters, two of them boys/children'. Consider also *persona* 'person' and *vástago* '(one) offspring', with contrasting gender (F ***la*** *persona* vs. M ***el*** *vástago*) but both sex-free: cf. *Juan es muy buena persona* 'John is a very good person'; *María es muy buena persona* 'Mary is a very good person'; *mis dos vástagos se llaman Juan y María* 'my two offspring are called John and Mary'. An in-depth discussion of the topic with additional references is available in Roca (2013).

The contrast with verbs is remarkable: verbs have six person-cum-number forms in each of nine tenses (two not fully mutually distinct semantically and one now obsolete), mostly distributed between two main moods, indicative and subjunctive. Additionally there is one mood with only two persons, and three non-conjugated non-finite forms: the number of Spanish variants for each verb hence amounts to 59. These are apportioned into three conjugation classes partially differing in segmental realisation, albeit not in meaning or stress patterns.

This chapter advances Optimality Theory–grounded stress grammars for both verbs and nouns. The analysis, while informed by theory, is purposely both data-driven and formally minimalist, in at least partial contrast to some of the alternatives present in the literature.

In addition to this introduction, the chapter includes five main sections and a conclusion. Section 2 ("Verb Morphology") reviews and analyses the Spanish verb morphological structure. Section 3 ("Verb Stress") deals with the Spanish verb stress grammar, subsequently to be shown to overlap with its non-verb counterpart only minimally, verb stress being generally tied in to specific verb morphemes. Section 4 ("Noun Morphology") examines the much simpler morphological structure of Spanish non-verbs. Section 5 ("Noun Stress") investigates the corresponding stress patterns. A morphological division between "stem" and "desinence" will be seen to hold the main key to stress here, with three distinct, although related, classes—U(nmarked), M(arked), and E(xtraneous)—mutually standing in numerically decreasing set-subset relations. Section 6 ("Syllabification of Adjacent Vowels") reviews the interaction between vowel cluster syllabification and stress. Section 7, the chapter's conclusion, offers an integrated sum-up of the OT grammar(s) arrived at, in Hasse diagram format for both visual convenience and ease of understanding.

2. Verb morphology

The complexity of Spanish verb morphology and its close interleaving with stress warrants a succinct review of the former as a preliminary.

The Spanish verb conjugational paradigm comprises a total of 10 sub-paradigms, all but one (the Imperative) doubled up into simple and compound and with six person/number forms each (the Imperative has only two). Additionally, the Spanish verb paradigm includes three non-conjugated forms, one for each of the three non-finite categories Infinitive, Gerund, and Past Participle.

The simple forms carry the inflection in the verb itself (*lav**o***, *lav**as***, . . . 'I, you, . . . wash') The compound ones have the inflection on the *haber* 'to have' auxiliary that precedes the conjugated verb's past participle, in the manner of English *I have washed*, Spanish *he lavado*.

As the respective labels indeed suggest, the principal semantic contrasts involve denotation of past, present, and future time. A division between two major moods, Indicative and Subjunctive, runs concurrently. A third mood, the Imperative, is highly defective: it has one single tense (the Present) with only two forms, both for the 2nd person, specifically singular and plural.

Next, I provide the full taxonomy of the Spanish verb, leaving out complex tenses as irrelevant to our current stress remit. All the inflected samples that follow but the Imperative concern the 1st Person singular, that is, the Person associated with the "I" pronoun in English. All the forms examined correspond to the 1st conjugation. The same basic configuration will later be seen to obtain in the other two, albeit with some segmental realisation differences.

Our labels for tenses are the usual ones: cf., e.g., Butt and Benjamin (1989). Their respective imports will be clarified as we go along. For clarity, I represent Spanish stress graphically with the standard " ˈ " IPA phonetic mark throughout, and simultaneously with an acute accent on the stressed vowel (*á*, etc.) where dictated by the Spanish orthography. The English glosses for tense and mood can only be approximate, as no strict semantic correspondences obtain between the two languages in these two areas. Previous comprehensive studies of Spanish verb morphology include Alcoba (1990, 1991, 1999), Ambadiang (1993), and Arregi (2000).

INDICATIVE
PRESENT (*l'avo* 'I wash')
PAST IMPERFECT (*lav'aba* 'I was washing') PRETERITE (*lav'é* 'I washed')
FUTURE (*lavar'é* 'I will wash') CONDITIONAL (*lavar'ía* 'I would wash')

The "Conditional" is semantically essentially a Future Past.

SUBJUNCTIVE
PRESENT (*l'ave*)
PAST IMPERFECT 1 (*lav'ara*) PAST IMPERFECT 2 (*lav'ase*)
"FUTURE" (*lav'are*)

The two subjunctive "Imperfects" essentially share the same meaning. Also largely the same usage, with some frequency advantage for the Past Imperfect 1.

IMPERATIVE
PRESENT (*¡l'ava!* 'wash!')

NON-FINITE
INFINITIVE (*lav'ar* 'to wash')
GERUND (*lav'ando* 'washing')
PAST PARTICIPLE (*lav'ado* 'washed')

Each of the three conjugated persons corresponds to one of the three speech act participants, 1st (the speaker), 2nd (the addressee), and 3rd (the remainder), each person in two numbers, singular and plural. The verb conjugation itself is structured into three classes ("conjugations"), mutually identical in their morphological composition and in their semantics but diverse in their morphophonology, slightly (2nd vs. 3rd) or more substantially (1st).

Each Spanish verb form is in turn made up of a maximum of four morphemes linearly arranged from left to right, as follows: the Root (e.g. *lav-*), a Theme Vowel (TV) (*-a-*), a Tense Aspect Mood (TAM) morpheme (*-ba-*), and a Person Number (PN) morpheme (*-mos*), hence, e.g., *lav-'á-ba-mos* 'we used to wash'. The Root is obviously lexically determined. The TV is conjugation-bound, in principle *-a-*, *-e-*, *-i-*, respectively, for the 1st, 2nd, and 3rd conjugations, the 2nd and 3rd nonetheless with considerable syncretism and TV diphthongisation in places. The TAM morpheme is mostly shared across conjugations. The PN morpheme exhibits a specific materialisation for each P+N combination, as follows (NB: 1/2/3 = 1st/2nd/3rd person; sg = singular; pl = plural): 1sg (usually) nil, 2sg *-s*, 3sg nil, 1pl *-mos*, 2pl *-is*, 3pl *-n*. The following paradigm of the *lavar* Past Imperfect appositely illustrates:

1sg *lav-a-ba*, 2sg *lav-a-ba-**s***, 3sg *lav-a-ba*, 1pl *lav-á-ba-**mos***, 2pl *lav-a-ba-**is***,
3pl *lav-a ba-**n*** 'I, etc., used to wash'. And so on correspondingly.

Morpheme realisation itself is enforced on an undominated MAX-MORPH constraint formulated as follows in Roca (2010: 411):

MAX-MORPH: A lexical morpheme has a surface realisation.

The Root—TV—TAM—PN linear arrangement in turn is a function of the following four alignment (AL) constraints, where R = right and RT = Root (*WD* = word):

AL(PN,WD)-R: The PN morpheme aligns with the word's right edge.
AL(TAM,WD)-R: The TAM morpheme aligns with the word's right edge.
AL(TV,WD)-R: The TV morpheme aligns with the word's right edge.
AL(RT,WD)-R: The Root morpheme aligns with the word's right edge.

The respective rankings are as follows:

AL(PN,WD)-R >> AL(TAM,WD)-R >> AL(TV,WD)-R >> AL(RT,WD)-R

The previously introduced MAX-MORPH constraint obviously needs to outrank all these, to favour morpheme-word misalignment over morpheme deletion: cf., e.g., correct full-fledged *lav-á-ba-mos* 'we used to wash' vs. false syncopated **mos*. The evaluation that follows materialises the procedure just sketched.

Our evaluation format follows Roca (2017) (cf. also Roca 2016), with the twin objectives of easing up the reading and speeding up the interpretation. In particular, it dispenses with the eye-hindering multiple inner boxes of conventional tableaux, instead only boxing in the evaluation winner, all along the top line, to draw the eye straight to it. The constraints themselves are placed linearly at the top of the diagram, with the usual symbols ">>" ('higher than') and "," ('level with') expressing their mutual ranking (*lavˈábamos* 'we used to wash').

lav-ˈá-ba-mos	MAX-MORPH >>	AL(PN,WD)-R >>	AL(TAM,WD)-R >>	AL(TV,WD)-R >>	AL(RT,WD)-R
lav-ˈá-ba-mos			*	**	***
lav-ˈá-mos-ba		*!		**	***
lav-ˈá	*!*				*
bˈa-mos	*!*		*		*

A substantial amount of allomorphy obtains both within and across conjugations. The specific details will not, however, concern us here.

3. Verb stress

Next we proceed to the examination of verb stress.

The study of Spanish verb stress has through the years lagged considerably behind that of its non-verb counterpart. Among the relevant works bearing on verb stress are, in descending chronological order, Doner (2017), Oltra-Massuet and Arregi (2005) alongside noun stress, Roca (1990, 1992), Harris (1987, 1989), Núñez-Cedeño (1985), and Hooper and Terrell (1976, as part of their general stress analysis).

Doner (2017), the latest account of Spanish verb stress to date, explicitly sets out to be the verb counterpart of Roca (2005) for nouns, both proposals are couched in Halle and Idsardi's (1995) general stress model.

Oltra-Massuet and Arregi (O-M&A) (2005), Doner's (2017) immediate predecessor, instead

> argue for a syntactic approach to the computation of stress in Spanish. Our basic claim will be that stress placement in this language makes crucial reference to the internal syntactic structure of words, in particular proposing that foot boundaries are projected from certain functional heads. Our analysis is set in the framework of Distributed Morphology.
>
> *(O-M&A 2005: 43, abstract)*

O-M&A's noun proposals are examined and critically evaluated in Roca (2005, 4.1.2, 4.2.2, 4.3.3, plus pp. 380, 382ff.), and those for verbs in Roca (2005: 6.4) and in Doner (2017: 6.2.1), both these works also including critical assessments of Harris (1995).

Doner's (2017) Spanish verb analysis indeed involves either LLR or RRR parametric alignment of Halle and Idsardi's (1995) binary trochaic foot (SW) (reduced to unary (S) under duress from segmental shortage) with either the Stem or Word morphological boundary.

"(. . .)" = foot; S = strong syllable; W = weak syllable. LLR reads "insert a **L**eft bracket to the **L**eft of the **R**ightmost element": e.g. *me(nˈú* 'menu', *ani(mˈal* 'animal', with syllables as the stress bearing elements, and correspondingly for the remaining L plus R combinations. Both Roca's (2005) and Doner's (2017) representations thus exclusively include left brackets, in line with Halle and Idsardi's (1995) practice. I nonetheless transcribe both paired brackets here (viz. (SW), (S)) so as to render both Foot size and contents fully transparent to the reader: compare, e.g., Doner's corresponding alternatives "*me(nˈú*" or "ani(*mˈal*" with our "*me(nˈú)*", "*ani(mˈal)*".

All, as said, in the mould of Roca (2005) for Nouns, although naturally with the settings adjusted to verbs. Here we will see that stress alignment with certain designated morphological constituents indeed lies at the heart of Spanish stress, in verbs and elsewhere. Our approach will notably simplify and rationalise Doner's (2017) by significantly cutting down on footing, which as we shall see is fully redundant in verbs, and all but fully in nouns (over 99%).

All the Spanish verb stress patterns, Present tense ones excepted indeed are morpheme-bound. Thus, Past tense stress is borne by the morpheme immediately following the Root: *lav-**ˈa–**ba* 'I washed', *lav- **ˈá–**ba-mos* 'we washed', and so on, with ***lav–*** the Root. The same holds in the three non-finite forms: Infinitive (*lav-**ˈa**-r* 'to wash'), Gerund (*lav-**ˈa–**ndo* 'washing'), and Past Participle (*lav-**ˈa**-do* 'washed'). An alternative approach with stress TV-anchored, at first blush simpler and more direct, will be seen below to run into difficulties in the Preterite.

In the two Futures proper (i.e. not the "Future" Subjunctive), stress is TAM-bound: cf. Future Present (here simply "Future") *lav-a-**rˈé*** 'I will wash', *lav-a-**rˈe**-mos* 'we will wash', etc.; Conditional (= Future Past) *lav-a-**rˈía*** 'I would wash', etc.

Last in our succinct review, the two Present tenses (Indicative and Subjunctive) contain a three-morpheme maximum each, the first the Root, the third (where present) the PN, and the second either the TV (*lav-**a**-s*, *lav-**a**-mos*, etc.) or the TAM (*lav-**o***, *lav-**e***). Their stress locus can provisionally be identified via the informal statement "stress falls on the word's rightmost non-final vowel", hence, e.g., *lav- **ˈa–**mos* 'we wash', *lav- **ˈá–i**s* (both with Paroxytone (PO) = penultimate) stress on the TV -ˈ*a*-) vs. *lˈ**av**-**o*** 'I wash', *lˈ**av-a**-n* 'they wash' (both with also PO stress on the Root *lˈav*-); etc.

Doner's (2017: 11, Table 2) RRR settings for both Presents do work on a vowel-based stress bearer count such as ours here, but do not quite so on her syllable-based count, which leads to, e.g., **lˈavais* for 2pl. *lavˈáis*. Cf. "I assume the single-bracketed grid theory of Idsardi (1992) and Halle and Idsardi (1995). This is a derivational approach to metrical structure which constructs metrical grids by projecting **syllable heads** [my emphasis, IR] and organizing them into constituents" (Doner 2017: 5). Non-standard Present tense variants scattered throughout the Spanish-speaking world will not be dealt with here, for want of space and on grounds of their relative marginality.

I next carry out a detailed examination of the distribution of stress in the full set of Spanish tenses, in the sequence Past, Future, Non-finite, Imperative, Present. I start off with the 1st conjugation for reasons that will become clear later.

Doner's (2017) analysis confinement to the 1st conjugation inevitably leaves unaddressed a number of central issues pertinent to the other two which are appositely dealt with here.

Our account will focus on the regular patterns. A handful of irregular forms apportioned into several classes also exist. One of these, which also has an irregular stress pattern, will be examined in 3.11.

3.1. 1st conjugation Past tenses

The full set of Spanish 1st conjugation Past tenses follows:

Sg = singular; Pl = plural; 1, 2, 3 = respectively 1st, 2nd, 3rd person. The terms "Imperfect" and "Perfect" here concern the semantics, respectively denoting an action's incompleteness or repetition vs. an action's completeness and unity. The Spanish subjunctive tenses lack straightforward English equivalents.

PAST IMPERFECT INDICATIVE 'I, etc., used to wash; was washing':
Sg 1lav-ˈ**a**-ba, 2lav-ˈ**a**-ba-s, 3lav-ˈ**a**-ba; Pl 1lav-ˈ**á**-ba-mos, 2lav-ˈ**a**-ba-is, 3lav-ˈ**a**-ba-n
PRETERITE INDICATIVE 'I, etc., washed':
Sg 1lav-ˈ**é**, 2lav-ˈ**a**-ste, 3lav-ˈ**ó**; Pl 1lav-ˈ**a**-mos, 2lav-ˈ**a**-ste-is, 3lav-ˈ**a**-ro-n
PAST IMPERFECT SUBJUNCTIVE 1:
Sg 1lav-ˈ**a**-ra, 2lav-ˈ**a**-ra-s, 3lav-ˈ**a**-ra; Pl 1lav-ˈ**á**-ra-mos, 2lav-ˈ**a**-ra-is, 3lav-ˈ**a**-ra-n
PAST IMPERFECT SUBJUNCTIVE 2:
Sg 1lav-ˈ**a**-se, 2lav-ˈ**a**-se-s, 3lav-ˈ**a**-se; Pl 1lav-ˈ**á**-se-mos, 2lav-ˈ**a**-se-is, 3lav-ˈ**a**-se-n
The so-called "Future" Subjunctive behaves similarly with regard to stress:

"FUTURE" SUBJUNCTIVE:
Sg 1lav-ˈ**a**-re, 2lav-ˈ**a**-re-s, 3lav-ˈ**a**-re; Pl 1lav-ˈ**á**-re-mos, 2lav-ˈ**a**-re-is, 3lav-ˈ**a**-re-n

This tense, now obsolete, was not a future as such but a hypothetical. There is classical discussion in Bello (1949 [1847]), and more recent treatments in Camús (1990), Eberenz (1990), and Rojo and Veiga (1999).

As can easily be noticed, Past tense stress falls **on the morpheme following the Root**, i.e. the **P**ost-**R**oo**t** **Morph**eme (P-RT MPH). Alternatively, and seemingly simpler, stress specifically falls on the TV: cf., e.g., *lav-ˈ**a**-bas*, *lav-ˈ**a**-ste*, *lav-ˈ**a**-ras*, *lav-ˈ**a**-ses*, *lav-ˈ**a**-res*. The *-é/-ó* Preterite endings of, respectively, 1sg *lav-ˈé* and 3sg *lav-ˈó* do not, however, include the 1st conjugation TV *-a-*. Roca (2010) tackles the issue on a twofold strategy, involving (1) *lavé*'s *é* and *lavó*'s *ó* construal as autosegmental composites of a [−cons] underspecified TV; and (2) also underspecified autosegmentalised TAM/PN Preterite morphemes [−low] (1sg) and [+round] (3sg). Cf. Roca's (2010: 415) statement that [p]reterite *-é*, *-ó* are the product of autosegmental incorporation of semantically cumulative 1st and 3rd sg Preterite feature-sized morphemes, respectively simply [−L] and [+R]. Non-tonal feature-sized morphemes are of course well established in the literature, both derivational and OT, accordingly needing no special plea: cf. McCarthy (1983), Lieber (1987), Akinlabi (1996), Zoll (1996), Piggott (2000), Wolf (2005, 2007), among others.

Besides the abstractness it incurs, this analysis does not fit well with the nil or at best minimal role autosegmentalism otherwise plays in Spanish phonology. An alternative targeting the TV slot independently of the vowel filling it also incurs a degree of abstractness (the TV slot has no material reality independently of the vowel filling it) appositely eschewed on our more concrete approach.

Settling thus for the Past tense post-Root stress generalisation, we formulate the corresponding constraint as follows:

POST-ROOT MORPHEME STRESS^{PAST} (P-RT MPH STRESS^{PAST}):
AL-L (ˈV, P-RT MPH STRESS)^{PAST}: In Past tenses stress aligns with the morpheme following the Root.

The following one-constraint evaluation demonstrates this:

lav'ó	AL-L (ˈV, (P-RT MPH STRESS^{PAST}):	'he, etc., washed'
lav-ˈó		
lˈav-o	*!	

Similar considerations apply to the remaining Past tenses, as illustrated now with the Imperfect Subjunctive-2 1/3sg *lavˈase*:

lav'ase	AL-L (ˈV, (P-RT MPH STRESS^{PAST}):	'I/he, etc., washed'
lav-ˈa-se		
lˈáv-a-se	*!	
lav-a-sˈé	*!	

This completes our presentation of 1st conjugation Past tense stress, shown to fall on the morpheme following the Root, often, albeit not always, the TV.

3.2. 1st conjugation Future tenses

Next we turn to the two Future tenses proper, viz. the Future Present and the Future Past or "Conditional", both with stress on the TAM morpheme itself:

FUTURE 'I, etc., will wash':
Sg 1lav-a-**r'é**, 2lav-a-rˈ**á**-s, 3lav-a-rˈ**á;** Pl 1lav-a-rˈ**e**-mos, 2lav-a-rˈ**é**-is, 3lav-a-rˈ**á**-n
CONDITIONAL 'I, etc., would wash':
Sg 1lav-a-rˈ**í**a, 2lav-a-rˈ**í**a-s, 3lav-a-rˈ**í**a; Pl 1lav-a-rˈ**í**a-mos, 2lav-a-rˈ**í**a-is, 3lav-a-rˈ**í**a-n

The *e/a* Future TAM allomorphy, e.g. *lav-a-rˈ**é***, etc./*lav-a-rˈ**á**(s)*, etc., obviously has no bearing on the stress location. An AL- L (STRESS, TAM^{FUT}) constraint adequately accounts for the stress position here. In Conditional (= Future Past) *lav-a-rˈí.a*, a **lav-a-riˈá* stress contour nonetheless would also fit this grammar. For ease of presentation, we defer discussion of the matter to section 3.7, on 2nd and 3rd conjugation Future tenses.

This completes our review of Spanish verb stress in 1st conjugation finite forms. There only remain only (i) the three non-conjugated non-finite forms, (ii) the defective two-member Imperative, and (iii) the two full-fledged Presents. We examine these next, in this order.

3.3. 1st conjugation non-finite forms

The three non-finite forms with their respective stress patterns now follow:

INFINITIVE	GERUND	PAST PARTICIPLE	
lav-ˈa-r	lav-ˈa-nd-o	lav-ˈa-d-o	'to wash; washing; washed'

The functional propinquity of these three verbal forms with their nominal counterparts needs noting. Thus, the infinitive *lavar* readily nominalises as *el lavar* (*de Pedro*) '(Peter's) washing', pluralisable as *los lavares* 'the washings'. The Past Participle in turn freely admits both pluralisation and genderisation: *lavad**o(s)**/**a(s)*** 'washedM/F(pl)'. The Gerund exhibits a more robust verbal condition, although still not an absolute one either: it can, for instance, colloquially undergo facetious diminutivisation into *lavandito* 'washing-DIM' (*corriendito* 'running-DIM' may possibly be more idiomatic). None of this is feasible with conjugated verb forms, a fact suggestive of a degree of shared verbal and nominal status in the three non-finite forms.

O-M&A's (2005: 67) analysis of the three non-finite categories (with reference to Harris 1996) includes a non-verbal structure layer above the verbal one (see section 3.8), in this way purporting to account for their verb–cum–non-verb behaviour.

In the three non-finite forms, stress falls on the TV, *a* here. This location can thus equally be construed as post-Root, as in Past tenses, which in principle integrated into the Noun stress apparatuswe shall examine in section 5 below.

3.4. 1st conjugation Imperative forms

Next we examine the Imperative mood. Its two "official" forms follow:

IMPERATIVE:

	SG	PL
1st conj.	lˈava 'wash!'	lavˈad 'wash you lot!

There are no Imperative 1st or 3rd persons, presumably on account of the pragmatic restrictions inherent in the act of giving direct orders: **I/we** order **you/you lot/you all**.

The verb's 2nd person encodes the informal mode of address. The attendant standard singular pronoun is *tú*. *Vos* nonetheless substitutes in a number of areas, Latin American in particular; the verb then appears in the 2nd person plural and the V+*i* sequence often simplifies to V: cf. *vos no sabé(i)s lo que decís* for *tú no sabes lo que dices*, both phrases expressing 'you-sg don't know what you are saying'. Presence of the *vosotros* 2pl pronoun is confined to Castilian Spanish, the 3pl *ustedes* (optionally *Vds*. in writing) substituting elsewhere. Indirect orders require a subordinate clause with the verb in the Subjunctive mood, e.g. *digo que **venga*** 'I say that **he/etc. (should) come over**'.

Use of the official plural Imperative forms *lavˈad*, etc., is limited to Castilian-oriented Peninsular Spanish, indeed to the formal register there; otherwise, the Infinitive *lavar*, etc., colloquially substitutes: *¡lavar esto!* thus normally manifests 'wash this, you lot/all!' Its formal counterpart overlaps in form with the Present Subjunctive: *lave esto* '(you-sg) please wash-sg this', *laven esto* '(you-pl) please wash-pl this', and so on.

Regarding stress, the Imperative singular matches the Present Indicative 3sg (both *lˈava*), the full analysis of which we will provide next. The (very formal) *d*-ending plural Imperative *lavˈad* displays the TV stress of the Infinitive (*lavˈar*), a form that, as just mentioned, habitually colloquially substitutes for the plural Imperative. No uniform stress pattern consequently obtains in the two-term Spanish Imperative paradigm.

3.5. 1st conjugation Present tenses

Last, we examine the two Present Tenses. Their respective stress patterns obey a "rightmost non-final vowel stress" grammar. The 1st conjugation Indicative and Subjunctive paradigms illustrate:

INDICATIVE
Sg 1l**ˈa**v**o**, 2lˈ**a**v**a**s, 3lˈ**a**v**a**; Pl 1lavˈ**a**m**o**s, 2lavˈ**ái**s, 3lˈ**a**v**a**n

SUBJUNCTIVE
Sg 1l**ˈa**v**e**, 2lˈ**a**v**e**s, 3lˈ**a**v**e**; Pl 1lavˈ**e**m**o**s, 2lavˈ**éi**s, 3lˈ**a**v**e**n

Stress here indeed falls on the rightmost nonfinal *vowel*, its syllabic status irrelevant: pointedly, the tautosyllabic 2pl *-**ái**s*, *-**éi**s* includes *two* stress bearers, one for each vowel, just like the heterosyllabic 1pl *lav**a**m**o**s/lav**e**m**o**s* or the 3pl *l**a**v**a**n/l**a**v**e**n*. A compelling case for vowels, not syllables, as Spanish stress bearers (the elements in the language that are visible to stress and thus are its receptors) is made in Roca (2016), expanding on Roca (2006), and we will indeed confirm and adopt this stand here: cf. section 6. All distance measurements concerning stress will consequently be made on vowels, not syllables, here.

In our OT-framed formal apparatus, Present tense stress falls out from the following two constraints and the corresponding mutual ranking:

The familiar "#" symbol stands for a word boundary without, however, specifying whether the left or the right one. The difference is obviously crucial here, and accordingly we are enriching the formalism with a context-signalling underscore "_#" signalling right-hand positioning. Compare the also dual symbol "[. . .]", its two components with distinct graphics and their mutual positions in the segmental string hence unambiguous.

CONSTRAINTS:	AL-L(ˈV, _#)$^{\text{PRES}}$:	ˈV and _# left-align in Present tenses.
	¬AL-L(ˈV, _#)$^{\text{PRES}}$:	ˈV and _# do not left-align in Present tenses.
RANKING:	¬AL-L(ˈV, _#)$^{\text{PRES}}$ >> AL-L(ˈV, _#)$^{\text{PRES}}$	

The following evaluations illustrate the approach we are developing:

lˈavas	¬AL-L (ˈV, _#)$^{\text{PRES}}$ >>	AL-L (ˈV, _#)$^{\text{PRES}}$	'you-sg wash'
lˈ**a**v-a-s#		*	
lav-ˈ**á**-s#	*!		
lavˈais			'you-pl wash'
lav-ˈ**á**-is#		*	
lˈ**a**v-a-is		**!	
lav-a-ˈ**í**s#	*!		
alˈabas			'you-sg praise'
alˈ**a**b-a-s#		*	
alab-ˈ**á**-s#	*!		
ˈálab-a-s#		**!	
alabˈáis			'you-pl praise'
alab-ˈ**á**-is#		*	
alˈ**a**b-a-is#			
alab-a-ˈ**í**s#	*!	**!	

As pointed out already, the *lavˈ**ái**s/alabˈ**ái**s* pattern falls outside the scope of Doner's (2017) analysis.

The ¬AL-L(ˈV, _#)^{PRES}-violating monosyllabic *dˈas* 'you-sg give' from *dˈar* (compare disyllabic *dˈonas* 'you-sg donate') also fits with our present model, on simple incorporation of a dominant WDSTRESS constraint ruling out stressless non-clitic words:

WDSTRESS: Non-clitic words bear stress.

Clitics by definition carry no word stress: e.g. ***se lo*** *dˈa* ***a*** *Pˈedro* 'he/etc. gives it to Peter'. In-depth analysis of phrase-bounded post-lexical Spanish secondary stress is available in Roca (1986).

The following evaluation displays the mechanics of the Present tense stress apparatus we are advancing (*das* 'you (informal) give):

das	WDSTRESS >>	¬AL-L(ˈV, _#)^{PRES} >>	AL-L(ˈV, _#)^{PRES}	'you-sg give'
dˈas		*		
das	*!		*	

Our examination of Spanish 1st conjugation stress ends here. Next we turn to the 2nd and 3rd conjugations, already anticipated to raise a number of substantial analytic challenges.

3.6. 2nd and 3rd conjugation Past tenses

We now enumerate the 2nd and 3rd conjugations Past tense forms with their respective stress patterns, beginning with the Imperfects:

The mutual phonological (indeed phonetic) proximity of our three chosen model verbs *lavar* 'to wash', *beber* 'to drink', *vivir* 'to live' advantageously renders their contrasts quasi-minimal, in this way facilitating mutual comparison. The common /b/ sound correspondence of the Spanish *b* and *v* letters obviously needs bearing in mind in this connection.

PRETERITE INDICATIVE '. . . drank'; '. . . lived':
2nd: Sg 1beb-ˈ**í**, 2beb-ˈ**i**-ste, 3beb-i-ˈ**ó**; Pl 1beb-ˈ**i**-mos, 2beb-ˈ**i**-ste-is, 3beb-iˈ**e**-ro-n
3rd: Sg 1viv-ˈ**í**, 2viv-ˈ**i**-ste, 3viv-iˈ-**ó**; Pl 1viv-ˈ**i**-mos, 2viv-ˈ**i**-ste-is, 3viv-iˈ**e**-ro-n

The diverging morphological constituency of 3sg *beb-**i-ó***, *viv-**i-ó***, on the one hand, and 3pl *beb-**iˈe**-ro-n*, *viv-**iˈe**-ro-n*, on the other, needs noting. In *beb-iˈe-ro-n*, *viv-iˈe-ro-n*, *-n* clearly materialises the 3pl morpheme, *-ro-* the TAM, and *iˈe* consequently the TV, here diphthongal as is also in *beb-ie-ra*, etc., *viv-ie-ra*, etc., and other similar forms to be introduced later in the section. In contrast, in *beb-i-ó*, *viv-i-ó*, we are taking *-i-* to be the TV, and *-ó* the TAM; Spanish of course lacks a 3sg PN morpheme. An alternative parsing of *io* as a diphthongal TV in line with the 3pl *-ie-*, while better fitting with the stress positioning (simply post-Root on this analysis), nonetheless appears to lack any empirical backing other than from stress itself, circularly. We will be taking up this matter shortly, for now resuming our 2nd and 3rd conjugation Past tense inventory:

PRETERITE INDICATIVE '. . . drank'; '. . . lived':
2nd: Sg 1beb-ˈ**í**, 2beb-ˈ**i**-ste, 3beb-i-ˈ**ó**; Pl 1beb-ˈ**i**-mos, 2beb-ˈ**i**-ste-is, 3beb-iˈ**e**-ro-n
3rd: Sg 1viv-ˈ**í**, 2viv-ˈ**i**-ste, 3viv-iˈ-**ó**; Pl 1viv-ˈ**i**-mos, 2viv-ˈ**i**-ste-is, 3viv-iˈ**e**-ro-n

IMPERFECT INDICATIVE '. . . was/were drinking/living; used to drink/live':
2nd: Sg 1beb-ˈí-a, 2beb-ˈí-a-s, 3beb-ˈí-a; Pl 1beb-ˈí-a-mos, 2beb-ˈí-a-is, 3beb-ˈí-a-n
3rd: Sg 1viv-ˈí-a, 2viv-ˈí-a-s, 3viv-ˈí-a; Pl 1viv-ˈí-a-mos, 2viv-ˈí-a-is, 3viv-ˈí-a-n

IMPERFECT SUBJUNCTIVE 1:
2nd: Sg 1beb-i'e-ra, 2beb-i'e-ra-s, 3beb-i'e-ra; Pl 1beb-i'é-ra-mos, 2beb-i'e-ra-is, 3beb-i'e-ra-n
3rd: Sg 1viv-i'e-ra, 2viv-i'e-ra-s, 3viv-i'e-ra; Pl 1viv-i'é-ra-mos, 2viv-i'e-ra-is, 3viv-i'e-ra-n

IMPERFECT SUBJUNCTIVE 2:
2nd: Sg 1beb-i'e-se, 2beb-i'e-se-s, 3beb-i'e-se; Pl 1beb-i'é-se-mos, 2beb-i'e-se-is, 3beb-i'e-se-n
3rd: Sg 1viv-i'e-se, 2viv-i'e-se-s, 3viv-i'e-se; Pl 1viv-i'é-se-mos, 2viv-i'e-se-is, 3viv-i'e-se-n

The now obsolete "future" subjunctive conjugates similarly:

"FUTURE" SUBJUNCTIVE:
2nd: Sg 1beb-i'e-re, 2beb-i'e-re-s, 3beb-i'e-re; Pl 1beb-i'é-re-mos, 2beb-i'e-re-is, 3beb-i'e-re-n
3rd: Sg 1viv-i'e-re, 2viv-i'e-re-s, 3viv-i'e-re; Pl 1viv-i'é-re-mos, 2viv-i'e-re-is, 3viv-i'e-re-n

All these forms but the noted *beb-i-'ó/viv-i-'ó* carry stress on the morpheme immediately post-Root, in line with the 1st conjugation's *lav-'ó*. One crucial difference with the 1st conjugation nonetheless obtains. In the 1st conjugation, stress falls on the only vowel available in the target position: cf. *lav-ó*, *lav-'a-ron*, *lav-'a-ba*, etc.; *lav-'a-ra*, etc.; *lav-'a-se*, etc.; *lav-'a-re*, etc., with stress indeed post-Root throughout. In the 2nd and 3rd conjugations, however, a number of forms include *two* adjacent tautosyllabic post-Root H∇ vowels (often, although not always, tautomorphemic) with stress on the second, not the first:

H = high vowel (i, u), ∇ = non-high vowel (a, e, o) throughout the exposition here.

PAST PERFECT INDICATIVE (aka INDEFINITE): 2nd conj. 3sg beb-**i-'ó**, 3pl beb-**i'e**-ro-n; 3rd conj. 3sg viv-**i-'ó**, 3pl viv-**i'e**-ro-n
PAST IMPERFECT SUBJUNCTIVE 1: 2nd conj. beb-**i'e**-ra, etc.; 3rd conj. viv-**i'e**-ra, etc.
PAST IMPERFECT SUBJUNCTIVE 2: 2nd conj. beb-**i'e**-se, etc.; 3rd conj. viv-**i'e**-se, etc.
"FUTURE" SUBJUNCTIVE: 2nd conj. beb-**i'e**-re, etc.; 3rd conj. viv-**i'e**-re, etc.

The question that arises concerns the stresslessness of the first vowel *i* notwithstanding its immediately post-Root position: cf. **beb-**'**i**e-re*, etc. The answer, however, is straightforward. First, our formulated P-RT MPH STRESS^{PAST} constraint enforces stress on the Past tense post-Root **morpheme**, not the post-Root **vowel**: cf. indeed ***beb-i'e**-re*, etc. Second, the occurrence of stress on the second of the two adjacent vowels rather than the first (*beb-i'e-re*, not **beb-'i.e-re*) is attributable to the hiatus-inhibiting ONSET constraint, fully active in Spanish: cf. Roca (2016) and section 6. ONSET reads as follows:

ONSET: A syllable includes an overt onset.

ONSET hence bars stress from the *ie* cluster's high vowel [i] (cf. **beb-'í.e-re*). The also *i*-stressed ONSET-compliant **beb-'i͡e-re* alternative is in turn ruled out on a universal GEN principle restricting stress to the syllable sonority peak formulated in Roca (2016: 66) in the shape of the following slightly reworded constraint:

SON PK = SYLL PK: A sonority peak and a syllable peak mutually correspond.

I now restate P-RT MPH STRESS^{PAST} as a reminder:

P-Rt Mph Stress^{PAST}: Al-L (ˈV, Post-Root Morpheme) in past tenses.

At the time we saw Onset be redundant in the 1st conjugation. In the 2nd and 3rd conjugations, however, Onset directly bears on the syllabification of the *-io* and *-ie-* clusters. In *beb-ie-ro-n*, for instance, the placement of stress on the second of the two adjacent vowels rather than on the first indeed falls out from Onset:

bebiˈeron	P-Rt Mph Stress^{PAST}	Onset	'they drank^{PAST}'
beb-iˈe-ro-n			
beb-ˈi.e-ro-n		*!	
beb-i.ˈe-ro-n		*!	
bˈeb-ie-ro-n	*!		
beb-ie-rˈón	*!		

A possible additional input candidate with an ˈîe contour again, omitted here, simply fails to output GEN.

The machinery now in place still falls short of accounting for the 3sg *bebiˈó* winner:

bebiˈó	P-Rt Mph Stress^{PAST}, Onset	'they drank'
✓beb-i-ˈo	*	
*beb-ˈí.-o	*	
*bˈeb-i-o	*	

The three candidates draw on number of level-ranked constraint violations, correct *bebiˈó* consequently failing to prevail. A P-Rt Mph Stress^{PAST} >> Onset ranking in turn yields a counterfactual **beb-ˈí.-o* winner, and an Onset >> P-Rt Mph Stress^{PAST} alternative a Π*beb-i-ˈo* and **bˈeb-i-o* draw:

bebió	P-Rt Mph Stress^{PAST} >> Onset	'he, etc., drank'
*beb-ˈí.-o	*	
bˈeb-i-o	*!	
✓beb-i-ˈo	*!	

bebió	Onset >> P-Rt Mph Stress^{PAST}	'he, etc., drank'
✓beb-i-ˈo	*	
*bˈeb-i-o	*	
beb-ˈí.- o	*!	

Our current machinery provides no obvious way of eschewing these false outcomes. Nonetheless, the appositeness of the corresponding analyses does however suggest that the *bebió* contour is at fault, not the flawless majority of the analyses or the analysis itself.

Understanding this problem takes us back into history. In particular and crucially, present-day *bebiˈó* indeed was *bebˈí.o* not that long ago. Thus, writing in the early 20th century, Menéndez Pidal (1962 [1904]: 39, fn. 1) reports that

> la preferencia del habla vulgar por el diptongo (§31_2 n.) hace que en ella abunde más la dislocación del acento a favor de la vocal más abierta [the low-class speech preference for the diphthong makes stress dislocation onto the more open vowel more abundant there],

in this connection mentioning an Imperfect *deciá* for *decía* (§117$_2$). Indeed, he notes that the

> *-ie-* medieval llevaba etimológicamente el acento en la *i* [. . .] siendo [el] medio más común de deshacer el hiato el formar un diptongo que necesitaba trasposición de acento sobre la vocal más abierta (§62): *tenién*, *comién*, *vivién* [the medieval *-ie-*'s etymological accent fell on the *i* . . ., and the commonest means of undoing the hiatus involved forming a diphthong with stress transposition onto the more open vowel: *tenién*, *comién*, *vivién*]. (p. 306 §117)

He further indicates that "el acento etimológico subsiste en el leonés occidental: *partíu*, *rumpíu*" [the etymological accent survives in Western Leonese: *partíu*, *rumpíu*] (p. 311) and that "en las aldeas de Astorga, San Justo y San Román se conserva aún hoy *you habié*, *tú habiés*, *eillos habién*, *él jacié*" [in the villages of San Justo and San Román *you habié*, *tú habiés*, *eillos habién*, *él jacié* live on down to this day] (pp. 317–318).

Consider also *part'i͡u* 'he, etc., broke' in contemporary Galician, a next-door neighbour to Leonese geographically, and partially akin to it formally, albeit still distinct.

We have just seen that *beb'í.o* is generated from *beb-'í.-o* on a P-Rt Mph Stress^{PAST} >> Onset ranking, in keeping with *bebi'eron* (> *beb-i'e-ro-n*) and the other relevant cases. What thus happened historically at some point was that the language's general aversion to vowel hiatus overpowered the extant heterosyllabicity-inducing forces, concomitantly triggering a stress shift from *beb'í.o* to *bebi'ó*.

Synchronically, *bebi'ó* simply constitutes a straightforward exception to our current otherwise fully successful grammar, and consequently it needs encoding as such. I shall simply follow Pater (2010) and postulate a TAM stress-promoting constraint Al-l ('V, TAM$^{\text{3sg 2nd/3rd conj. Pret}}$) prioritised in the ranking over the regular P-Rt Mph Stress^{PAST} on Stringency grounds:

Al-l ('V, TAM$^{\text{3sg 2nd/3rd conj. Pret}}$): In the 2nd and 3rd conjugation Preterite, the stressed vowel in the 2nd and 3rd person singular left-aligns with the TAM morpheme.

Pater indeed sums up the crux of the general situation as follows: "I have [. . .] provided a learnability account in which indexed constraints are created to deal with inconsistency in the learning data" (2010: 25).

It bears reminding generally in the present connection that languages are not the output of highly trained teams of sophisticated draftsmen engaged in the composition of perfectly geometric shapes on pre-arranged brand new clean spreadsheets. Rather, languages are the result of spontaneous *pêle-mêle* secular evolution, over millennia, in the mouths, ears and brains of large numbers of ordinary human individuals continuously engaged in mostly unmonitored random mutual interactions.

The evaluation that follows spells out the strategy's formal mechanics:

bebi'ó	Al-L ('V, TAM$^{\text{3sg 2nd/3rd conj. Pret}}$) >>	P-Rt Mph Stress^{PAST} >>	Onset	'he, etc., drank'
beb-i-'o		*		
beb-'í.- o	*!		*	
b'eb-i-o	*!*			

Doner's (2017: 26, 38) account (but not ours) also runs into the problem in the 1st conjugation. Her analysis indeed requires LLR(S) stress settings ("insert a **L**eft bracket to the **L**eft of the **R**ight **S**tem edge") for both the 1st person forms and the 3rd person singular, but RRR(S) for both 2nd person forms and the 3rd person plural, all of this at odds with the Spanish stress settings' tendency toward regular uniformity.

The *bebiˈó* stress transposition obviously failed to take place in Imperfect Indicative *bebˈía*, with the two adjacent vowels *i*, *a* also heteromorphemic (-*i*- is the TV, and -*a* the TAM), and the -*i*-*a* morphological structure thus matches the 1st conjugation's -*a*-*ba*-. Our P-RT MPH STRESS-PAST constraint correspondingly places stress on the post-RT morpheme -*i*-:

> The scope of the "3sg 2nd/3rd conj. Pret" restriction responsible for *bebió* is of course limited to this one form, and hence orthogonal to *bebía*.

bebˈí.a	P-RT MPH STRESS^{PAST}	>> ONSET	'he, etc., was drinking'
beb-ˈí.-a		*	
beb-i-.ˈá	*!	*	
beb-i-ˈá	*!		
bˈeb-i-a	*!		

As expected, stress falls on the post-Root morpheme, the TV *i* here. Correspondingly, the two adjacent vowels parse heterosyllabically (*ˈí.a*), again on the by-now familiar GEN restriction that limits syllable peak assignment to local sonority peaks (see earlier discussion), which would be contravened by *ˈ*ía*'s tautosyllabicity.

Our presentation of both the morphological structure and the stress patterns of the Spanish regular Past tenses in the three conjugations is now complete. In the next section, we shall consider the 2nd and 3rd conjugations' two Future Indicative tenses, viz. the Future and the Conditional, both of which with stress on the TAM morpheme.

As pointed out earlier, the now obsolete "Future" Subjunctive was semantically not a Future as such. Morphologically and accentually, it patterns with the two Past Subjunctive tenses.

3.7. 2nd and 3rd conjugation Future tenses

The 2nd and 3rd conjugation Future tenses with their respective stress loci now follow:

FUTURE 'I, etc., will drink/live':
Sg 1beb-e-**rˈé**, 2beb-e -rˈ**á**-s, 3beb-e -rˈ**á**; Pl 1beb-e-rˈ**e**-mos, 2beb-e-rˈ**é**-is, 3beb-e-rˈ**á**-n
Sg 1viv-i-**rˈé**, 2viv-i-rˈ**á**-s, 3viv-i-rˈ**á**; Pl 1viv-i-rˈ**e**-mos, 2viv-i-rˈ**é**-is, 3viv-i-rˈ**á**-n

CONDITIONAL 'I, etc., would drink/live':
Sg 1beb-e-**rˈí**a, 2beb-e-rˈ**í**a-s, 3beb-e-rˈ**í**a; Pl 1beb-e-rˈ**í**a-mos, 2beb-e-rˈ**í**a-is, 3beb-e-rˈ**í**a-n
Sg 1viv-i-**rˈí**a, 2viv-i-rˈ**í**a-s, 3viv-i-rˈ**í**a; Pl 1viv-i-rˈ**í**a-mos, 2viv-i-rˈ**í**a-is, 3viv-i-rˈ**í**a-n

The Future morpheme's alternating ***re/ra*** vowel systematically bears stress: *beb-e-**rˈé***, *beb-e-rˈ**á**-s*, etc. The Conditional's *ría* derives historically from the *ía* Past Imperfect Indicative sequence examined in section 3.6: compare Conditional *beber**ía***, *vivir**ía***, with Imperfect *beb**ía***, *viv**ía***; the *ia* cluster is heterosyllabic (*í.a*) in both. The Imperfect's *í* is additionally heteromorphemic (*beb-í-a/viv-í-a*: cf. 1st conj. *lav-a-ba*), while the Conditional's is tautomorphemic (*beb-e-ría*, *viv-i-ría*).

It is, however, heteromorphemic in O-M&A's remarkably abstract analysis, which we shall briefly refer to later on.

We already have attributed the Imperfect's -ˈ*i*- stress to its immediately post-Root position. The Conditional's -ˈ*i*- poses, however, the challenge of a tautomorphemic *i*V cluster that is heterosyllabic for no obvious reason.

Doner's (2017) data restriction to the 1st conjugation limits the occurrence of vowel clusters to the 2pl tautosyllabic sonority-falling *ai*, *ei* and the heterosyllabic sonority-rising *'í.a* (*lav-a-rí.a*, etc.).

STRESSLESS: 2pl lav-ˈa-b**a–i**s, lav-ˈa-st**e–i**s, lav-ˈa-r**a–i**s, lav-ˈa-s**e–i**s, lav-ˈa-r**e–i**s
STRESSED: ˈ∇H (H = high vowel; ∇ = nonhigh) 2pl lav-a-rˈ**é–i**s, lav-ˈ**á–i**s, lav-ˈ**é–i**s;
ˈH∇ lav-a-rˈ**í.a**, etc.

The Conditional's -*ía* ending is a historical clipping of the originally verb-postposed *haber* Imperfect Indicative: *bebería* < *beber* + *(hab)-ía*. Currently, *i* stress falls out from our Past tense Post-Root Morpheme Stress constraint, a target met by -*i*- here. In *beb-e-rˈí.a*, however, both **beb-e-ri.ˈá* and **beb-e-riˈá* also comply with AL-L (ˈV, MORPH^{FUT}): "a ˈV aligns with the Future morpheme." We next consider the plain Future, before tackling the Conditional:

beb-e-r'é	AL-L (ˈV, MORPH)^{FUT}	'I will drink'
beb-e-rˈé		
beb-ˈe-re	*!	
bˈéb-e-re	*!*	

Correct *beberˈé* thus indeed comes out the winner.

In the Conditional (= Future Past), however, AL-L (ˈV, MORPH)^{FUT} by itself yields a draw between the three relevant candidates:

beb-e-r'í.a	AL-L (ˈV, MORPH^{FUT})	'I would drink'
✓beb-e-rˈí.a		
*beb-e-ri.ˈá		
*beb-e-riˈá		

The solution involves a narrowing of ALIGN's scope to AL(IGN)-L(EFT), as follows:

AL-L(ˈV, MORPH)^{FUT}: ˈV aligns with the Future morpheme's **left** edge.

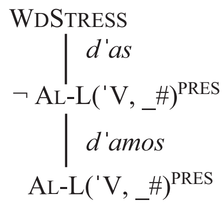
AL-L(ˈV, MORPH)^{FUT} obviously needs to outrank ONSET:

beb-e-r'í.a	AL-L(ˈV, MORPH)^{FUT} >>	ONSET	'I would drink'
beb-e-rˈí.a		*	
beb-e-ri.ˈá	*!	*	
beb-e-riˈá	*!		

The two Hasse diagrams enriched with sample data that follow in Figure 8.1 display the two stress grammars built so far:

We shall end the section with a brief comparison of our approach to the Conditional and O-M&A's. Ours involves the single constraint AL-L(ˈV, TAM^{FUT}), whereas O-M&A's necessitates the rich machinery that now follows.

First, a synchronic Future TAM morphological division into a tense (T) morpheme *r* and a T's TV *e/a* (*beb-e-**r-é***, *beb-e-**r-á***, etc.), for which O-M&A (2005: 54, (20)) adduce both Oltra-Massuet's (1999) and Arregi's (2000) backing. Similarly, OM&A's (p. 54) OM&A's Conditional -*ría* analysis (p. 54) as a T+T-TV complex, in parallel with the Imperfect Past surface ∅+*a*.



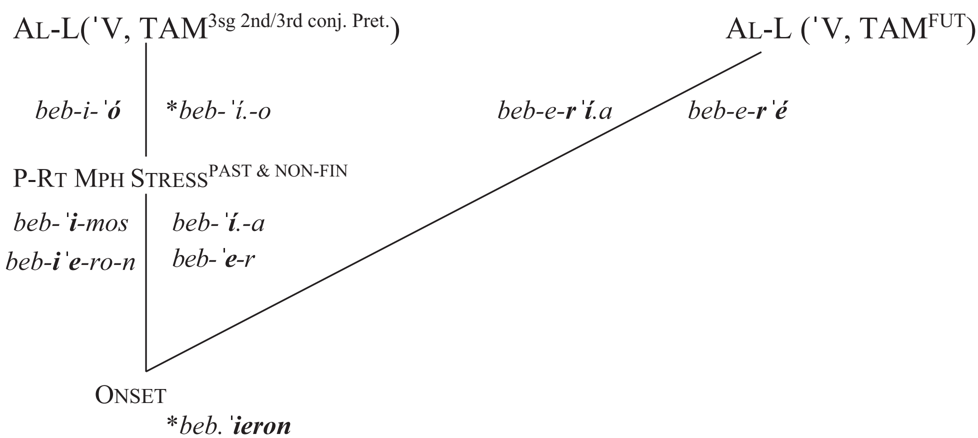


Figure 8.1 First Hasse diagram

Following from this, O-M&A assign Conditional stress to the T-TV {i}, whence *beb-e-r-**í**-a*, paralleling the 2nd and 3rd conjugations' Imperfect *beb-**í**-a*, *viv-**í**-a*. The table that follows spells out this analysis:

O-M&A's (2005: 54, (20)) Conditional's analysis as Future + Past:

	[√ [v Th	**F**	**Th**]	[**T Th**]	√ = root; v = verb; Th = TV; F = Future; T = tense
Fut		**r**	**á/é**		
Cond		**r**	**í**	Ø **a**	
Imp Ind				Ø **a**	

The complexity and abstractness of these structures, in keeping with O-M&A's -grounded overall analysis, is notable: Doner (2017: section 6.2, pp. 53ff.) provides a detailed critical evaluation. In sharp contrast, our present machinery makes do with the one AL-L('V, TAM^{FUT}) constraint, in full agreement with the surface facts.

3.8. 2nd and 3rd conjugation non-finite forms

Next we review the 2nd and 3rd conjugations' three non-finite forms:

	INFINITIVE	GERUND	PAST PARTICIPLE
2nd conj.	beb-'e-r	beb-i'end-o	beb-'i-do
3rd conj.	viv-'i-r	viv-i'end-o	viv-'i-do

All the additional observations we made about the equivalent 1st conjugation set also apply here: the Infinitive's ready nominalisation *el beber/el vivir* (*de Pedro*) '(Peter's) drinking/living', with plurals *los beberes/los vivires* 'the drinkings/livings'; the Past Participle's pluralisation and genderisation *bebido(s)/a(s)* 'drunk (M/F(pl))'; and, indeed, the Gerund's possible if not usual colloquial light-hearted diminutivisation into *bebiendito/viviendito* 'drinking/living-DIM'.

An anonymous reviewer suggests *corriendito* 'running-DIM' as a more idiomatic example.

With regard to stress, it likewise falls on the respective TVs, the Gerund's $i + e$ and the Past Participle's single *i* here. The pattern consequently needs construing as post-Root, as in Past tenses, or else integrating with noun stress, to be analysed in section 5. Either way, stress will appositely fall on the cluster's second, more open vowel, *e*, its tautosyllabicity in turn falling out from ONSET:

	P-RT MPH STRESS^NON-FIN >>	ONSET
beb-iˈe-ndo		
beb-i.ˈe-ndo		*!
beb-ˈi.e-ndo		*!

3.9. 2nd and 3rd conjugation Imperative forms

The 2nd and 3rd conjugation Imperatives display the same stress patterns as in the 1st conjugation:

	2nd conj.	3rd conj.
2sg	bˈebe	vˈive
2pl	bebˈed	vivˈid

Also as in the 1st conjugation, the two official Imperative plurals are learned and reserved for formal occasions, the Infinitive otherwise normally substituting: *bebˈer*, *vivˈir*. The word-final unstressed syllable' $i > e$ shift (*viv**e(-s/n)***), with the concomitant 2nd and 3rd conjugation neutralisation (*bˈeb**e**/vˈiv**e***, *bˈeb**e**s/vˈiv**e**s*, *bˈeb**e**n/vˈiv**e**n*), is morphophonological and general throughout the Spanish verb (cf. Roca 2010: 420 (29)).

3.10. 2nd and 3rd conjugation Present tenses

The 2nd and 3rd conjugation Present tense paradigms now follow:

INDICATIVE 'I, etc., drink/live':
2nd: Sg 1bˈeb-o, 2bˈeb-es, 3bˈeb-e; Pl 1beb-ˈ**e**-mos, 2beb-ˈ**e** -is, 3bˈeb-e-n
3rd: Sg 1vˈiv-o, 2vˈiv-e-s, 3vˈiv-e; Pl 1viv-ˈ**i**-mos, 2viv-ˈ**í**-s, 3vˈiv-e-n

SUBJUNCTIVE:
2nd: Sg 1bˈeb-a, 2bˈeb-a-s, 3bˈeb-a; Pl 1beb-ˈ**a**-mos, 2beb-ˈ**a** -is, 3bˈeb-a-n
3rd: Sg 1vˈiv-a, 2vˈiv-a-s, 3vˈiv-a; Pl 1viv-ˈ**a**-mos, 2viv-ˈa-**i**-s, 3vˈiv-a-n

All these stress patterns fit in with the by-now familiar 1st conjugation "stress the second-to-last vowel" principle. The likewise familiar two corresponding constraints, given with their mutual ranking, formalise the situation in OT machinery:

AL-L (ˈV, _#)^PRES:	ˈV and _# align in the Present tenses.
¬AL-L (ˈV, _#)^PRES:	ˈV and _# do not align in the Present tenses.

AL-L (ˈV, _#)^{PRES}: ˈV and _# align in the Present tenses.
RANKING: ¬AL-L (ˈV, _#)^{PRES} >> AL-L (ˈV, _#)^{PRES}

The following evaluations illustrate the mechanics (*bebo* 'I drink', *bebemos* 'we drink', *vivo* 'I live', *vivimos* 'we live'):

b'ebo	¬AL-L (ˈV, _#)^{PRES} >>	AL-L (ˈV, _#)^{PRES}
bˈeb-o		*
beb-ˈó	*!	
beb'emos		
beb-ˈe-mos		*
bˈéb-e-mos		**!
beb-e-mˈós	*!	

v'ivo	¬AL-L (ˈV, _#)^{PRES} >>	AL-L (ˈV, _#)^{PRES}
vˈiv-o		*
viv-ˈó	*!	
viv'imos		
viv-ˈi-mos		*
vˈív-i-mos		**!
viv-i-mˈós	*!	

The 3rd conjugation's 2pl Indicative *vivˈís* poses an obvious challenge to our extant machinery, instead yields **vˈivis*, with stress on the rightmost non-final vowel. In attested *vivˈís*, however, stress falls precisely on the word's last vowel, again in contrast with *lavˈá**i**s*, *bebˈé**i**s*, where the stressed *ˈá*, *ˈé* are followed by the stressless *i*, stress consequently being penultimate on our required vowel count.

I shall now advance a *vivˈís* analysis fully in line with our general vowel-grounded Present tense stress account. Suppose indeed that *vivˈís* is *viv-ˈí-is* in fitting with the Root + TV(+ Tense) + Person Spanish usual verb structure: *viv-ˈí-s*, by contrast, lacks the ***i*** of the 2pl suffix ***–is***, is overt in *lav-á-**is***, *beb-é-**is***. The *viv-ˈí-**is*** alternative now being proposed does include it, and stress concomitantly falls on the penultimate vowel, as per our general outlook on the Present forms.

The strategy we are advancing may at first blush seem contrived, indeed ad hoc. Minimal reflection nonetheless will reveal that it is in fact neither: simply, an [ˈíi] *tautosyllabic* sequence is *un*pronounceable, and the ˈi] realisation hence inevitable. Thus, empirically, while the converse [i.ˈi] sequence, if generally scarce, does turn up in Spanish (cf., e.g., *ch**i.ˈí**ta* 'Shiite' vs. *cˈ**i**ta* 'date', or *ant**i.ˈí**dolo* 'anti-idol' vs. *antˈídoto* 'antidote'), its *ˈí.i* counterpart does not: no such forms come up intuitively, nor do data searches yield any returns. The quasi-phonetic Spanish spelling simply reflects this phonetic reality. In hypothetical contrast, its morphophonemically oriented English counterpart most likely would allow, indeed favour, an *ii* spelling precisely on morphological grounds.

In-depth discussion of the English phonology-spelling interaction with some reference to Spanish is available in Roca (2016).

In sum, it seems reasonable to assume that, orthographic appearances notwithstanding, the *viv**í**s* single [ˈi] corresponds to an {i}+{is} morphological structure, and its *ˈíi* stress pattern is consequently in harmony with the "rightmost nonfinal" analysis we are postulating across the board for the Spanish Present forms. Our proposed stress grammar indeed yields [viv'iis] from /viv-i-is/, at variance with orthographic *vivís*:

viv'*i***is*	¬AL-L ('V, _#)PRES >>	AL-L ('V, _#)PRES
viv-'**i**-is#		*
viv-i-'**í**s#	*!	
v'**í**v-i-**i**s#		**!
viv-'**i**-s#	*!*	

This outcome hence suggests that the motive for the spoken *viví***s**, rather than **viví***is**, indeed concerns phonetics, not phonology, and is consequently external to grammar. An alternative *vivís* analysis as irregular along the lines of, e.g., 1sg Present Indicative *quepo* 'I fit in' (for regular **cabo* from *caber* 'to fit in'), while indeed feasible, would clearly not contribute any advantage here.

Viv'ís falls outside Doner's (2017) exclusively 1st conjugation remit. Her extant machinery yields **v'ivis*.

This ends our analysis of Spanish Present tense stress.

3.11. Strong Preterite

A last set of data needs attention before we close the verb stress section: an irregular class of Preterites with a mixed stress pattern. The indeed irregular "strong" (= stem-stressed) Preterite of the just cited also morphologically irregular 2nd conjugation *caber* 'to fit in' illustrates:

Sg. 1c'**u**p**e**, 2cup'**i**st**e**, 3c'**u**p**o**; Pl. 1cup'**i**m**o**s, 2cup'**i**st**ei**s, 3cupi'**e**r**o**n

This pattern may at first blush seem that of the Present tenses, viz. word-rightmost non-final stress, the computation as usual effected on vowels: cf., e.g., *c'***upe**, *cup'***imos**. The 2pl *cup'***isteis**, with stress on the **third** vowel from the word's end, stands, however, in the way of this analysis: cf. ordinary Present 2pl *cab'***éis** (Ind.), *quep'***áis** (Subj.), both forms indeed with vowel-counted penultimate stress.

On further reflection, however, the quandary turns out only to be apparent: simply, the indeed *irregular* paradigm in question incorporates both the Present tenses' penultimate V stress, in the "strong" 1sg and 3sg forms *c'***upe**, *c'***upo** (cf. Present Indicative *qu'***epo**, *c'***abe**, *cab'***emos**, just like fully regular *b'***ebo**, *b'***ebe**, *beb'***emos**) and the post-Root Past tense stress elsewhere (*cup-'***i***-ste*, *cup-'***i***-mos*, *cup-'***i***-ste-is*, *cup-i'***e***-ro-n*); cf. regular *beb-'***i***-ste*, *beb-'***i***-mos*, *beb-'***i***-ste-is*, *beb-i'***e***-ro-n*. Once this reality is perceived and duly taken on, the strong Preterite stress pattern duality unproblematically integrates in the model we have built, its specificity ("irregularity") resting solely in the mix.

3.12. Our grammar so far

We now close the section with the Hasse diagrams (Figure 8.2) pertinent to the grammar we have proposed for verbs, prior to turning to the analysis of nouns in the next section.

4. Noun morphology: stem-desinence divide

The Spanish "noun" stress location mostly involves having the stressed vowel right-aligned with the "**stem**" (". . . 'V]"), a word-internal constituent possibly followed by a vocalic "**desinence**" ("] . . . #"), stress being in consequence either word penultimate (# . . . **'V**]**V#**) or word final (# . . . **'V]#**). Intervening consonants are as usual irrelevant to the stress computation, exclusively effected on the vowel projection, here in boldface for ease of identification:

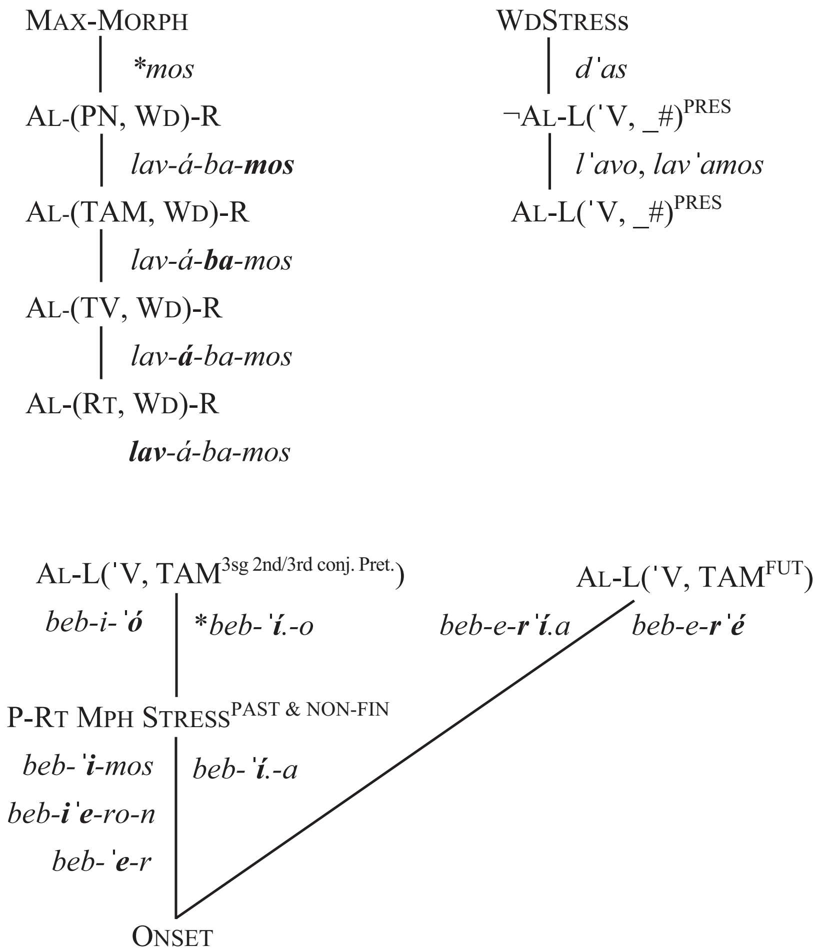


Figure 8.2 Second Hasse diagram

]V#	c'a**p**]**o#**	m'**o**f]**a#**	c'**at**]**e#**	tr'**ib**]**u#**	graf'**it**]**i #**
	'mafia boss'	'scorn'	'exam fail'	'tribe'	'graffiti'
]#	ca**p**'**ó**]#	s**o**f'**á**]#	p**a**t'**é**]#	c**e**b'**ú**]#	j**a**ba**l**'**í**]#
	'car bonnet'	'sofa'	'pâté'	'zebu'	'wild boar'

The Spanish desinence may lexically include a coda *-s* after the vowel, the desinence then correspondingly complex:

]Vs#	c'osm]**os**#	'atl]**as**#	'Alp]**es**#	'tif]**us**#	b'il]**is**#
	'cosmos'	'atlas'	'Alps'	'typhus'	'bile'

A V-initial full suffix directly concatenates to the stem, a possible lexical desinence is hence lost. Addition of the *-ito/a* diminutive suffix to the set of words before last will handily flesh out the situation (NB: a *-c-* increment between a 'V-ending base word and the initial V of the following diminutive suffix is habitual, cf., e.g., *sof'á* > *sofa-***c***-'ito*):

]V#	capo- it]**o#**	mof-ˈit]**a#**	cat-ˈit]**o#**	trib-ˈit]**a#**	grafit-ˈit]**o#**
]#	capo(-c-)ˈi**t]o**#	sofa**-c-**ˈit**]o**#	pate-ˈit]**o#**	cebu-ˈit]**o#**	jabali]ˈit]**o#**

All judgements are mine. An anonymous reviewer expresses disagreement with some, unsurprisingly given the phenomenon's variability.

The *-s#* plural morpheme, where present, immediately follows the vocalic desinence: cap]o# > cap]o**-s**#). The *-avo/a* '-th (= fraction)' partitive suffix combines, however, with the *full* word in the numeral class (*doc**e*** 'twelve' > *doc**ea**vo* '(a) twelfth', *dieci**o**cho* 'eighteen' > *dieciocho**a**vo* '(an) eighteenth', etc.), and lexical marking of such words to this effect is hence required. In forms with a C-ending stem and no desinence, an *-e-* plural augment impedes the formation of a word-final consonant cluster, a phonotactic configuration that Spanish disfavours: cf., e.g., *cˈóndor*]# > *cˈóndor*]***e**-s*# 'condor/s', not **cˈóndo**r**]**s***#. A desinential -s (vir-u**s̲** 'virus') pre-empts overt pluralisation: cf. plural *los vir*]*us*, not **vir*]*us-s* or **vír*]*us-e-s*; the latter nonetheless attested on a speaker's *virus*] *e-s* substandard analysis.

Evidence for the desinence morphological reality hence abounds. Historically, the desinence is but a fossilised remnant of its Latin TV predecessor: cf. Lat. acc. sg. *amˈic-**u**-m* 'friend' (nom. sg. *amˈic-**u**-s*, gen. sg. *amˈic-**i***, dat. sg. *amˈic-**o***, acc. pl. *amˈic-**o**-s*, etc.) > Vulgar Latin *amˈic-**u*** > Sp. *amig-**o***, with stressless *u*# to *o*# generalised historical lowering. Synchronically, the Spanish desinence's main traits concern its strictly word-final position and its just noted usual exclusively vocalic body, the possible *-s* increment excepted: *lej]**o-s*** 'far' > *lej-an]o* 'distant', *alej-ar* 'to move away', not **lejos-an]o*, **a-lejos-ar*; etc. The desinence is thus synchronically a lexical appendix to the stem potentially present in all Spanish words but verbs, in itself meaningless and with no obvious function other than word closure. Gender attribution nonetheless is frequent in the literature, but speciously so, given the desinence's orthogonality to the word's grammatical gender, and, conversely, the compatibility of all desinences with either gender:

As already noted, the word *gender* is here intended with sole reference to grammatical agreement.

la pan]**a** 'the corduroy' vs. **la** man]**o** 'the hand': **same gender** F, **different desinences**] a vs.] o
el pañ]**o** 'the cloth' vs. **la** man]**o** 'the hand': **same desinence**] o, **different genders** M vs. F
el comet]**a** 'the comet' vs. **la** comet]**a** 'the kite': **same desinence**] a, **different genders** M vs. F

The Spanish desinence is thus but a phonetic residue of its Latin TV predecessor, and has no current Spanish import other than its lexically determined presence.

This fact casts obvious doubt on the phi-feature status at times claimed in the literature for the Spanish desinence: cf., e.g., Piñeros (2016), Doner (2017), recently.

What is directly pertinent to our current task is the fact that the desinence consistently eschews stress; indeed, it parses outside the stress domain both in Spanish and in the other Romance languages: cf. Roca (1999). On the traditional outlook, the desinence is simply "extrametrical."

5. Noun stress

5.1. Unmarked stress

Spanish noun stress is stem-final with a frequency of 90.72% in Morales-Front's (2014) corpus, the pattern correspondingly being unmarked.

Morales-Front's (2014) 91,000 corpus originated in the University of Michigan's Linguistic Archive (linguistic.archive. umich.edu; no longer online). It indeed reports (2014: 244–245) a distribution of (on our AL-(ˈV,)] criterion) 90.72% unmarked items (raw number 82,553 items) vs. 9.28% marked (8,447 items).

ˈV]#	manˈá]#	'manna'
ˈVC]#	desvˈán]#	'loft'
ˈV]V#	menˈe]o#	'shake'
ˈVC]V#	mˈan]o#	'hand'

The following alignment constraint yields precisely these results:

AL-L (ˈV,]) : A stressed vowel right-aligns with the Stem boundary.

The constraint's lexical scope includes both desinenced and non-desinenced items, in the singular as well as the plural. The following maximally simplified evaluations, with one constraint each and hence no ranking, appositely demonstrate this ("/(*e*)-*s*" stands for the optional plural):

burˈó/s	AL-L (ˈV,])	'writing desk/s'
burˈó]/s#		
bˈuro]/s#	*!	
desvˈán /e-s		'loft/s'
desvˈán]/-e-s#		
dˈésvan]/-e-s#	*!	
desvan]-ˈé-s#	*!	

As mentioned already, this patently simple machinery accounts for the stress locus of 90.71% of Morales-Front's (2014) 91,000-item corpus, correspondingly defining the unmarked (U) Spanish stress pattern.

The evidence for the noted marked-unmarked imbalance goes beyond lexical statistics, as it also includes behavioural facts present in both children and adults. For the former, an experiment with 50 three- to five-year-old bilingual speakers (Hochberg 1988) revealed substantial positive correlations between the children's error rates and the word's degree of stress markedness on criteria matching ours here. As for adults, they spontaneously assign the patterns in question to acronyms given in capitals and hence by convention without orthographic accent marks (our " ˈ " here is of course the IPA phonetic one): cf. *FˈIFA*, *ˈONU*, *ˈUSA*, *NˈATO*, *UNˈESCO*, *SˈIDA*, *RˈENFE*, *CˈAMPSA*, but *REPSˈOL*, *UNˈED*, *INˈEF*, *INˈEM*, *CEPˈAL*, *ALFˈAL*, *UNICˈEF*, etc.

Words like *ˈébano* 'ebony tree' or *azˈúcar* 'sugar', respectively desinenced and desinenceless (*ˈéban*]***o#***, *azˈúcar*]**#**), do not exhibit the stem-final stress that we would thus far expect:

ˈébano/-s	AL-L (ˈV,])	'ebony tree/s'
*ebˈan]-o/-s#		
✓ˈéban]-o/-s#	*!	

azˈúcar/-e-s	AL-L (ˈV,])	'sugar/s'
*azucˈar]/-e-s#		
✓azˈúcar]/-e-s#	*!	

The **eb'an]o/s*, **azuc'ar]/e-s* counterfactual contours are both legitimate in Spanish: cf., e.g., *hab'an]o/s* 'Havana cigar/s', *azah'ar]/e-s* 'orange blossom/s'. However, they fail to match the extant *'éban]o-s*, *az'úcar]e-s* extant patterns, both of them unobtainable on our present machinery, as a consequence in need of enrichment.

Two distinct issues arise in this connection, one concerning the mechanics responsible for this additional pattern, and the other the identification of the set of words subject to it. Dealing with the latter matter first, the pattern in question is but a Latin legacy; its Spanish lexical scope is hence arbitrary, piecemeal lexical marking consequently being required. A brief excursus on Latin stress will appositely shed background light on the matter.

5.2. Excursus on Latin stress

The Latin stress mechanics were substantially at odds with those of present-day Spanish, notwithstanding the mother-daughter historical relation obtaining between the two languages. Their sole systematic overlap with regard to stress concerns the usual persistence of the Latin stressed vowel as such in Spanish. In the words of Menéndez Pidal (1962: 36, §5bis):

> [E]l acento permanece inalterable desde el tiempo de Plauto, de Horacio, de Prudencio, hasta el de Cervantes y hasta el nuestro, informando como un alma a la palabra, y asegurando la identidad sustancial de esta a pesar de los cambios más profundos que sus otros elementos puedan sufrir. [Stress remains unchanged since the time of Plautus, Horace, Prudence, until that of Cervantes and our own, informing the word like a soul and ensuring its substantial identity regardless of the more profound changes its other elements may have undergone.]

This reality notwithstanding, a strand of Spanish noun stress research has through the years argued for Spanish continuity of the Latin stress mechanics.

Cf. Foley (1965), Harris (1967, 1969), and Otero (1986) in the early days. I myself more recently felt obliged to pay service to this tradition (Roca 2005), as the following quotes encapsulate: "we shall be showing below that important elements of the Latin [stress] system apparently persist in present-day Spanish" (p. 354); "the majority of the Latin stress settings can be assumed to live on in Spanish" (p. 357); "the presence of the Spanish binary trochee outside the unmarked set can plausibly be related to Latin" (p. 366); "[m]ost relevant parameters remain set as in Latin" (p. 375); "persistence in Spanish of the Latin ICC [Iterative Constituent Construction; IMR], and of the line 1 R settings for both Edge Marking (in all three components) and Head Location" (p. 380); "[t]he remainder of the parameters made available by Halle & Idsardi's theory keep the settings they had in Latin, with the possible exception of SBP" (p. 390). More recently, Piñeros (2016) explicitly takes sides against the exclusion of the desinence from the Spanish stress domain, on two grounds: (i) an analysis involving a word-final trochee accounts for two thirds of the lexicon, and the desinence is obviously required to complete such trochees; and (ii) the desinence's exclusion from the stress domain is Spanish-specific. The first argument is clearly vacuous, since our stem-alignment alternative accounts for 90.72% of the words, and 90.72% outruns two thirds (66.66%) by some margin. The second is specious, since stress-stem alignment also accounts for stress in the bulk of the Romance languages (Roca 1990), hence not being language-specific.

A thumbnail account of the Latin stress system will at this point help dispel possible doubts about the Spanish one's independence from it.

Latin's stress distribution hinged on both length oppositions among vowels and quantity differences among syllables, the former along the lines of the English short [ɪ] vs. long [iː] opposition, respectively embodied in *bit* and *beat*: Latin indeed was in possession of two vowel sets differentiated on length, viz. short [i, e, a, o, u] (e.g. *li̱ber* 'book') and long [iː, eː, aː, oː, uː] (e.g. *l**i̱ː**ber* 'free'). Moreover, also as in English, Latin syllables were either light or heavy: light with a short nucleus vowel and no coda (e.g. ˈ*an**i̱.**ma* 'soul', *dom*ˈ*est**i̱.**cus* 'domestic'), and heavy otherwise (*ref*ˈ***e̱ː.**cit* 'rebuilt', *perf*ˈ***e̱c̱.**tum* 'finished'). Additionally, the Latin word-final syllable systematically was "extrametrical" (< . . . >), and hence excluded from the stress domain, except for monosyllables on account of the general requirement of the word stress realisation encapsulated in the WDSTRESS constraint formulated in section 3.5: cf. Latin ˈ*ani**<**ma*>, *dom*ˈ*esti**<**cus*>, *ref*ˈ***eː<.**cit*>, *perf*ˈ***ec<**tum*>, but *m*ˈ*ons* 'mountain', not stressless *<*mons*>.

On this basis, Latin's "foot" construction would take place iteratively from right to left, the "foot" itself being the basic metrical constituent, in Latin inclusive of precisely two "moras" (μ μ), not one (μ) or three (μ μ μ). The mora in turn is the unit of segmental quantity; the /iː/ of English [ˈsiːtɐ] (*seater*) hence comprises two, and the /ɪ/ of [ˈsɪtɐ] (*sitter*) just the one. Each Latin foot (X.Y) thus included precisely two moras, hence (ˈ***a̱***$^{\mu}$.*n**i̱***$^{\mu}$)<*ma*>, *do(m*ˈ***e̱***$^{\mu}$***s̱***$^{\mu}$*)ti**<**cus*>), *re*(f***e̱***$^{\mu\mu}$)**<***cit*>, *per(f**e̱***$^{\mu}$***c̱***$^{\mu}$**)<***tum*>.

The Latin stress locus was thus a function of the word's metrical structure. First, the word-final syllable (monosyllables again excluded) was extrametrical. Second, a left-headed foot inclusive of precisely two moras, whether distributed over two light syllables or accumulated in one heavy one, right-aligned with the word's remainder, all indeed as shown in the preceding examples.

Decisively for us here, Latin's vowel length differences got lost in the course of its evolution into both Spanish and other Romance languages, all the vowels hence becoming short. As a consequence, the Latin stress system underwent automatic collapse.

Hall (1976: 182) indeed comments on the post-Latin situation thus: "several [. . .] sound changes [. . .] resulted in the position of stress becoming unpredictable [. . .]. In these circumstances, it is therefore necessary to mark significant stress."

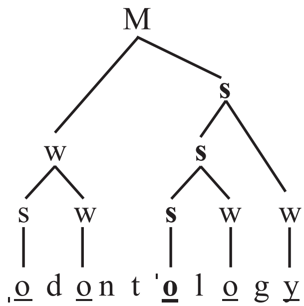
As a result, the Spanish stress locus became unpredictable on prosodic grounds, whence our present appeal to morphology and lexical marking instead.

5.3. Back to Spanish: marked stress

Having thus established the need for lexical tagging of Spanish marked stress ("M") in Spanish ("M" here of course stands for "marked," not for "masculine"), we can proceed to the investigation of the formal mechanism responsible for the location of stress itself.

Our "M" mark hacks back to Harris's (1975) "X" diacritic, and subsequently was taken on by Hooper and Terrell (1976). Harris (1975) indeed commendably acknowledges as a shortcoming his earlier (1967, 1969) resort to abstract underlying representations incorporating ad hoc Latin-like vowel length differences, which we know (and no doubt he then knew) in Spanish do not obtain. The model Harris was then working in (Chomsky and Halle's *The Sound Pattern of English*) did, however, countenance this permissiveness.

Both Harris's doctoral dissertation (Harris 1967) and its subsequent book version (Harris 1969) approach Spanish stress as a function of the word's segmental string. The Chomsky and Halle (1968) stress account Harris built his early work on soon, however, was superseded by Liberman and Prince's (L&P) (1977) metrical alternative with arboreal structures as a formal reflection of the participating elements' hierarchical prominence contrasts, as follows (*M* = "Mot" = word; *s* = strong, *w* = weak; fully structurally connected ***s***'s are given in bold):



(L&P 1977: 282)

Consequently, ˌ*odont*ˈ*ology* has the main stress on *to* and a secondary one on the initial *o*.

Significantly, however, both L&P's discovery and the ensuing account were concerned with English, a language indeed known to be endowed with rhythmically driven stress: cf. L&P's very work title "On Stress and Linguistic *Rhythm*" [my emphasis]. Unsurprisingly, but not always appropriately, L&P's successful analysis of English soon led researchers to extend its rhythmic grounding to non-rhythmic languages, Spanish among them: cf. Harris's (1983) ensuing monograph *Syllable Structure and Stress in Spanish: A Non-Linear Analysis*, a straight application to Spanish of L&P's English-based approach. This trend notwithstanding, Spanish rhythm and concomitantly Spanish stress are clearly not metrical in the manner their English counterparts are: consider indeed the traditional distinction between stress-timed rhythm (English) and syllable-timed rhythm (Spanish), also informally and more transparently referred to as "Morse code rhythm" (English) and "machine-gun rhythm" (Spanish).

In the context of these objective realities, L&P's stress model, while indeed suitable for English, is patently inappropriate for Spanish. Notwithstanding this obvious fact, L&P's English analysis soon got transferred to Spanish (Harris 1983) as well as to a number of other syllable-timed languages.

The one aspect of relevance in Spanish stress in our present context concerns M noun stress, evidently outside the scope of our extant AL-L (ˈV,]) constraint: cf., e.g., *ébano* or *azúcar* in section 5.1. In particular, Spanish M stress then got accounted for (and still often does) on a stem right-aligned binary trochee, as follows (cf., e.g., Roca 2019):

/M/	**BINFT^{M}, TROCH, AL**-),] >>	AL-L (ˈV]) >>	PARSE-SYLL
al(mˈíbar)]#		*	*
al(mibˈar)]#	*!		*
almi(bˈar)]#	*!		**
(ˈálmi)bar]#	*!		**

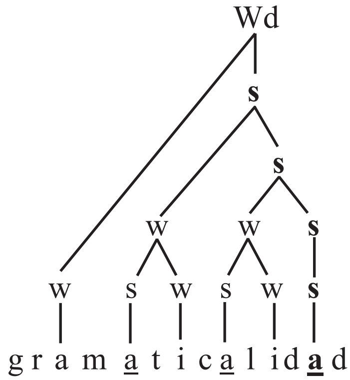
This complex and ostensibly Spanish-alien stress apparatus (by now we know of Spanish stress's dissimilarity with English's, indeed with Latin's) can straightforwardly be dispensed with on simple appeal to the two AL-L (ˈV,_#) and ¬AL-L (ˈV,_#) constraints already familiar to us here for their role in the Spanish Present tense verb stress, as follows:

Present tenses ¬AL-L (ˈV,_#)^{PRES} >> AL-L (ˈV,_#)^{PRES}
Nouns ¬AL-L (ˈV, _])^{M} >> AL-L (ˈV, _])

This remarkably simple apparatus enables whole dispensation with metrics for the two overwhelmingly predominant Spanish non-verb stress patterns U and M. Only the extraneous stress patterns we shall examine in section 5.4 fall outside this grammar, precisely in line with their extraneousness.

Harris (1983)—as we know the classical post-SPE monographic account of Spanish non-verb stress—indeed approaches the task along L&P's lines, as follows (Harris 1983: 96):

Harris's procedure generates secondary stresses in tandem with the primary stress, whence *gra*(*m*ˌ*ati*)(*c*ˌ*ali*)(*d*ˈ*ad*) here. As subsequently argued in Roca (1986), however, such secondary stresses, if at all present in Spanish, are generated post-lexically, not in step with the primary stress.



I shall next sketch a novel, notably simplified account of Spanish noun stress.

As was noted in subsections 3.5 and 3.10, the Spanish Present tense stress falls on the word's rightmost but not last vowel, a target we then met on a ¬Al-l (ˈV,]) >> Al-l (ˈV,]) ranking. Extension of this simple grammar to nouns, with Al-l (ˈV,]) responsible for unmarked stress and ¬Al-l (ˈV,]), appropriately tagged with the "M" mark, for its ¬Al-l (ˈV,])^{M} marked counterpart, will evidently go some way towards achieving an arguably desirable overlap between the Spanish verb and non-verb stress grammars, as follows:

VERBS: Al-l (ˈV, _#)^{PRES}: A stressed vowel right-aligns with the word in Present tenses.
¬Al-l (ˈV, _#)^{PRES}: A stressed vowel does not right-align with the word in Present tenses.
RANKING: ¬Al-l (ˈV, _#)^{PRES} >> Al-l (ˈV, _#)^{PRES}

NOUNS: Al-l (ˈV,]) : A stressed vowel right-aligns with the stem.
¬Al-l (ˈV,]) ^{M}: A stressed vowel does not right-align with the stem in M-marked items.
RANKING: ¬Al-l (ˈV, _#)^{PRES} >> Al-l (ˈV, _#)^{PRES}

Examples: sˈában]a 'bed sheet' (on ¬Al- l (ˈV,]) ^{M}), ventˈan]a 'window' (on Al-l (ˈV,]))

The scope of ¬Al-l (ˈV,])^{M} among "nouns" (remember: nouns = all non-verbs here) by definition is confined to the M-marked set, while that of Al-l (ˈV,]) lacks lexical restrictions. Their mutual ranking consequently needs to be the same as for verb Present tenses, i.e. ¬Al-l (ˈV,])^{M} >> Al-l (ˈV,]): ¬Al-l (ˈV,]) would simply be annulled on the opposite ranking. The two evaluations that follow illustrate the workings of this machinery in the noun domain now under scrutiny:

sabˈana	¬Al-l (ˈV,])^{M} >>	Al-l (ˈV,])	'savannah'
sabˈan]a	NA		
sˈában]a	NA	*!	
saban]ˈá	NA	*!	

s'ábana	¬Al-L (ˈV,]$^{\text{M)}}$ >>	Al-L (ˈV,])	‘bed sheet’
✓sˈában]a		*	
*saban]ˈá		*	
sabˈan]a	*!		

As has just been shown, our current grammar yields precisely the sought outcome for the U noun set: *sabˈana*. For the M set, however, it leads to a draw between the factual *sˈában]a* and a counterfactual **saban]ˈá*, with desinence stress in contradiction to the stresslessness we know unexceptionally characterises the desinence. It is hence evident that desinence stresslessness cannot always be achieved on simple stress-stem alignment but instead requires specific blocking of desinence stress. We shall meet this target on the familiar “extrametricality” device, and consequently declare the Spanish desinence extrametrical (“< . . . >”), in this way excluding it from the stress domain, e.g. [ˈ*ében*]<*o*>.

This simple grammar with scope over both the U and the M sets accounts for the patterns of over 99% of Spanish nouns. The small remainder (0.14% of Morales-Front’s corpus) concerns what may appositely be dubbed “extraneous stress” (the “supermarked stress” of the author’s previous work) on account of (a) its extremely low numerical incidence, (b) its unique appeal to trochaic footing, and (c) its unique resort to foot-stress alignment or misalignment. We undertake examination of this pattern ($C^{\neg s}$ = a consonant other than *s*, found mainly in Germanic words nowadays brought into Spanish discourse de facto ad libitum) in the next subsection. In the next subsection we undertake the examination of this pattern ($C^{\neg s}$ = a consonant other than *s*), mainly found in Germanic words nowadays brought into Spanish discourse de facto ad libitum.

5.4. Extraneous stress

The established set of Spanish words with extraneous stress (ES) is very small: 36 items in Morales-Front’s (2014) count (= 0.14%). Nonetheless, (a) the set now freely incorporates PPO (**P**ro**P**ar**O**xytone = three units left of the word’s end) $C^{\neg s}$-ending ($C^{\neg s}$ = a consonant other than *s*) mainly Germanic words nowadays brought into Spanish discourse de facto ad libitum; and (b) the spontaneity of the speakers’ behaviour plausibly points to internalised ES (extraneous stress) competence, i.e. not the simple output mirroring Harris has frequently argued for.

The Spanish ES set is made up of three subsets with a distinct stress pattern each. Following previous work by the author (Roca 1997, 2006, 2014, 2017), we shall number them from 1 to 3, hence respectively ES1, ES2 and ES3. ES1’s and ES3’s memberships lie at opposite ends of the numerical scale, with ES1 in effect constituting the ES default (its corresponding set is hence open), while ES3 is confined to one item, *carˈácter* ~ *caractˈeres* ‘character/s’, moreover often treated as simple M by ordinary Spanish speakers: cf. usual *carˈácter* ~ *carˈácteres*, in the mould of, e.g., M *crˈáter* ~ *crˈáteres* ‘crater/s’. And indeed there is no other motive but academic pressure for a *caractˈeres* Spanish plural. Such pressure in turn stems from an unwarranted assumption (in fact, a prejudice) that words forever retain their ancestral traits, cf. the *cha*(*rˈac*)<***teːr***> ~ *charac*(***tˈeː***)<*res*> Latin accentual structures here: both forms with stress on the rightmost non-final heavy metrical syllable, (*rˈac*) and (*tˈeː*) respectively, all of this in line with the Latin metrical procedure expounded in section 5.2. above. Should this need for persistence of language traits indeed obtain, current Spanish would of course simply be Latin!

At the scale’s opposite end, the ES1 pattern brings out the speaker’s unmonitored spontaneous behaviour. As pointed out already, this set chiefly includes Germanic words nowadays all but freely entering Spanish discourse mainly from or through English. Pointedly, Spanish speakers now seem to favour PPO stress for this set irrespective of the original stress: cf., e.g., the now often heard Spanish *Hˈalloween*, *ˈAberdeen*, for English *Hallowˈeen*, *Aberdˈeen*; Spanish

ˈAmsterdam, *Rˈotterdam*, for Dutch *Amsterdˈam*, *Rotterdˈam*; and so on. Clearly, thus, a growing body of Spanish speakers have made this pattern their own, intuitively associating it with a Germanic source.

ES2, last, concerns a handful of Latinate words, of which *espˈécimen* > pl. *especˈímenes* 'specimen/s', and particularly *rˈégimen* > pl. *regˈímenes* 'régime/s', are the main and perhaps only ones. The singular pattern matches *Wˈashington*'s in being PPO in a word with a C ≠ s ending and hence no desinence. In the plural, the *rˈégimen* > *regˈímenes* stress shift ensures compliance with the Three Syllable Window, the familiar observation that Spanish, as indeed many other languages, Latin included, confines stress to the word's last three syllables (cf. **rˈégimenes*), a matter to be specifically addressed in section 5.6.

Roca's (2017 et ante) account of the three ES patterns involves post-childhood incorporation into the grammar (the relevant word set obviously lies beyond the scope of young children) of an ES-specific binary trochee (remember this set's learned origin), either right-aligned or misaligned with either the stem or the word boundary, as per lexical specification. First, a general ES constraint enforces foot binarity across the entire ES class:

BINTROCH^{ES}: ES items associate with a left-headed binary foot, i.e. a "trochee."

Roca's (2017: 58) three alignment constraints{ES} AL-),#^{ES1}, AL-),#^{ES2} and AL-),#^{ES3} also need retaining here. We shall consider AL-),#^{ES3}-ruled *carˈácter* ~ *caractˈeres* first:

A foot (. . .) **right-aligns** with the **word boundary #**; e.g. ca(rˈácter**)**]**#** ~ carac(tˈer]es**)#**.

/ES3/	BinTroch{ES},	Al-),#{ES3} >>	Al-),] >>	¬Al-ˈV,]
ca(rˈácter**)**]**#**				
(cˈárac)ter]#		*!	*	
ca(ractˈer)]#	*!			*
carac(tˈer)]#	*!			*
carac(tˈer]es)**#**			*	*
(cˈárac)ter]es#		*!*	*	
ca(rˈácte)r]es#		*!		
carac(tˈer)]es#	*!	*!		*

Next we turn to the ES2 class. The corresponding constraint is ¬AL-),#^{ES2}:

¬AL-),#^{ES2}: An ES2 foot does **not right-align** with the **word boundary** (e.g. (rˈégi**)**men]**#** ~ re**(**gˈíme**)**n]es**#**).

The two following evaluations demonstrate this:

/ES2/	BinTroch{ES},	¬Al-),#{ES2} >>	Al-),] >>	Al-ˈV,] >>	¬Al-ˈV,]
(rˈégi)men]#			*	**	
re(gˈimen)]#		*!		*	
regi(mˈén)]#	*!	*!			
re(gimˈén)]#	*!	*!			

re(gˈíme)n]es#				*	*
(rˈégi)men]es#			*!	**	**
regi(mˈe)n]es#	*!				
regi(mˈen]es)#		*!	*		

Last, the ES1-relevant constraint is ¬AL-),] ^{ES1}:

¬Al-),]^{ES1}: An ES1 foot does **not right-align** with the **stem boundary** (e.g. *(ómi)cron]# ~ omi(crˈon]es)#*).

Our present unilinear constraint arrangement readily accounts for the singular *ˈómicron*:

/ES1/	BinTroch$^{\{ES\}}$, ¬Al-),]$^{\{ES1\}}$ >>	¬Al-),] >>	¬Al-ˈV,] >>	Al-ˈV,]
(ˈómi)cron])	*!			**
o(mˈícron)]	*!	*		*
o(micrˈón)]	*! *!	*	*	
omi(crˈón)]	*! *!	*	*	

In the plural, however, this ranking leads to a 3SW-deviant counterfactual *ˈ*ómicrones*, not to the sought 3SW-respectful *omicrˈones*:

/ES1/	BinTroch$^{\{ES\}}$, ¬Al-),]$^{\{ES1\}}$ >>	¬Al-),] >>	¬Al-ˈV,] >>	Al-ˈV,]
*(ˈómi)cron]es				**
✓omi(crˈon]es)	*!		*!	
o(mˈícro)n]es	*!	*		*
omicro(n]ˈés)	*!			*

The problem is, however, purely formal, and thus not substantial, just a simple side effect of the conventional unilinear constraint arrangement standard in tableaux. Thus, in actual fact, of the five constraints present in our current stress grammar, four indeed are mutually related unilinearly. However, the fifth one, BinTroch, is not, as it exclusively connects to the lowest-ranking Al-ˈV,]. All of it as follows:

Arboreal format

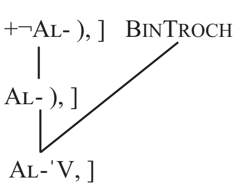


Tableau format with evaluation demonstration

	BinTroch >>	¬Al-),] >>	Al-),] >>	Al-ˈV,]
(ˈómi)cron]			*	**
o(mˈicron)]		*!		*
omi(crˈón)]	*!	*!		
o(micrˈón)]	*!	*!		

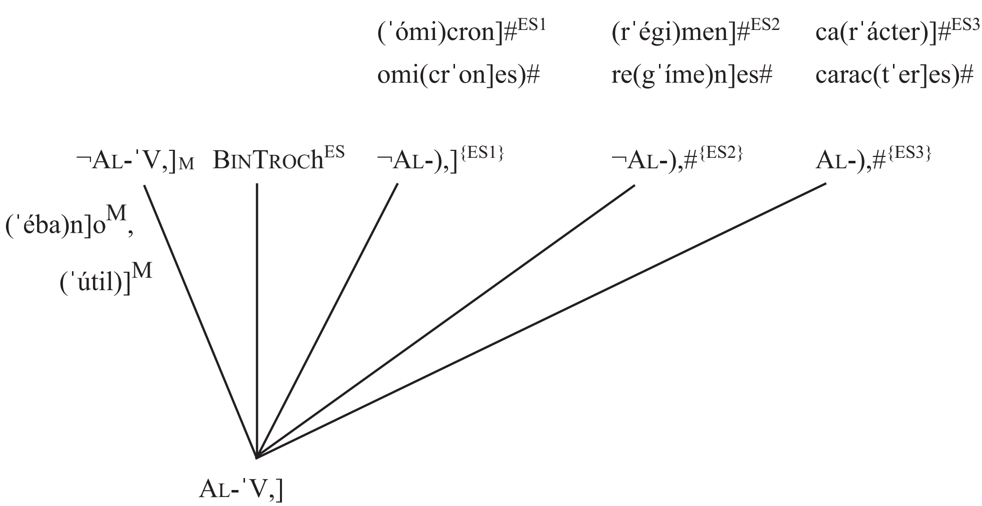
Both diagrams encode precisely the same relations: ¬Al -),] >> Al -),] >> Al-ˈV,] on the one hand, and BinTroch >> Al-ˈV,] on the other. Nonetheless, only the non-arboreal arrangement on the right-hand side is compatible with a tableau format, just as shown.

This complex ranking is incompatible with the straight-line display of conventional tableaux, as indeed must already be obvious. A multidimensional spatial arrangement (bidimensional here) is consequently required, again as follows for the data now under scrutiny (cf. Roca 2017):

		¬Al -),] >> Al -),]	>>	
	BinTroch >>		>>	Al-ˈV,]
omi(crˈón]es)		*		
(ˈómi)cron]es				*!*
o(mˈicron)]es	*!	*		*
o(micrˈón)]es	*!	*!		
omi(crˈón)]es		*!		
		*!		

The three ES constraints proposed thus indeed fully account for the behaviour of the Spanish ES set.

Next we display the Spanish noun stress core grammar in a conventional Hasse diagram:



This ends our analysis of Spanish stress. In the next section we shall address two further issues also bearing on it: quantity sensitivity and the so-called Three Syllable Window.

5.5. Quantity sensitivity

It is both notable and noteworthy that Spanish proper appears to lack vowel-desinenced PPO words whose stem ends in a heavy syllable (in Spanish a syllable closed by a coda consonant in the Spanish absence of long vowels): *ˈ*éba**s.**n]o*, *ˈ*éba**r.**n]o*, etc. indeed do not exist in Spanish, nor could they seemingly exist (the place name *Frómist]a* constitutes a noted and perhaps single exception). In sharp contrast, we know that PPO items with a light penult such as *ˈéba.n]o* indeed obtain.

We are already aware of Latin's stress "quantity sensitivity" (QS); a Latin heavy penult (a syllable with either a long nucleus vowel or a coda consonant) systematically attracts stress. The same has often been claimed for Spanish, pace Pensado's (1984) early disagreement, independently reiterated and elaborated on in work by the present author as well as in that of others. In particular, the Spanish stress compliance with QS in Latin-originated Spanish words can reasonably be interpreted as a by-product of the general preservation of Latin's stress locus in Spanish (cf. Menéndez Pidal's quote in section 5.2), and hence not necessarily as proof of QS in Spanish itself.

A number of studies have indeed contributed experimental evidence against Spanish stress QS: cf., e.g., Barkanyi (2002), Alvord (2003), Face (2004, 2006), Face and Alvord (2005). A significant number of facts do point in the same direction:

a) Speakers' current tendency for PPO# stress in Germanic borrowings now in common Spanish use, irrespective of the penult's weight, in both proper nouns (*Wˈa**shing**ton*, *Bˈi**rming**ham*, *Mˈan**ches**ter*, *Dˈü**ssel**dorf*, *Rˈo**bin**son*, *Pˈar**kin**son*) and common nouns (*bˈád**min**ton*, *rˈé**ming**ton*, *ˈómbu**ds**man*).
b) The trend's independence from the input stress locus: cf. the not infrequently heard *ˈAmsterdam*, *Rˈotterdam*, *ˈEdam*, *ˈAberdeen*, *Hˈalloween*, all of which have final stress in the respective source languages: Dutch (*Amsterdˈam*, *Rotterdˈam*, *Edˈam*) and English (*Aberdˈeen*, *Hallowˈeen*).
c) The trend's increasing incidence: cf. earlier *Liverp*[ˈu]*l*, but now more generally *Lˈiverp*[u]*l*, in Spain at least.
d) The contrast between formerly everyday *Lan<u>cˈas</u>ter* (Burt, a popular cinema actor of the time) and the then more formal *<u>Lˈan</u>caster* (the duke, the town); also the household *Robin<u>sˈón</u> Crusˈoe* of Defoe's novel vs. the *Mrs <u>Rˈo</u>binson* of Simon and Garfunkel's song.
e) The co-occurrence of PPO# stress with a heavy penult in the Castilian place name *<u>Frˈó</u>mi**s**ta*, which is thus stressed both officially and reportedly locally.
f) Trubetzkoy's (1939/1969) traditional observation to the effect that quantity-sensitive languages tend to exhibit vowel length oppositions, which is indeed the case in Latin (and in English also), although clearly not in Spanish.

Such facts point to Spanish QS irrelevance. Two spontaneous phenomena present in some Spanish speakers may nonetheless appear suggestive of it: (1) the so-called *mania esdrujulista* 'PPO obsession' ("esdrújulo" = PPO-stressed), and (2) the Dominican Republic *hablar fino* ('refined speech') style. We examine these next.

The *manía esdrujulista* (ME) concerns a traditional Peninsular popular penchant (now however seemingly extinct) for PPO noun stress in a number of words with a standard PO one: cf., e.g., ME *ˈáccesit* 'second prize', *cˈábila* 'Kabyle', *cˈólega* 'colleague', *endˈócrino* 'endocrine', *epˈíglotis* 'epiglottis', *epˈígrama* 'epigram', *intˈérvalo* 'ˈinterval', *lˈíbido* 'libido', *mˈéndigo* 'beggar', *pˈápiro* 'papyrus', *pˈérito* 'expert', *rˈácimo* 'cluster', *telˈégrama* 'telegram', *vˈámpiro* 'vampire', all of them PO# both etymologically and in standard Spanish.

The ME has consistently been frowned upon by the language establishment. Its QS import concerns ME's systematic blocking by a heavy penult: notice indeed the absence of heavy penults in the preceding sample, and seemingly likewise in any other such. The concomitant implication of at least some Spanish QS activity would consequently seem reasonable, if not indeed inevitable.

A second phenomenon possibly with QS bearing concerns Dominican Republic's hypercorrected coda *s*, a sound weakened to varying degrees or even fully suppressed in a number of Spanish language accents, ordinary Dominican among them. The Dominican speech style there ironically referred to as *hablar fisno* (HF) (*fisno* < standard *fino* 'refined, posh', hence HF = 'refined speech') indeed randomly inserts a coda *s* in words that lack it etymologically and in standard Spanish: cf., e.g., standard *sábanas* 'bed sheets' vs. HF *sábana*, *sásbana* or indeed *sábanas*, the latter two forms inclusive of the HF hypercorrected *s*. HF's relevance to QS concerns its usual absence from contexts where it would lead to a QS-violating stressless heavy penult, **sábasna* for instance.

All this said, the Dominican-born phonologist Rafael Núñez-Cedeño more than once has pointed out (p.c.; Núñez-Cedeño and Morales-Front 1999; Núñez-Cedeño et al. 2014; cf. also Bullock et al. 2014; Bradley 2014) that HF's complexity on the ground renders opaque the interpretation of these facts. Also that extrapolation from what amounts to a language game bound to a specific language community (the Dominican Republic) onto the whole of the Spanish-speaking world (reportedly with some 500 million speakers at present and growing) would clearly be ill advised.

Our overall conclusion consequently needs to be that neither the ME nor the HF speech modes outweigh the evidence available against Spanish QS, and hence that a verdict of Spanish word stress quantity **in**sensitivity indeed does seem reasonable.

5.6. Three Syllable Window

A stress property commonly found in languages in possession of a synchronic or even just a diachronic stress-grounded metrical system concerns Spanish tress locus confinement to the word's last three syllables, a situation commonly referred to in the literature with the expression "Three Syllable Window" (3SW) (cf. Kager 2012 recently), and we have indeed seen this structure respected in the five Spanish noun stress grammars we have analysed. Harris has nonetheless more than once appealed to simple speaker mimicry as the phenomenon's most likely source: cf., e.g., "unshifted stress in loan words tells us nothing about the rules internalized by borrowers [. . .]. [A]ll we learn is that mimicry of foreign stress patterns is possible" (Harris 1992: 17). We address this issue next.

Latin-originated Spanish words unsurprisingly comply with the window: Latin was indeed subject to it, and by now we know of Latin's stress locus general preservation in Spanish (cf. again Menéndez Pidal 1962: 36, §5bis). Additionally, Spanish also generally respects the basic input segmental structure, either literally or possibly simplified. The Spanish relevance of the 3SW is consequently confined to foreign words either fully incorporated into Spanish discourse or occasionally used by Spanish speakers.

We have already shown the 3SW to be generated by our noun stress grammar: Spanish noun stress is inevitably hence sited at most two syllables left of the stem's right boundary, itself at most followed by the desinence vowel (the also possible additional final *s*, as a consonant, has no effect on stress location). Our verb stress grammars are also consistent with the 3SW at the syllable level at which it operates. The only possible violation of the Spanish 3SW would hence concern imported foreign words that themselves transgress it in the source language.

We shall limit our present search to a handful of words of likely familiarity to at least some Spanish speakers. The most common such word in reasonable use may perhaps be *Cˈanterbury*, the town harbouring the English Anglican Church's head seat and the Archbishop of Canterbury's residence. The English *Cˈanterbury* PPPO stress indeed falls beyond the scope of the Spanish 3SW. Ordinary Spanish speakers are hence unable spontaneously and naturally to reproduce it, instead keeping it within the window and hence realising *Canterbˈury*, or at best *Cantˈerbury*, not the English *Cˈanterbury*.

Second in the list may be *Bratislava*, Slovakia's capital, with the source stress *Brˈatislava* also outside the window. And again Spanish speakers tend to place the stress inside the window, indeed favour PO *Bratislˈava* over an also possible in Spanish PPO *Bratˈislava*.

A third relevant item may be *Kalevala*, the Finnish national epic's title, at times heard in the media in connection with Sibelius's famed Finlandia symphony. Here, too, Spanish media announcers and ordinary speakers alike tend to shy away from the PPPO Finnish *Kˈalevala* contour and instead go for *Kalevˈala* or *Kalˈevala*, both realisations in line with the 3SW.

Last in our of necessity limited survey is *Schˈeveningen*, the name of a Dutch seaside resort cited more than once in print by the present writer precisely in connection with the 3SW. And again the *Schˈeveningen* Dutch contour appears irreproducible to Spanish speakers unacquainted with the Dutch language or a similar one; they instead aim for *Schevˈeningen* or perhaps more commonly *Schevenˈingen*, both realisations indeed habitual in a number of face-to-face interactions set up by this writer with the aim of testing the matter. Similar outcomes came up in a separate informal experiment reported in Roca (2017: 243, fn. 6); the 3SW is hence ostensibly customarily adhered to. Next, and indeed most tellingly, Spanish-speaking English beginners tend to shun reproduction of input stresses sited outside the window, substituting them with loci that respect it: *sˈecretary* > *secretˈary*, *pˈarsimony* > *parsimˈony*, *cˈategory* > *categˈory*, etc. Last, it bears reminding that ME practitioners systematically comply with the 3SW. Indeed, ordinary Spanish speakers have difficulties with a spontaneous PPPO *rˈégimenes* plural with stress locus constancy, rather than a window-confined stress as in *regˈímenes* or (nonstandard) *regimˈenes*. Facts like these clearly suggest Spanish 3SW activity.

Puzzlingly, a PPPO plural stress with singular locus constancy can occasionally be heard from some Spanish speakers. I indeed recently witnessed a *rˈégimenes* delivery from an English-fluent Spanish member of the European Parliament in the course of an oral interview in the media. English language influence (cf., e.g., *cˈatamaran*, *collˈaborative*) cannot be excluded as a possible source of this behaviour. Alternatively or in conjunction, would be a speaker's impromptu clitic analysis of the word-final syllable, whence *rˈégimen#es*, along the lines of, e.g., *comprˈemos#se-lo* 'let us buy it from/for him/etc.'.

6. Adjacent vowels syllabification

We are by now well acquainted with the presence of H + ∇ vowel clusters in either order in a number of Spanish verb forms, and have indeed provided a principled account of their respective syllabifications.

TAUTOSYLLABIC: *bebiˈó*, *bebiˈeron*, *bebiˈeran*, *bebiˈesen*, *bebiˈeren*, *bebiˈendo*
HETEROSYLLABIC: *bebˈí.a*, *beberˈí.a*, and the remainder of the two paradigms

We also have seen verb stress systematically fall on a given designated morpheme in the following forms:

PAST TENSES: the post-Root morpheme, e.g. *lav-**ˈa**-ba* 'he/etc. was washing', *lav-**ˈé*** 'I washed'
FUTURE TENSES: the TAM, e.g. *lav-a-**rˈá*** 'he/etc. will wash', *lav-a-**rˈía*** 'he/etc. would wash'

In the Present tenses and in the Imperative singular stress keeps a given distance from the word's right boundary, as our ¬AL-L (ˈV, _#)$^{\mathrm{PRES}}$ >> AL-L (ˈV, _#)$^{\mathrm{PRES}}$ ranking indeed encodes:

PRESENT IND.: lˈ**a**v-**a** 'he/etc. washes', lav-ˈ**á**-**i**s 'you lot/all wash'
PRESENT SUBJ.: lˈ**a**v-**e** 'he/etc. washes$^{\mathrm{SUBJ}}$', lav-ˈ**é**-**i**s 'you lot/all wash$^{\mathrm{SUBJ}}$'

∇H and H∇ clusters are of course aplenty in the Spanish verb conjugation and beyond: cf. by way of example among non-verbs tautosyllabic *ˈ**ai**re* 'air', *acˈ**ei**te* 'oil', *bˈ**oi**na* 'beret', as against ***ca.ˈí**da* 'fall', *caf**e.ˈí**na* 'caffeine', ***o.ˈí**do* 'ear', with ∇.H heterosyllabicity instead. The three sets of words now following, the second and third ones with a common root but contrasting syllabifications, illustrate tautosyllabic (1 and 2) and heterosyllabic (3) parsings:

1) Tautosyllabic: cˈamb**io**, camb**iˈó**, camb**iˈa**mos, camb**iˈa**nte, camb**iˈa**ble
'I change', 'he/etc. changed', 'we change/d', 'changing', 'changeable'
2) Tautosyllabic: vˈár**io**, variac**iˈó**n, var**ia**rˈé 'various', 'variation', 'I'll vary'
3) Heterosyllabic: var**ˈí.o**, var**i.ˈó**, var**i.ˈá**mos, var**i.ˈá**nte, var**i.ˈa**ble
'I vary', 'he/etc. varied', 'we vary/varied', 'variant', 'variable'

iˈ∇ hiatus is common where possible, if perhaps still not absolute, in Castile and Castile-related areas, while tautosyllabicity prevails in Latin America and some areas of Spain.

Vowel-adjacent tautosyllabic high vowels have traditionally been construed as "glides," as against "vowels" for the heterosyllabic ones. Work by the present author nonetheless has for a number of years advanced a battery of arguments against the "glide" construct (cf. Roca 1997, 2006, 2016), in effect an opaque ad hoc shorthand for what is simply a **vowel** with a parse outside the syllable peak. A widespread gratuitous and perhaps subconscious identification of vowels with syllable peaks possibly underlies this erroneous thought and the ensuing analysis.

Roca's contrary outlook rests on one simple and transparent fact: the glide construct's misguided and misleading phonological interpretation. Thus, both the ∇-adjacent non-syllabic H (*y*) of *hˈ**ay*** 'there is/are' or *¡ay!* 'ouch!' (the Spanish letter *h* is of course merely orthographic, and a Spanish post-vowel word-final *y* stands for /i/) and the likewise ∇-adjacent /i/ of *a.hˈí* necessitate analysis as vowels, in the manifest absence of grounds to do otherwise: see Roca (2016) for detailed argumentation.

The Spanish preference with regard to these clusters is indeed for tautosyllabicity: cf., e.g., *comˈed**ia*** 'comedy', *hˈ**ay*** 'there is/are', *carˈ**ay*** 'gosh!' (*y* = /i/ here). It is indeed preference but crucially not necessity, as attested in, cf., e.g., *Marˈ**í.a*** 'Mary', *abadˈ**í.a*** 'abbey', ***a**.(h)ˈ**í*** 'there', all three of which are words with the two adjacent vowels in separate syllables: Roca (2016) provides further information. The ∇H and H∇ tautosyllabicity that is also possible here is driven by Onset (*comˈed**ia***, *hˈ**ay***, *carˈ**ay***, *Faradˈ**ay***, etc. all comply with it), a constraint that consequently needs blocking wherever the adjacent high vowel empirically parses in a separate syllable: cf. *aver**í.a*** 'breadown', ***a**.(h)**í*** 'there'. Roca (2016 et ante) implements such blocking with a twofold strategy involving (a) /.H/ and /H./ lexical peakness, and (b) concomitant /.H/, /H./ protection via an Onset-dominant Max-Pk constraint:

Max-Pk: A lexical nucleus peak surfaces as a nucleus peak.

Let us indeed compare *avarˈicia* 'avarice' with *policˈí.a* 'police' (NA = not applicable):

avaricia	Max-Pk >>	Onset	'greediness'
avarˈicia	NA		
avarˈici.a	NA	*!	
avaricˈí.a	NA	*!	

polic/i./a			'police'
policˈí.a		*	
polˈicia	*!		

As mentioned already, *i* + ˈV heterosyllabicity in the (b) set is more common in conservative varieties such as the Castile-oriented ones.

Particularly revealing are word constellations like those shown at the outset of this section and repeated now for convenience:

a) cˈamb**io**, camb**iˈó**, camb**iˈa**mos, camb**iˈa**nte, camb**iˈa**ble
b) var**ˈí.o**, var**i.ˈó**, var**i.ˈa**mos, var**i.ˈa**nte, var**i.ˈa**ble vs. vˈar**io**, var**ia**ciˈón, var**iar**ˈé

In set (a), <*i*> is consistently both stressless and tautosyllabic with the following ∇. In set (b), in contrast, <*i*> can either be stressed or stressless, as well as tautosyllabic or heterosyllabic: it is systematically heterosyllabic where stressed, and idiosyncratically so where not. I next offer an analysis of these data grounded in facts, not ghosts, in Roca's (2016) purposely translucent terminology.

An anonymous reviewer objects that "there is a vast number of experimental studies on the phonetics of Spanish glides, in this language referred as 'paravocales,' 'semiconsonantes' or 'semivocales.'" As the reviewer appositely notes, however, the studies in question are concerned with phonetics, not phonology, the sole object of our present enquiry.

A stressed high vowel ˈH of necessity parses as a syllable peak, as consequently also does a stressless ˈH-abutting non-high ∇, e.g. *navˈ**í.o*** 'ship'.

We already know (section 3.6) that a hypothetical tautosyllabic **navˈi͡o* simply does not exit GEN.

The issue hence concerns the motive for *navío*'s stress to fall on the /i/ rather than the /o/: compare the verbal Preterite *var**i.ˈó*** 'he/etc. varied', where it indeed falls on the /o/. The answer is also familiar by now: in Preterite *variˈó*, P-Rt Mph Stress$^{\text{PAST}}$ (see section 3.1) places the stress on the post-Root morpheme *-o* rather than on the Root-internal *i*. In Present Indicative *varˈí-o*, however, the ¬Al-L(ˈV, _#)$^{\text{PRES}}$ >> Al-L(ˈV, _#)$^{\text{PRES}}$ ranking induces stress on the Root-final *i*. In contrast, in the also Present tense *cˈambio*, the stress falls left of the *io* cluster, counter our "second from last vowel" Present tense stress principle: stress here indeed falls three rather than two vowels inward from the word's end, contrary to our extant ranking.

cˈambio	¬Al-l(ˈV, _#)$^{\text{PRES}}$ >>	Al-l(ˈV, _#)$^{\text{PRES}}$	'I change'
*cambˈí.o		*	
✓cˈambio		**!	
cambiˈó	*!		

The motive for *cˈambio*'s leftward stress shift must, however, by now be obvious, viz. Onset's predominance over the Present tense constraint Al-L(ˈV, _#)$^{\text{PRES}}$, as follows:

cambio	**Onset**, ¬Al-L(ˈV, _#)$^{\text{PRES}}$ >>	**Al-L(ˈV, _#)$^{\text{PRES}}$**	'I change'
cˈambi-o		**	
cambˈí.-o	*!	*	
cambi-ˈó	*!		

Varˈ**í.o** 'I vary', from *variar* 'to vary', runs against our **vˈar**io*** current expectation and hence may look like a counterexample: *vˈario* does exist as an adjective (see the second tableau that follows), but does not as a verb, which appears instead as *varˈí.o* instead, with stress on the *i* penult and the cluster hence heterosyllabic. The reason for the *varˈí.o* contour must nonetheless by now also be obvious: *i* lexical peakness (var/**i.**/-), along lines already familiar. In turn, the complementary constraint **Max-Pk** necessitates domination over Onset so as to preserve lexical syllabicity:

*var/***i.***/o*	**Max-Pk** >>	**Onset**,	¬AL-L('V, _#)^{PRES} >>	AL-L('V, _#)^{PRES} ‘I vary’
var'í.o		*		*
v'ário	*!			**
vari.'ó		*	*!	

Max-Pk evidently plays no role in *c'ambio*, simply without lexical /i./. The adjective *v'ario* (cf. the verb *var'í.o*) at first sight may appear to contradict this ranking. This is however not so, however, given that, as an adjective, *v'ario* is subject to the noun stress procedure, not the verb stress. Additionally, *v'ario*’s M lexical mark activates stress retraction in the already familiar manner. A Max-Pk -dominant *V̆.V̆ constraint (for V̆ = stressless vowel) consequently now needs incorporation in the ranking:

* V̆.V̆: Stressless adjacent vowels are tautosyllabic.

*var/*i.*/o*^{M}	¬Al-L ('V,])^{M}, ***V̆.V̆** >>	**Max-Pk** >>	Onset >>	AL-L('V,])	‘various’
v'ari] o		*		*	
v'ari.] o	*!		*	*	
var'í.] o	*!		*		

/M/’s scope needs restricting to nouns in our present broad sense, whence the *var'í.o* ‘I vary’ verb pattern, not **v'ari͡o*, in the evaluation before last. In contrast, in the noun *vari͡ación* ‘variation’, the H∇ cluster turns out tautosyllabic despite the /i./ lexical peakness. *V̆.V̆’s dominance over Max-Pk accounts for this result:

*var/*i.*/ación*	* **V̆.V̆** >>	**Max-Pk** >>	Onset >>	AL-'V,]	‘variation’
var**ia**ci'ón]#		*			
var**i.a**ci'ón]#	*!		*		

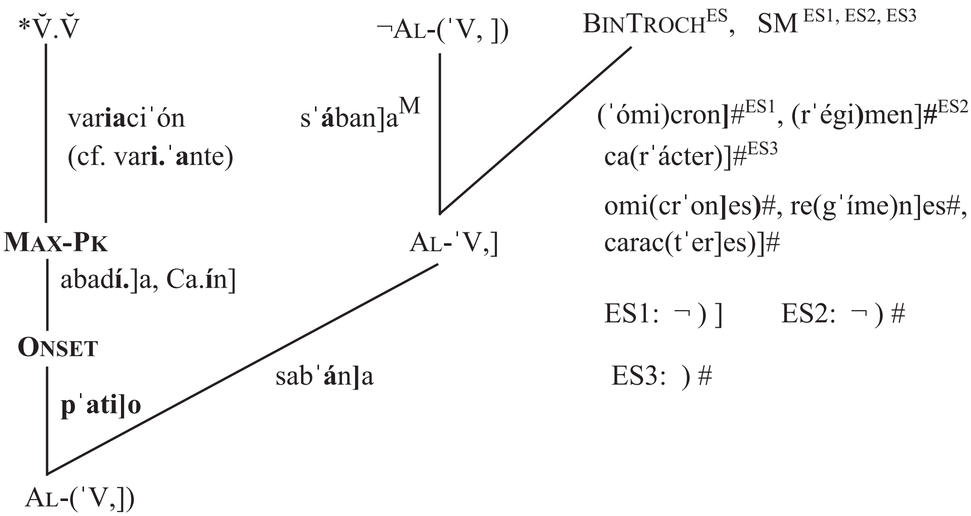
All ∇-adjacent /i/ peak ~ non-peak alternations in either order have now been accounted for in a principled way, without recourse to the specious glide category. The situation with the reverse ∇H cluster is similar: cf., e.g., *a.(h)'í* ‘there’ vs. *'ay/h'ay* ‘ouch/there is/are’. Our proposal’s solidity is therefore manifest, in sharp contrast with the formal and empirical vacuity of the glide alternative. Further, in-depth discussion of the matter is available in Roca (2016).

7. Conclusion

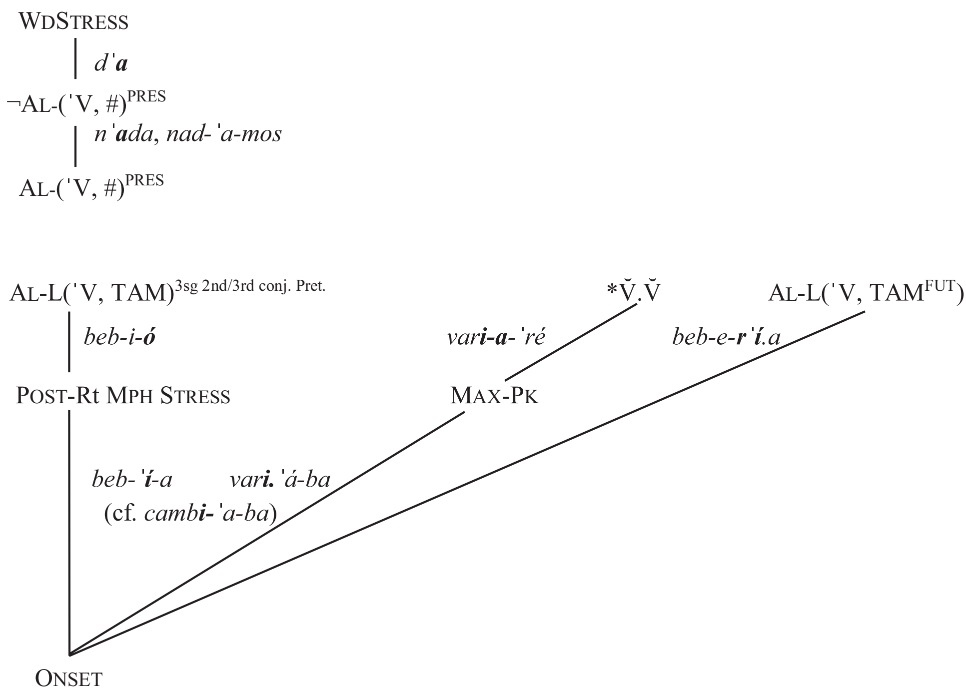
The two Hasse diagrams that follow display the two Spanish stress grammars we have arrived at, one for verbs and the other for nouns. They both share, and are thus interconnected through, our familiar *V̆.V̆ >> Max-Pk >> Onset ranking, we mark in bold for salience in the two diagrams:

Our split of the single grammar in two diagrams is aimed at by-passing the awkwardness of fitting them into a single one.

NOUNS:


*V̆.V̆
¬AL-(ˈV,])
BINTROCH^ES, SM ^ES1, ES2, ES3
variaciˈón
(cf. vari.ˈante)
sˈában]a^M
(ˈómi)cron]#^ES1, (rˈégi)men]#^ES2
ca(rˈácter)]#^ES3
omi(crˈon]es)#, re(gˈíme)n]es#,
carac(tˈer]es)]#
MAX-PK
AL-ˈV,]
abadí.]a, Ca.ín]
ES1: ¬)]
ES2: ¬) #
ONSET
sabˈán]a
ES3:) #
pˈati]o
AL-(ˈV,])

VERBS:


WDSTRESS
dˈa
¬AL-(ˈV, #)^PRES
nˈada, nad-ˈa-mos
AL-(ˈV, #)^PRES
AL-L(ˈV, TAM)^3sg 2nd/3rd conj. Pret.
*V̆.V̆
AL-L(ˈV, TAM^FUT)
beb-i-ó
vari-a-ˈré
beb-e-rˈí.a
POST-Rt MPH STRESS
MAX-PK
beb-ˈí-a
vari.ˈá-ba
(cf. cambi-ˈa-ba)
ONSET

The noun diagram includes the two *V̆V̆ and Max-Pk syllabification constraints that are operative in Spanish across the board alongside Onset, a situation highlighted in the trees via boldfacing.

Summing up our findings, we have shown the existence of close interaction between the Spanish stress and syllabification grammars, neither of them describable, nor indeed fully learnable or understandable, without the other. The syllabification grammar is shared by both verbs and nouns, while the two stress grammars diverge as regards both scope and mechanics. In particular, verb stress is closely linked to morphosemantics, each tense class hence being endowed with its own characteristic stress pattern. For nouns, in contrast, U, M or ES membership is synchronically arbitrary, a simple legacy of each word's historical antecedent, respectively Vulgar Latin (U), Classical Latin (M) and either also Classical Latin or a modern Germanic language, English in particular (ES).

The Spanish primary stress distribution is consequently not a product of rhythm as mistakenly was assumed in some previous studies. Rather, its apportioning in the three observed classes is arbitrary and hence in need of piecemeal learning, both in childhood for the first words, and in adulthood for inputs became available throughout the speaker's life span. It is arbitrary nonetheless within the bounds of the lexical spaces delimited here, and of the numerical biases embodied in the three U, M and ES "noun" classes. No equivalent obtains for verbs, notwithstanding their stress correspondences with the three morphosemantic categories Present, Past and Future.

Acknowledgements

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9

Current issues and challenges in Spanish intonational research

Pilar Prieto and Paolo Roseano

1. Introduction: functions of intonation in Spanish and main concepts

The goal of this chapter is twofold. First, it will offer a general overview of the set of linguistic functions that intonation serves in the Spanish language, as well as provide a brief historical background of Spanish intonational research. Second, it will outline the most important challenges that the field of Spanish intonation will face in the near future, among them the adoption of a universally accepted coding system for transcribing Spanish intonation and the proper integration of intonation into other areas of linguistic inquiry such as syntax and pragmatics.

In very broad terms, intonation can be defined as the linguistic use of pitch variation (or fundamental frequency variation) to affect phrasal meaning, although it is worth noting that pitch variation is typically accompanied by changes in other prosodic features, like duration, amplitude, or voice quality. Regarding the set of linguistic functions that intonation (together with those other prosodic features) may serve, there is good consensus among researchers that it comprises at least the following four: (a) to prosodically mark lexical stress/word prominence, as well as phrasal prominence; (b) to prosodically mark phrasal units, the so-called prosodic phrases; (c) to convey information status and focus marking; and (d) to convey information about the semantico-pragmatic value of an utterance typically related to speech act type, as well as epistemic and affective positioning (on the functions of intonation, please refer to Lee 1956; Halliday 1967; Brazil 1975; Couper-Kuhlen 1986; Bolinger 1989; Cruttenden 1996; Ladd 1996; Prieto 2003; Gussenhoven 2004; Wells 2006; Michaud and Vaissière 2015; for a general review, see Hirschberg 2017; for a review on Spanish, see Escandell-Vidal and Prieto forthcoming).

First of all, lexically stressed syllables in Spanish are usually associated with some kind of pitch movement, typically a rise or fall. The tonal events associated with a stressed syllable are called pitch accents (Sp. *acentos tonales*). The pitch accent associated with the last stressed syllable of an utterance (which is generally the most prominent within the prosodic phrase) is known as the nuclear pitch accent (Sp. *acento nuclear*). The presence of either a falling or a rising pitch accent associated with the stressed syllable will depend mainly on the chosen intonational pattern. For example, whereas the nuclear pitch accent of an interrogative intonation contour such as *¿Venden mandarinas?* 'Do you-pl sell tangerines?' shows the lowest pitch levels in the pitch contour (i.e., the low pitch associated with the final stressed syllable *ri*), in an exclamative sentence like *¡Venden mandarinas!* 'They sell tangerines!' this same syllable bears a rising pitch accent that reaches a high peak toward the end of the syllable (see Figure 9.1) (more information about the pitch-accent types in Spanish dialects may be found in Prieto and Roseano 2010).

A second important function of intonation in Spanish is that of marking prosodic phrasing at the phrasal level. Like speakers of most intonational languages, Spanish speakers use pitch modulations (and also duration and intensity) at the ends of phrasal constituents to give the listener information about syntactic groupings (more information about prosodic phrasing in Spanish may be found in Nibert 2000 and in Prieto 2007, among others). The tonal movements that appear at the edges of prosodic phrases are generally known as boundary tones (Sp. *tonos de frontera* or *tonos de juntura*). In Figure 9.1, while the intonational contour of a yes-no question (left panel) ends in a high boundary tone, the intonational contour for the exclamative sentence (right panel) ends in a low boundary tone. The use of intonation for syntactic disambiguation is also well known. In the case of Spanish, the presence of a high boundary tone at the end of a constituent can perceptually disambiguate different syntactic structures. This becomes evident if we consider, for example, the following conversational exchange.

A: ¿Quién vendrá?
B: La madre de Ana y María.

The answer to speaker A's question *¿Quién vendrá?* 'Who's coming?' can be uttered with two different intonational patterns (see Figure 9.2). If speaker B places a high boundary tone after the word *Ana* (Figure 9.2, right panel), A will interpret the sentence as meaning that 'Ana's mother is coming, and María is coming, too'. Conversely, if no phrase boundary is placed between Ana

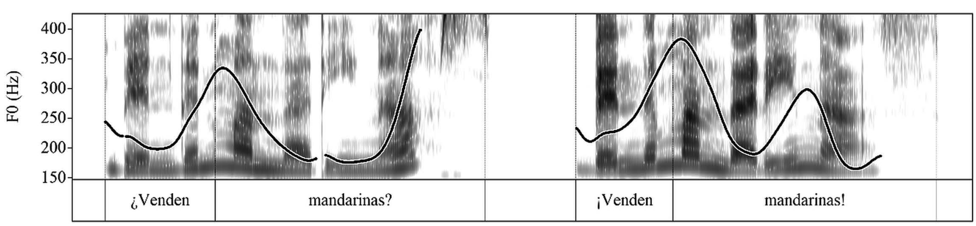

Figure 9.1 Spectrogram and intonational pitch contour of the interrogative sentence *¿Venden mandarinas?* 'Do you-pl sell tangerines?' (left panel) and the exclamative sentence *¡Venden mandarinas!* 'They sell tangerines!' (right panel)

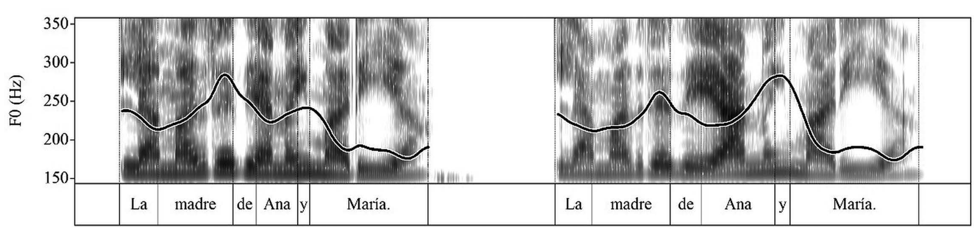

Figure 9.2 Spectrogram and intonational pitch contour of the sentences *La madre de Ana y María* 'The mother of Ana and María' (left panel) and *La madre de Ana, y María* 'Ana's mother, and María' (right panel)

and María (Figure 9.2, left panel), then A will probably understand that 'the mother of both Ana and María is coming'.

The third function that is commonly attributed to intonation in Spanish is focusing. Many Spanish dialects signal a corrective focused element through a dramatic pitch rise, which allows the listener to identify it. For example, while the word *limones* 'lemons' in the Castilian Spanish broad focus statement *He comido limones* 'I ate lemons' displays a falling pitch accent, in a corrective sentence like *No, he comido LIMONES* 'No, I ate LEMONS (not pears)' it shows a rising pitch accent. This rising pattern—which is quite different from the pattern seen in broad focus statements—has been documented in the corrective focus pitch contour across a good set of Spanish dialects (see Prieto and Roseano 2010; see also Vanrell et al. 2013 for a prosodic description of contrastive focus in Spanish, Catalan, and Italian).

The fourth universally accepted function of intonation is its contribution to the semantico-pragmatic interpretation of sentences. Several works, including Prieto and Roseano (2010), Hualde and Prieto (2015), and Prieto and Roseano (2018), show that intonation is used in Spanish to convey various communicative meanings that include speech act marking (statement, question, request, etc.), belief status (i.e., the epistemic positioning of the speaker with respect to the information exchange), politeness, and affective states. Typically, the most salient part of an intonation contour—now commonly labeled the nuclear configuration (Sp. *configuración nuclear*) though traditionally called the pitch nuclear configuration (Sp. *tonema*)—lies at the end of the pitch contour. This nuclear configuration is made up of the tonal movements associated with the last stressed syllable (the nuclear pitch accent) together with the boundary tones associated with the end of the prosodic phrase. The part of the pitch contour that precedes the nuclear configuration is called *prenúcleo* (prenucleus) or, in more traditional terms, *cuerpo* or *pretonema*.

For example, in several Spanish dialects an information-seeking yes-no question like *¿Venden mandarinas?* 'Do you-pl sell tangerines?' (see Figure 9.1, right panel) is characterized by a low nuclear pitch accent (associated with the stressed syllable *ri*) followed by a final high boundary tone (associated with the final syllable *nas*), whereas the broad focus statement like *Venden mandarinas* 'They sell tangerines' displays a falling nuclear pitch accent followed by a final low tone.

The present chapter contains three main sections. In this introduction we have summarized the main functions of intonation in Spanish and explained a few basic concepts that will appear in the following pages. The second section contains a summary of the most important advances in Spanish intonational research in the past few decades. The third section presents a panorama of the main research issues that are currently being investigated and will probably gain momentum over the next few years.

2. Historical background: Spanish intonational research

Despite the importance of intonation in the linguistic system of Spanish, prior to the past two decades of the twentieth century its study was relatively limited. In a survey of the literature, Quilis (1984) identified only about 60 publications related to Spanish intonation. In the past few decades, however, Spanish intonation has truly taken off, probably stimulated by the growing research in linguistic prosody in the international arena coupled with the greater affordability of speech analysis programs, which allow for easy and accurate acoustic analyses of intonation. The first scientific description of Spanish intonation can be dated back to 1918, when the phonetician Tomás Navarro Tomás published his *Manual de pronunciación española*. This handbook contained a phonetic description of the intonation of Central Peninsular Spanish read speech, which Navarro Tomás was able to describe experimentally thanks to one of the technical innovations of that time, the kymograph, an instrument that recorded variations in sound waves by means of a stylus trace on a rotating cylinder (Navarro Tomás 1918: 166). Navarro Tomás's work was fully in line with the most innovative intonational research being carried out in Europe at the time, and showed close ties with the so-called British School of intonation (see García-Lecumberri 2003 for a detailed description of intonational analysis as practiced by the British School). Thanks to his scientific thoroughness, Navarro Tomás's works on intonation (the *Manual de pronunciación española* and a handbook published in 1944 in the United States under the title *Manual de entonación española*) continue to be widely referenced in Spanish intonational research even today.

While Navarro Tomás worked within the tenets of the British School, other influential traditional authors found inspiration in the American School of intonation (see Martínez Celdrán 2003 for an overview of their work). Anthony (1948), the first study within this framework, focused on the phonetic description of a set of Spanish intonational contours. This approach returned to favor in the 1970s and 1980s, possibly because a group of influential Spanish and American linguists including Emilio Alarcos Llorach, Charles Hockett, and Joseph Matluck had begun to apply to Spanish the concept of tonal levels put forward by the American School. Work by Antonio Quilis in the last two decades of the twentieth century was pivotal in the subsequent upsurge of interest in Spanish intonation, and even the intonation section of the Spanish grammar published by the Real Academia Española in 1973 played a role.

The resulting flurry of empirical research on the intonation of Spanish and its dialects has been carried out from within a variety of theoretical models. Among the models focusing on the phonetic aspects of intonation, we find the so-called Dutch School or 'IPO model' (see Garrido Almiñana 2003 for a review), the 'Aix-en-Provence model' (see Baqué and Estruch 2003 for a review), and Cantero Serena's (1999) Melodic Analysis of Speech model. Though developed several decades ago, the majority of these models are still currently in use.

However, the most influential model of intonation at present is arguably the Autosegmental Metrical (henceforth AM) framework, which claims that suprasegmentals should be described at two complementary levels of representation, the phonetic and the phonological (Pierrehumbert 1980; Ladd 1996; Gussenhoven 2004). Initially developed in the 1980s by Janet Pierrehumbert, the AM framework asserts that intonational pitch contours can best be understood as sequences of two main types of phonologically distinctive tonal units, pitch accents and edge tones. Pitch accents are pitch movements associated with stressed syllables, while edge tones (which can be separated into phrase accents and boundary tones) are associated with the ends of prosodic phrases. These units are represented in terms of H(igh) and L(ow) targets. For edge tones the symbol '%' indicates that a tone is associated with the final edge of an utterance (e.g., L%, H%, and LH%, among other possibilities), whereas the symbol '-' indicates that a tone is associated with utterance-internal phrase boundaries (like L- and H-, among other possibilities). For pitch accents an asterisk '*' signals the tone associated with the stressed syllable (e.g., H*, L*, L+H*, or H+L*).

Based on the AM model, a set of language-specific prosodic annotation conventions called Tones and Break Indices (abbreviated as ToBI) has been developed for a variety of languages (see Jun 2005 for a review). The first ToBI model for Spanish—labeled Sp_ToBI—was proposed by Beckman and colleagues in 2002 (Beckman et al. 2002) and has subsequently been revised several times (see Prieto and Roseano 2010; Hualde and Prieto 2015 for a review). The first comprehensive analysis of Spanish intonation within the AM model was Sosa's influential book *La entonación del español* (1999b), which generated great interest. In the following decades, hundreds of papers, books, and multimedia atlases have shown the robustness of the AM model—along with Sp_ToBI—for describing Spanish intonation. Even the 2011 edition of the Real Academia Española official grammar endorsed the AM model, applying Sp_ToBI in its description of Spanish intonation.

Nonetheless, despite the appeal of Sp_ToBI, total consensus on a framework for the transcription of Spanish intonation remains elusive (see section 3.1). By the same token, further research is needed to fully characterize and understand the semantic effects of pitch events within Spanish intonational phonology (see section 3.2).

3. Current issues and challenges

The present section contains a brief discussion of some of the current issues and challenges faced by Spanish intonational research nowadays.

3.1. Intonation and the phonetics-phonology interface: the transcription of intonation

The most important consequence of the long-lasting coexistence of different theoretical approaches and traditions in Spanish intonation research is that there is as yet neither agreement on the level of description (e.g., phonetic or phonological) at which intonation should be transcribed nor a universally accepted set of labels for those target pitch events. The current variability in pitch labels is clearly a shortcoming, particularly because it renders comparisons across studies difficult. Though there is full agreement that phonetic and phonological analyses must both be present and must complement each other, the truth is that while phonetic models of intonation have provided detailed descriptions of pitch contours but given little weight to phonological analysis, for their part phonological analyses have tended to pay insufficient attention to the phonetic realization. Nevertheless, since the rise in the 1990s of what is known as Laboratory Phonology approaches, which combine acoustic phonetic analyses, perception studies, and phonological representations, there has been a progressive reconciliation between the two lines of research. As a result, recent work has dealt explicitly with the phonetics-phonology interface in Spanish intonation, with studies focusing on issues such as the alignment of tonal targets or the phonetic outcomes of tonal crowding and stress clash (see Hualde and Prieto 2015 for a review).

Another initiative undertaken has had the goal of clarifying the mapping between phonological and phonetic transcriptions of intonation. Recently, some researchers have explicitly argued in favor of incorporating another layer of phonetic transcription—be it narrow (Roseano and Fernández Planas 2013) or broad (Hualde and Prieto 2016)—into an AM-based phonological transcription system, though such proposals for prosodic labeling at the broad or narrow phonetic level are not conceived as alternatives to the phonological ToBI transcription systems but rather as complementary tools. For example, when describing how the phonological L* HL% nuclear configuration surfaces in Cantabrian Spanish yes-no questions, the prosodic annotation provided must necessarily account for the difference between a prototypical phonetic realization of such contour (Figure 9.3, left) and a truncated realization (Figure 9.3, right). To this end, the phonetic label [H!H%] might be used in order to signify that the second utterance ends with a fall from high to mid level, instead of a fall from high to low level [HL%].

Importantly, recent computational work has led to the development of several different ToBI automatic labeling systems that operate at either the phonological (Escudero et al. 2017) or the phonetic level of transcription (Elvira-García et al. 2016). Nonetheless, though a general consensus has been reached on the basic building blocks of intonation (to wit, pitch accents and boundary tones as well as nuclear and prenuclear pitch contours) across several Spanish

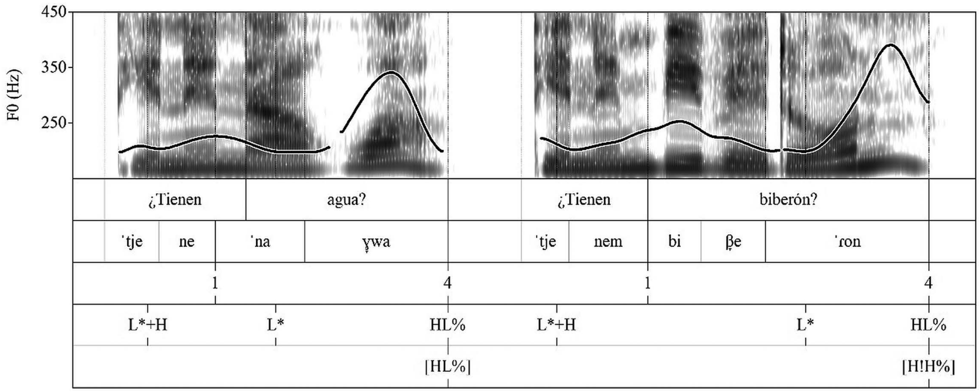

Figure 9.3 Spectrogram, pitch contour, and phonological and phonetic intonational transcription of the intonation of two yes-no questions in Cantabrian Spanish (the question on the left shows the prototypical realization of the contour, while the question on the right shows a truncated realization of the same contour)

dialects, further work will be needed to achieve full agreement on a set of accepted labels and levels of representation.

3.2. Intonational meaning: the intonation-pragmatics interface

Despite the fact that intonation is now regarded as an integral part of linguistic grammar, the study of intonational meaning has been generally neglected, and Spanish intonational research is no exception (for example, the models reviewed in section 2 have focused mainly on the representational issues without paying attention to meaning). One of the first authors to seriously investigate intonational meaning in Spanish was Escandell-Vidal (1998, 2011). Her papers have investigated the semantic effects of certain intonational contours (and also the effects of prosodic lengthening) in Spanish through a set of detailed conversational and acoustic analyses. For example, in Escandell-Vidal (1998) she discusses the meaning associated with three main nuclear configurations for Peninsular Spanish yes-no questions: the low-rise, the rise, and the rise-fall or circumflex (see Figure 9.4). She argues that the low-rise (L* H%) pitch contour encodes a general meaning of interrogativity, while the other two are pragmatically marked and encode restrictions on the inferential process. While the rise-fall pattern (L+H* L%) encodes an echoic meaning with an attribution of the proposition to someone other than the speaker (typically the hearer), the rising contour (L+H* H%) encodes speaker knowledge about the proposition, that is, the notion that the speaker already knows the answer to the question.

Recently, good progress has been made in the description of the use of intonation patterns to convey pragmatic meanings related to sentence types and epistemic meanings (see also section 3.3). One of the most widely used methods for intonation elicitation is the Discourse Completion Task (henceforth DCT), a method that prompts the speaker to respond to a given situation (see Vanrell et al. 2018 for a review of the benefits and disadvantages of this method for intonational research). However, despite these advances, more empirical and theoretical work would be helpful to unify prosodic and pragmatic models (for a review, see Prieto 2015).

From a methodological point of view, the past few decades have witnessed a major shift from a reliance on descriptive methods largely based on the reading of isolated sentences to

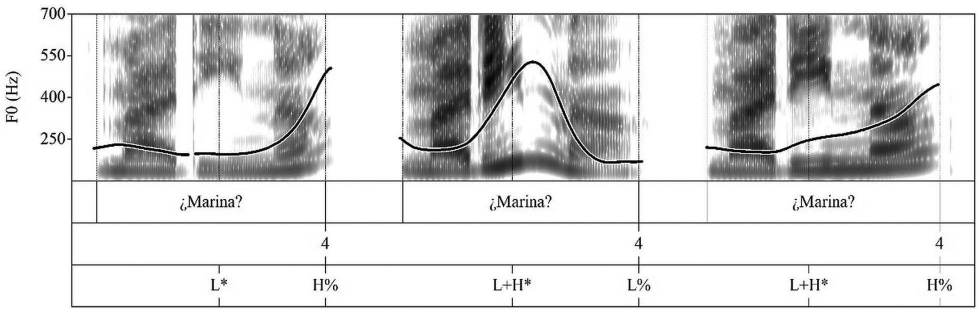

Figure 9.4 Spectrogram and intonational pitch contour of the three main nuclear configurations of yes-no questions in Spanish exemplified by the utterance *¿Marina?* 'Marina?'. A low -rise L* H% (left panel) encodes an open interrogative; a rise-fall pattern L+H* L% (center) encodes an echo question where the proposition is attributed to the interlocutor, not the speaker; and a rising contour L+H* H% (right panel) encodes a tentative attribution of the proposition to the speaker himself/herself.

the application of a variety of empirical methods that integrate intonation into discourse. For example, recent experimental work has explored the dynamic interplay between intonational meaning and discourse context in different types of yes-no questions in Puerto Rican Spanish (Armstrong and Prieto 2015). The study examined the effect of five types of bias found in intonation contours used for polar questions. Through an experimental task in which subjects were asked to rate the degree of appropriateness of a given polar question pitch contour in its discourse context, the study revealed that (a) the listener uses both intonation and discourse context to infer information about the speaker's belief states, and (b) some clear implicatures are conventionally derived from pitch contours that may clash with contextual expectations.

3.3. Intonational variation: geolectal differences

From the very beginning, research into Spanish prosody has pointed to significant differences in intonation across Spanish dialects. Navarro Tomás himself noted that

> intonation [. . .] shows a multitude of special circumstances whereby not only languages of different linguistic families but also those with a common origin and even the smallest regional and local varieties of the same language differ from each other. Many differences of pronunciation between Castilians, Andalusians, Aragonese, Argentines, Mexicans, etc., are basically differences in intonation.
>
> (1918: 162)

Nevertheless, Navarro Tomás did not expand on this idea but limited his meticulous description to the intonation of Central Peninsular Spanish, which at that time was the variety with the highest prestige. The first intonation studies of Spanish dialects appeared a few decades later, in the 1940s (see Canellada 1941, about *extremeño* Spanish, and Álvarez 1948, about Argentinian Spanish). Nevertheless, it was only in the 1960s and 1970s that dialectal variation in Spanish intonation began to receive the attention it deserved, with key work carried out by researchers such as Fontanella de Weinberg (1966), García Riverón (1976–1977), Kvavik (1974), and Matluck (1965).

A turning point in the study of geolectal variation in intonation came with Quilis (1987). Though the study showed a strong bias toward Peninsular Spanish, its novelty consisted in systematically comparing a set of intonational contours produced in three dialects of Spanish, namely, those of Madrid, Mexico City, and Puerto Rico. Quilis's work contributed to moving the field of intonational dialectology toward a more pan-Hispanic approach. The same can be said of Sosa (1999a), which analyzed intonational contours in a considerable number of Spanish varieties, from both Latin America (Buenos Aires, Bogotá, Mexico City, San Juan de Puerto Rico, Caracas, Havana, and Lima) and the Iberian Peninsula (Seville, Barcelona, Pamplona, and Madrid).

The first decade of the 21st century saw what could be called the 'globalization' of studies about Spanish intonation. The intensification of international academic networking (thanks to the internet) and technological progress, which greatly facilitated recording techniques and acoustic analysis, bore fruit in the creation of two interactive online atlases: the Spanish section of the *Atlas Multimédia Prosodique de l'Espace Roman* (AMPER-ESP; Martínez Celdrán and Fernández Planas 2003–2017) and the *Interactive Atlas of Spanish Intonation* (IASI; Prieto and Roseano 2009–2013). Both of them are compendia of information about the intonation of several Spanish dialects that incorporate descriptive and explanatory text, interactive maps, audio tracks, and diagrams. Crucially, the two works have used largely the same methodology to gather their data, with the result that their entries can be easily compared. Nevertheless, as we will see in the following, the two projects—both of them still under way—are somewhat different in nature and can therefore be seen as complementary.

The AMPER (Contini et al. 2003) is an ambitious project whose ultimate goal is to compile intonational information about all the Romance languages and make it accessible online. The specific aim of the Spanish section (AMPER-ESP) is to describe, from a phonetic point of view, the intonation of two sentence types in Spanish, broad focus statements and information-seeking yes-no questions. The data have been collected using four different methodologies, namely, read sentences, map tasks, interviews, and (in a small number of cases) DCTs. Nevertheless, the reproducible audio materials at the moment consist only of excerpts of read speech. As of 2017, the varieties covered by the AMPER-ESP are those spoken in Spain, Mexico, the United States, Cuba, the Dominican Republic, Honduras, Venezuela, Colombia, Ecuador, Peru, Argentina, Uruguay, and Chile.

For its part, the IASI, one of a set of similar websites related to the *Interactive Atlas of Romance Intonation* (Prieto et al. 2010–2014), takes a more phonological and pragmatic approach. Here, though some data have been collected by means of map tasks and interviews, pride of place is given to the abundant data gathered by means of DCTs, which cover a wide range of sentence types and subtypes, including yes-no questions, wh-questions, echo questions, exclamatives, imperatives, and vocatives. As of 2017, the IASI offers intonation data for Spanish varieties spoken in Spain, Mexico, the Dominican Republic, Puerto Rico, Venezuela, Colombia, Ecuador, Peru, Argentina, and Chile. An analysis of the data collected in the IASI was published in book form in 2010 (Prieto and Roseano 2010), and the chapter by Hualde and Prieto in *Intonation in Romance* (Frota and Prieto 2015) constitutes an updated summary of this report.

These two atlases clearly show that the study of the geolectal variation of Spanish intonation is no longer in its infancy. Nevertheless, the picture is far from complete. To begin with, many varieties of Spanish lack a full intonational description. In addition, and even more important, there is still no agreed classification of Spanish dialects from an intonational point of view, largely because the mapping of Spanish prosody is still incomplete, but also in part because there is a lack of adequate instruments for the kind of quantitative analysis of dialects that is required (Elvira-García et al. 2018). In the upcoming years, researchers will need to continue the description of Spanish intonation patterns across dialects (especially in the Americas) in order to, for example, sketch out intonational isoglosses, describe sociolinguistic variation, and explore the effects of language contact on intonation patterns, including the intonation systems of Spanish-based creoles and of heritage Spanish (Ronquest and Rao 2018).

4. Future directions

As we have seen, the past three decades have witnessed an upsurge of interest in Spanish intonational research. This chapter has presented a panorama of Spanish intonational research as it now stands and has highlighted a set of advances made in the field.

First, the chapter has shown how great progress has been made in the description of intonation patterns and their pragmatic meanings related to sentence types and epistemic meanings across Spanish dialects (see Hualde and Prieto 2015 for a review). Substantial advances have been made on cross-dialectal intonational variation, with two recent interactive online atlas projects that have provided a systematic description of the phonetic and phonological realization of intonation patterns across a set of geographical areas and their effects on pragmatic meaning. Similarly, these atlases exemplify the shift from a reliance on descriptive methods based on reading and production of isolated sentences to the use of a much wider variety of empirical methods that integrate intonation into conversational discourse.

However, as already noted, several challenges lie ahead. The first—which concerns intonational research on not only Spanish but other languages as well—is to work toward a universally accepted, standardized system of intonational transcription that includes and integrates both phonological and broad/narrow phonetic levels. As we saw in section 2, Spanish intonational research has traditionally been framed in a variety of theoretical models, and although the AM model has gained wide acceptance, a variety of tonal labels and intonation frameworks continue to be in use today. There is also a clear need to work for internationally accepted prosodic labels. Recent proposals for a common international prosodic alphabet (IPrA; see Hualde and Prieto 2016) and the inclusion of either a broad or a narrow phonetic level of transcription (Roseano and Fernández Planas 2013) will need to be assessed in the coming years. Similarly, current work on intonation needs to explore the interface between intonational and nonintonational prosodic features such as duration, intensity, and voice quality. Another important challenge is developing research about the acquisition of prosody, which—in spite of a few recently published studies (like Armstrong 2018)—does not yet constitute a main trend in Spanish (see Prieto and Esteve-Gibert 2018 for an overview).

Perhaps the most overarching challenge for intonational research is its progressive integration with the study of other parts of grammar, especially semantics and syntax. Although some recent studies have investigated in detail certain aspects of Spanish intonational meaning, more work is needed in this area. In order to have a complete analysis of intonational patterns in a given language, the description needs to encompass co-occurring lexical and syntactic properties, such as the use of discourse particles and the order of constituents. In connection with this, the field needs to incorporate a new set of empirical methodological techniques that allow for a full integration of the study of intonation with research on interactive discourse. While we are witnessing a trend toward greater empiricism in general, much needs to be done to fully integrate the study of prosody with other branches of theoretical and experimental linguistics, as well as areas of applied linguistics like language development, computation, and speech therapy.

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Part III
Interfaces

10

Spanish rhotics and the phonetics-phonology interface

Travis G. Bradley

1. Introduction

Normative Spanish varieties have two voiced apico-alveolar rhotics, the percussive tap /ɾ/ and the vibrant trill /r/ (Real Academia Española 2011: 243). Impressionistically, the consonants differ in the number of lingual contacts, one for the tap versus two or more for the trill. From a structuralist perspective, Spanish rhotics combine all three types of segmental distribution—contrastive, complementary, and free—within a single consonant manner class. The examples presented below are from Hualde (2014). There is contrastive distribution between vowels within the morphological word, where the tap and trill syllabify as single onset consonants:

(1)	a.	*caro*	[ˈka.ɾo]	‘expensive, dear’	b.	*carro*	[ˈka.ro]	‘car’
		ahora	[a.ˈo.ɾa]	‘now’		*ahorra*	[a.ˈo.ra]	‘saves’
		mira	[ˈmi.ɾa]	‘looks’		*mirra*	[ˈmi.ra]	‘myrrh’

The contrast in (1) is neutralized outside of the word-medial intervocalic environment. Before a vowel within the same syllable, the rhotics are in complementary distribution. The trill appears in syllable-initial prevocalic contexts; word-initially after a pause (2a), vowel (2b), or consonant (2c); and word-medially after a preceding syllable-final consonant (2d–f):

(2)	a.	*rocas*	[‖ˈro.kas]	‘rocks’	d.	*honra*	[ˈon.ra]	‘honor’
	b.	*da rocas*	[ˈd̪a.ˈro.kas]	‘gives rocks’	e.	*alrededor*	[al.re.ð̞e.ˈð̞oɾ]	‘around’
		la roca	[la.ˈro.ka]	‘the rock’	f.	*Israel*	[i$^{(z)}$.ra.ˈel]	‘Israel’
	c.	*con rocas*	[kon.ˈro.kas]	‘with rocks’				

The tap appears in non-syllable-initial prevocalic contexts, both word-initially and word-medially, after voiceless and voiced obstruents, which include the labiodental fricative (3a) and the labial, coronal, and dorsal plosives (3b,c). Voiced plosives (3c) alternate with voiced approximants after a preceding continuant segment, both word-medially as seen here and word-initially, e.g. *la* [β̞]*roma* ‘the joke’. In the absence of an intervening pause, a word-final consonant in

Spanish is syllabified as the onset of a following vowel-initial word. In this context, word-final prevocalic rhotics are pronounced as taps (3d):

(3)	a.	*fruta*	[ˈfɾu.t̪a]	'fruit'	*sufro*	[ˈsu.fɾo]	'I suffer'
	b.	*pronto*	[ˈpɾon̪.t̪o]	'soon'	*siempre*	[ˈsjem.pɾe]	'always'
		trampa	[ˈt̪ɾam.pa]	'trap'	*vientre*	[ˈbjen̪.t̪ɾe]	'abdomen'
		crema	[ˈkɾe.ma]	'cream'	*lucro*	[ˈlu.kɾo]	'profit'
	c.	*broma*	[ˈbɾo.ma]	'joke'	*abro*	[ˈa.β̞ɾo]	'I open'
		drama	[ˈd̪ɾa.ma]	'drama'	*cedro*	[ˈθe.ð̞ɾo]	'cedar'
		gramo	[ˈɡɾa.mo]	'gram'	*logro*	[ˈlo.ɣ̞ɾo]	'gain'
	d.	*dar ocas*	[ˈd̪a.ˈɾo.kas]	'to give geese'			
		por eso	[po.ˈɾe.so]	'for that reason'			

After a vowel within the same syllable, the rhotics are in free variation. The difference between the tap and trill is phonologically nondistinctive before a consonant, both word-medially (4a) and word-finally (4b), and before a pause (4c):

(4)	a.	*arde*	[ˈaɾ.ð̞e~ˈar.ð̞e]	'burns'
	b.	*dar paso*	[ˈd̪aɾ.ˈpa.so~ˈd̪ar.ˈpa.so]	'to give way'
	c.	*dar*	[ˈd̪aɾ‖~ˈd̪ar‖]	'to give'

Noncontrastive variation obtains only in syllable-final position, as seen in (4) versus (3d). Even though syllable-initial prevocalic rhotics (2) are normally pronounced as trills, *word-final* syllable-initial prevocalic rhotics surface as taps, patterning instead with non-syllable-initial prevocalic rhotics (3a–c). The distribution of rhotics at the word edge makes it possible to construct "phrasal minimal pairs" distinguished solely by the intervocalic consonants:

(5)	a.	*da rocas*	[ˈd̪a.ˈro.kas]	'gives rocks'	=(2b)
	b.	*dar ocas*	[ˈd̪a.ˈɾo.kas]	'to give geese'	=(3d)
	c.	*dar rocas*	[ˈd̪a⁽ɾ⁾.ˈro.kas]	'to give rocks'	

The pronunciation difference in (5a,b) is not a phonological contrast per se, as in word-medial intervocalic position (1), but rather serves to indicate the morphological affiliation of the rhotic: the trill can be word-initial only in *rocas*, while the tap can be word-final only in *dar*. In Spanish, sequences of identical continuants across a word boundary undergo temporal reduction. Because minute durational differences can still be maintained between the reduced cluster and its singleton counterpart, the neutralization between /ɾ#r/ in (5c) and /r/ in (5a) is incomplete.

The remainder of this chapter is organized as follows. A review of experimental studies in Section 2 reveals the phonetic details of rhotic contrast and neutralization, enriching the descriptive data set. Drawing on insights from laboratory and theoretical phonology, Section 3 presents a novel analysis of Spanish rhotics based on a particular model of the phonetics-phonology interface, followed by a discussion of theoretical alternatives and of the phonetics-phonology mismatch between trills and geminate taps. Section 4 concludes.

2. Moving beyond impressionistic data

Recent advances in laboratory phonology have led to an increased focus on phonetic detail. Acoustic analysis reveals that the pronunciation of rhotics by normative Spanish speakers is much more continuous and gradient than suggested by the discrete and categorical symbols of broad phonetic transcription. Using acoustic analysis of experimentally collected data from two male native speakers of North-Central Peninsular Spanish (NCPS) in semiformal laboratory read speech, Blecua (2001, 2008) identifies a common property shared by taps and trills that defines the natural class of Spanish rhotic consonants: *the presence of a brief voiced occlusion between two vocalic periods, with trills repeating the structure at least once*. Consider the most frequent realizations in intervocalic position and in consonant clusters:

(6)	a.	Intervocalic:	/VɾV/	[V+**occl.**+V]
	b.		/VrV/	[V+**occl.**+**voc.el.**+**occl.**+(. . .)V]
	c.	Complex onset:	/CɾV/	[C+**voc.el.**+**occl.**+V]
	d.	Coda:	/VɾC/	[V+**occl.**+**voc.el.**+C]

The boldfaced acoustic components are occlusions and vocalic elements, which reflect lingual closures and openings, respectively. The brief voiced occlusion of an intervocalic tap /ɾ/ (6a) is flanked by vowels, which count as the vocalic periods referred to in Blecua's definition. The medial vocalic element of an intervocalic trill /r/ (6b) ensures that vocalic periods surround each occlusion. In consonant clusters, a vocalic element intervenes between the tap and a preceding (6c) or following (6d) consonant.

Lingual occlusions are 21 ms long on average. Vocalic elements are more variable and usually longer than the adjacent occlusion(s), i.e. 23 ms (6b), 27.9 ms (6c), and 26 ms (6d). The average total duration of intervocalic trills (6b) is 64 ms, which contrasts maximally with the single 21 ms occlusion of intervocalic taps (6a).

Taps and trills alternate with other variants along the continuum in Figure 10.1, where solid boxes denote the canonical forms in (6). Table 10.1 describes the acoustic components listed above the continuum, based on properties visible in spectrograms and waveforms. Each rhotic context is associated with a continuous range of phonetic exponents, ordered in terms of relative weakening and strengthening. More lenited variants appear to the right and involve a weakening of lingual occlusions to approximants or fricatives, as well as a reduction in both the number of components and the total duration of the rhotic segment. Coda rhotics show the most variation.

Blecua and Cicres (2019) examine syllable-final rhotics in the spontaneous speech of six male speakers from Madrid and Salamanca. The preconsonantal and prepausal exponents they find in

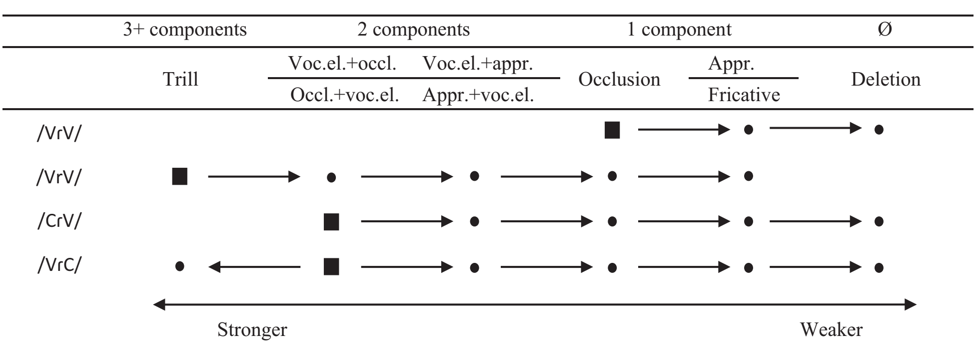

Figure 10.1 Gradient continuum of weakening in NCPS rhotics

Source: Based on Blecua (2008: 26).

Table 10.1 Acoustic characteristics of rhotic components

	Well-defined formants	*Noise at high frequencies*	*Hold period (with or without release burst)*	*Large number of zero crossings*
Occlusion			✓	
Fricative		✓		✓
Approximant	✓			
Vocalic element	✓			

Source: Based on Blecua and Cicres (2019: 25).

relaxed style are the same ones found before consonants in laboratory speech but with a different distribution: more single-component approximants and fricatives and deletion in spontaneous speech, versus more trills in read speech. The researchers tie this difference to the predictions of Lindblom's (1990) theory of Hyper and Hypo-articulation: because speakers vary in the clarity of their articulation according to the informational requirements of the listener, relaxed speech styles will favor more weakened realizations.

Electropalatography (EPG) measures areas of contact between the tongue and the hard palate in real time. Although the trill in (6b) has twice the number of lingual contacts as the tap in (6a) and has been analyzed by some phonologists as a geminate tap (see Sections 3.4 and 3.5), Martínez Celdrán and Fernández Planas (2007: 143–161) present EPG data from NCPS showing that [r] is not just a repetition of the lingual gestures of /ɾ/ but that different production mechanisms are involved. The tap shows a single voluntary movement toward the alveolar ridge followed by a movement away from the constriction. The trill requires greater lingual tension in order to initiate the Bernoulli effect, which causes the tongue tip to passively vibrate against the postalveolar zone until trilling is extinguished. In /Cɾ/ and /ɾC/ clusters, the acoustic vocalic element between the consonants corresponds to a lack of lingual contacts in the EPG data.

ElectroMagnetic Midsagittal Articulometry (EMMA) traces the movement of articulators through space and time using sensor coils positioned in the vocal tract. Based on EMMA measurement data from a single speaker of NCPS, Romero (1996) characterizes the production of /ɾ/ as a "flap": the tongue tip first moves slightly up and back, then slides forward, briefly striking against the alveolar ridge before finally returning to rest position. In [Vɾð̞V], the tongue tip movements of the tap and the voiced dental approximant are realized sequentially, and the interval between constrictions gives rise to the intervening vocalic element. In [Vl̪d̪V], the tongue tip gestures are overlapped and blended to produce a single closure that is intermediate between dental and alveolar. The asymmetry between the quick flapping motion of /ɾ/ and the slower trajectory of /l/ is also found in the mirror-image context of obstruent+liquid onsets. In an EMMA study with six speakers of NCPS, Gibson et al. (2019) find significantly longer intervals between constriction phases in /Cɾ/ clusters as compared to /Cl/. Kinematic measurement data show that the tap is a sequence of two gestures: "a first tongue back-lowering gesture followed by a forward gesture of the tongue tip" (23).

Ultrasound imaging provides a dynamic view of the posturing and movement of the tongue along the midsagittal plane. Based on ultrasound data from five speakers of different Latin American Spanish dialects, Proctor (2011) argues that the coronal liquids /ɾ,r,l/ are all complex articulations in which a secondary tongue body gesture is coordinated with a primary tongue tip gesture. He proposes gestural representations for Spanish voiced coronal consonants within the framework of Articulatory Phonology (see Sections 3.1 and 3.3). The specifications in Table 10.2 characterize the production of coronal consonants in terms of constriction location (CL) and constriction degree (CD) of the tongue tip (TT) and tongue body (TB) articulators. All four consonants have a primary tongue tip constriction gesture, but only the liquids have a secondary tongue body gesture of wide constriction degree. The secondary gesture of the trill has a more posterior constriction location than that of the tap, i.e. uvular-pharyngeal versus uvular. (This could explain the EPG-based finding of Martínez Celdrán and Fernández Planas that NCPS /r/ has a more retracted, postalveolar tongue tip contact than alveolar /ɾ/, given the synergy between the tongue body and tip as lingual articulators.) Another crucial difference (not shown) is that the tongue tip gesture of /ɾ/ is specified to produce a high-velocity, ballistic movement to achieve the brief hit-and-run constriction that is the defining characteristic of the tap. Proctor argues that the secondary tongue body gesture is responsible for the vocalic element that accompanies the brief tap constriction in non-intervocalic contexts. Furthermore, gradient allophony in both the tap and the trill follows naturally from their representation as complex lingual gestures. Since both rhotics require "the coordination of a stabilizing tongue body gesture with a coronal approximation gesture, different rhotic allophones can result from small differences in airstream properties, tongue-tip stiffness, coronal aperture, tongue body placement, and inter-gestural timing" (475). A successful voiced alveolar trill requires a high degree of aerodynamic constraint, and small changes in pressure can result in the loss of trilling and/or voicing (Solé 2002). A higher pressure difference is needed to begin lingual trilling than to sustain it: "initiating a trill involves greater targeting of tongue contact and release," but once "trilling is initiated by muscle action and aerodynamic forces [. . .], tongue-tip vibration is maintained as a self-sustaining vibratory system" (Solé 2002: 675). For a more extensive investigation of the production mechanisms underlying consonant clusters containing rhotics and other consonant types in Romance languages, see Recasens (2018).

Relatively less attention has been paid to how Spanish listeners perceive the acoustic exponents of rhotics. Martínez Celdrán and Rallo (1995) carried out a perceptual test with eighteen native listeners at the University of Barcelona. The researchers digitally edited recordings of words containing intervocalic rhotics, turning taps into trills and vice versa. Based on auditory impressions, listeners accepted 94.37% of the total manipulations as well-formed, which gives perceptual evidence that the most characteristic trait of Spanish taps and trills is the brevity of their lingual occlusions. Romero (2008) investigated the effect of vocalic elements on the perceptibility of taps in preconsonantal contexts. He digitally manipulated recorded tokens of /(C)VsCV/ words to create a continuum of stimuli differing in the duration of the alveolar fricative and in the presence and duration of a vocalic element, copied from /(C)VɾCV/ tokens

Table 10.2 Lingual gestures for Spanish voiced coronal consonants

	/d̪/	/l/	/ɾ/	/r/
TTCL	dental	alveolar	alveolar	alveolar
TTCD	closed	closed	narrow	narrow
TBCL	—	palatal	uvular	uvular-pharyngeal
TBCD	—	wide	wide	wide

Source: Based on Proctor (2011: 474).

and inserted after the shortened /s/. Results from an XYZ-choice task with fourteen native listeners from Tarragona indicate that

> the presence of a vocalic element facilitates hearers' perception of r+C clusters, even though they are capable of hearing /ɾ/ even when that vocalic element is missing, and as long as the duration of the tongue-tip gesture is short enough. (67)

Perceptual factors have been argued to play a role in shaping the phonological distribution of the tap and trill. In a typological survey and theoretical account of languages that have a phonological distinction between apico-alveolar /ɾ/ and /r/, Bradley (2001) established an implicational hierarchy for positions of contrast and neutralization, shown in (7).

(7) intervocalic < word-initial < elsewhere (i.e. word-final, consonant-adjacent)

A contrast in a given position entails a contrast in positions to the left. None of the languages surveyed allows the contrast outside the intervocalic position without also allowing it between vowels. This finding paved the way for new theoretical treatments of rhotics in Catalan (Padgett 2003b, 2009) and Spanish (Bradley 2005, 2006b) based on perceptual distinctiveness. These accounts hypothesize that the perception of a consonant's duration depends on the correct identification of its beginning and ending points, which are easier to hear when the consonant is flanked by vowels. Dmitrieva (2012, 2018) provides experimental support for this hypothesis based on the perceptual categorization of short versus long consonants in different contexts by a total of eighty-eight native speakers of Italian and Russian, which have geminate consonants, and American English, which does not. In a forced-choice identification task, the Italian and Russian listeners showed the highest rates of correct classification in intervocalic position, especially after a stressed vowel. This mirrors the cross-linguistic preference for geminate consonants to appear between vowels and to avoid adjacent consonants. Although the same listeners showed greater perceptual acuity in word-initial than word-final position, final geminate consonants turn out to be typologically more common for independent reasons having to do with the phonology of syllable weight. Most important, Dmitrieva's results show that the distribution of contrasts based on consonant duration is partially regulated by perceptual distinctiveness, and this provides a functional explanation for the implicational hierarchy of tap-trill contrasts in (7).

3. Spanish rhotics at the phonetics-phonology interface

A critical issue for research on the phonetics-phonology interface in generative grammar is to better understand the relationship between the categorical nature of abstract phonological representations, which are qualitative, discrete, cognitive, and timeless, and the gradient nature of phonetic realizations, which are quantitative, continuous, physical, and dynamic in space and time. In early generative phonology (Chomsky and Halle 1968), there was a sharp division between language-specific phonology and universal phonetic implementation. On this view, language-specific sound patterns are necessarily the result of rules applying in the phonological component. Since then, laboratory phonology studies have amassed enough evidence of gradient allophony to argue that phonetics is not just the universal, mechanical, and automatic realization of a language-specific phonological output. Also under the speaker's control is phonetic knowledge (Kingston and Diehl 1994), which varies systematically across languages and styles.

For an overview of laboratory phonology studies reporting gradient allophony in Spanish, see Campos-Astorkiza (this volume). For a discussion of how gradient acoustic information is assigned to discrete phonemic categories during phonological encoding by listeners, see Simonet (this volume).

Different conceptions of the relationship between language-specific phonetic and phonological knowledge have been proposed, but an overall theoretical consensus has yet to be achieved. The rule-based nonlinear and autosegmental frameworks of the 1980s posit a language-specific phonetic implementation component that is derivationally ordered after the phonology, along with various algorithms for transducing the abstract features and segments of the surface representation into concrete physical parameters. Phonological analysis since the 1990s has focused increasingly on the interaction of ranked and violable constraints and has assumed mostly parallel evaluation of output candidates, without ordered rules and intermediate derivational steps. Many phonologists working within parallel Optimality Theory (OT; Prince and Smolensky 1993, 2004) still retain a derivational phonology-phonetics ordering, as well as a distinction between categorical and gradient representations. In surface-oriented OT, the phonological contrastiveness of a feature depends not on whether the feature is specified in the underlying representation but on whether the constraint system allows it to map faithfully from the input to the output. Because contrastiveness is separated from representation, the grammar is free to incorporate phonetically gradient and continuous detail without the danger of overpredicting unattested phonological contrasts. In phonetically based OT (Hayes et al. 2004), the modular feed-forward architecture inherited from rule-based phonology is eliminated. Phonetic representations and constraints are included directly in the phonological grammar, and there is no interface between phonology and phonetics as separate modules. This approach is argued to capture more directly the interacting articulatory and perceptual biases that shape phonological patterns and to avoid the duplication of having to represent sounds twice: abstractly in the phonology and concretely in the phonetics.

Kingston (2007: 401) perceives an ongoing lack of consensus in the field about what constitutes the phonetics-phonology interface, including whether one even exists. While theoretical phonology must contend with an ever-increasing amount of experimental data brought to light by laboratory phonologists, Hamann (2010) argues that theoretical questions about the relationship between phonetics and phonology cannot be answered by further experimentation alone and urges researchers "to think more in terms of models that can formalize the interface" (222). Observing that modern phonology is more interdisciplinary than ever before, van Oostendorp (2013) cautions against letting the field become too fractured, lest experimentalists and theoreticians should one day consider each others' work irrelevant. This calls for even greater synergy between laboratory and theoretical phonology.

Toward this end, I offer a novel account of NCPS rhotics that integrates empirical evidence and computational models from both subfields. In particular, the analysis formalizes a modular interface between an optimization-based phonology and an implementation-based phonetics, both of which operate on articulatory gestures as representational primitives.

3.1. Gestural coordination in Articulatory Phonology

Around the same time as the inception of OT, researchers in laboratory phonology had already begun to develop Articulatory Phonology (AP) as an alternative to phonological theories based on autosegmental features (Browman and Goldstein 1989, 1990, 1992). The basic unit of phonological representation in AP is the gesture, which is a task to be achieved through movements of the articulators. For example, the lingual gestures of /ɾ/ involve two simultaneous tasks: the tongue body forms a wide constriction in the uvular region, while a ballistic flapping motion of the tongue tip forms a brief narrow constriction against the alveolar ridge. By contrast, /d̪/ requires only that the tongue tip form a closure against the upper teeth. Because gestures serve both as units of contrast and as units of speech production, AP does not have to worry about mapping categorical phonological features onto their gradient physical correlates.

Autosegmental phonology and AP represent time differently (Zsiga 2011). Autosegmental association allows for only two degrees of freedom in the temporal relationship between features—either linear precedence or simultaneity. Because gestures in AP are dynamically defined tasks with internal duration, it is possible for two adjacent gestures to be more or less overlapped in time. Earlier versions of AP defined the gesture as a 360° cycle and stipulated timing by making reference to degrees of gestural phasing (e.g. Zsiga 2000) or to a reduced set of five temporal landmarks, i.e. ONSET, TARGET, CENTER, RELEASE, and OFFSET (e.g. Gafos 2002; Bradley 2005, 2006a). Both approaches have the drawback of allowing many more possible timing relations than the two degrees of freedom predicted by autosegmental theory. Researchers working on the computational modeling of AP have introduced a coupled-oscillator component of speech planning, which offers a more constrained approach (Goldstein et al. 2006; Nam 2007). In the new model, there are only two kinds of coupling between gestures. When two gestures are coupled *in-phase*, both will begin simultaneously. When coupled *anti-phase*, they will be realized sequentially, with one gesture beginning around the other's halfway point. The onset-coda distinction is recast as a difference in gestural coupling: onset consonants are coupled in-phase with a following vowel, while codas are coupled anti-phase with a preceding vowel. Coordination relations are formalized in an intergestural coupling graph, where connecting lines indicate coupling modes: solid for in-phase and dotted for anti-phase.

I propose the coupling graphs in Figure 10.2, which illustrate four syllable contexts containing rhotic gestures. In each liquid, the secondary tongue body gesture is coupled in-phase with its primary tongue tip gesture, which is, in turn, coupled with adjacent primary gestures. Word-initial /rV/ has a single onset trill, coupled in-phase with the vowel. The in-phase CV couplings in /d̪ɾV/ place both consonants in competition to begin simultaneously with each

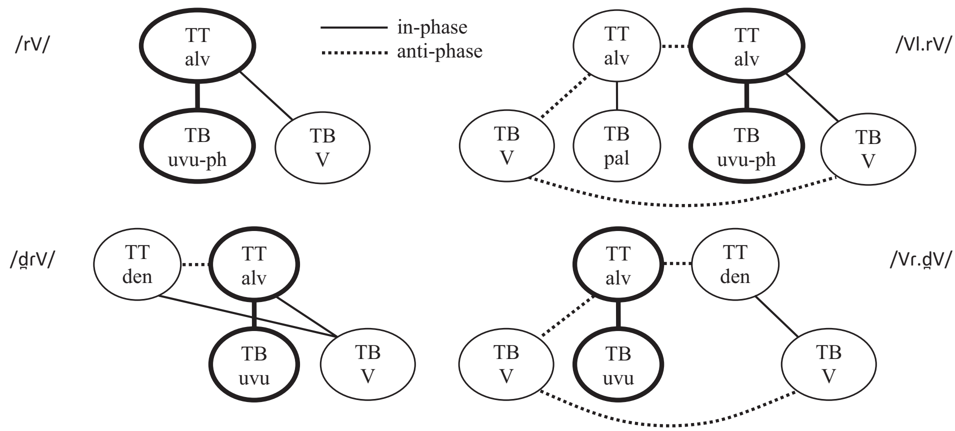

Figure 10.2 Intergestural coupling graphs for NCPS rhotics (boldfaced) in four syllable contexts. Only abbreviations of consonantal constriction locations (see Table 10.2) are shown (i.e. dental, alveolar, palatal, uvular, and uvular-pharyngeal). Primary gestures of adjacent consonants are coupled anti-phase, as are tongue body gestures of vowels (TB V) across adjacent syllables.

other and the vowel. However, total overlap between the two consonants is prevented by their mutual anti-phase coupling. The result is a compromise, known as the *c-center effect*, whereby the beginning of the vowel shows a stable timing relationship with the middle point between the two onset consonants. Competitive coupling obtains only when consonants are coordinated with the same vowel, as in /d̪ɾV/.

Evidence of competitive in-phase coupling in complex onsets comes from an EMMA study by Gafos et al. (2019), who compare the articulation of word-initial /lV/ versus /klV/ syllables by two native NCPS speakers. Adding /k/ to /lV/ reduces the duration of the lateral and causes it to overlap more with the vowel, which suggests that a global timing relationship holds over the entire /CCV/ sequence (cf. Moroccan Arabic /k.lat/ 'to eat', in which the vowel is coordinated locally with only the immediately preceding consonant).

The coda liquids in /Vl.rV/ and /Vɾ.d̪V/ are coupled anti-phase with the preceding vowel, and the onset consonants are coupled in-phase with the following vowel. In /Vl.rV/, the postconsonantal trill has the same in-phase CV coupling as in word-initial /rV/.

Intergestural coupling graphs form the basis of a computational model of speech production known as Task Dynamics Application (TaDA), shown in Figure 10.3, which operates based on the physics of coupled oscillators and the mathematical equations of task dynamics. The intergestural coordination component takes the coupling graphs and, through a planning process, determines the most stable overall timing pattern for a specified rate of speech. The output is a gestural score, which displays the length and relative timing of the articulatory gestures (see examples in Section 3.3). The gestural score is fed into the interarticulator coordination component, in which task dynamic equations derive articulatory movement trajectories. The trajectories can serve as the basis for subsequent vocal tract modeling and speech synthesis (not examined in this chapter). Unlike autosegmental phonology, AP posits no formal representation for the traditional segment. Gestures are considered to be the "atomic" units of speech production, which are glued together by coupling relations into larger "molecules" that ultimately cohere into word forms (Goldstein et al. 2006). These forms are stored in the lexicon, which is assumed to be the source of intergestural coupling graphs in the TaDA model.

In the following analysis, the initial component of the model in Figure 10.3 is recast as a constraint-based OT grammar, in accordance with similar proposals by Smith (2018) and Walker and Proctor (2019). Within the gestural molecules that make up words, optimal coupling graphs are established by the grammar (Section 3.2) and phonetically implemented as gestural scores in TaDA (Section 3.3).

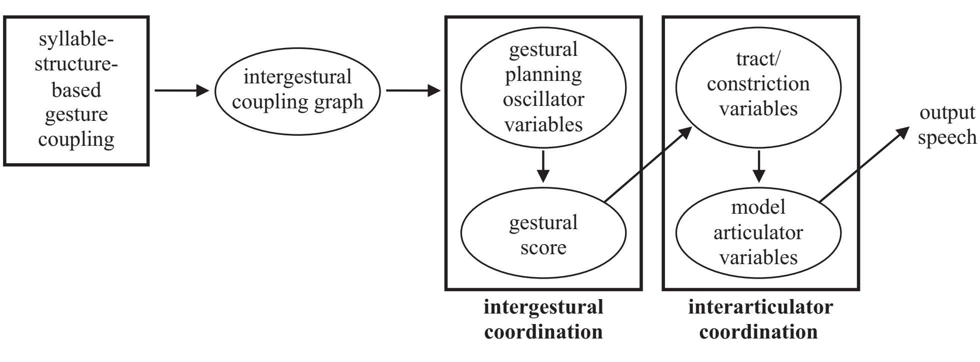

Figure 10.3 TaDA (Task Dynamics Application) model
Source: Based on Browman et al. (2006).

3.2. Phonological optimization

Following Smith (2018), I formalize default coordination relations as markedness constraints that require specific couplings between adjacent consonant and vowel gestures. These constraints ensure (i) an in-phase coupling between a consonant and a following nuclear vowel, (ii) an anti-phase coupling between adjacent consonants, and (iii) an anti-phase coupling between vowels. Anti-phase coupling between a nuclear vowel and a following consonant emerges from a universal prohibition against uncoupled gestures in the output. Default coupling constraints rank high in NCPS and are not shown in the analysis. The in-phase coupling of primary and secondary tongue gestures within liquids is assumed here to be lexically specified.

Insights from the articulatory studies reviewed in Section 2 provide a substantive basis for formulating markedness constraints on the coupling of tap, trill, and vowel gestures. Both rhotics impose strict postural and aerodynamic requirements at the beginning of their lingual gestures. The ballistic flapping motion of /ɾ/ first requires a retraction of the tongue body and a cocking back of the tongue tip, and the tongue tip vibration of /r/ requires greater lingual tension and oral pressure to initiate than to sustain. The conditions for meeting these requirements are more favorable during the middle part of an adjacent vowel, where there is maximum airflow and more time to organize tongue movements, than when the rhotic begins simultaneously with the vowel. I formalize the asymmetry as gestural coupling constraints:

(8) a. $*[ɾ\text{–}V]_{MWd}$
Assign a violation for every exclusive in-phase coupling between a tap and a following vowel within the same morphological word (MWd).
b. *r–V
Assign a violation for every in-phase coupling between a trill and a following vowel.

Both constraints penalize in-phase coupling but differ in specificity. First, (8a) is violated only when there is an exclusive in-phase coupling between /ɾ/ and the vowel, i.e. when there is no competitive in-phase coupling between the vowel and another consonant. Second, (8a) is violated only when /ɾ/ and the vowel belong to the same MWd. By contrast, the more general (8b) is blind to morphological context and does not care if the in-phase coupling between /r/ and the vowel is exclusive or competes with another CV coupling.

Because they impose restrictions on intergestural coupling graphs in the output, gestural coupling constraints potentially conflict with a constraint that promotes faithfulness to input gestures. The correspondence constraint in (9) requires the constriction location, degree, and velocity specifications of gestures in the output to match the values specified in the input:

(9) Identity-IO(gesture)
Assign a violation for every gesture or set of gestures whose output specifications are not identical to the values specified in the input.

I assume that the primary and secondary gestures of a liquid count as a single set for the purposes of evaluating input-output identity; i.e. the unfaithful mappings /ɾ/→r and /r/→ɾ each incur a single violation of (9). When faithfulness dominates the relevant gestural coupling constraints, a potential input contrast involving those gestures will be preserved in the output.

However, faithfulness to input gestures can be overridden in contexts where the relevant phonological contrast is less likely to be perceived by listeners. As discussed in Section 2, differences in consonant duration are most perceptible between vowels, less so in word-initial position, and least so word-finally and next to a consonant. Dmitrieva (2012) formalizes contextual differences in the perceptual distinctiveness of consonant duration contrasts using Dispersion Theory (DT; Flemming 2004), a version of OT in which markedness constraints enforce minimum degrees of distance among contrastive sounds along some phonological dimension directly in the output. Flemming's framework eliminates the notion of inputs and replaces input-output faithfulness with a single output constraint requiring the maximum number of allowable contrasts. Instead, I follow Padgett (2003a, 2003b, 2009) and Bradley (2005, 2006b), who use markedness constraints to regulate the perceptual spacing of output contrasts while maintaining inputs and faithfulness constraints. The space between two consonants contrasting in duration varies systematically by context, which can be formalized as in (10):

(10)	a.	shorter C..longer C	$(\ldots V\_V\ldots)_{PWd}$
	b.	shorter C...................................longer C	$_{PWd}(\_V\ldots$
	c.	shorter C.................longer C	elsewhere

These scales are abstract representations of "the speaker's partial understanding of the physical conditions under which speech is produced and perceived" (Hayes and Steriade 2004: 1). The labels "shorter" and "longer" refer to relative durational differences between output consonants, independently of the longer consonant's status as a phonological singleton or geminate (see Section 3.4). The contrast is maximally dispersed between vowels within a prosodic word (PWd) (10a), less dispersed at the beginning of a PWd (10b), and least dispersed elsewhere (10c).

The phonology uses Space constraints, projected from the perceptibility scales, to help predict whether a consonant duration contrast in the input will be realized in the output. Only one such constraint plays a role in the NCPS rhotic system:

(11) Space_{V_V}

For every potential minimal pair based on duration, assign a violation if the consonants occupy less perceptual space than they do *between vowels within a prosodic word*.

Unlike (8a,b), which evaluate individual CV couplings, (11) is a systemic markedness constraint that evaluates the perceptual distinctiveness of contrasts within a larger phonological system of word forms. A "potential minimal pair" is defined as two words or phrases that are identical in all respects, except for the gesture or set of gestures corresponding to one segment, i.e. /ɾ/ versus /r/. Words under evaluation need not be actually existing lexical items. As in any generative framework, the goal of a DT analysis is to predict the set of phonologically possible words and phrases, independently of accidental gaps in the lexicon. Space_{V_V} is violated by potential minimal pairs in which the tap and trill appear in any position other than between vowels within a PWd, where consonant duration contrasts are maximally perceptible.

The analysis proceeds by constructing a chain of ranking arguments until a total ranking is deduced that generates all and only the optimal intergestural coupling graphs in the output. Tableau (12) gives the first argument, based on word-medial intervocalic position. Candidates are coupling graphs in which phonetic symbols stand in as shortcuts for sets of gestures corresponding to individual segments. Input gestures are shown in the first cell of the tableau, where each word is tagged with its own subscript. The output candidates show contrast between the tap and trill (a), neutralization to the tap (b), and neutralization to the trill (c). The first member of the pair in (12a) violates *[ɾ–V]$_{\text{MWd}}$ because the tap and the vowel show an exclusive in-phase coupling within the same MWd. The second word violates *r–V. The contrast between input words is neutralized in (12b,c), as indicated by the merged subscripts. Each unfaithful mapping of rhotic gestures incurs a fatal violation (*!) of Ident. The intervocalic contrast in (12a) is optimal (☞) because faithfulness outranks the two gestural coupling constraints, whose mutual ranking is still to be determined.

(12)

		/k a ɾ o$_1$	k a r o$_2$/	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
☞	a.	k—a ɾ—o$_1$	k—a r—o$_2$		*	*
	b.	k—a ɾ—o$_{1,2}$		*!	*	
	c.		k—a r—o$_{1,2}$	*!		*

Tableau (13) gives two additional ranking arguments, based on word-initial position. Unlike (12a), the word-initial contrast in (13a) fatally violates Space$_{\text{V_V}}$, which dominates faithfulness. Neutralization candidates (13b,c) are tied on their faithfulness violations, which allows the lower-ranking gestural constraints to become active and their mutual ranking to be determined. In (13b) there is an exclusive in-phase coupling between the tap and the following vowel within the same MWd, ruled out by *[ɾ–V]$_{\text{MWd}}$. The trill emerges as the unmarked rhotic in word-initial position because (13c) violates lowest-ranked *r–V.

(13)

		/ɾ o k a$_1$	r o k a$_2$/	Space$_{\text{V_V}}$	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
	a.	ɾ—o k—a$_1$	r—o k—a$_2$	*!		*	*
	b.	ɾ—o k—a$_{1,2}$			*	*!	
☞	c.		r—o k—a$_{1,2}$		*		*

This is an example of a more general effect in OT known as the Emergence of the Unmarked (TETU): "Even in languages where [some markedness constraint] C is crucially dominated and therefore violated, the effects of C can still be observed under conditions where the dominating constraint is not relevant" (McCarthy and Prince 1994: 334). When Space$_{\text{V_V}}$ forces a tie on Ident, the tie is broken by the interaction of lower-ranking gestural markedness constraints.

Syllable-initial postconsonantal rhotics show the same gestural TETU effects as in word-initial position. Both contexts involve an exclusive in-phase coupling between the rhotic and the following vowel, making a unified analysis possible. The non-intervocalic contrast in (14a) fatally violates Space$_{\text{V_V}}$, and [ɾ–V]$_{\text{MWd}}$ chooses the trill in (14c), as it does in (13c).

(14)

		/o n ɾ a$_1$	o n r a$_2$/	Space$_{\text{V_V}}$	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
	a.	o·····n·····ɾ—a$_1$	o·····n·····r—a$_2$	*!		*	*
	b.	o·····n·····ɾ—a$_{1,2}$			*	*!	
☞	c.		o·····n·····r—a$_{1,2}$		*		*

The ranking also makes the correct predictions for complex onsets. Although /ɾ/ in (15b) is coupled in-phase with a following vowel that belongs to the same MWd, so is the preceding /b/. As defined in (8a), *[ɾ–V]$_{\text{MWd}}$ is satisfied because the tap and vowel are not exclusively coupled. The violation of lower-ranking *r–V by (15c) now proves fatal, and the tap emerges as the unmarked rhotic in the complex onset of (15b).

(15)

		/a b ɾ o$_1$	a b r o$_2$/	Space$_{\text{V_V}}$	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
	a.	a b·····ɾ—o$_1$	a b·····r—o$_2$	*!			*
☞	b.	a b·····ɾ—o$_{1,2}$			*		
	c.		a b·····r—o$_{1,2}$		*		*!

Gestural markedness constraints govern the distribution of rhotics coupled in-phase with a following vowel, but they have nothing to say about those coupled anti-phase with a preceding vowel. In word-medial coda position, the neutralization candidates (16b,c) are again tied on Ident, but this time the gestural constraints are vacuously satisfied. Assuming nothing else in the phonological grammar distinguishes between the candidates, (16b,c) emerge as co-optimal. The ranking also explains free variation in word-final position before a consonant or a pause.

(16)

		/a ɾ d̪ e$_1$	a r d̪ e$_2$/	Space$_{\text{V_V}}$	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
	a.	a····ɾ····d̪—e$_1$	a····r····d̪—e$_2$	*!			
☞	b.	a····ɾ····d̪—e$_{1,2}$			*		
☞	c.		a····r····d̪—e$_{1,2}$		*		

The last pattern to account for is the asymmetry between word-initial trills and word-final taps in phrasal intervocalic contexts (5). In Figure 10.4, the rhotic and the following vowel belong to the same MWd in *da rocas* but not in *dar ocas*. When the input to phonology includes an entire phrase, default constraints will couple a word-final prevocalic consonant in-phase with the following word-initial vowel, while coupling the flanking vowels anti-phase with each other. In *dar ocas*, the rhotic and following vowel are coupled in-phase, but the rhotic remains affiliated to the preceding PWd (see Strycharczuk and Kohlberger 2016: 14). In both phrases, the flanking vowels belong to different PWds.

The definition of Space$_{\text{V_V}}$ and *[ɾ–V]$_{\text{MWd}}$ as positional constraints explains why free variation in word-final rhotics is suspended prevocalically. Both contexts in Figure 10.4 are intervocalic, but neither is contained within the same PWd. Because the maximum perceptual distance in (10a) obtains only between PWd-internal vowels, Space$_{\text{V_V}}$ rules out intervocalic contrast at the edges of the PWd in (17a) and (18a):

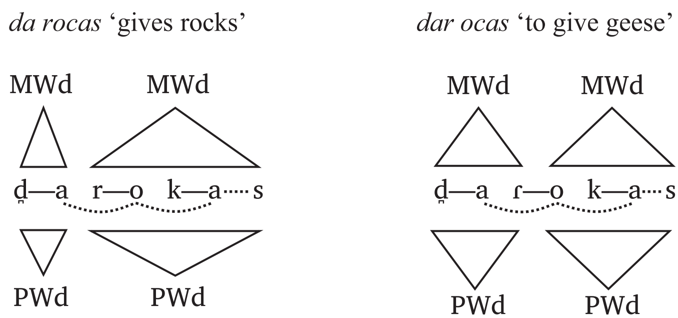

Figure 10.4 Morphological and prosodic word structure of a "phrasal minimal pair"

(17)

		/d̪a#ɾokas$_1$	d̪a#rokas$_2$/	Space$_{\text{V_V}}$	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
	a.	d̪—a ɾ—o$_1$	d̪—a r—o$_2$	*!		*	*
	b.	d̪—a ɾ—o$_{1,2}$			*	*!	
☞	c.		d̪—a r—o$_{1,2}$		*		*

(18)

		/d̪aɾ#okas$_1$	d̪ar#okas$_2$/	Space$_{\text{V_V}}$	Ident	*[ɾ–V]$_{\text{MWd}}$	*r–V
	a.	d̪—a ɾ—o$_1$	d̪—a r—o$_2$	*!			*
☞	b.	d̪—a ɾ—o$_{1,2}$			*		
	c.		d̪—a r—o$_{1,2}$		*		*!

The exclusive in-phase coupling between the tap and vowel within the same MWd in (17b) fatally violates *[ɾ–V]$_{\text{MWd}}$. The trill emerges in (17c), as it does word-initially after a pause (13c) and word-medially after a coda consonant (14c). In (18b) there is an exclusive in-phase CV coupling, but because the tap and the vowel belong to different MWds, *[ɾ–V]$_{\text{MWd}}$ becomes inactive. The trill in (18c) fatally violates *r–V, and the tap emerges instead in (18b).

A closer look at the phrasal phonology of unstressed words in Spanish reveals that the maximum distance between shorter and longer consonants in (10a) obtains only when the PWd-internal intervocalic consonants are not edge-adjacent. Hualde (2009: 202–204) argues that unstressed function words, such as the definite article of *la roca* (2b) and the preposition of *por eso* (3d), are lexically specified to undergo prosodic merger with a following word into a single PWd. I assume instead, following Itô and Mester (2009a, 2009b), that merger of two-word phrases creates a recursive structure with minimal and maximal PWd (ω) projections. The rhotics in (la(ˈroka)ω_{min})ω_{max} and (poɾ(ˈeso)ω_{min})ω_{max} appear between two vowels that are contained within ω_{max}, but only one of the vowels is contained within ω_{min}. In order for Space$_{\text{V_V}}$ to bring about contrast neutralization and gestural TETU effects across recursive PWd boundaries, the perceptibility scale in (10a) must be interpreted as follows: the flanking vowels both belong to the same ω, and the intervocalic consonants are not adjacent to a lower ω boundary. This interpretation also explains why intervocalic stem-initial trills are obligatory in prefixed words and in word-level and phrasal compounds, e.g. (a(riŋkoˈnaðo)ω_{min})ω_{max} *arrinconado* 'cornered', (mat̪a(ˈrat̪as)ω_{min})ω_{max} *matarratas* 'rat poison', and ((ˈombɾe)ω_{min}(ˈrana)ω_{min})ω_{max} *hombre rana* 'frogman, scuba diver' (cf. Colina 2009: 73–96, who uses a markedness constraint against stem-initial taps).

To summarize, an interaction of phonetically grounded constraints accounts for the phonological distribution of rhotics in NCPS. Faithfulness dominates gestural coupling constraints on rhotics, making a contrast possible, but perceptual distinctiveness further dominates faithfulness, limiting the contrast to intervocalic non-edge-adjacent position within the PWd. Gestural TETU effects become visible in all other contexts, where coupling constraints get to determine the outcome. The complementary distribution between syllable-initial [r] and non-syllable-initial [ɾ] before a vowel follows from the fact that *[ɾ–V]$_{\text{MWd}}$ is active in word-initial (13) and syllable-initial postconsonantal (14) environments but inactive in complex onsets (15), where lowest ranking *r–V chooses the tap instead. Free variation arises after a vowel within the same syllable because neither gestural constraint is active on anti-phase VC couplings, leaving the tap and trill co-optimal in (16) and other coda contexts. The behavior of word-final prevocalic rhotics (18) follows naturally from the same constraint hierarchy without any further assumptions.

3.3. Phonetic implementation

The categorical distribution of /ɾ/ and /r/ is fully specified in the optimal intergestural coupling graphs, which the coupled-oscillator component of speech planning uses to generate a gestural score at a specified rate of speech. As Blecua and Cicres (2019) show, relaxed speech favors more weakened realizations along the continuum in Figure 10.1. In AP, gradient differences across speech styles are understood as "consequences of variation in the overlap and magnitude of gestures" (Browman and Goldstein 1990: 371), whereby casual style shows greater degrees of gestural overlap and reduction. Faster speech rates shorten the duration of gestures. All things being equal, a shorter duration results in a looser constriction because the articulator has less time to reach its constriction target. Articulatory undershoot of the extra-short tap occlusion yields an approximant and, in the extreme case, deletion, e.g. [paɾa~paɾ̞a~pa(ɾ̞)a] *para* 'for'. For the longer trill, variation in airflow and tongue tip posture yields a wider range of phonetic exponents, stopping short of deletion, e.g. [ˈkaɾɹo~ˈkaɾ̞ɹo~ˈkaɾo~ˈkaɹo~ˈkaɹ̞o] *carro* 'car'.

Rhotic variation in clusters also depends on the timing of adjacent consonants, which can be visualized in gestural scores. Figure 10.5 compares the careful and casual speech realizations of /abɾo/ (15b). Gestures are displayed as rectangles, organized vertically along tiers corresponding to the lips, tongue tip, and tongue body. The horizontal axis denotes time, and the activation interval of a gesture is indicated by the length of its rectangle. Time-aligned narrow

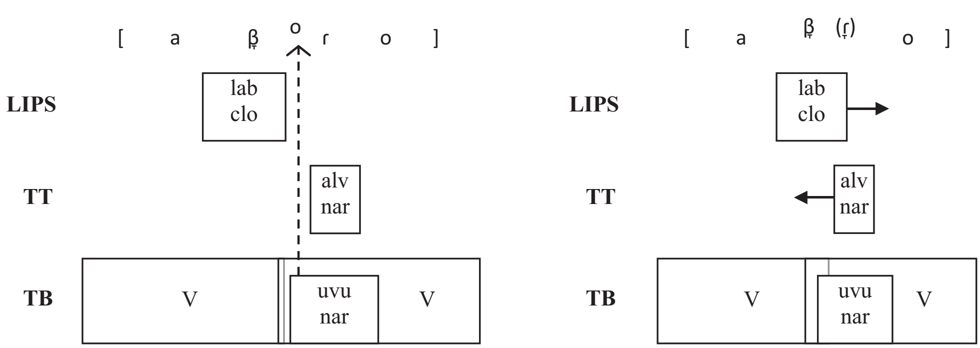

Figure 10.5 Gestural scores for /abɾo/ (15b) in careful (left) versus casual (right) speech. Abbreviations are given for constriction location of consonants (i.e. labial, alveolar, and uvular) and for constriction degree (i.e. closed, narrow, and V, for vowel).

transcriptions represent the hypothesized acoustic outputs of each gestural score. The comparison reveals two important points. First, casual speech promotes gestural reduction, as seen in the shorter rectangles of the right-hand panel. With less time available, the lips and tongue tip undershoot their constriction degree targets (see Parrell 2011 for experimental evidence of undershoot in postvocalic /b/, based on an EMMA study with two NCPS speakers and TaDA simulations). Second, the adjacent consonant gestures are more overlapped in casual speech. In careful style, the slower speech rate pulls the competitively coupled consonants apart in time, and a portion of the overlapping tongue body gestures of the tap and the nuclear vowel becomes audible as an intervening vocalic element (dashed arrow). In casual speech, the vocalic element is obscured by greater overlap between consonant gestures (solid arrows). Without the canonical vocalic element, listeners will be less likely to hear the weakened tap in the acoustic output.

Gestural timing also conditions gradient variation in preconsonantal rhotics. Figure 10.6 compares the careful versus casual pronunciations of /aɾd̪e/ (16b) (top row) and /ard̪e/ (16c) (bottom row). The canonical two-component realization of preconsonantal /ɾ/ emerges from a lack of overlap between tongue tip gestures in careful speech, while the perception of the single-component approximant is jeopardized by gestural reduction and overlap in casual speech. In the careful realization of preconsonantal /r/, the tongue tip successfully initiates a passive vibration and sustains it long enough to produce a three-component rhotic, [ɾ^{a}ɾ], in which the overlapping tongue body gestures become audible between the lingual occlusions (dashed arrow). In casual speech, when tongue tip vibration is extinguished before a second hold period can be achieved, the acoustic result is a two-component rhotic not unlike the realization of preconsonantal /ɾ/ in the top left panel (see Martínez Celdrán and Fernández Planas 2007: 155–156 for EPG support). However, the rhotic gestures are different in each

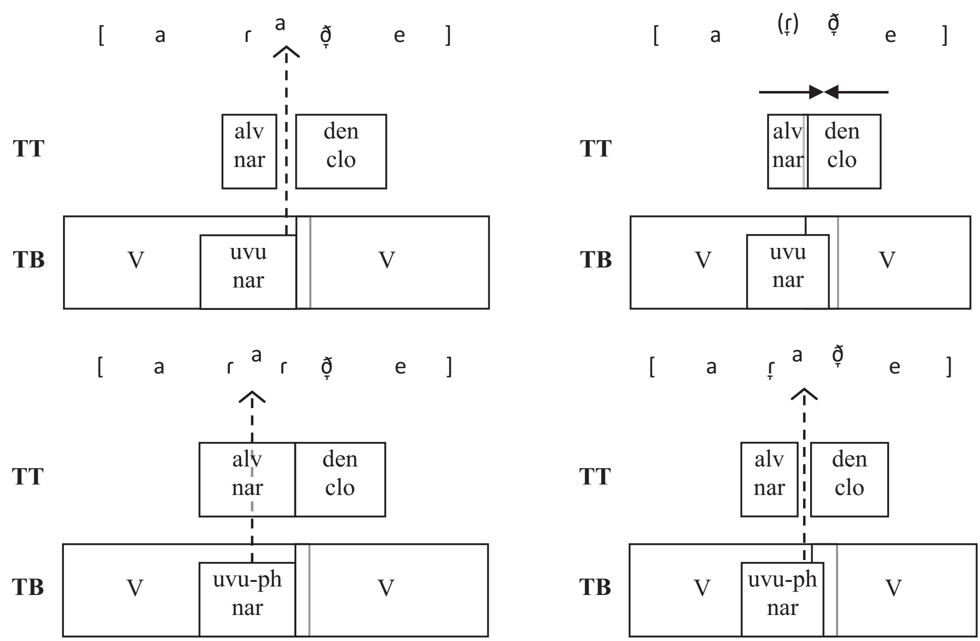

Figure 10.6 Gestural scores for /aɾd̪e~ard̪e/ (16b,c) in careful (left) versus casual (right) speech

context: a tap in (16b) versus a trill in (16c). Even though the grammar predicts a 50/50 split between co-optimal outputs, phonetic implementation interacts with the phonology to skew the distribution of three-component rhotics toward careful style, by reducing coda trills to just two acoustic components in casual speech.

3.4. Comparison with alternative theoretical accounts

The syllabification of the tap and trill as single intervocalic onsets in minimal pairs (1) suggests that Spanish has two rhotic phonemes. However, this makes it difficult to explain why a phonemic contrast should be restricted to just a single phonological context. Harris (1983, 2002) and Núñez Cedeño (1994) represent the intervocalic trill as an underlying geminate tap and derive all surface trills from underlying taps by rules that refer to syllable structure. The contrast is limited to intervocalic position because that is the only context in Spanish that allows /ɾɾ/ to be properly syllabified. The analysis requires two obligatory lexical rules for word-initial and syllable-initial postconsonantal strengthening, and to account for **da*[r] *ocas*, a postlexical coda strengthening rule that applies optionally after, and thus is bled by, phrasal resyllabification. An additional rule of coda rhotic deletion must be ordered after word-level postconsonantal strengthening to derive, e.g., [ˈka.ro] from underlying /kaɾɾo/, i.e. ˈkaɾ.ɾo → ˈkaɾ.ro → ˈka.ro. One argument often cited in support of the geminate tap is that Spanish allows penultimately stressed words like *chamarra* 'jacket', with onset [.r] in the final syllable, but lacks similar such words with antepenultimate stress. Since a heterosyllabic geminate closes the preceding syllable, */ˈʧa.maɾ.ɾa/ is explained independently by the fact that Spanish does not allow primary stress to the left of a heavy penult. One problem with the geminate approach is that Spanish otherwise lacks a singleton-geminate distinction within the morpheme—except for rhotics. Another is that separate rules are needed to generate syllable-initial trills, which belies the simple generalization that [r] *is obligatory in syllable-initial position except after a vowel* (for other critiques, see Baković 2009).

Colina (2010) proposes a syllable-based analysis in monostratal OT without intermediate derivational steps or a lexical-postlexical distinction. She gives a diachronic account of the intervocalic contrast, whereby geminate /ɾɾ/ in Latin evolved into a singleton /r/ to avoid neutralizing the contrast with /ɾ/ when Spanish lost geminates, thereby satisfying the systemic faithfulness constraint *Merge (Padgett 2003a, 2003b, 2009; Bradley 2005; Holt 2006). Latin allowed geminate consonants only in word-medial intervocalic position, which explains why the tap-trill contrast is limited to the same context in modern Spanish (Hualde 2014: 185–186).

The absence of words like **chámarra* is also a historical gap, as Latin did not allow antepenultimate stress in words with heavy penults. Based on accuracy and reaction time data from a nonword naming study with forty-six Southern Peninsular Spanish speakers, Shelton (2013) finds that intervocalic trills do not pattern as heterosyllabic geminate taps with respect to the antepenultimate stress restriction. The existence of counterexamples, i.e. the Basque names Chávarri and Achúcarro, the variant *tábarro* (a possible blend of *tábano* 'horsefly' and *tabarra* 'nuisance'), and the onomatopoeic *chánchar-ras-máncharras* (Hualde 2014: 243), suggests that there is no synchronically active proscription against CV́.CV*rr*V word shapes. Rather, "native speakers are sensitive to the fact that the frequency of this pattern in their lexicon approaches zero" (Shelton 2013: 147).

Colina (2010: 79–83) models the distribution of /ɾ/ and /r/ in the synchronic grammar with a crucial ranking of faithfulness below multiple constraints: a novel type of systemic faithfulness constraint (*Split) to rule out variability in word-initial /r/, which supplants a markedness constraint against stem-initial taps (*|[ɾ]) from an earlier version of the analysis (Colina

2009: 90–94); a constraint requiring trills after a homorganic nasal or lateral (AGREEPA/A0); two constraints (*sɾ >> *sr) against /s/+rhotic clusters, which are vanishingly rare in Spanish (see Bradley 2006b); a constraint banning trills from codas (*[r]/coda), dominated by another constraint requiring coda trills in emphatic speech; and a sonority constraint that bans the less sonorous trill from complex onsets.

Combining phonetically based AP and DT offers several advantages over the phonological accounts just described. First, Harris posits separate strengthening rules to generate syllable-initial trills in different phonological contexts, and Colina makes analogous use of separate high-ranking constraints. My approach unifies the preference for syllable-initial trills in neutralization contexts under a single gestural coupling constraint, $*[ɾ–V]_{MWd}$ (cf. the perceptually based $_{\sigma}$[r constraint of Padgett 2003b, 2009; Bradley 2006b, no longer necessary here). The interaction between gestural coupling and contrastiveness simplifies the analysis of syllable-initial trills within the morphological word: *a rhotic coupled exclusively in-phase with a following vowel must be a trill except after a preceding vowel, where trills contrast with taps*. Second, to explain **da*[r] *ocas*, Harris's account requires a lexical-postlexical level distinction, as well as a bleeding order between postlexical resyllabification and coda strengthening, while Colina's monostratal OT account posits a constraint favoring coda trills in emphatic speech. My analysis is also monostratal and eschews rule ordering but does not need additional constraints on coda rhotics. The patterning of word-final rhotics in all phrasal contexts is predicted by the same constraints that produce gestural TETU effects under neutralization more generally. Third, because Harris and Colina intend to explain only the categorical distribution of Spanish rhotics, they have little to say about the mapping of discrete surface representations onto continuous phonetic ones, other than to assume it happens downstream in phonetic implementation. In this chapter, my analytical tack has been the opposite: start with the insights from phonetic studies (Section 2), then show how gestural representations in AP (Section 3.1) not only simplify the phonological analysis of rhotics (Section 3.2) but also model gradient phonetic variation (Section 3.3).

Finally, my analysis, like Colina's, avoids positing a geminate tap for a language that otherwise lacks morpheme-internal geminates. However, a diachronic account of why the rhotic contrast is limited to intervocalic position only pushes the explanation back one level. Why were geminate consonants restricted to intervocalic position in Latin? The scales in (10) offer a perceptual explanation for why such a restriction exists in the first place, as consonant duration contrasts are best perceived in intervocalic non-edge-adjacent position within the PWd. This approach readily extends to tap-trill languages in which the trill is demonstrably not a geminate tap (see Bradley 2001), and it makes predictions about possible versus impossible languages; e.g. no language allows a consonant duration contrast outside the intervocalic position without also allowing it between vowels.

3.5. A phonetics-phonology mismatch between [r] and /ɾɾ/

From the articulatory perspective, the tap and trill involve different gestures and production mechanisms. How does a single phonetic [r] emerge from phonological /ɾɾ/ in languages that allow geminate consonants? Colina (2010) suggests that Latin intervocalic /ɾɾ/

> would have been phonetically implemented as a phonetic trill (through the strengthening of a tap preceded by a rhotic, which is subsequently deleted). This may explain why the contrast was maintained [. . .] by means of a trill rather than other rhotic sounds. (78, fn.5)

However, it is unclear how the phonetics could produce such a categorical change, if implementation is limited to gradient variation in gestural overlap and magnitude. I argue instead that the mismatch between phonetic [r] and phonological /ɾɾ/ should be accounted for in the phonology by a universal prohibition against incompatible articulations that involve contradictory motor commands. In the same way that a vowel cannot be simultaneously [+high] and [+low], a consonant cannot be both [+long] and [+extra-short]. An input geminate /ɾɾ/ will necessarily map to an output trill gesture because its three-component acoustic structure [ɾᵊɾ] is perceptually indistinguishable from a hypothetical sequence of two taps separated by a vocalic element. Simply stated, /r/ is easier to pronounce than the phonetically uninterpretable geminate /ɾɾ/ and sounds at least just as long (see Bradley and Adams 2018: 1481–1482, who formalize a similar proposal in OT; Blecua and Rost 2012 discuss the phonetic factors involved in the diachronic simplification of Latin /ɾɾ/ and other sonorant geminates).

4. Conclusion

This chapter has examined the patterning of normative Spanish rhotics within the context of contemporary research on the phonetics-phonology interface. Laboratory studies have further solidified the empirical database with fine-grained details about the phonetic exponents of NCPS rhotics and their variation across speech styles. Experimental insights have led to a new theoretical understanding of the phonological distribution of rhotics and, more generally, the relationship between phonetic and phonological knowledge in generative grammar.

The proposed analysis formalizes a division of labor between phonology and phonetic implementation as distinct but representationally linked modules, both of which operate on articulatory gestures. There is no transduction from categorical segments and features into gradient physical parameters, only optimization and implementation of intergestural coupling graphs. The phonology uses abstract phonetic knowledge about perceptibility to help predict the distribution of consonant duration contrasts. When optimal coupling graphs are phonetically implemented, lawful changes in the overlap and magnitude of gestures give rise to gradient and continuous variation in the articulatory and acoustic output. Combining AP and DT makes possible a simpler, monostratal account of the patterning of Spanish rhotics at both the word and phrase levels. Laboratory studies should continue to investigate stylistic and cross-dialectal variation in rhotics, with the aim of building and testing explicit theories and models of their phonological and phonetic behavior.

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11

Laboratory Phonology methods in Spanish phonology

Rebeka Campos-Astorkiza

1. Introduction

The main idea behind Laboratory Phonology is that the sound structures of languages are best explored by utilizing experimental and instrumental approaches, which allow researchers to advance theoretical models based on empirical findings. Laboratory Phonology is at its core interdisciplinary in nature and addresses issues related to sound structures, knowledge and use that are the object of inquiry of diverse fields including phonetics, phonology, language acquisition, sociophonetics and language change. This chapter focuses on laboratory methodologies applied to Spanish phonology (see also Bradley, this volume, and Simonet, this volume, for related topics). The theoretical approaches may vary across researchers working within Laboratory Phonology, but the common thread among practitioners is the use of experimental and instrumental techniques, which usually goes hand in hand with an expanded view of phonology compared to traditional or generative phonology (Cohn et al. 2017; see Bradley, this volume). Thus, the main feature of Laboratory Phonology is that it is empirically and experimentally based, although data might be gathered not only via experiments but also via interviews, for example, showing that instrumental work can be carried out in or outside the lab. This methodological approach allows researchers to reach conclusions based on systematic data analysis and stands in contrast with the impressionistic and introspective observations that were the basis for many of the earlier generative analyses within phonological theory.

Laboratory studies take as their point of departure testable hypotheses that are proven or refuted through data analysis and interpretation. These hypotheses might be related to data distribution, factors that affect a given process, or predictions made by phonological models. In fact, as Kawahara (2011) explains, laboratory studies can be inspired by phonological theory in order to test some component or prediction of such theory. Colantoni (2015) emphasizes that laboratory studies should necessarily stem from data observation and research questions based on testable hypotheses, rather than becoming vehicles for developing new methodologies and data analysis techniques. However, laboratory studies have undeniably contributed to the advancement of new data collection and instrumental techniques (see, for example, Cohn et al. 2012). Furthermore, laboratory studies have played a crucial role in the development of phonological theories that integrate phonetics or that explicitly address and model the phonetics-phonology interface (see Bradley, this volume). More precisely, the main contributions of Laboratory Phonology studies are the reevaluation of phonological data (e.g. categorical vs. gradient processes) and traditional descriptions; the argument that phonological theory can benefit from phonetic information together with the development of new theories (see Bradley, this volume); and the evaluation of the psychological reality of phonological analyses or formal mechanisms (see Simonet, this volume, for the latter) (Kawahara 2011; Bradley 2014).

Laboratory Phonology studies may collect and analyze production, perception or psycholinguistic data. This chapter focuses on studies that make use of production data, which comes primarily in the form of acoustic and articulatory data (see Simonet, this volume, for perception and psycholinguistic studies) and is the most prevalent type of data in laboratory approaches to Spanish. Most laboratory studies of production analyze acoustic data given the ease of collecting it and the availability of acoustic analysis software. Articulatory data is more costly to obtain, and its analysis requires more specialized software. Furthermore, acoustic recordings can be easily obtained outside the laboratory setting, making it a portable technique suitable for fieldwork-based projects. For these reasons, many of the studies surveyed here present only acoustic data, although an effort has been made to also include studies that analyze articulatory data, since the most solid conclusions are reached when both acoustic and articulatory evidence are present (see Martínez Celdrán and Fernández Planas 2007: 183–188 for one such case). Beyond the type of data, Laboratory Phonology studies need to consider further methodological issues such as participant selection and appropriate statistical analyses (see the volume by Cohn et al. 2012 for several contributions on these topics that are not discussed in this chapter).

The development of Laboratory Phonology, which started three decades ago, has been accompanied by conferences and publications devoted to this field (for example, the biennial Lab Phon conference, the *Journal of Laboratory Phonology*, etc.). Within Hispanic linguistics, there is a growing body of laboratory work, and specialized venues have been developed, such as the conference series Laboratory Approaches to Spanish/Romance Phonology. Given the wide range of laboratory studies dealing with the Spanish sound system, this chapter, which complements chapters 10 and 12, does not attempt to offer a comprehensive view of all the advancements but rather focuses on four areas that have attracted considerable attention and where we can find studies that (i) are hypothesis based and aim to contribute to theories of phonology, (ii) challenge previous assumptions regarding Spanish sound patterns, and (iii) bring diverse methodologies focusing on different types of data, more precisely both acoustic and articulatory data. It is important to note that even though intonation has been a prevalent topic in the Spanish Laboratory Phonology tradition, this chapter will not discuss studies on intonation because chapter 9 (Prieto and Roseano) in the current volume is devoted to this topic. Thus, the areas that we focus on are stop weakening (section 2), nasal place assimilation and velarization (section 3), /s/ weakening (section 4), and the realization of vowel sequences (section 5). The chapter concludes with some challenges and trends, in section 6.

2. Stop weakening: spirantization and voicing

The production of stops, especially the phenomenon known as spirantization, has attracted considerable attention from laboratory approaches, which have had an impact on different aspects of phonological theory. Spirantization is defined as the alternation between voiced stops and approximants depending on the phonological context: voiced stops occur in phrase-initial position (1a) and after a homorganic nasal or lateral (1b), and approximants are produced elsewhere, i.e. after a vowel (1c) or a consonant that is not a homorganic nasal or lateral (1d). In coda position, even though an approximant production is expected, there is a lot of variation within and across dialects, and the discussion of this goes beyond the goal of this section (see Hualde 2005; Martínez-Gil, this volume; and González, this volume).

(1) Distribution of voiced stop and approximant allophones

a.	[ˈbete]	*Vete*	‘go away!’	[ˈdimelo]	*Dímelo*	‘say it to me’	[gaˈne]	*Gané*	‘I won’
b.	[tamˈboɾ]	*tambor*	‘drum’	[ˈkon̪de]	*conde*	‘count’	[ˈteŋgo]	*tengo*	‘I have’
				[ˈtol̪do]	*toldo*	‘awning’			
c.	[ˈpaβo]	*pavo*	‘turkey’	[ˈkoðo]	*codo*	‘elbow’	[ˈlweɣo]	*luego*	‘later’
d.	[ˈkweɾβo]	*cuervo*	‘crow’	[ˈkweɾða]	*cuerda*	‘rope’	[ˈkaɾɣa]	*carga*	‘load’
	[ˈpolβo]	*polvo*	‘dust’				[ˈbelɣa]	*belga*	‘Belgian’
	[dezˈβio]	*desvío*	‘detour’	[ˈdezðe]	*desde*	‘from’	[ˈmuzɣo]	*musgo*	‘moss’

One of the earliest contributions of laboratory approaches to spirantization was to describe nonstop productions as approximants (Santagada and Gurlekian 1989; Martínez Celdrán 1991, 2013; Romero 1995), rather than fricatives, as early accounts described these sounds (Quilis 1993). In fact, these approximant allophones should be transcribed as [β̞, ð̞, ɣ̞], although many authors, like in this chapter, leave out the diacritic for simplicity’s sake (e.g. Hualde 2005). Traditional phonological approaches to spirantization consider this process as a type of lenition, where stops weaken to continuant sounds. Many derivational accounts of spirantization argue that the approximant variants are the result of assimilation to the continuancy of the preceding sound, which depends on a series of ordered rules that determine whether the surface specification of the sound is either [+continuant] (approximant) or [−continuant] (stop) (e.g. Harris 1984a; Mascaró 1991). Some recent analyses couched within Optimality Theory (OT) also argue that the continuancy specification of the surface consonant depends on the surrounding context and posit a restriction on stops after vowels and continuant consonants (Martínez-Gil 2003; González 2006). According to these analyses, the alternation between voiced stops and approximants is a categorical process that can be captured by the binary feature [±continuant].

Laboratory approaches to spirantization have tackled the phenomenon from different perspectives, but they all agree that the stop-approximant alternation is variable and gradient, with the degree of opening of the approximant allophone dependent on a series of factors, including stress, surrounding vowels and consonants, speech rate and style, and dialect (Cole et al. 1999; Lavoie 2001; Ortega-Llebaría 2004; Eddington 2011; Parrell 2011; Carrasco et al. 2012). These studies present both articulatory and acoustic data that problematize any binary analysis of spirantization since they all conclude that the phonological context, beyond the nature of the preceding sound, affects the degree of weakening. In fact, these findings have sparked the development of several phonological analyses that aim at accounting for this variation. Based on the characterization of spirantization as weakening, some authors argue that the process takes place to minimize articulatory effort (Kirchner 1998; Piñeros 2002) and, working within OT, posit phonetically grounded constraints that penalize articulatory effort. These constraints quantify the amount of articulatory effort incurred by a particular sound depending on the phonological context where it occurs. This effort-based analysis can capture the gradient nature of the approximant allophones and the factors that condition this gradience. Also working within OT, Colina (2016) offers a different approach to Spanish spirantization by making use of phonetic or output underspecification to explain the variable and context-dependent production of the approximant allophones (see Keating 1988 for more on phonetic underspecification, also known as output or surface underspecification). According to Colina, Spanish stops are produced without a phonetic target for continuancy after continuant sounds, and these "targetless outputs" are realized with a variable degree of constriction depending on the context.

Another issue related to spirantization that has been explored from a laboratory perspective is the nature of the phonological or underlying representation of the voiced obstruents, namely whether they are specified as stops or approximants. While most phonological accounts assume that stops are the underlying representation, some studies argue that approximants are in fact the basic forms, and stops are derived or alternate due to a process of fortition (Baković 1997; Lavoie 2001; Barlow 2003). Parrell (2011) uses articulatory data and modeling to address this issue. He finds that both types of allophones (stops and approximants) do actually have the same kind of constriction degree specification, more precisely, a complete closure target, but temporal differences result in variation in constriction degree in production. The author argues that these results can be explained within an Articulatory Phonology (AP; Browman and Goldstein 1989; see also Bradley, this volume) model of spirantization, which is able to capture contextual effects in a simple manner. The AP framework predicts that factors that affect temporal features will influence the degree of constriction, thus accounting for the influence of context, stress and speech rate. Further articulatory, or acoustic, data are necessary to test some of the predictions made by this model, especially the relationship between weakening of voiced and voiceless stops and the role of duration in spirantization.

Some dialects have a more restrictive occurrence of approximant allophones than that presented in (1). More precisely, in these dialects approximants tend to occur only after a vowel, while stops are the most common productions in all other contexts. This type of limited spirantization has been reported in Central America, Colombia and Mexico (Canfield 1981; Quilis 1993; Moreno Fernández 2009). Laboratory approaches to this dialectal variation have found that, in fact, there seem to be two patterns of limited spirantization. Some dialects present approximants only after a vowel, and stops after any consonant (e.g. Costa Rica; Carrasco et al. 2012). Other dialects show a similar distribution of stops and approximants after both vowels and consonants; i.e. stop and approximant productions are found after a vowel or a consonant. This latter type of highly variable spirantization has been reported for dialects of Spanish in contact with other languages, such as Yucatan Spanish (Michnowicz 2011) and Peruvian Amazonian Spanish (O'Rourke and Fafulas 2015). These findings based on instrumental studies offer a better picture of limited spirantization and should inform any phonological analysis or model of the process.

Voicing of voiceless stops had been reported for certain dialects in traditional descriptions of Spanish, especially Cuban and Canary Island Spanish (Quilis 1993). However, only with the recent application of instrumental techniques has this phenomenon been described in more detail, allowing for exploration of its repercussions for the phonological analysis of Spanish obstruent voicing. More precisely, recent acoustic studies have found that this voicing process is gradient and may result in partial voicing, full voicing or weakening to an approximant (Torreira and Ernestus 2011). Despite interspeaker variation, gender and speech rate have been identified as two factors that may account for some of the variation (Nadeu and Hualde 2015). As for its phonological account, some authors analyze this voicing as a type of weakening and place it within the broader phenomenon of Spanish obstruent weakening together with voiced stops (Hualde et al. 2011). Others have instrumentally explored the connections between stop voicing and spirantization to argue for certain phonological approaches to weakening (i.e. lenition; Kingston 2008; Colantoni and Marinescu 2010). Kingston (2008) puts forth a perception-based account of Spanish spirantization according to which lack of lenition serves as a separation between two prosodic elements, and thus its goal is to reduce intensity between adjacent sounds when they belong to the same prosodic constituent. Kingston contrasts his proposal with the articulatory-effort model (Kirchner 1998; see earlier discussion). The author presents acoustic data from Ecuadorian and Peruvian Spanish and concludes that the observed patterns do not match the effort-reduction predictions. On the contrary, his results agree with this perception-based model, which predicts no effect of surrounding vowels and a strong effect of the type of preceding consonant. Colantoni and Marinescu (2010) further investigate the connection between voicing and spirantization in an effort to understand the nature of lenition in Spanish obstruents. They explore the two models compared by Kingston (2008) and also consider a model according to which voicing and spirantization are part of a chain-shift sound change (Lloyd 1993). Colantoni and Marinescu analyze acoustic data from Argentine Spanish and find that voicing of voiceless stops is very limited, while spirantization is very common. They also find that the degree of opening of the approximant is partially conditioned by the surrounding consonants, which leads the authors to conclude that their results seem to support Kingston's perception-based model. The inconclusive results reached by this study leave the door open to models that are capable of operationalizing articulatory effort and perceptual difference, and possibly their interaction, in a more sophisticated way, which could in turn inform laboratory studies exploring these definitions.

3. Nasal place assimilation and velarization

The phonological behavior and analysis of nasals in Spanish is an area that has recently benefited from laboratory studies (using diverse methodologies and instrumental techniques) that have revisited traditional descriptions and contributed to the discussion of several theoretical issues. The relevant nasal patterns fall into two types, namely (i) place assimilation and (ii) velarization. In what follows, I explain the basic facts as presented in traditional descriptions, before discussing how recent laboratory explorations have questioned assumptions about the patterns and raised questions related to their phonological analyses.

According to traditional descriptions, preconsonantal nasals undergo place assimilation and adopt the place features of a following consonant, both within and across words (see 2a). Before a following vowel or a pause, the nasal is realized as alveolar [n] (2b), except in so-called velarizing dialects, where a prevocalic or prepausal nasal is produced as velar [ŋ] (2c). Velarizing dialects include those varieties from the Caribbean, the Pacific coast of South America, Central America, the Canary Islands and several regions in Spain, such as Asturias, León, Galicia and Andalusia (Quilis 1993; Lipski 1994; Piñeros 2006; see Goodin-Mayeda 2016 for dialectal differences within velarizing varieties; see González, this volume, on nasal place assimilation).

(2) Examples of nasal place assimilation and velarization

a.	[kompaˈloma]	*con Paloma*	'with Paloma'			
	[koɱfeˈlipe]	*con Felipe*	'with Felipe'			
	[kon̪t̪eˈɾesa]	*con Teresa*	'with Teresa'			
	[konsoˈfia]	*con Sofía*	'with Sofia'			
	[konʲˈtʃaɾo]	*con Charo*	'with Charo'			
	[koŋˈgaβi]	*con Gabi*	'with Gabi'			
b.	[konˈana]	*con Ana*	'with Ana'	[kaˈmjon]	*camión*	'truck'
c.	[koŋˈana]	*con Ana*	'with Ana'	[kaˈmjoŋ]	*camión*	'truck'

The observations on nasal place assimilation are deemed a crucial catalyst in the development of phonological theories, especially in relation to defining the nature of phonological representations and rules (see Martínez-Gil 2012 for an overview). Within autosegmental phonology, nasal place assimilation in Spanish stems from a neutralization rule that targets nasals in preconsonantal position and removes their place of articulation (PA) features, along with a feature spreading rule that spreads the PA features from a following consonant to the preceding nasal. The result is PA feature sharing between the nasal and the following consonant. Those nasals followed by a vowel or a pause and thus unable to share PA features with a following consonant get assigned a default alveolar PA value (Harris 1984b). In velarizing dialects, the assumption is that the default value is velar. Within Optimality Theory (OT), nasal place assimilation has been analyzed as resulting either from a restriction on coda consonant place features, formalized as the constraint Coda Condition (Colina 2009), or from a requirement for adjacent consonants to have the same PA specification, captured by the constraint Agree(PA) (Baković 2000; Piñeros 2006). Alveolar realizations in prepausal and prevocalic contexts are analyzed as the result of the ranking of PA markedness constraints. Despite differences in the conceptualization and representation of the assimilation, all of these analyses make two basic predictions: place assimilation is categorical, and it results in a nasal fully specified for PA features.

Laboratory approaches to nasal place assimilation have presented instrumental evidence that sheds new light on traditional assumptions and questions the phonological machinery that has been assumed to account for this assimilation process. Furthermore, this area of inquiry has proven fruitful in the use of different techniques, and we find studies that present acoustic and articulatory data, allowing for a more comprehensive and thorough picture. Honorof (1999) analyzes articulatory data from Castilian Spanish using electromagnetic articulography (EMA) and finds no evidence of a tongue tip gesture corresponding to the nasal when the following consonant is noncoronal, arguing that in these cases the assimilation is complete. On the other hand, when the following consonant is coronal, namely the dental /t̪/, Honorof finds indication of persistence of the nasal tongue tip gesture, which, he argues, results in gestural blending; i.e. the tongue tip gestures of both consonants influence each other, and the resulting PA reflects this (see also Martínez Celdrán and Fernández Planas 2007). The author claims that this finding for sequences of nasal and coronal poses problems for the neutralization and feature sharing account, since it assumes that the nasal has no PA of its own; in contrast, the behavior of nasal and noncoronal sequences fits with this account since the nasal seems to have the same PA as the following consonant. In order to capture this asymmetry, Honorof presents a diachronic explanation according to which nasal assimilation to a noncoronal consonant would have eventually resulted in complete hiding of the nasal coronal gesture without any acoustic or auditory cue to recover it. On the other hand, assimilation to a coronal consonant would have resulted in gestural blending and, consequently, the presence of acoustic and auditory cues to recover the nasal place.

Ramsammy (2011) also explores the nature of nasal place assimilation but using acoustic data from Iberian Spanish. He finds no difference in the production of a nasal assimilated to an alveolar or a velar consonant, which is contrary to the expectations of the traditional description of the process. His findings lead Ramsammy to conclude that this assimilatory process is not categorical but rather gradient. The author accounts for this pattern by arguing that preconsonantal nasals are phonetically underspecified for PA (see section 2 on phonetic underspecification). This means that these nasals are produced without a target for PA, resulting in a high degree of coarticulation with surrounding consonants. Kochetov and Colantoni (2011a) further explore the nature of nasal place assimilation by analyzing articulatory data collected via electropalatography (EPG) from Cuban and Argentine Spanish. Based on their results, they conclude that the assimilation is almost complete and categorical, except before fricative consonants, where nasals display a more variable production. This finding seems to mirror the typological observation that fricative triggers of nasal place assimilation are less common than other types of consonants (Padgett 1994). Kochetov and Colantoni (2011a) also find that even though the general patterns hold for both Cuban and Argentine Spanish, the two dialects vary in the actual implementation of the assimilation process. The authors emphasize the theoretical interest of their findings and suggest that a gestural account within AP (Browman and Goldstein 1989) might be able to capture the general and dialectal tendencies (see also Honorof 1999; Hualde 2005 for gestural approaches to Spanish nasal place assimilation). All in all, these laboratory studies offer innovative methodologies to explore nasal assimilation in Spanish and present findings that challenge previous models. Their results and conclusions differ, presenting interesting issues related to instrumental methods (differences might stem from the use of acoustic vs. articulatory data, and EMA vs. EPG articulatory data) and dialectal variation, but all of these studies are theory and hypothesis motivated and reach conclusions that have implications for phonological theory.

Velarization of nasals in Spanish (see [2c]) poses a challenge for phonological accounts because alveolar is claimed to be the unmarked PA and, consequently, the expected articulation in neutralizing contexts where no assimilation takes place. The occurrence of a velar nasal in these cases goes counter to this widely held phonological assumption. Working within OT, Baković (2000) develops an analysis of nasal place assimilation and neutralization in Spanish and addresses the issue of velarization. He argues that velar productions are in fact placeless or debuccalized nasals, i.e. nasals phonetically underspecified for PA, that auditorily resemble velar nasals. Ramsammy (2013) sets out to explore this claim by analyzing the articulatory production of nasals by speakers of a velarizing dialect of Iberian Spanish. He finds that velar nasals are produced with a closure in the velar region, leading the author to conclude that these nasals are not placeless but rather have a velar specification. In light of this finding, Ramsammy presents an analysis couched within Stratal OT (Bermúdez-Otero 2006) and argues that the markedness of place features for nasals is language-specific, contrary to traditional assumptions.

Piñeros (2006) also rejects the underspecification account of velarization and instead argues that this process is part of a continuum of consonant weakening. The author explains that nasal velarization in many dialects of Spanish frequently occurs together with nasalization of the preceding vowel, oftentimes resulting in complete nasal absorption by the vowel. Piñeros claims that nasal velarization and absorption are two manifestations of a weakening process that affects coda consonants in these velarizing dialects. This weakening is gradient and variable, and, consequently, nasal velarization and absorption have these features too. Piñeros concludes that this situation is a change in progress from a full coda nasal to a nasalized vowel, an account that resolves the challenge of having velar be the default or unmarked PA. Colantoni and Kochetov (2012) explore from a laboratory perspective the hypothesis that velarization is part of a weakening continuum by analyzing articulatory data from Cuban Spanish, a velarizing dialect, and Argentine Spanish, a nonvelarizing one. The authors find that while in Argentine Spanish prevocalic and final nasals are produced as alveolar, in Cuban Spanish these sounds present more variation, including alveolar and velar nasals, and vocalized productions. Colantoni and Kochetov argue that their results align with Piñeros's analysis and provide evidence of an ongoing change in the velarizing dialect. However, a challenge that Colantoni and Kochetov face is that their articulatory data are not precise enough to differentiate between velars and vocalized nasals, and the authors state that their analysis needs further instrumental confirmation. This is an instance where the use of acoustic data would complement the articulatory analysis and help clarify the distinction between the stages of the weakening continuum, which would allow us to explore predictions based on what we know about sound change.

4. /s/ weakening

The phenomenon of /s/ weakening is widely held to be the most explored phonological process in Spanish. It can be found in varieties in southern and central Iberia, the Canary Islands and many parts of Latin America, with the exception of Mexico, Guatemala, central Costa Rica and the Andean region (Lipski 1994; Hualde 2005: 161). This process is usually described as affecting syllable-final /s/, i.e. /s/ in preconsonantal and prepausal positions, although /s/ may also weaken before a vowel in some varieties. The degree and frequency of the weakening and its resulting production vary across dialects, although aspiration [h] and deletion are the most common results, and this variation is conditioned by linguistic, social and stylistic factors, as revealed by a plethora of sociolinguistic and variationist studies. There have also been some phonological accounts of the phenomenon (see Martínez-Gil 2012 for a summary), including autosegmental approaches that represent /s/ aspiration as delinking of oral features, as well as OT accounts that posit a constraint that restricts the occurrence of /s/ in coda position.

Despite the number of quantitative studies on /s/ weakening, there are few studies that explore the phenomenon from a laboratory or instrumental perspective. Traditionally, most studies have relied on auditory transcriptions (e.g. transcribing a realization as [s], [h] or Ø), sometimes aided by acoustic representations, and it has been only recently that some researchers have applied instrumental techniques, mainly acoustic analysis, to understand the nature of the process and model it within phonological theory. Erker (2010) argues for a subsegmental analysis of weakened /s/ in the speech of Dominican Spanish speakers in New York City, and analyzes two acoustic properties, namely duration and center of gravity, a measurement that identifies the frequency at which the frication energy concentrates, and that distinguishes different places of articulation among fricatives. He complements this acoustic analysis with a segmental one, where each token is coded as [s], [h] or deleted. Consequently, there are tokens coded for the same segment that might present acoustic differences, and Erker actually shows that these differences are conditioned by the factors known from previous studies to influence /s/ weakening. Furthermore, these independent factors are able to account for more of the variation observed in the acoustic measurements than in the segmental coding. Erker relates these findings to the nature of the weakening, which is better observed at the subsegmental level via acoustic data, and to the explanatory power of the factors considered. Some other studies have also analyzed acoustic information and reached similar conclusions, arguing for the need of instrumental techniques to develop a model of /s/ weakening in Spanish (File-Muriel and Brown 2011; Henriksen and Harper 2017). Even though articulatory data on the phenomenon are elusive, we find an articulatory study by Kochetov and Colantoni (2011b) that highlights the unique insights that this type of data can bring. The authors analyze EPG data from Buenos Aires Spanish to explore the weakening of preconsonantal /s/ to [h]. Their aim is to test previous findings based on auditory analysis and argue for the importance of gestural coordination, following the AP framework. One of the observations guiding their study is that /s/ weakening varies depending on the PA of the following consonant; more precisely, there tends to be more weakening before coronal consonants than before noncoronals. Based on the EPG profiles of articulatory oral contact, the authors find that the asymmetry in rate of weakening is not based on coronals vs. noncoronals, but rather lingual (coronal and dorsals) vs. nonlingual (labials) consonants, and that these differences are greater as the temporal span of the fricative progresses. Kochetov and Colantoni conclude that this pattern is due to /s/ weakening to [h] together with anticipatory assimilation or coarticulation with the tongue (tongue tip or dorsum) gestures for the following consonant, which gets manifested in the articulatory pattern of lingual contact and also in mixed acoustic characteristics. The articulatory analysis provides evidence of coarticulation that would be difficult to obtain via auditory or only acoustic analysis.

/s/ weakening may result in a variety of realizations depending on the dialect, and the Andalusian macrodialect has been a rich source of different patterns that have been instrumentally explored and connected to developments in phonological theory. For instance, in some Andalusian varieties, /s/ deletion results in lengthening or gemination of the following consonant, with possible preaspiration of the lengthened consonants in some cases (e.g. [ˈkappa] *caspa* 'dandruff', [ˈmimmo] *mismo* 'same'). Gerfen (2002) instrumentally explores this pattern and analyzes acoustic data from speakers of Eastern Andalusian Spanish, a variety where not only /s/ but any preconsonantal obstruent weakens. Thus, the author explores the compensatory effects of preconsonantal obstruent weakening on preceding vowel aspiration and duration, and following consonant duration. Gerfen finds that consonant lengthening is a more robust cue for the deleted consonant than vowel duration. However, these two durations are not independent reflexes of the obstruent weakening: there is a trade-off between both durations. As the author argues, this finding is problematic for traditional mora-sharing analyses of lengthening (e.g. Hualde 1989) because they have no means to represent either the trade-off relationship or the more robust nature of consonant lengthening in obstruent weakening contexts. Instead, Gerfen develops a gestural analysis of Eastern Andalusian Spanish obstruent weakening within AP. In a nutshell, he argues that the pattern of lengthening and trade-off stems from the phasing relationships between the glottal opening, the oral closure and the vowel gestures.

In Western Andalusian Spanish, /s/ weakening before a voiceless stop results in a postaspirated stop or an affricate (e.g. [ˈpotʰe ~ ˈpotse] *poste* 'post', [ˈetʰe ~ ˈetse] *este* 'this'; Parrell 2012; Torreira 2012). This pattern has been analyzed acoustically by several studies, which conclude that the postaspiration is the result of a reconfiguration of the articulatory timing between the gestures involved in the sequence (/s/ + voiceless stop), once the oral gesture for the fricative is lost (Parrell 2012). More precisely, preaspiration involves an anti-phase relationship between glottal and oral gestures, which is an unstable timing relationship and consequently changes to an in-phase, i.e. postaspiration, relationship. This articulatory model not only captures the synchronic variation but also explains the sound change in Western Andalusian Spanish. However, it remains unclear why this dialect changes the articulatory timing to postaspiration while many other dialects maintain the anti-phase or preaspiration coordination.

Finally, it is worth mentioning that the role of lexical frequency in /s/ weakening in Spanish has been used as evidence to support the Usage-Based Model of phonology (Bybee 2001) and Exemplar Theory (Johnson 1997). Several studies have found that high-frequency words present higher rates of weakening than lower-frequency words in a variety of dialects (Brown 2008; File-Muriel 2009; File-Muriel and Brown 2011). File-Muriel (2009), working with a variety of Colombian Spanish, finds that lexical frequency is the most significant factor in predicting /s/ weakening or retention. File-Muriel and Brown (2011) use acoustic data to show this effect of lexical frequency, which is apparent in the duration of the fricative. The authors argue that this result supports a usage-based model of phonology, which holds that linguistic structure is highly affected by experience and emerges through language use. This kind of approach further claims that language users store very detailed phonetic information about the words in an exemplar cluster, which also contains semantic, pragmatic and social information. These studies, and those discussed earlier in this section, clearly indicate that an instrumental approach to /s/ weakening can shed new light on this well-established phenomenon and help us elucidate how understanding this process can contribute to phonological theory. It is imperative that new methodologies be applied to the study of /s/ weakening.

5. Vowel sequences: exceptional hiatuses

The analysis of Spanish vowels has recently benefited from laboratory studies that present instrumental, mainly acoustic, data to test hypotheses in relation to several vocalic processes, including the allophonic variation of mid vowels (Martínez Celdrán and Fernández Planas 2007), vowel devoicing (Delforge 2008), vowel raising (Barajas 2016) and vowel opening and harmony (Hualde and Sanders 1995; Henriksen 2017). However, the behavior of vowel sequences has attracted the most attention, and there is a growing body of laboratory studies that explore the production of these sequences both within and across words. More precisely, they focus on the phenomenon known as hiatus resolution, i.e. the tendency to avoid hiatuses in favor of other strategies such as diphthongization, deletion, epenthesis or coalescence (e.g. Jenkins 1999; Alba 2006; Garrido 2007; Barberia 2012). Hiatus resolution is of interest to phonological theory because it has an impact of models on syllable structure and syllabification. Furthermore, the alternation between diphthongs and hiatuses has been relevant to determine the phonological status of glides vs. high vowels in Spanish. Several authors argue that glides are allophones of high vowels, rather than independent phonemes (see Hualde 2005), based on the fact that high vowels are produced as glides when they are unstressed and occur next to another vowel. However, in some dialects, especially in Iberian varieties, there are so-called exceptional hiatuses, i.e. vowel sequences formed by an unstressed high vowel and another vowel that would be expected to be produced as diphthongs but get realized as hiatuses, as illustrated in (3). In these cases, there seems to be a quasi-phonemic contrast between high vowels and glides.

(3) Exceptional hiatuses

Exceptional high vowel			*Expected glide*		
[bi.ˈe.njo]	*bieno*	‘biennium’	[ˈbjen̪.to]	*viento*	‘wind’
[du.ˈe.to]	*dueto*	‘duet’	[ˈdwe.lo]	*duelo*	‘duel’

Some authors claim that exceptional hiatuses are marked at the lexical level, obviating the need to posit a phonemic category for glides (e.g. Harris and Kaisse 1999). On the other hand, Hualde (2004) claims that exceptional hiatuses are conditioned by factors that explain the positions that tend to display this exceptional syllabification; more precisely, morphological analogy, word-initial position and closeness to the stressed syllable seem to favor exceptional hiatuses. Many of the traditional claims regarding exceptional hiatuses were based on intuitions by the authors, with limited phonetic evidence. However, some recent studies have instrumentally examined these hiatuses, shedding light on the variability between the two types of productions. Hualde and Prieto (2002) aim at establishing whether there are acoustic differences between diphthong and hiatus contrasts such as those in (3). The authors analyze the duration of several predicted [i.a] and [ja] sequences in Madrid Spanish speech, and also explore the syllabification intuitions of their participants. As for the latter, participants show a high degree of agreement in the syllabification. There are also robust differences in duration between the predicted hiatuses and diphthongs in the expected direction (i.e. hiatuses are longer), but there is some degree of overlap between the duration ranges for the two types of vocalic sequences. Based on this, the authors conclude that while there is evidence that speakers are separating the two types of sequences into two classes, there is some variation. They suggest that durational differences might not be sufficient and that formant structure should also be taken into account.

Chitoran and Hualde (2007) expand on this study and acoustically examine hiatuses and diphthongs in five Romance languages, in order to test two conditionings on the change from hiatus to diphthong: (i) the presence of diphthongs in the language from other historical sources and (ii) the durational effects of prosodic structure on the vocalic sequences. For Spanish, they focus on the variable alternation between exceptional hiatuses and diphthongs (as exemplified in [3]), and analyze durational differences depending on prosodic structure, namely the position within the word and the proximity to stress. They find that these differences are significant and in the expected direction given the factors that favor exceptional hiatuses according to Hualde (2004): durations are longer in word-initial position and in stressed and prestressed syllables. These results shed light on how the variability between exceptional hiatuses and diphthongs is constrained, and any phonological analysis of this phenomenon needs to be able to capture this pattern, rather than exceptionally assigning a marked status to the lexical entries. Chitoran and Hualde argue that in order to understand the alternation under study, i.e. between a high vowel and a glide in a vowel sequence, it is important to consider it in articulatory terms, similarly to work within AP. They claim that the change results from variable overlap of the vocalic gestures in a hiatus sequence and that diphthongs represent a stable mode of gestural coordination that can attract other sequences toward the same timing (see also Colantoni and Limanni 2010). Limanni (2014) analyzes the articulation of diphthongs and hiatuses by Mexican Spanish speakers using EMA data, and she finds that these two types of sequences differ in the timing of their articulatory gestures, whereby those for diphthongs are timed more closely together. According to the author, this aligns with Chitoran and Hualde's (2007) proposal. Findings from the studies discussed in this section highlight the way in which articulatory data can complement acoustic efforts to better model hiatus and diphthong alternations.

6. Conclusion

This chapter has offered a brief introduction and definition of laboratory approaches to Spanish phonology, focusing on four areas that are taken as illustrative of the advancements that Laboratory Phonology studies have made in our understanding and modeling of Spanish sound structures and patterns. The aim has been to highlight how theory- and hypothesis-based instrumental methodologies can contribute to phonological theory. Apart from these four areas and intonation (mentioned in section 1), there are some other recurrent themes in laboratory studies of Spanish phonology that are worth mentioning, although we cannot thoroughly describe them due to space limitations. For instance, rhotic production has been explored from a laboratory perspective, not only to address dialectal differences, but also to advance the phonological representation of these types of sounds in Spanish (e.g. Bradley 2004; Willis 2007). Traditional accounts of preconsonantal fricative voicing assimilation have been revisited using instrumental techniques in an effort to elucidate the nature of the assimilation process and how to model it (see Campos-Astorkiza 2019 for a summary). Neutralization of liquids in Caribbean dialects of Spanish has also recently been explored from an instrumental perspective (e.g. Simonet et al. 2008; Beaton 2015), and these studies have shed light on the nature of phonological mergers in general.

Despite the focus of this chapter on theory- and hypothesis-based methodologies, one of the challenges faced by laboratory studies of phonology is to present a solid foundation for their research questions (Colantoni 2015), rather than finding their motivation in the refutation of impressionistic descriptions. While new methods, especially in data collection and statistical analyses (see Cohn et al. 2012 for more on these), should be paramount to laboratory studies, interpretation of the quantitative results should also be placed at the center in order to contribute to theories and models of phonological behavior. Analyzing the results within a framework also highlights the relevance of the study beyond adding more nuance to the description of Spanish sounds. In terms of focus, Laboratory Phonology in Spanish should continue to expand to a diverse range of dialects, since it has become clear that dialectal differences offer a wealth of resources and are key to modeling phonological patterns. Finally, sophisticated hybrid methodologies should be pursued, and production results need to be further complemented with evidence from perception studies.

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12

Phonological encoding and the phonology of Spanish

The role of the syllable

Miquel Simonet

1. Introduction

Speech is fast, continuous, variable, and nonunique; yet vocabularies comprise discrete entries, words. Spoken language is not divided into chunks separated by pauses—speech does not typically cue word boundaries—and listeners must learn to cope with this by developing segmentation strategies (i.e., they must deal with the "segmentation" problem). The representation of words in the lexicon is (perhaps) abstract and discrete, but two iterations of the same word pronounced by two different speakers are never acoustically identical—listeners must therefore learn to cope with extreme phonetic variability (i.e., the "lack of invariance" problem). Words often have other words embedded in them (e.g., *star* is embedded in *start*) or are phonologically similar to each other (e.g., *admiral* and *admiration* differ only after their fifth segment, ignoring stress), which further demonstrates that the fact that listeners typically recognize the words intended by speakers is nothing short of miraculous (i.e., the "nonuniqueness" problem)—see Cutler (2012), especially chapter 2, for an overview. The evidence to date demonstrates that spoken word recognition

> is an active process of hypothesis construction. Listeners do not simply wait and understand utterances once they end. Nor do they even wait until the end of a word. Multiple word candidates, potentially consistent with the incoming speech, are considered concurrently.
>
> *(Cutler 2012: 40)*

In order to segment the speech signal into processable chunks and to access the phonological forms of words in the lexicon (and discard competitors), listeners utilize as many cues as they can. Most of these cues are gradient, probabilistic. It follows that the strategies listeners use must be expressed in probabilistic terms. Laboratory phonologists are interested in discovering what such strategies are, since understanding their nature is potentially akin to understanding (one aspect of) what listeners know (or can find out) about the sounds of their language, a fundamental question in the field of phonology. (Psycholinguists are interested in such strategies for different reasons.) It turns out that many such strategies are language-specific because they depend on the composition of a language's vocabulary. This suggests that much of this knowledge is learned rather than innate.

While listeners care about meaning, not sounds, it is sounds that they are met with, and it is only through the successful encoding of sounds into abstract representations that they can access meaning. The constellation of strategies listeners use to deal with sounds in real time—i.e., to encode them into abstract representations and, ultimately, words—is hereafter referred to as *phonological encoding*. The present chapter is motivated by the informed assumption that phonological encoding is informative to those who want to understand what speakers know about the sounds of their language(s). Evidence from the world of phonological encoding can contribute its own set of facts to whatever set of facts formal analyses can provide us with in favor of (or against) traditional phonological structures. Understanding phonological structure entails gathering as many facts as possible from as many paradigms as possible. Excluding *a priori* an entire set of facts or dismissing them as "performance phenomena" is akin to arbitrarily limiting our knowledge.

This chapter is about a single aspect of the phonological knowledge of Spanish speakers—the syllable. The syllable organizes segments into a hierarchical structure, and there is ample formal evidence that syllables are part of the phonological knowledge of Spanish speakers (Colina 2009). Many phonological processes, for instance, are best expressed as operations over segments located in specific nodes on a hierarchical structure. But is there evidence from phonological encoding—i.e., from the world of speech comprehension—that syllables are part of the phonological knowledge of Spanish speakers? Does syllabic knowledge modulate how listeners who speak Spanish segment a continuous signal into chunks or how they access their lexicon (i.e., activate and deactivate word candidates)? The answer appears to be (for the most part) yes.

Rather than providing an overview of what aspects of Spanish phonology have been studied from the perspective of phonological encoding, this chapter focuses on a single aspect of Spanish phonology. Nevertheless, various laboratory techniques are illustrated. Other aspects of the phonology of Spanish, such as lexical stress, have received some attention from this perspective (Soto-Faraco et al. 2001), but most have not. In fact, in order to illustrate the facts about the syllable, this literature review must go beyond Spanish and include studies on Catalan, French, Italian, and English. This should provide relevant context. Perhaps identifying this void will motivate future laboratory research on the phonology of Spanish.

The remainder of this chapter assumes that, in the process of comprehending speech in real time, segmentation strategies and lexical activation processes are different sets of processes—although obviously not independent of each other, the strategies used to break up the signal into chunks and those used to activate lexical candidates are, in principle, of different natures (Norris and Cutler 1985). The chapter is organized into two main sections, one focusing on segmentation-based evidence and one focusing on activation-based evidence. This division is pragmatic for the purposes of presentation and discussion. The relation between these two sets of processes needs to be better understood. In terms of the role of syllabification in each set of processes, four alternatives present themselves: on the one hand, it is possible that syllabic information is used during speech segmentation but not lexical activation, or it may be used in lexical activation but not segmentation; on the other hand, it could be exploited by both sets of processes, or it could be not used at all.

2. Syllabic segmentation: word spotting and syllable monitoring

This section reviews some of the extant evidence supporting the hypothesis that listeners deploy their syllabic knowledge during speech segmentation—i.e., syllabification as a segmentation strategy. It will be seen that there is reason to believe that this is so, but not in all languages. In particular, the evidence suggests that French speakers employ syllable-based segmentation strategies while English speakers do not. The evidence regarding Romance languages other than French, including Spanish, is more nuanced. The experimental studies reviewed in this section employ two types of comprehension-oriented psycholinguistic tasks, the word-spotting task of Cutler and Norris (1988) and a version of the syllable-monitoring task (Mehler et al. 1981).

Let us begin with the word-spotting evidence. The only word-spotting study exploring the role of the syllable during speech segmentation was run on French (Dumay et al. 2002). At present, there are no comparable data for Spanish, but the syllabic patterns of French and Spanish are similar, and the French results should be extrapolatable to Spanish, at least in principle. Dumay et al. (2002: 147) hypothesize that syllable onsets help the listener segment the speech flow by providing clues to word onsets. Since word onsets necessarily coincide with syllable onsets, knowledge about possible (and impossible) syllable onsets should aid the task of finding possible word onsets or extracting possible words from a continuous signal. For instance, in French (like in Spanish), a word may begin in /bl/ but not /nl/; this, in turn, means that syllables in French may begin with /bl/ but not /nl/. By hypothesis, when French speakers hear an /nl/ sequence, they assign the /n/ to the coda and the /l/ to the onset of separate syllables; but when they hear a /bl/ sequence, they may assign both consonants to the same syllable as an onset cluster. The question in Dumay et al. (2002) was as follows: does syllable-based phonotactic information aid French listeners during online speech segmentation? If so, this would provide evidence that French listeners have some type of syllabic knowledge and that they employ this knowledge during speech segmentation.

The researchers played disyllabic nonword sequences with intervocalic consonant clusters to a group of French-speaking listeners. Real French words, such as *lac* 'lake,' were embedded in the second half of nonwords, and the composition of the intervocalic consonant clusters was manipulated. For instance, listeners heard nonwords such as [zunlak] and [zublak]. If French listeners exploit syllable-based phonotactic information, the argument goes, it should be easier for them to spot the word *lac* 'lake' in [zunlak] than in [zublak]. Indeed, it was found that *lac* was more likely to go undetected in [zublak] than in [zunlak] nonwords and that, when correctly spotted, detection was much faster (±100 milliseconds) in [zunlak] than in [zublak]. It appears that, when hearing a nonword sequence such as [zublak], French listeners have the tendency to automatically syllabify it as [zu.blak], which hinders their identification of *lac* 'lake' by creating a situation in which word onset and syllable onset are not aligned.

Evidence that listeners use syllable-based segmentation strategies comes not only from the word-spotting experiment just discussed but also from multiple syllable-monitoring experiments on French, starting with Mehler et al. (1981). Comparable syllable-monitoring experiments have been conducted on Catalan, Italian, and Spanish. The articles will be discussed in approximate chronological order, and it will be seen that whereas the French (and, perhaps, the Catalan) data may have a straightforward interpretation, the Spanish (and Italian) data do not.

Mehler et al. (1981) designed a monitoring experiment in which French-speaking listeners were asked to press a button as soon as they identified, from a list of words, a sequence of sounds comprising either two or three segments. Two-segment sequences were composed of a consonant and a vowel—e.g., participants were asked to monitor for sequences such as /ba/ or /pa/. Similarly, three-segment sequences had a consonant, a vowel, and a consonant—e.g., participants were asked to monitor for sequences such /pas/ or /bal/. By hypothesis, participants would create a syllabic "mental image" of the sequence they were instructed to monitor for, which means that, without having been explicitly instructed to do so, participants would be monitoring for syllables rather than segment sequences (at least at some level). The target words played to the participants could have one of two key forms: they could begin with an open (or vowel-final) or a closed (or consonant-final) syllable. These included, for instance, words such as *ballon* 'ball' and *balcon* 'balcony,' or *palace* 'palace' and *palmier* 'palm tree.' Target words were presented in isolation rather than embedded in carrier phrases.

The first finding was that the participants could detect /ba/ in both *balcon* and *ballon*, and they could detect /bal/ in both *ballon* and *balcon* as well—i.e., they pushed the recognition button in all cases. This shows that, as expected, they understood the task to be one in which they were to monitor for segment sequences, not full syllables. The most important finding lies in the time it took for them to react to the words as a function of the sequence they were asked to monitor for. First, listeners detected /ba/ faster in *ballon* than in *balcon*. Second, they detected /bal/ faster in *balcon* than in *ballon*. This was called the "target-type by word-type interaction" (hereafter, target-by-word interaction), and finding such an interaction was key. In a second experiment, listeners monitored for vowel + consonant sequences, such as /al/, in words that consistently began with a consonant, such as *ballon* and *balcon*. It was found that participants were faster at detecting /al/ in *balcon* than in *ballon*. It seems that it was easier for these listeners to recognize a sequence of two segments when they are part of the same syllable (i.e., the rhyme) than when they are not. In French the /l/ in *balcon* is syllabified as the coda of the first syllable while the /l/ in *ballon* is syllabified as the onset of the second syllable.

The findings are in line with the following interpretation: as the auditorily presented words are being played to the listeners, they are being automatically encoded into sublexical phonological units. One of those sublexical units is, arguably, the syllable. A word such as *balcon* is divided into two syllables, and the /l/ is assigned to the first syllable because /lk/ is not a possible onset in French. If participants are monitoring for /ba/, the mismatch between what they are monitoring for and what they automatically encode from the signal (*bal.con*) triggers a recognition delay. The same is true if they are monitoring for /bal/ and they hear *ballon* (*ba.llon*): the mismatch triggers a delay. This finding clearly suggests that French-speaking listeners encode auditorily presented words in chunks that look very much like syllables. These findings led Mehler and colleagues to propose that since all languages have syllables, online syllabic encoding is a fundamental, universal aspect of speech comprehension. While the findings for French are still standing (but see Content et al. 2001), the cross-linguistic scope of the "syllabic hypothesis" was short-lived. In any case, as Cutler et al. (1986: 386) put it, "for our present purposes what is important in these studies is that listeners are clearly capable of extracting syllabic units from continuous speech when required to do so." This suggests that syllabification is, at one level of representation, part of the phonological knowledge of French speakers.

Syllabification patterns differ across languages, and they are more complex and variable in some languages than they are in others. This may lead to cross-linguistic differences in syllabic knowledge, unless syllabic segmentation is a true universal. Syllabification patterns in French are relatively simple and consistent, and French listeners seem to have relatively robust syllabification intuitions (Content et al. 2001). In English, syllabification patterns are less transparent than in French, and English speakers are less consistent when explicitly asked to syllabify English words. One syllabic difference between French (and Spanish) and English is ambisyllabicity. In English, an intervocalic consonant preceding an unstressed vowel is potentially ambisyllabic—e.g., the /l/ in *palace* might be part of both the first ([pæl]) and the second ([ləs]) syllables, since both [pæl] and [ləs] are well-formed English syllabic units (but neither [pæ] nor [əs] is). Cutler et al. (1986) asked whether the syllable-monitoring evidence presented in Mehler et al. (1981) using French materials would prove reliable in a language such as English with widespread ambisyllabicity. They replicated the French-based experiment with English materials and English-speaking listeners.

Cutler et al. (1986) reported on four experiments. The first experiment focused exclusively on English. English-speaking listeners were asked to monitor for sequences comprising two or three segments, such as /ba/ and /bal/. The word list played to the listeners contained words such as *balance* and *balcony*. The /l/ in *balcony* is syllabified with the first syllable as its coda, but the /l/ in *balance* is potentially ambisyllabic. There was no clear prediction for words such as *balance*, since predictions came from the French results in a prior experiment and ambisyllabicity is not a property of French phonology. But if English listeners use syllabification during speech segmentation, their behavior should align with that of French listeners in words such as *balcony*—they should detect /bal/ faster than /ba/ in such words. This experiment, however, led to a null result—in other words, there was no target-by-word interaction. English listeners did not detect /bal/ faster in *balcony* than in *balance*, and, what is more telling, they did not detect /ba/ faster in *balance* than in *balcony*.

The difference between the English (Cutler et al. 1986) and the French (Mehler et al. 1981) results lends itself to various interpretations. Perhaps French listeners use syllabification during speech segmentation, and English listeners do not, which would mean that syllabic segmentation is not universal. Or perhaps the French materials—that is, the auditory stimuli used in Mehler et al. (1981)—contain important subsegmental information that facilitates the exploitation of syllabic segmentation strategies, and the English materials do not. In order to test whether the French auditory stimuli were special in any way, the second experiment in Cutler et al. (1986) played the French word list used in Mehler et al. (1981) to a group of English-speaking listeners. (Note that syllable monitoring is not a lexical task; therefore, in such a task, participants do not need to speak the language from which the lexical items have been selected. In fact, one may run syllabic-monitoring tasks using nonwords, which is exactly what Cutler et al. (1986) did in their third experiment.) The task was the same as in the first experiment. The findings, once again, led to a null result—there was no target-by-word interaction. English listeners did not detect /bal/ faster in French *balcon* 'balcony' than in *ballon* 'ball,' and neither did they detect /ba/ faster in *ballon* than in *balcon*. Importantly, they did not detect /bal/ faster than /a/ in *balcon*. It seems that the difference between the French and the English results was based on the participants rather than the materials.

The fourth (and final) experiment returned to French-speaking listeners. Cutler et al. (1986) asked whether French participants would demonstrate the use of syllabification in the segmentation of English materials, as it had been demonstrated with French materials. In order to run this experiment, the authors took the English auditory stimuli they had used in their first experiment and played them to a group of French participants. Interestingly, this experiment led to a target-by-word interaction—French participants detected /ba/ faster in English *balance* than in *balcony*, and they detected /bal/ faster in *balcony* than in *balance*. In sum, it would appear that French-speaking listeners (but, crucially, not English-speaking listeners) exploit syllabic information in their segmentation of the speech signal, somewhat independently of the language of the materials.

At this juncture, two questions arise. First, are there other languages like French, in which syllabification is consistent and simple, whose speakers exploit syllabic segmentation during processing? Second, what is known about French-English bilinguals? For reasons of space, this chapter addresses exclusively the first question. Readers interested in bilingualism are referred to two articles, one on French-English bilinguals (Cutler et al. 1992) and one on Spanish-English bilinguals (Bradley et al. 1993, experiment 5). The articles discussed in the remainder of this section report on experiments designed to replicate the syllable-monitoring task of Mehler et al. (1981) with listeners who speak other Romance languages (including Spanish), all of which have syllabification patterns similar to those of French but also have some potentially important prosodic differences.

Sebastián-Gallés et al. (1992) observed that all the words used in the English materials of Cutler et al. (1986) were stress-initial, and all those used in the French materials of Mehler et al. (1981) were stress-final. This points to a confound between lexical stress and syllabicity—the confound is due to lexical limitations of the languages involved rather than a design flaw. Catalan and Spanish, like English (but unlike French), have variable lexical stress—that is, unlike in French, stress is assigned lexically in these languages and does not consistently fall on the same syllable. For instance, /ba/ is stressed in *bala* 'bullet' but unstressed in *balada* 'ballad,' both of them Spanish words. Neither Catalan nor Spanish, like French (but unlike English), has ambisyllabicity. This means that, by exploring Catalan and Spanish, one may examine any potential interactions between stress and syllabic structure, which neither French nor English allows. Finally, Catalan, unlike Spanish, has unstressed vowel reduction. The experiments presented in Sebastián-Gallés et al. (1992) explored the possibility that lexical stress and unstressed vowel reduction play a role in the segmentation of the speech signal, perhaps interacting with syllabification.

The first experiment in Sebastián-Gallés et al. (1992) was run on Catalan. While Catalan has unstressed vowel reduction, the authors focused on vowel phonemes that do not reduce in unstressed position, /i/ and /u/, to examine suprasegmental, rather than segmental, stress effects. Importantly, the words they used could begin with either a stressed or an unstressed syllable. Otherwise, the design mimicked the one in Mehler et al. (1981). A group of Catalan participants were asked to monitor for sequences such as /pu/ or /puɾ/ in word lists that included words such as *pura* 'holy' and *purga* 'laxative' (stressed on the first syllable), and *puré* 'purée' and *purgant* 'depletory' (stressed on the last syllable). The results yielded a target-by-word interaction but only for words whose first syllable was unstressed—there was a null effect in the case of the words whose first syllable was stressed. Unstressed syllables are shorter, and, relative to those in stressed syllables, their segments are hypoarticulated (De Jong 1995; Nadeu 2014). According to Sebastián-Gallés and colleagues, listeners might need to rely more on top-down segmentation strategies—such as syllabification—when dealing with unstressed syllables, where the acoustic-segmental information is less reliable. This, in itself, could explain the difference between the English and the French results discussed previously; but, again, Catalan has unstressed vowel reduction, and the pattern obtained in this experiment might result from a strategy specific to the processing of languages with unstressed vowel reduction, even in full vowels.

In the case of Spanish, it will be seen that while some experiments have yielded positive results, others have led to null results. There are two published articles on syllable monitoring in Spanish (Bradley et al. 1993; Sebastián-Gallés et al. 1992). In their second experiment, Sebastián-Gallés et al. (1992) manipulated, like in their Catalan experiment, the presence (vs. absence) of lexical stress in the first syllable of words used as auditory stimuli. Spanish-speaking participants from Barcelona were asked to monitor for sequences such as /ba/ and /bal/ in words such as *balón* 'ball' and *balcón* 'balcony' (whose first syllable is unstressed), and *bala* 'bullet' and *balsa* 'raft' (whose first syllable is stressed). There were no positive effects—there was no target-by-word interaction. This was true for all words regardless of whether their first syllable was stressed or unstressed. The authors point out, however, that a comparable experiment with Spanish speakers and Spanish materials had found a syllabic effect, a target-by-word interaction (Sánchez-Casas 1988). And, indeed, the second article, discussed in the following paragraphy, did yield a positive result (Bradley et al. 1993).

Bradley and colleagues asked a group of Spanish-speaking participants from Madrid to monitor for sequences such as /pa/ and /pal/ in words such as *paloma* 'dove' and *palmera* 'palm tree.' This study did find a target-by-word interaction—/pa/ was detected faster in *paloma* than in *palmera*, and /pal/ was detected faster in *palmera* than in *paloma*. This replicated the French findings and the "unstressed" Catalan findings, but was in contrast with the Spanish null finding reported in Sebastián-Gallés et al. (1992). In a follow-up experiment, however, Spanish-speaking listeners monitored English materials, and this time they did not demonstrate the target-by-word interaction they had demonstrated when monitoring comparable Spanish materials. The latter finding contrasts with that in Cutler et al. (1986), which showed that French participants used syllabification when segmenting English materials. These findings lead us to ask the following: what explains the fact that Spanish listeners use syllabification strategies, but only for native materials (unlike French listeners, who used them for both native and foreign materials)? And, most important, why did Bradley et al. (1993) find an effect where Sebastián-Gallés et al. (1992) had found none? It would appear that syllabic effects, as a segmentation strategy, are especially vulnerable in Spanish—sometimes they are found, and sometimes they are not.

One observation is that the average response times in Sebastián-Gallés et al. (1992) were between 350 and 400 milliseconds, while those reported in Bradley et al. (1993) were between 550 and 600 milliseconds. Recall that while the former found no target-by-word interaction, the latter did. The tasks used in the two studies were identical, but there was a difference in the fillers (the words for which no response was expected because they did not include any of the target sequences). In Bradley et al. (1993), but not in the other study, the fillers included words that were phonologically similar to the experimental words. This means that one task was cognitively more demanding than the other, and participants may have been more "careful" in one task than in the other. This explains the latency difference. But what is important is that the processing stages these two studies tapped into might have been different, leading to different results. Thus, one possibility is that, in Spanish, syllabic segmentation exists but takes place only at later, higher processing levels. When a task is completed at a very shallow processing level, syllabic effects might not come into effect. Indeed, in a final experiment, Sebastián-Gallés et al. (1992) replicated their own first experiment, but this time they told their participants that, at the end of the task, they would be given a recognition test including some of the words presented in the experiment. This slowed participants down. Interestingly, this time syllabic effects emerged—there was an interaction between target type and word type.

Sebastián-Gallés and colleagues noted that, relative to French and Catalan, Spanish has fewer vowels, and it does not have unstressed vowel reduction. For native listeners, making phonological decisions (i.e., segmental categorization) about Spanish auditory stimuli may be easier than making them about French or Catalan materials, especially in the case of unstressed vowels—there are fewer candidate phonemes to choose from and less allophonic variability to filter out. In their words, Spanish is more "acoustically transparent" than French or Catalan. Perhaps this explains why, for Spanish-speaking listeners, syllabification is particularly vulnerable—i.e., it is part of the processing system, but it may be bypassed relatively easily when the acoustic evidence is clear enough to make an early decision. Note that, interestingly, syllabic segmentation also seems to be vulnerable among Italian listeners (Tabossi et al. 2000). In Italian, as in Spanish, some tasks yield it, but others do not.

There seems to be no doubt that syllabification is part of Spanish speakers' phonological knowledge. This knowledge is exploited, at least under some processing conditions, during speech comprehension. Relative to French and Catalan, however, syllabic segmentation seems to be less robust in Spanish. Nonetheless, there is behavioral evidence suggesting syllabic segmentation in all the Romance languages that have been examined to date: French, Catalan, Italian, and Spanish. It can be argued that speakers of Spanish and other Romance languages, but not English, "spontaneously tend to represent and segment speech signals in terms of syllables" (Sebastián-Gallés et al. 1992: 29).

3. Syllabic activation: word recognition and priming

The early "syllabic hypothesis" of Mehler and colleagues (Mehler 1981; Mehler et al. 1981) holds that syllables are natural units in speech processing. Among other things, syllabic structure is hypothesized to modulate lexical access—i.e., initial contact with the mental lexicon is sifted by syllabic structure. But the evidence discussed so far comes from segmentation strategies, which are the ones revealed in syllable-monitoring and word-spotting tasks. While the results of segmentation-based experiments tend to support the hypothesis that (at least in some languages) syllabic structures affect speech processing, these studies "give no indication as to whether during the early phases of word recognition the first contact with the mental lexicon is actually established by a word's initial syllable" (Tagliapietra et al. 2009: 513). Evidence from speech segmentation is informative, and it suggests that in languages such as Spanish, syllables are indeed processing units and thus are part of the phonological knowledge of Spanish speakers. Nonetheless, it is theoretically relevant to know whether, beyond segmentation, syllables are employed in word activation. If they are, this could be interpreted to suggest that the phonological representations of words in the mental lexicon contain syllabic information, at least in some form.

Several experimental studies have addressed this issue, and evidence comes from at least two Romance languages, Italian and Spanish. Two published articles deal with *spoken* word recognition data; they are both on Italian (Tabossi et al. 2000; Tagliapietra et al. 2009). Also, a relatively large body of literature deals with *visual* word recognition data and focuses on Spanish (e.g., Álvarez et al. 2004; Álvarez et al. 2001; Álvarez et al. 1998; Carreiras et al. 1993; Carreiras and Perea 2002).

A series of studies, of which two are reviewed in some depth, investigate the potential role of the syllable in Spanish visual lexical access—see Ferrand et al. (1996) for an example from French. The main conclusion of this body of literature is that words are indeed accessed syllabically. The majority of these studies typically contend that in polysyllabic words the first syllable is more prominent than the others in the process of activating lexical entries—the first syllable, for instance, determines to a certain extent the candidate words that enter the competition for lexical selection and the words that do not (e.g., Álvarez et al. 2000; Álvarez et al. 1998). It is not the case that reading proceeds strictly from left to right; the evidence, however, does suggest that word-initial letters play a privileged role in visual word recognition (Perea 1998). To the extent that phonology is involved in visual lexical access (e.g., Pollatsek et al. 2005), findings from visual word recognition may help us understand phonological processing and, in turn, phonological representations.

In studies that maintain that lexical activation processes privilege the first syllable, it is usually found that words beginning with a high-frequency syllable—that is, those whose first syllable is shared with many other words—take longer to be recognized than words beginning with low-frequency syllables—that is, those whose first syllable is shared with few other words (Carreiras et al. 1993; Carreiras and Perea 2002). The explanation is that the first syllable activates the entire cohort of words that begin with it but not those that do not. In large cohorts, lexical competition among the activated candidates triggers the recognition delay: as the size of the cohort increases, so does the competition. However, follow-up studies have found that what modulates a word's recognition latency is the token frequency of its syllabic neighbors, not the sheer number of such neighbors. In other words, a word with higher-frequency syllabic neighbors—that is, syllabic neighbors with a higher token frequency than the target word itself—will take longer to be recognized than a word with lower-frequency syllabic neighbors (Carreiras and Perea 2002; Perea and Carreiras 1995, 1998). On the basis of the available evidence, these studies tend to conclude, along with Álvarez et al. (2001: 553), that "any model of lexical access has to incorporate a syllabic model of representation or include the syllable as a sublexical unit of processing in Spanish."

Carreiras and Perea (2002) reported on four visual lexical decision tasks with Spanish materials. In visual lexical decision tasks, participants are shown words and nonwords (in their language) in random order, and they are asked to press a button if they recognize an actual word in the string of letters they see in a particular trial. The four lexical decision tasks in Carreiras and Perea (2002) used the masked priming paradigm. In this paradigm, a trial comprises a forward mask (four pound signs are displayed for 500 milliseconds, in this case); a prime (a word or nonword displayed in lowercase), which, crucially, is shown for a very short period of time; and a target (usually a word or nonword in capital letters). A prime is a word form acting as a cue or intervention preceding a target; the target is the word form where the measurement is taken or the observation made. Participants, who are not warned of the presence of the mask or the prime, perform lexical decisions only on the targets, and it is typically reported that they are unaware of the presence of the primes. With this paradigm, researchers investigate how some experimentally manipulated, structural aspect of the prime affects (or does not affect) the target's recognition latency. Since participants are typically unaware of the presence of the primes due to the fact that they are shown just for a few milliseconds, masked priming experiments tap into unconscious lexical and prelexical processes, including phonological encoding.

The first experiment in Carreiras and Perea (2002) had two conditions: a target such as *bono* 'bond' was preceded by either an unrelated control prime, such as *caja* 'box' (with which it does not share the initial syllable), or an experimental prime, such as *boca* 'mouth' (with which it shares the first syllable). In this case, the experimental prime is a Spanish word of a higher token frequency than the target. Relative to unrelated controls, orthographically similar primes tend to facilitate recognition, and thus accelerate response latencies. In this experiment, however, the authors found that, relative to unrelated controls (*caja-BONO*), the experimental primes (*boca-BONO*) delayed the recognition of target words. Arguably, the related prime (*boca*) and target (*bono*) compete for recognition—they are simultaneously activated because they are syllabic neighbors. In this experiment, since primes were selected to have higher token frequencies than targets, recognition rates were delayed rather than accelerated—this is known as inhibition.

Nonwords have the potential to facilitate the recognition of words if they share crucial phonological material, such as the first syllable, but they cannot compete for recognition, as they are not stored in the lexicon—they cannot, by definition, trigger inhibition. In their second experiment, Carreiras and Perea (2002) used nonword primes in two experimental conditions: one in which a target, such as *bono* 'bond,' was preceded by a nonword with which it shared the first syllable (*bopa*) and one in which it did not (*caya*). It was found that the recognition latencies of the targets were shorter in the experimental (*bopa*) than in the control (*caya*) condition. Evidently, words are recognized faster after participants have seen nonwords that share the first syllable, which suggests that activating a syllabic item (*bo-*) facilitates the accessing of words that begin with that syllable. But the inhibition and facilitation effects found in these experiments may have an easier explanation—the effects may be due, not to the first syllable per se, but to the first two letters. Two additional experiments address this issue.

First, the authors compared the facilitation of the *bopa-BONO* condition (relative to the control, *caya-BONO*) with two additional conditions, one in which a monosyllabic four-letter word (e.g., *zinc* 'zinc') was preceded by a monosyllabic four-letter nonword (*ziel*) with which it shares the first two letters but, crucially, not the entire syllable (*ziel-ZINC*), and one in which the monosyllabic four-letter word is preceded by an unrelated nonword (*flur*). This experiment did not find any facilitation effects for the *ziel-ZINC* condition. It seems, therefore, that a word's cohort is determined by the first syllable, and not merely the first two segments. However, as the authors point out, monosyllabic content words are unusual in Spanish, and processing differences between disyllabic and monosyllabic words must be interpreted with care.

The last experiment in Carreiras and Perea (2002) utilized the partial masked priming paradigm and focused on the difference between closed and open syllables. The targets were six-letter words with either a closed (*bastón* 'cane') or an open (*basura*) word-initial syllable; importantly, the first three letters were identical in both cases, but the third letter was syllabified with either the first or the second syllable. Partial masked primes were either two-letter (*ba*###) or three-letter (*bas*###) sequences followed by pound signs. If lexical activation takes into account syllabic configuration, one would expect that two-letter partial primes facilitate words such as *basura* while three-letter partial primes facilitate words such as *bastón*. Indeed, lexical decision times for *bastón* were shorter after *bas*-type than after *ba*-type partial primes, and recognition latencies for *basura* were shorter after *ba*-type than after *bas*-type partial primes. By hypothesis, when participants see *bas*####, they create a syllabic "mental image" consisting of a closed syllable, which facilitates the activation of words beginning with that particular closed syllable. This experiment suggests that *bastón* and *bastante* 'enough,' but not *basura*, are part of the same syllabic cohort, which, in turn, suggests that syllabic structure is (somehow) part of the representation of words in the mental lexicon.

Even though the evidence comes from reading experiments, "syllabic effects on visual word recognition have usually been interpreted as involving phonological processing" (Álvarez et al. 2004: 428). But this needs to be tested directly, rather than assumed. In order to explore whether phonological processing is at the root of the syllabic effects found in previous experiments, Álvarez et al. (2004) ran three visual word recognition experiments similar to the ones reported in Carreiras and Perea (2002), but with a crucial twist. The main idea in this new set of studies stems from the fact that although the Spanish spelling system is shallow, it is not transparent. The first experiment is a replication of prior work with a similar, but not identical, experimental paradigm. This experiment tested whether the activation of five-letter words, such as *junio* 'June,' may be facilitated by the presentation of masked primes (nonwords) with which they share the first three letters but not the first syllable—*junio* was preceded by either *juntu* or *junas*. It was found that words such as *junio* were indeed facilitated by nonwords such as *junas*, with which they share the first syllable, but not by words such as *juntu*, with which they do not.

Álvarez et al.'s (2004) second experiment added a crucial condition. The conditions in the first experiment exploited the orthographic and phonological similarities between nonword primes and target words. The condition added in the second experiment broke the orthographic similarity but retained the phonological one—the target *girar* 'to turn' could be preceded not only by *girol* or *girten* but also by *jirol* or *jirten*. Note that in Spanish both <gi> and <ji> correspond to /xi/. The first pair of primes share with the target word not only the pronunciation of the first three letters but also the letters themselves; the second pair of primes, on the other hand, share with the target word only the pronunciation of the first three letters, but not the letters themselves. The results showed that both conditions triggered the expected syllabic effects. Thus, upon seeing a nonword such as *jirol*, readers create a "phonological image" of this nonword (i.e., reading the word activates the phonological system), and it is this phonological image that facilitates the recognition of words with which the nonword shares the first phonemes (and, crucially, the first syllable). In sum, a word's cohort, activated during visual and spoken word recognition, comprises its syllabic neighbors, the words with which it shares the first phonological (not orthographic) syllable.

We are not aware of any Spanish *spoken* word recognition experiments focusing on the syllable, but two studies on Italian seem relevant (Tabossi et al. 2000; Tagliapietra et al. 2009). Tabossi et al. (2000) reported on five experiments, four of which dealt with syllable- and phoneme-monitoring data; the fifth experiment was concerned with lexical activation and the potential role of the syllable, and that one is discussed here. This experiment utilized the lexical decision task in a cross-modal priming paradigm. In this paradigm, target words (the ones about which participants make lexical decisions) are presented visually, but primes are presented auditorily. In such tasks, participants are instructed to focus only on the visual targets, but they cannot avoid hearing the primes. In Tabossi et al.'s (2000) fifth experiment, primes were partial words. The partial primes consisted of three segments, always a consonant + vowel + consonant sequence, that would have been extracted from two types of words: (i) words whose second consonant is part of the first syllable (closed condition, such as *silvestre* 'silvan, of the woods'), and (ii) words whose second consonant is part of the second syllable (open condition, such as *silenzio* 'silence'). Targets were selected from among the semantic associates of the words from which the primes had been extracted—e.g., *silenzio* 'silence' and *rumore* 'noise' are associates. For instance, participants would hear *La prossima parola é sil-* 'The next word is sil-' in two conditions (one [sil] sequence extracted from *silvestre* and one from *silenzio*), and immediately see RUMORE; they were to make a lexical decision on RUMORE. If [sil] facilitated the activation of *silenzio*, RUMORE would be primed relative to a control condition. This experiment found, indeed, that [sil] extracted from a rendering of *silenzio* (but, crucially, not *silvestre*) primed RUMORE, and [sol] extracted from a rendering of *soldato* 'soldier' (but, crucially, not *solare* 'solar') primed GUERRA 'war.' Tabossi and colleagues tested only words whose first syllable was unstressed, but Tagliapietra et al. (2009) extended these findings to words whose first syllable was stressed. The authors conclude that syllabic structure is involved in lexical activation, and it would follow that it is part of the mental lexicon: "when the syllabic structure of a sequence of phonemes is the same as the word initial structure of a word that is semantically related to the target, the sequence effectively primes the visual target" (Tabossi et al. 2000: 770). Thus, [sil] from *silvestre* and [sil] from *silenzio* are phonetically different, and this difference is consistent enough to have formed a pattern. Listeners are finely tuned to these differences, which stem from syllabification (among other things), and they exploit them in their lexical searches. Tangentially, these findings also suggest that mental representations of word forms do not comprise merely abstract phonemes (as typically assumed in formal phonological models) but segments with detailed phonetic content.

The findings in the studies discussed so far in this section are strongly in line with the hypothesis that syllabification is exploited in lexical access, and syllabic configurations are included in a word's mental representation. The last study to be discussed, in contrast, provides some counterevidence to this hypothesis. In Tagliapietra et al.'s (2009) second experiment, Italian speakers participated in a lexical decision task with the cross-modal priming paradigm. Auditory primes were two-segment sequences, rather than three-segment ones. The setup was very similar to Tabossi et al.'s (2000) fifth experiment. The authors reasoned that if a word's cohort is formed only by its syllabic neighbors, a two-segment sequence such as [ku] could not prime *curva* 'bend' but only *cura* 'treatment.' (It had already been demonstrated that [sol] primed *soldato* 'soldier' but not *solare* 'solar.') In this experiment, two-segment sequences extracted out of words whose first syllable was closed—e.g., [ku] cut out from *curva*—were found to prime semantic associates of words whose first syllable is open. In other words, a sequence such as [ku] extracted from *curva* was found to facilitate the word MEDICO 'doctor,' which is an associate of *cura* 'treatment' but not *curva* 'bend.' This study demonstrates that a word's cohort is not restricted to the words with which it shares an entire word-initial syllable. Lexical access may exploit subsyllabic information. These results may be in contrast with those in Carreiras and Perea's (2002) last experiment, but note the differences in the experimental setup and the language tested. The evidence presented in Tabossi et al. (2000) and Tagliapietra et al. (2009) suggests that Italian speakers may use syllabic information during word recognition, but they are not restricted to it, as they may exploit other information, including subsyllabic information.

The studies reviewed in this section have been concerned with the potential role of the syllable in the activation and recognition of visual words. These studies have all used the lexical decision task with either cross-modal (auditory) or monomodal (visual) priming, and they have investigated two very similar languages, Spanish and Italian. It has been found that in the process of recognizing words, the syllabic similarities of primes and target words modulate (but do not fully restrict) lexical activation. In conditions in which primes and targets present matching syllabic configurations, primes facilitate the recognition of lexical targets by reducing response times. It follows that syllabic structures (syllabification) are important in the process of recognizing words, but parallel processes are available. It also follows that the phonological representation of words, in Spanish and Italian, must include syllabic information. The syllable is an important aspect of the phonological knowledge of speakers of Spanish and Italian, and it would seem that the entries in the lexicon include such syllabic information.

4. Conclusion

The present chapter has reviewed some of the evidence suggesting that syllabification is part of the phonological knowledge of Spanish speakers as well as that of speakers of other Romance languages, such as French, Catalan, and Italian. Some of the experimental findings discussed here suggest that listeners who speak Spanish exploit their knowledge of their language's syllable structure to dynamically segment the speech signal into chunks that may then be used to initiate lexical searches. This is not their only segmentation strategy, but it is one of them. In other words, speakers of Romance languages such as French and Spanish are not necessarily restricted to syllable-based segmentation, but this segmentation process is part of their repertoire. Other experimental findings suggest that the strategy Spanish listeners use to select (or activate) lexical items, during word recognition, is (at least partially) based on the syllabification patterns of this language. Again, the lexicon may be accessed in more than one way, but syllable-based activation is one of them. That is, speakers of Romance languages such as Italian and Spanish are not restricted to syllable-based lexical access, but this lexical-activation process is part of their repertoire. Finally, some evidence also suggests that long-term phonological representations of lexical items (also known as *phonolexical* forms or underlying representations) include information about their syllable structure. The nature of this knowledge has yet to be determined.

Importantly, it appears that not all languages exploit syllabification as a segmentation or word-activation strategy, and it is not clear that syllabic configuration is part of the long-term representation of words in all languages. A case in point is that of English, for which experimental evidence has failed to find any performance-based evidence of syllabic segmentation and syllable-based lexical access. This is not to say that syllables are not part of the phonology of English, but it appears at least that the complexity of English syllabic patterns encourage English listeners to ignore syllabification during the online segmentation of the speech signal, perhaps because it might not be as efficient a strategy as it is in other languages. This is reminiscent of the facts regarding lexical stress. While lexical stress is contrastive in both Spanish and English (that is, it is used to distinguish words, as in English *trusty* and *trustee*, and in Spanish *bebe* 's/he drinks' and *bebé* 'baby'), only Spanish listeners exploit lexical stress during spoken word recognition (Soto-Faraco et al. 2001). This might be so because English lexical stress is mostly word-initial (and therefore mostly predictable) or because English lexical stress tends to be cued by vowel timbre and only sporadically is not (Cutler 2005; van Donselaar et al. 2005).

The most important contribution of this chapter is that it illustrates that behavioral evidence extracted from speech comprehension tasks, such as segmentation- and activation-based paradigms, may provide important information to phonologists. In addition to examining the phonetics of speech production, laboratory phonologists must investigate the speech comprehension process. During speech comprehension, listeners engage in a process known as phonological encoding, which consists of processes such as detecting word onsets (segmentation), assigning acoustic information to phonemic categories (categorization), and searching for words in the lexicon (lexical access). Evidence gathered from tasks that tap into phonological encoding may prove to be relevant for our understanding of speakers' mental representations, which is the object of phonology.

In writing this chapter, I decided to illustrate the importance of comprehension-based phonological evidence by focusing on a single issue, the role of the syllable. The chapter has argued that the evidence to date suggests that Spanish speakers engage in syllable-based segmentation strategies. This demonstrates that they possess some type of mental representation of what is a possible Spanish syllable. This knowledge is deployed when segmenting the speech signal (including words and nonwords) into parsable chunks. Spanish speakers also engage in syllabification-based word activation—that is, syllabic knowledge is part of the mechanism that helps them to find words in the mental lexicon. The present review concludes by posing the following question: are there other structures of the phonology of Spanish that may receive support (or, on the contrary, may be falsified) by the phonological-encoding evidence?

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13
Allomorphic variation

María Ohannesian

1. Introduction

There is allomorphic variation or allomorphy when a morphological unit has more than one phonological representation in the lexicon. At first glance, this definition suggests that allomorphy is a noncomplex phenomenon. However, as we will see in this chapter, this concept has been applied in the linguistics literature to quite a diverse set of situations, ranging from cases that can be reduced to one single lexical representation and are resolved by the application of general phonological rules (the assimilation of nasals in coda position) to other, more complex cases where the formal relation between possible allomorphs is not so obvious. This can be seen, for example, in what is known as suppletive allomorphy, or suppletion, which encompasses not only forms that can be more or less easily related, like *leche* 'milk'/*lechero* 'milkman'/*lácteo* 'dairy', but also forms where the relationship is by no means self-evident like *cola* 'tail'/*caudal* 'caudal' (as in *aleta caudal* 'caudal fin').

Morphological units, or morphemes, are defined as "the smallest individually meaningful elements in the utterances of a language" (Hockett 1958: 123). However, Pena (1999) prefers to define morphemes as the minimal grammatical unit, without allusion to meaning, a point of view perhaps close to Bloomfield (1933) or Aronoff (1976). Bloomfield regards a morpheme as "a linguistic form which bears no partial phonetic-semantic resemblances to any other form" and adds that the meaning of a morpheme "cannot be analyzed within the scope of our science" (1933: 161). Pena (1999) avoids the reference to meaning in order to include morphological units such as interfixes (e.g. -*ar*- in *polvareda* 'dust cloud' or *humareda* 'abundant smoke'), which are "carentes de significado" (devoid of meaning) (Pena 1999: 4318), within the category of morphemes. Similarly, Haspelmath and Sims (2010: 139) also call them "semantically empty morphemes."

A morpheme manifests itself—or takes phonological form—as a morph or exponent (Bonet 2016). These morphs or exponents can be related in different ways. Pena (1999) lists a set of such relationships, adapted as follows: (1) a recurrent morph associated with a recurrent meaning, such as the prefix *re*- (expressing repetition) in *re-leer* 'to reread' or *re-escribir* 'to rewrite'; (2) a recurrent morph with a distinctive function without recurrent meaning, such as *re*- in *re-ferir* 'to refer' or *re-ducir* 'to reduce' (cf. *in-ferir* 'to infer' or *in-ducir* 'to induce'); (3) partially or totally different morphs associated with a recurrent meaning, such as *jueg*- and *jug*- in *juego* 'I play' and *jug-amos* 'we play' in the former case, or *er*- and *so*- in *ér-amos* 'we were' and *so-mos* 'we are' in the latter; and, finally,

(4) recurrent morphs without meaning, such as *-ar-* in *hum-ar-eda* and *polv-ar-eda*. In light of the preceding classification, there are different kinds of morphemes (roots like *jug-* or *so-*, affixes like the prefix *re-* and interfixes like *-ar-*), which also bear different kinds of information.

A word about interfixes is in order here because, exceptionally among the morphemes, they occasionally do not provide any special information and their recurrent condition is not always fulfilled. Nonetheless, in many instances they act as intensifiers in some way, as in *polv-ar-eda* or *hum-ar-eda*, where the interfix *-ar-* appears between the root of an uncountable noun and the suffix *-eda*, used to forms collective nouns, as in *arbol-eda* 'grove of trees' or *ros-al-eda* 'rose garden'. As is true of other affixes, the occurrence of interfixes is subject to specific conditions. For example, the occurrence of the interfix *-t-* depends on morphological conditions: it must appear between a verbal root and the suffix *-ear*, as in *corr-e-t-e-ar/*corr-e-ar* < *corr-er* 'to run' vs. *blan*[k]*-e-ar* 'to whiten' < *blan*[k]*-o* 'white'.

As we can see, one of the ways in which morphs may be related—and one of the more complex—is allomorphic variation, that is, when phonetically different morphs are associated with the same meaning, exhibiting "different phonological shapes under different circumstances" (Haspelmath and Sims 2010: 22). Examples of some of the Spanish morphophonological alternations are supplied in this section. However, due to space limitations, this chapter is centered in the analysis of two case studies, diphthongization and diminutivization. Allomorphic variation can affect all types of morphemes (with the possible exception of interfixes, at least in Spanish):

a) Roots or stems, such as the aforementioned *jug-* ~ *jueg-* in *jug-ar* 'to play' ~ *jueg-o* 'I play', or roots that can display velar lenition: /k/ ~ /θ/ (or /s/), (*médi*[k]*-o* 'doctor' ~ *medi*[θ]*-ina* 'medicine', *sue*[k]*o* 'Swede' ~ *Sue*[θ/s]*ia* 'Sweden', *análo*[g]*o* 'analogous' ~ *analo*[x]*ía* 'analogy', *bel*[g]*a* 'Belgian' ~ *Bél*[x]*ica* 'Belgium'). Deverbal athematic nouns constitute another example of root allomorphy. They usually exhibit dental assibilation: /t, d/ ~ /s/, (*inver*[t]*-ir* 'to invest' ~ *inver*[s]*-ión* 'investment', *divi*[d]*-ir* 'to divide' ~ *divi*[s]*-ión* 'division').
b) Prefixes, such as *des-* ~ *de-* ~ *dis-* ~ *di-* (*des-aprobar* 'disapprove', *de-formar* 'to deform', *dis-continuo* 'discontinuous', *di-fundir* 'to spread'), *tras-* ~ *trans-* (*tras-pasar* 'to run through', *trans-formar* 'to transform'; or doublets such as *entre-* ~ *inter-* (*entre-acto* 'intermission' ~ *inter-nacional* 'international'), *sobre-* ~ *super-* (*sobre-volar* 'to fly over' ~ *super-poner* 'to superimpose') or *so-* ~ *sub-* (*so-cavar* 'to undermine', *sub-rayar* 'to underline'), etc.
c) Suffixes, such as the deverbal derivational suffix *-ble* ~ *-bil-*, the former in word-final position, the latter before another derivational suffix, as in *ama-ble* 'kind'/*ama-bil-idad* 'kindness' vs.**ama-bil*/**ama-ble-idad*; the denominal adjective suffixes *-ar* ~ *-al* (*sol-ar* 'solar' ~ *flor-al* 'floral'); deadjectival nominalizers such as *-edad* ~ *-idad* (*brev-edad* 'brevity' ~ *atroc-idad* 'atrocity') or the allomorphs *-eza* ~ *-ez* (*bell-eza* 'beauty' ~ *estupid-ez* 'silliness', *delicad-eza* 'delicateness' ~ *delgad-ez* 'slimness', and the colloquial *mem-ez* **mem-eza* 'silliness'. See, for detailed analysis, Trommer (2015); Bonet 2016).
d) Inflectional suffixes, as in *-ra*/*-se* in *ama-ra*/*ama-se* 'loved 3rd sg imperf. subj.', or theme vowel alternation in verbal conjugation (see Roca 2010 for detailed analysis; for gender and number allomorphy in nominal inflection, see Bonet 2006; Wiltshire, this volume).
e) Words, especially pronominal forms and conjunctions, such as *y*/*e* 'and' (*e* before *i-*, as in *par e*/**y impar* 'even and odd') and *o*/*u* 'or' (*u* before *o-*, as in *sujetos u*/**o objetos* 'subjects or objects'). In Catalan, even the adjectives *dolent* 'bad' and *mal* 'bad' alternate depending on their position: *solució dolenta*/**dolenta solució* vs. **solució mala*/*mala solució* 'bad solution' (Bonet et al. 2015b).

Several issues related to the phenomenon of allomorphy require clarification. As Nevins (2011: 2357) reminds us, "since Jakobson's (1948) analysis of Russian verbs as having one stem rather than two, it has been an attempt of generative phonology to minimize distinctly listed allomorphs in favor of phonological rules." For example, the negative prefix /in/ surfaces as [in],

[im], [iŋ], depending on the following phone ([in]*útil* 'useless', [im]*posible* 'impossible', [iŋ]*curable* 'incurable'), among other realizations. Nasal assimilation in coda position is a general rule, so this is not a condition limited to the prefix *in-*. It is applied always, without exception, even between words, as in *u*[n] *árbol* 'one tree', *u*[n] *día* 'one day', *u*[m] *burro* 'a donkey' or *u*[ŋ] *gato* 'a cat'. Nonetheless, in *i-legal* 'illegal' or *i-rreal* 'unreal', *i-* does constitute a true allomorph, because the language has words like ***en-l****azar* 'link' or ***en-r****edar* 'tangle'. Thus, the morpheme IN- has two lexical exponents, /in/ and /i/, /i/ being the more specific because it may only precede liquids [l] or [r], while /in/ is the variant that occurs in all other contexts, that is, the elsewhere variant (Fábregas and Scalise 2012; Mascaró 2016).

Therefore, one allomorph cannot be derived from another allomorph (Nevins 2011), and allomorphs are phonological or lexical variants of the same morpheme that are not subject to regularities, such as general phonological processes, as illustrated by the example of nasal assimilation in coda position (Mascaró 2016). If we discard, then, the so-called phonological or superficial allomorphy as true allomorphy, there are, however, a great number of cases where the choice of a particular allomorph is phonologically conditioned, as we have seen with the aforementioned example of the negative morpheme /in/, realized as [in] or [i]. Allomorph selection also depends on morphological or grammatical factors (e.g. the alternation between roots *and-* and *anduv-* depends on the verbal tense: *and-o* 'I go/walk' vs. *anduv-e* 'I went/walked'), lexical factors (*lech-* or *lact-* 'milk' are selected by *-ero* and *-e-* respectively to form *lech-ero/*léch-eo* and *láct-eo/*lact-ero*) and syntactic factors: for instance, the Russian 3rd person plural pronominal form *ix* is realized as *nix* after prepositions and as a nucleus, and as *ix* after prepositions in nonnuclear position: *bez nix* 'without them'/*bez ix brata* 'without their brother' (example from Nevins 2011: 2374). To take another example of the role of syntax in allomorph selection, the Spanish definite feminine article displays two allomorphs, *la* and *el*, the latter before nouns beginning with tonic *a*, but not before adjectives with an initial tonic *a*: *el ama de llaves alta/*la ama de llaves alta/la alta ama de llaves/*el alta ama de llaves* 'the tall housekeeper'.

Usually allomorphs show a complementary distribution, since each allomorph occurs in a specific context in which the others cannot occur, as we have seen with the preceding examples. However, allomorphy can also display free variation; that is, two or more different forms with the same meaning can occur in the same environments, such as the freely alternating imperfective subjunctive forms *-ra/-se*.

Spanish speakers nowadays tend to prefer the *-ra* form, unlike in the 19th century, when the *-se* form was favored (Bello [1847] 1984). In their analysis of this example of free alternation from Spanish and the similar Catalan *res/re* 'nothing' (as in *No vol re/res més* '(S)he doesn't want anything else'), Bonet and Harbour (2012: 210) observe that "there does not seem to be any contextual information, so either can be used (subject, doubtless, to extragrammatical, sociolinguistic factors)," adding that, in comparison with contextual allomorphy, truly free alternation is a rare phenomenon. By the same token, with regard to the *-ra/-se* alternation, Lloret (2011) and Lloret and Clua (2011) note that pragmatic reasons play a role in the choice of the allomorph in some varieties of Spanish, as Asratián (2007) shows in his analysis of Caracas Spanish, where, among other factors, upper-class speakers regard the *-se* variant as more prestigious. (For a full description and exhaustive analysis of Spanish allomorphs, see Saporta 1959.)

Thus far I have focused on what constitutes a proper definition of allomorphy and the factors determining the choice of an allomorph. Let us now address some terminological issues revolving around the terms 'suppletion' or 'suppletive allomorphy', which are used by many authors (among others, Carstairs 1987, 1988, or Paster 2006, 2009, 2015) as a synonym for 'allomorphy'. These authors are not always in full agreement. For example, Paster (2014) argues that suppletive allomorphs must be in complementary distribution. For his part, Carstairs (1987, 1988) distinguishes the phonologically conditioned surface allomorphy from phonologically conditioned lexical allomorphy (or suppletive allomorphy).

A few more words about labeling are in order here. Haspelmath and Sims (2010: 25) reserve the term 'suppletion' for exponents whose (dis)similarity cannot be described by phonological rules and classify this type of allomorphic relation according to the degree of formal distance between allomorphs. They distinguish 'weak suppletive allomorphy', where alternating forms exhibit some similarity that cannot be accounted for by phonological rules, like English *buy/bough-*, *catch/caugh-* or Spanish *dec-ir* 'to say' /*dich-o* 'said (participle), *hac-er* 'to do' /*hech-o* 'done (participle)', from 'strong suppletive allomorphy', where allomorphs do not exhibit similarity at all, as in English *good/bett-* or Spanish *bueno/mejor*. In relatively similar fashion, Embick (2010) reserves the term 'suppletion' for nonaffixal allomorphy. In relation to 'strong suppletive allomorphy', when forms are completely different, with "wholly unpredictable alternations" (Bobaljik 2015: 1), it is important to distinguish between allomorphic variation and a merely semantic relationship. To be considered allomorphic variation, completely different forms must have a paradigmatic or morphological relation, as is the case with the roots of the verb *ser* 'to be' or comparative forms. By contrast, independent words like *toro* 'bull' /*vaca* 'cow', despite their obvious semantic relationship, which is analogous to *gato/gata* 'cat (fem.)' (Pensado 1999), do not constitute an allomorphic relation, because they do not belong to the same morphological paradigm. For a detailed analysis across different languages, see Bonet and Harbour (2012), and for an analysis within nanosyntax, see Starke (2009) and Caha (2009: 58–60).

As Inkelas (2014: 282) notes, "suppletive allomorphy enters the realm of the morphology-phonology interface when the choice between or among suppletive allomorphs is phonologically determined."

In this chapter, my discussion will basically be centered around such cases, focusing in particular on two cases of allomorphic variation in Spanish: (1) the diphthongization of mid vowels when they are stressed, as in *nov-edad* 'novelty'/*nuev-o* 'new' or *vej-ez* 'old age'/*viej-o* 'old', but *com-o* **cuem-o* 'I eat' or *vel-o* **viel-o* 'I keep vigil'; and (2) the formation of the diminutive with *-ito*: *cas-a* 'house' ⇒ *cas-ita*/**cas-ecita* 'small house' vs. *cajón* ⇒ *cajon-cito* **cajon-ito* 'small box'. Of particular interest will be the interaction between the two phenomena, as seen in, for example, *nuev-o* ⇒ *nuev-e-cito/nuev-ito* **nov-ito* 'new-dim.' or *viej-o* ⇒ *viej-e-cito/viej-ito* **vej-ito* 'old-dim.'

The next section presents different types of phonological conditioning and discusses them from different perspectives based on recent research within Optimality Theory (OT), such as the concepts of external allomorphy and stratal phonology. In section 3, I propose an analysis of the diminutivization process in Spanish. Finally, the conclusions are presented in section 4.

2. Phonologically conditioned allomorphy and OT

2.1. Internal and external allomorphy

Allomorphs that cannot be reduced to a single underlying form and the cases where the choice of one of them rather than other is controlled by the phonological context ("controlled or contextual allomorphy" in Bonet et al. 2007; Bonet and Lloret 2016) constitute what is known as *phonologically conditioned allomorphy* (henceforth PCA). PCA can occur in either inflectional or derivational processes (Carstairs 1988).

PCA appears in two ways, depending on how the selection is made: (a) it can be carried out according to markedness criteria; in other words, it is phonologically optimizing allomorphy because the selection leads to unmarked structures; or (b) if the phonological conditions that regulate the choice do not lead to unmarked forms, it is phonologically nonoptimizing. As Bonet and Lloret (2016), Lloret (2011), Mascaró (2007) and others point out, unlike rule-based derivational theories, which fail to capture phonology-morphology interactions, OT provides an appropriate machinery to deal with them, especially in optimizing PCA, where allomorph selection results as an effect of the action of *The Emergence of the Unmarked*, henceforth TETU (McCarthy and Prince 1994).

There have been earlier proposals in this direction. Mester (1994) analyzes the distribution of *-io* Latin verbs in the third and fourth conjugations depending on prosodic settings. Kager (1996) discusses syllable-counting allomorphy, one of the manifestations of PCA, in Estonian by way of phonological constraints, as do Tranel (1996) and Perlmutter (1998) for French. Along the same lines, Mascaró (1996a, 1996b) proposes allomorphic selection led by TETU in the Romance languages.

More recently, Mascaró (2007) refers to nonoptimizing PCA as 'internal allomorphy', because it "is irregular and *internally* conditioned in the lexicon." Instead, the optimizing PCA, 'external allomorphy' in Mascaró's (2007) terms, "is regular and *externally* conditioned by phonology." The Tzeltal perfective suffixes -*oh* and -*ɛh* exemplify a case of internal allomorphy. Their distribution depends on phonology, since -*oh* appears after monosyllabic stems and -*ɛh* after polysyllabic stems, as in *j-il-oh* 'he has seen something' vs. *smak'lij-ɛh* 'he has listened to something' (Dickey 1999, cited in Mascaró 2007: 715). However, this selection is lexical; i.e. it must be specified in the lexical entry of each allomorph, because the choice is arbitrary and idiosyncratic; even though it is phonologically conditioned (PCA), it does not represent an improvement in terms of markedness (see Trommer 2015 for a detailed analysis). As an example of external allomorphy, Mascaró (2007) provides a case from Northwestern Catalan, where the definite article displays two shapes, *l* before vowels and *lo* before consonants, as in *l'ámo* 'the owner' vs. *lo pà* 'the bread'. In this case, allomorphic choice "is phonologically natural since it determines a less-marked CV syllable structure" (Mascaró 2007: 715). TETU effects are not limited to syllabic well-formedness but have "an extensive empirical basis, since [they affect] cliticization, derivation and inflection" (Mascaró 2007: 718). The examples in (1) illustrate internal and external allomorphy in Spanish.

(1)	a.	**Internal allomorphy**		*Imperfective past tense*	
			-ba/a	am-a-ba (1st conjugation)	'I loved'
				tem-í-a (2nd conjugation)	'I was afraid'
				part-í-a (3rd conjugation)	'I left'
	b.	**External allomorphy**		*Definite article (feminine)*	
			la/el	la casa	'the (fem.) house'
				el alma (fem.)/las (fem.) almas	'the soul/souls'

Although the distribution of the alternating suffixes of the imperfective tense -*ba* and -*a* is usually considered an example of grammatical conditioning (the former for the first conjugation and the latter for the others), Harris (1979: 289) proposes a rule that deletes /b/ when located between /i/ and a morpheme boundary. Paster (2006: 89) proposes two allomorphs, /-a/ and /-ba/, considering the arbitrariness of the deletion rule. The selection of the allomorph does not lie in phonological naturalness nor improve on markedness. Moreover, the selected suffix -*a* creates syllables without onset in (1a), whereas in (1b) the distribution of feminine definite article allomorphs /la/ and /el/ before nouns beginning with stressed /a/ avoids an undesirable and marked sequence of two identical vowels (for further details, see Kikuchi 2001; Cutillas 2003; Bonet et al. 2015b).

There are two basic ways to account for allomorphy. On the one hand, it can be explained in terms of subcategorization frames, to handle either nonoptimizing or optimizing allomorphy, as Paster (2015) and others propose. Under this assumption, external allomorphy becomes as idiosyncratic and accidental as internal allomorphy, lacking the generalizations that regulate allomorphic choice. On the other hand, in order to avoid such undesirable outcomes, "allomorphic choice, in regular cases, can be determined by Eval (OT's general constraint evaluation procedure) through TETU" (Bonet et al. 2015a: 2), selecting the most harmonic candidate. Moreover, Mascaró (2007: 716) proposes that "the linguistic generalization that the allomorph is chosen because it yields an unmarked structure should be incorporated into grammatical theory." Nevertheless, there are situations where TETU effects are insufficient. For such cases, Mascaró (2007) and Bonet et al. (2007) propose a partial ordering of allomorphs according to their relative markedness, instead of a bare lexical listing. Even so, lexical specifications must be limited to arbitrary, idiosyncratic instances.

RESPECT, a faithfulness constraint, will force these specifications to be fulfilled (Bonet 2006). We will return to this constraint in the following section.

A faithfulness constraint, PRIORITY, defined in (2), requires that the partial ordering must be respected (Mascaró 2007: 726; Bonet et al. 2007: 906):

(2) PRIORITY: Respect lexical priority (ordering) of allomorphs.

Given an input containing allomorphs $m_1, m_2, \ldots, m_n$, and a candidate m_i', where m_i' is in correspondence with m_i, PRIORITY assigns as many violation marks as the depth of ordering between m_i and the highest dominating morph(s).

An example of lexical ordering in Spanish is supplied by the conjunctions *y* 'and' and *o* 'or', and their allomorphs, *e* and *u* respectively, as seen in (3).

(3)	a.	par e impar	'even and odd'	*par y impar
		impar y par		*impar e par
		sujetos u objetos	'subjects and objects'	*sujetos o objetos
		objetos o sujetos		*objetos u sujetos
	b.	mi interés	'my interest'	*me interés
		lo obvio	'the obvious'	*lu obvio

In (4) I present the lexically ordered set of the allomorph of the conjunctions under study, following Bonet and Mascaró (2006: 5):

(4) a. Y ↔ {i > e}
b. O ↔ {o > u}
(where '>' indicates 'is preferred over')

PRIORITY will penalize candidates with the dispreferred allomorph, such as **libros e flores* (*libros y flores* 'books and flowers'), or **collares u anillos* (*collares o anillos* 'necklaces and rings'). But dissimilation in the examples in (3a) avoids a violation of the Obligatory Contour Principle (OCP), a markedness constraint that disfavors two adjacent segments that are either very similar or identical. Then, OCP dominates PRIORITY in order to obtain the correct output. When there is no possibility of incurring an OCP violation, as in the sequence *y adornos* 'and ornaments', the choice of the correct allomorph depends on PRIORITY. For a complete analysis, see Bonet and Mascaró (2006).

Finally, it is worth noting that external allomorphy, besides being phonologically natural, must be lexically restricted (Mascaró 2007), as shown by the examples in (3b), which do not display dissimilation. Otherwise, if it were general, it would be indistinguishable from surface or pseudo-allomorphy.

2.2. Stratal approaches

As described in the following, stratal approaches defend the view that evaluation takes place at different successive levels.

It is well known that OT is based on the parallel evaluation of candidates through a particular language hierarchy of universal constraints. This framework also permits putting phonological and morphological categories in relation. Nevertheless, one of the most hotly debated issues is whether phenomena related to what is known as phonological opacity (for details on opacity see, among others, Kiparsky 1973, 2000; McCarthy 2007b; Bakovic 2011) can be dealt with within a monostratal and parallel version of OT, or instead require a model that includes intermediate levels.

There have been various attempts to solve this problem either through the monostratal or parallel model or by means of intermediate levels. I present briefly the most important proposals and then focus my discussion on Stratal OT (SOT).

Among the monostratal proposals put forth, the one that has attracted most support so far is Correspondence Theory (Benua [1997] 2000), where in addition to input-output faithfulness constraints there are output-output faithfulness constraints. Another proposal that sheds light on opacity phenomena is what McCarthy (1999) calls 'sympathy constraints' ('sympathy' in the sense seen in 'sympathetic ophthalmia', where inflammation in one eye is due to a problem with the other eye), which interact in parallel with the other constraints to influence the output through a 'sympathy' relation and select a failed candidate, the 'sympathetic' candidate.

Among non-monostratal versions of OT, McCarthy (2007a) proposes a serial model consisting of Candidate Chains (OT-CC), based on Harmonic Serialism (HS), a derivational version of OT (McCarthy 2010). In OT-CC each candidate constitutes a link in a sequence, or chain, each link presenting a minimal change with respect to the preceding one. Every change, and every link, step by step, must represent a harmonic improvement in accordance with the constraint ranking of a given language. For his part, Wolf (2008) proposes a serial constraint-based version of OT, Optimal Interleaving, which uses the notion of 'interleaving' phonological operations to get around the difficulties that standard OT otherwise faces when it comes to accounting for opacity.

SOT (Bermúdez-Otero 2006, 2013; Kiparsky 2015) combines the phonological cycle and lexical stratification with OT constraints, which replace the ordered rules of Lexical Phonology (Kiparsky 1982). In addition, a stratal-cyclic architecture obviates the need to resort to correspondence relations.

In his discussion of the diphthongization of Spanish mid vowels, in particular in the cases of overapplication (illustrated in (5a2)), which exemplifies the well-known paradox of cyclicity, Bermúdez-Otero (2013) argues that, in order to resolve it, a stem driven approach—that is, one that assumes that the lexicon stores stems with their theme vowels, including allomorphs in the lexical entries of stems—is better than a root-driven approach, as is usually proposed in Distributed Morphology (Halle and Marantz 1993; Embick 2010; and others; for arguments against stem storage, see Myler 2015). Another important tenet of SOT is that the grammar is set up in such a way that it enforces correspondences between grammatical constructions and phonological domains, which must be either stem level or word level, since "roots do not define phonological domains" (Bermúdez-Otero 2006: 281). For example, *-dor*, in *conta-dor* 'accountant', is a stem-level suffix, because it is derived at that level, by adding the suffix to the stem *conta-*, while *-(e-c)it-*, the diminutive suffix, in *cuent-(e-c)ito* 'tale-dim.' is a word-level suffix, because its base is the word *cuent-o*.

As already noted, in Bermúdez-Otero's model, the Spanish lexicon stores stems, whether nominal or verbal, together with their theme vowels (which undergo a phonological process of deletion before vowel-initial suffixes). Bermúdez-Otero's (2006, 2013) inventory of nominal theme vowels (what he calls 'stem formatives') differs from the classic 'word markers' or 'terminal elements' presented in Harris (1991a, 1991b). Bermúdez-Otero (2006, 2013) proposes three core classes according to their theme vowels, namely *o*-stems (*libr-o* 'book', *man-o* 'hand'), *a*-stems (*cas-a* 'house', *map-a* 'map') and *e*-stems, which are in turn divided into two subclasses, ordinary *e*-stems (/-{e, ∅}-/, e.g. *luz* 'light' but plural *luces*, *padr-e* 'father') and *e*- only stems (/-e/ *cruce* 'crossing'). The distribution of ordinary *e*-stem allomorphs depends on Spanish phonotactics, such that the vowel *-e* appears after a prohibited word-final segment (e.g. *-dr-* in *padre*), while the *e*-only stem subclass exhibits *e* after a permitted final segment (e.g. [θ] in *cru*[θ]*e*). Finally, he adds a fourth class, the athematic stems (*fan* 'fan', *clip* 'clip'), whose plurals do not have *e* (*fan-s*, *clip-s*). In these cases, some words, such as *club* 'club', present variation depending on the speaker in the plural: *club-s*, like the athematic stems, or *club-es*, like the plural of the *e*-stem class, e.g. *luc-es*, *padr-es* and *cruc-es* (even the same speaker may be inconsistent about such plural forms).

As already noted, the contemporary Spanish mid vowels that derive from the Vulgar Latin open mid vowels /ɛ, ɔ/ undergo diphthongization when stressed. By contrast, mid vowels that do not derive from these two open vowels do not display diphthongization under stress. In addition, there are instances in which diphthongs occur in nontonic position. The alternating and nonalternating mid vowels are shown in (5). (5a) illustrates the alternating mid vowels, divided into those that display normal application of diphthongization (5a1) and those that present overapplication (5a2). (5b) shows nonalternating theme vowels, and (5c) nonalternating diphthongs. Although this is not reflected in (5), stem high vowels in some instances can also diphthongize, as seen in *adquir-ir/adquier-o* 'to acquire/I acquire', *jug-ar/jueg-o* 'to play/I play', but here diphthongization is clearly exceptional, since the vast majority of high-vowel stems do not diphthongize, as seen in *viv-ir/viv-o* 'to live/I live', *jur-ar/jur-o* 'to swear/I swear' (see also Harris 1985 for an analysis of Spanish diphthongization; for clarity, and when it is pertinent, I mark the tonic vowel without regard for the orthographic norm).

(5)	***a. Alternating mid vowels***			
	1. Normal application			
	p[ˈje]nso	'I think'	p[e]nsár	'to think'
			p[e]nsámos	'we think'
			p[e]nsadór	'thinker'
	c[ˈwe]nto	'I tell'	c[o]ntár	'to tell'
	c[ˈwe]nto	'tale'	c[o]ntámos	'we tell'
			c[o]ntadór	'accountant'
	vejéz	'old age'	v[ˈje]jo	'old'
	c[o]rporál	adj. 'corporal'	c[ˈwe]rpo	'body'
	2. Overapplication			
	v[ˈje]jo		v[je]jíto	'old-dim.'
			v[je]jón	'old + augmentative'
			v[je]jísimo	'old + superlative'
			av[je]jár	'to make old'
	c[ˈwe]nto		c[we]ntecíto	'tale-dim.'
			c[we]ntísta	'storyteller'
			c[we]ntéro	'liar'
	b. Nonalternating mid vowels			
	c[ˈe]do	'I give way'	c[e]dér	'to give way'
	c[ˈo]mo	'to eat'	c[o]mér	'I eat'
	par[ˈe]d	'wall'	par[e]dón	'thick wall'
	r[ˈo]sa	'rose'	r[o]sál	'rosebush'
	c. Nonalternating diphthongs			
	V[ˈje]na	'Vienna'	v[je]nés	'Viennese'
	enc[ˈwe]sta	'to survey'	enc[we]stár	'survey'

Let us illustrate this with *c*[o]*ntár/c*[ˈwe]*nto*. As we saw previously, in Bermúdez-Otero's model, the lexicon in Spanish stores stems with their theme vowels. In the case of *c*[o]*ntár/ c*[ˈwe]*nto*, both alternant forms are present in the underlying representation, as is illustrated in (6).

(6) UR: $\left(\begin{Bmatrix} \text{koNt - o} \\ \text{kweNt - o} \end{Bmatrix}\right)$

In (7), adapted from Bermúdez-Otero (2013: 42), we see the stem-level and word-level derivations.

(7) ***a. Stem-level:*** *normal (non)application*

Normal application	underived noun	[ˈkwento]	'tale'
	verb inflection	[ˈkwentas]	'you tell'
Normal nonapplication	verb inflection	[konˈtamos]	'we tell'
	derived noun	[konˈtaßle]	'accountant'

b. Word-level: *overapplication*

	evaluative noun	[kwenteˈθito]	'little tale'
	other word-level derivations	[kwenˈtista]	'storyteller'

Like the examples in (5a2), which all exhibit overapplication, the derivations in (7b) confirm that evaluative and other suffixes do not fall within the domain of diphthongization, and diphthongization is therefore a stem-level process (Bermúdez-Otero 2006) and the base for the word-level processes. If diphthongization were a word-level process, it should not misapply in those cases.

C[we]*nt-ísta*, *c*[we]*nt-éro* and *a-v*[je]*j-ár* coexist with forms such as *conc*[e]*rt-ísta* 'concert soloist' (*conc*[ˈje]*rt-o/conc*[je]*rt-ít-o* 'concert/concert-dim.'), *p*[o]*rt-éro* 'doorman' (*p*[ˈwe]*rt-a/p*[we]*rt-(e-c) íta* 'door/door-dim.) and *a-t*[e]*rr-ár* 'reach land' (*t*[ˈje]*rr-a/t*[je]*rr-(e-c)íta* 'land/land-dim.'). This is due to the fact that these affixes are less productive than evaluative and superlative ones, and examples with diphthongs are chronologically more recent than examples without diphthongs, although some variation is possible, such as the more generally used *am*[we]*blár* 'to furnish' as opposed to the less common *am*[o]*blár* (Carreira 1991).

It is important to bear in mind that superlative forms like *f*[o]*rt-ísimo* 'very strong' are still used, albeit marginally, and Bello ([1847] 1984) gives examples with diphthong/pure vowel alternation such as *v*[je]*j-(e-c)-íto*, *v*[je]*j-e-cíllo*, *v*[je]*j-e-zuélo* but *v*[e]*j-e-zuelo* or *v*[e]*j-ete,* and *c*[je]*gu-(e-c)-íto* 'blind-dim.' but *c*[e]*gu-e-zuelo*. As we see, the more productive an affix, the more prone it is to misapplication (Ohannesian and Pons 2009).

Bermúdez-Otero (2013) provides the interesting doublet *enc*[o]*ntr-ón* ('abrupt meeting') and *enc*[we]*ntr-ón* 'sports gathering + augmentative', analyzed under the SOT model. He confers two different underlying representations, one for the verbal stem 'enc[ˈwe]ntr-a', another for the nominal stem, 'enc[ˈwe]ntr-o', both with monophthongal and diphthongal allomorphs. (8) represents the phonological derivation (SL = stem level; WL = word level):

		Input	output
(8) a.			
	First cycle (SL)	/eNkoNtɾ-a/ →	[eŋ.ˈkon.tɾa]
		/eNkweNtɾ-a/ →	[eŋ.ˈkwen.tɾa]
	Second cycle (SL)	[eŋ.ˈkon.tɾa]-on	[eŋ.kon.ˈtɾon]
		[eŋ.ˈkwen.tɾa]-on	

		Input	output
(8) b.			
	First cycle (SL)	/eNkoNtɾ-o/ →	[eŋ.ˈkon.tɾo]
		/eNkwentɾ-o/ →	[eŋ.ˈkwen.tɾo]
	Second cycle (SL)	[eŋ.ˈkon.tɾo]	[eŋ.ˈkwen.tɾo]
		[eŋ.ˈkwen.tɾo]	
	Third cycle (WL)	[eŋ.ˈkwen.tɾo]-on	[eŋ.kwen.ˈtɾon]

The fact that these words are not in common use among Spanish speakers, who prefer *encontr-on-ázo* and *encuentr-ázo* instead of *encontr-ón* and *encuentr-ón*, respectively, does not invalidate Bermúdez-Otero's analysis, which predicts correctly that the *-ón* suffix is stem level when it is attached to verbs, as we see in *trop*[e]*z-ár/trop*[e]*z-ón* 'to stumble/a stumble', *apr*[e]*t-ár/apr*[e]*t-ón* 'to squeeze/a squeeze', *rev*[o]*lc-ár/rev*[o]*lc-ón* 'to tumble/a tumble', but word level with nouns, as in *enc*[ˈwe]*ntr-o/enc*[we]*ntr-ón*, *v*[ˈje]*j-o/v*[je]*j-ón*.

Three constraints are enough to account for the correct output: a faithfulness constraint, Identity (Ident) between input and output, and *Complex Nucleus (*ComplexNuc), which militates against diphthongal nuclei. *Peak$_{\text{FOOT}}$/e,o, which avoids stressed pure vowels, is responsible for the output [eŋˈkwentɾo] in (9), which, in turn, will be the input in (11). (10) illustrates the evaluation in the second cycle of derivation. Its input is the stem with two allomorphs, and the constraint hierarchy selects the most harmonic in relation to it, while (11) shows the third cycle at word level. As we see, in (11) there is no competition, since at word level the input is [eŋˈkwentɾo].

(9) eŋˈkwentɾo: noun 'normal application'

input: eNk{we/o}Ntɾ-o	Ident	*Peak$_{\text{FOOT}}$/e,o	*ComplexNuc
a. eŋˈkontɾ-o		*!	
☞ b. eŋ'kwentɾ-o			*

(10) eŋkonˈtɾon: deverbal noun 'normal application'

input: eŋk{we/o}ntɾa-on	Ident	*Peak$_{\text{FOOT}}$/e,o	*ComplexNuc
a. eŋkwenˈtɾ-on		(*)	*!
☞ b. eŋkonˈtɾ-on		(*)	

(11) eŋkwenˈtɾon: denominal evaluative noun ‘overapplication’

input: eŋˈkwentɾo-on	IDENT	*PEAK$_{\text{FOOT}}$/e,o	*COMPLEXNUC
a. eŋkonˈtɾon	*!	(*)	
☞ b. eŋkwenˈtɾon		(*)	*

3. Diminutivization and diphthongization in parallel OT

The diminutivization process and diphthong formation can also be dealt with in an OT parallel framework, which, without resorting to intermediate levels, allows us to conjugate phonological and morphological requirements by means of alignment constraints. Transderivational Correspondence Theory accounts for output-based processes (Benua [1997] 2000), while optimal paradigmatic constraints (McCarthy 2005) deal with paradigm uniformity.

Since Jaeggli (1980), Spanish diminutives directly or indirectly have been the object of many morphophonological studies (see, among others, Prieto 1992; Crowhurst 1992; Harris 1994; Ohannesian 1996; Ambadiang 1996; Lázaro Mora 1999; Colina 2003). This interest is due to the peculiarities of this process, such as its productivity, as well as its interrelation with other phenomena, such as diphthongization, or those that involve paradigmatic effects (Cabré and Ohannesian 2009; Ohannesian and Pons 2009).

The process of diminutivization in Spanish (henceforth DIM) is closely related with noun classes according to their word markers or terminal elements (henceforth TEs). All unstressed final vowels in Spanish, whether followed by *-s* or not, can be TEs. However, in (12), which is adapted from Harris (1991a, 1991b), I present only classes that are relevant to diminutive formation and leave out marginal TEs that are not usually very prone to diminutivization, like *-i* (*taxi*, ?*taxi-cito*) and *-u* (*espíritu*, ?*espiritu-cito*/?*espirit-ito*).

The assignation of TEs is idiosyncratic, so is controlled by the RESPECT constraint (Bonet et al. 2007).

(12)

<table>
<tr><td colspan="5">CLASS I</td></tr>
<tr><td>subclass</td><td>-a</td><td>-o</td><td>-as</td><td>-os</td></tr>
<tr><td></td><td>casa ‘house’
mapa ‘map’</td><td>libro ‘book’
soprano ‘soprano’</td><td>Lucas (name)</td><td>lejos ‘far’</td></tr>
<tr><td colspan="5">CLASS II</td></tr>
<tr><td>subclass</td><td colspan="2">-e</td><td colspan="2">-∅</td></tr>
<tr><td></td><td colspan="2">madre ‘mother’
pase ‘pass’</td><td colspan="2">árbol ‘tree’
flor ‘flower’
corazón ‘heart’</td></tr>
</table>

I omit from this analysis discussion of the epenthetic condition of the default vowel *-e* after illicit final consonant clusters in Spanish, such as *madr-* or *pobr-* (see Bonet 2006 for details), and I analyze it as a TE, because these words behave the same as *clas-e* or *pas-e* in relation to DIM. Nevertheless, as we can see in the following, if we regard *-e* as an epenthetic vowel, *madr-e* or *pobr-e* might be analyzed as monosyllabic bases along the lines of, for example, *sol*.

The most productive diminutive suffix has two allomorphs, *-it-* and *-cit-*. The latter may be preceded by an epenthetic *e-* to permit syllabification, as can be seen in (13d, e and f). Other suffixes such as *-ill-/-cill-* or *-ic-/-cic-* have the same distribution, while others like *-uelo/-uela* are no longer very productive nowadays in Peninsular Spanish (PS) and some American Spanish (AS) varieties.

Although the examples in (13) correspond to standard PS, the distribution of allomorphs is almost the same in all varieties of Spanish. In fact, only monosyllabic words exhibit consistent differences between PS and AS, as in *flor* ⇒ *florecita* and *florcita* respectively. Indeed, differences between varieties are more quantitative than qualitative, given that in AS almost every class of word can undergo diminutivization.

(13)			*Glosses*	*diminutives*
	a.	cas-a	'house'	cas-ita *cas-e-cita
		libr-o	'book'	libr-ito *libr-e-cito
		map-a	'map'	map-ita *map-ito *map-e-cito
		sopran-o	'soprano'	sopran-ito *sopran-ita *sopran-e-cita
		lejos	'far'	lej-it-os *lej-ito *lej-e-cito(s)
		Lucas	(name)	Luqu-it-as *Luqu-ito*Luqu-e-cito
	b.	corazón	'heart'	corazon-cito *corazon-ito
		calor	'heat'	calor-cito *calor-ito
	c.	pase	'pass'	pas-e-cito *pas-ito
		madre	'mother'	madr-e-cita *madr-ita
	d.	labio	'lip'	labi-e-cito *lab-ito
	e.	nieto	'grandchild'	niet-e-cito/niet-ito
	f.	pan	'bread'	pan-e-cito *pan-cito
		rey	'king'	rey-e-cito *rey-cito
	g.	comadre	'midwife'	comadr-ita *comadr-e-cita
		despacio	'lipstick'	despac-ito *despaci-e-cito
		bisnieto	'great-grandchild'	bisniet-ito *bisniet-e-cito
	h.	virrey	'viceroy'	virrey-cito *virrey-e-cito
	i.	árbol	'tree'	arbol-ito *arbol-cito
		reloj	'clock'	reloj-ito *reloj-cito

The DIM process displays four striking peculiarities, all of which are exemplified in (13) (for the sake of capturing general patterns, I leave out exceptional or isolated cases that are simply the result of the spontaneity and productivity of the process, as well as cases that display vacillation, like *estuch-e* 'case' ⇒ *estuch-ito/estuch-e-cito* 'case-dim.').

a) The DIM allomorph *-it-* can be followed only by *-o*, *-a*, *-os* or *-as* TEs. Words belonging to the *-a(s)* and *-o(s)* subclasses conserve their original TE. In the rest, including *-cit-* allomorph TEs, the diminutive form is followed by the unmarked TE (what Harris 1991a calls the inner core), that is, *-o* for masculine and *-a* for feminine.

This peculiarity led some authors to consider the diminutive as an infix in these cases (among others Jaeggli 1980; Varela 2005). Nevertheless, infixes are inserted into another morpheme, usually the root (Pena 1999; Fábregas 2013), whereas the DIM morpheme is adjacent to the root, as in *lej-*: *lej-os* 'far' ⇒ *lej-ano* 'distant', *a-lej-ar* 'move away', and *lej-it-os* 'far + dim. + TE'. It is worth noting that another derivational process, the superlative formation, *lej-ísim-os* 'far + superlative + TE', exhibits similar proprieties to DIM. For residual and rare cases such as *azuquítar* ⇐ *azúcar*, see Lázaro Mora (1999). Forms such as *man-i-ta* 'hand + dim.' ⇐ *man-o* 'hand', frequent in PS, represent the natural movement to regularize, as we see later on.

b) DIM preserves the base's syllabic characteristics in C-ending nonmonosyllabic words, such as *canción* 'song' ⇒ *cancion-cit-a* **cancion-it-a*, or in disyllabic words with a final high vowel, which becomes a glide before the TE, as in *lab*[j]*-o* ⇒ *lab*[j]*-e-cit-o* **labi-ít-o*/**lab-it-o* vs. *Roc*[ˈi]*-o* (name) ⇒ *Roc*[i]*-ít-o*/**Roc-it-o*, although in this case there are a few very usual words, like *rub*[j]*-o* 'blond' or *limp*[j]*-o* 'clean', which diminutivize with the form *-it-*: *rub-*[i]*to*/*rub*[j]*-e-cito* ⇐ *rub*[j]*-o*, *limp-*[i]*to*/**limp*[j]*-ecito* ⇐ *limp*[j]*-o*.
c) Stems with diphthong/pure vowel alternation not only display overapplication but also, unexpectedly, diphthongize with the form *-(e)cito* rather than with *-it-*, especially in PS.

Diminutives like *corp-e-cic-o* ⇐ *cuerp-o* 'body', *herb-e-cica* ⇐ *hierb-a* 'grass', or superlatives such as *fort-ísimo* ⇐ *fuerte* 'strong', reveal that in its early stages Spanish diphthongization was not misapplied and diminutive forms presented the pure vowel. Probably the *-cit-* allomorph preference was a strategy to distinguish nonalternating mid vowels (which diminutivize with the *-it-* suffix) from alternating mid vowels. In current usage, PS speakers prefer *cuerp-e-cito*, with the inherited suffix *-cit-*. Furthermore, in spite of the fact that Spanish words have only one accent (Navarro Tomás [1948] 1996; Quilis 1993; Roca 1986; Ohannesian 2004), this suffix permits a root to preserve a disyllabic foot with a diphthong in the head position (Crowhurst 1992), as in (*cuerpe*)(*cito*), which is not possible with the form (*cuer*)(*pito*).

d) PS requires a disyllabic base to attach the diminutive. This condition is observed by interspersing an epenthetic vowel, the default vowel *e*, between the root and the suffix (*flor* ⇒ *flor-e-cita*). As already noted, AS does not have this requirement.

Conditions *a*, *b* and *c* show that DIM is a base word process subject to Output-Output (O-O) identity because (1) DIM adopts the TEs of Class I words; (2) the high vowel of the base followed by TE becomes a glide, and it is maintained by DIM (*lab*[j]*o* ⇒ *lab*[j]*ecito*); and (3) the diphthong is present in nontonic position, as in *n*[ˈje]*to* ⇒ *n*[je]*t-ecito*/*ito* (see Section 2.2).

Next, I present briefly the basic constraints to evaluate DIM.

TE must be final. This condition is controlled with an alignment constraint that forces the edge of the TE to align with the right edge of the prosodic word (PrWD) (Colina 2003: 57). I omit this constraint and the candidates that violate it from tableau (19).

Priority (Prior), defined in (2), demands respect for the allomorph ordering {-it- > -cit-}; i.e. *-it-* is preferred over *-cit-*, which is observed by Class I words, as is shown in (19A). Prior expresses the unmarked case, so it is active when the constraints that precede it in the hierarchy are not decisive, as in (19A) and (19G), as we see in the following. (14) and (15) are unordered constraints that require a DIM suffix to be a foot. (14) accounts for the ⊘-subclass words, whose last syllable ends in a coda, and is responsible for ruling out **corazonito* (19B), while (15) accounts for *e*-subclass disyllabic words.

(14) Align dim Foot l PrWd_{C} r (Al dim_{F} l PrWd_{C} r): Align the left edge of the diminutive suffix foot with the right edge of the PrWd ending in a consonant.
(15) Align dim foot l binary PrWd r (Al dim_{F} l bin PrWd r): Align the left edge of the diminutive suffix foot with the right edge of a disyllabic PrWd.

Following McCarthy and Prince (1993), feet must be binary at the moraic or syllabic level. DIM requires a disyllabic foot to suffix it. Monosyllabic words must add an epenthetic vowel to conform to the requirement for a disyllabic foot. (16) refers to PrWDs as bases for DIM derivation and refuses either monosyllabic (19D) or longer-than-disyllabic bases (19G).

(16) BASEBINARITY (BASEBIN): The PRWD as a DIM base must be binary under a syllabic analysis.

Constraint (17) deals exclusively with disyllabic PrWDs containing a word-final high front vowel that surfaces as a glide before TEs, as in *lab*[j]*o* ⇒ *lab*[j]*ecito*. (17) ensures that base and derived words preserve syllable structure.

(17) IDENT (O-O): In disyllabic bases, each segment [−cons −syll] in the output must be identical to each segment in the base.

(18) accounts for disyllabic PrWDs whose tonic syllable nucleus is an alternant diphthong [we]/[je]. In the derived word, the diphthong must be in the head position of the disyllabic foot constituted by the base PrWD, as was explained in the preceding (*n*[ˈwe]*v-o* ⇒ *n*[we]*v-e-cíto*). Nonalternating diphthongs behave in the same way: *qu*[ˈje]*to* ⇒ *qu*[je]*tecíto*. This constraint is not active when these words diminutivize with *-it-*.

(18) DIPHTHONG LEFT FOOT (DIPHTH): Diphthongs [we]/[je] must preserve their position in the base foot when they are followed by DIM suffix.

These three constraints are unordered and share some characteristics: they are relevant only with monosyllabic (16) or disyllabic words (17 and 18). However, in the case of words with more than two syllables with [we]/[je] as the head, the only constraint responsible for the selection of the diminutive allomorph is PRIOR (19G).

(19)

Base: A) cas-a	IDENT (O-O)	DIPHTH	BASEBIN	AL DIM$_F$ L BIN PRWD R	AL DIM$_F$ L PRWD$_C$ R	PRIOR
☞ a. cas-ita	NA	NA	✓	*	NA	✓
b. cas-e-cita	NA	NA	✓	*	NA	*!
c. cas-cita	NA	NA	✓	*	NA	*!
Base: B) corazón C) madre D) sol						
☞ a. corazon-cito	NA	NA	*	NA	✓	*
b. corazon-ito	NA	NA	*	NA	*!	✓
☞ a. madre-cita	NA	NA	✓	✓	NA	*

b. madr-ita	NA	NA	✓	*!	NA	✓
☞ a. sol-e-cito	NA	NA	✓	NA	*	*
b. sol-cito	NA	NA	*!	NA	✓	*
c. sol-ito	NA	NA	*!	NA	*	✓
Base: E) lab[j]-o F) n[ˈje]t-o						
☞ a. lab[j]-e-cito	✓	NA	✓	*	NA	*
b. lab[i]-i-to	*!	NA	✓	*	NA	✓
☞ a. n[je]t-e-cito	✓	NA	✓	*	NA	*
b. n[je]t-íto	✓	*!	✓	*	NA	✓
Base: G) bisn[ˈje]t-o comadr-e despac[j]-o						
☞ a. bisn[je]t-ito	NA	NA	*	NA	NA	✓
b. bisn[je]t-e-cito	NA	NA	*	NA	NA	*!
☞ a. comadr-ita	NA	NA	*	NA	NA	✓
b. comadr-e-cita	NA	NA	*	NA	NA	*!
☞ a. despac-ito	NA	NA	*	NA	NA	✓
b. despac[j]-e-cito	NA	NA	*	NA	NA	*!

This analysis shows DIM allomorph selection contexts. When one of these constraints is not active in some variety, either dialectal or idiolectal, Prior decides, and the candidate with the preferred allomorph wins, just as Prior stipulates.

Two further observations concerning DIM are required. First, cases such as *árbol* or *reloj* (cf. (13i)), omitted from tableau (19), probably may obey an OCP constraint, restricted in the case of the lateral consonant to DIM derivation (e.g. word-internal *al*[θ]*e* 'elk' and *al*[θ]*ar* 'to raise'). This constraint may dominate the set of alignment constraints, which prevents the resyllabification of the final consonant in a PrWD and the initial vowel of a DIM suffix. Second, cases like *cazador* 'hunter', *cazador-a* 'hunter (fem.)' ⇒ *cazador-cito*, *cazador-cita*, **cazador-ita*, but *cazado-ra* 'safari jacket' ⇒ *cazador-ita/*cazador-cita* reveal that DIM is subject to paradigm uniformity effects (see Kenstowicz 2005; Cabré and Ohannesian 2009; and Ohannesian and Pons 2009 for detailed analyses of uniformity and (sub)paradigmatic pressure in derivation).

4. Conclusion

Diphthongization and diminutivization are two of the major issues in Spanish allomorphic variation. I have presented them under the OT framework, from a stratal as well as a parallel version of OT. The key question for the non-monostratal accounts is the treatment of opacity cases.

However, as we have seen, the parallel version also provides enough tools to deal with opacity, such as transderivational or output-to-output correspondence relations, on one hand, and optimal paradigms and subparadigms, on the other. Allomorph selection by TETU effects in external or optimizing allomorphy becomes one of the most important achievements of OT in the field of allomorphy. In the same way, when the choice of allomorph does not depend—either totally or partially—on grammatical regularities (that is, in nonoptimizing—internal—allomorphy), the compliance with lexical partial ordering of allomorphs or idiosyncratic specifications is guaranteed by Priority or Respect faithfulness constraints, which account for the language specificities. It will be an important future task to explore the influence of TETU effects on the different derivational or inflectional process that involve allomorphic variation, and, as Mascaró (2007) points out, the fact that external allomorphy encloses only bound forms, including clitics.

As is well known, inflection does not create new words, while derivation does. In consequence, allomorphs are more closely related in inflection than in derivation, as recent psycholinguistic investigations have confirmed (see Álvarez et al. 2011 for experiment details and neuropsychological explanations). Based on this generalization, another promising field for further research might be to explore allomorph relationships in suppletion (i.e. the 'strong suppletive allomorphy'), with the ultimate goal of setting up a hierarchy to explain how speakers relate suppletive allomorphs, taking into account the following assumptions: suppletive allomorphs in verbal roots are more easily related to each other than suppletive allomorphs in nominals, at least in languages without declensions; and inflectional allomorphs are more easily related than derivational allomorphs. Finally, a strong case can be made for the need to explore the possible differences in the ways that speakers relate root suppletive allomorphs vis-à-vis affixal allomorphs.

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14
Plural formation and gender allomorphy

Caroline R. Wiltshire

1. Introduction

As Anderson (1961) writes, "there are no monomorphemic nouns in Spanish" (1961: 285); every noun has an obligatory gender, and in most cases that gender is overtly marked with a suffix. Adjectives and determiners agree in gender with the nouns they modify, and many pronouns agree in gender with their antecedents. In many cases, though not all, gender is marked by a final vowel; the marker may appear after a root or stem, where a stem refers to a root plus suffixes such as the diminutive, and may be followed only by the plural suffix. Various researchers have proposed different terms for these stem-forming suffixes, including "gender morphemes" (Anderson 1961), "word-markers" (Harris 1991), and "stem-formatives" (Bermúdez-Otero 2006); as later works have divorced these suffixes from gender, I will use "class markers", intended as a neutral term.

The class markers can take various phonetic forms, which are often classified into a few smaller categories in which the same morpheme has more than one allomorph. While grammatical gender is distinct from biological sex, gender in Spanish nouns is categorized as masculine or feminine. Grammatical gender also includes neuter, which is found in pronouns in Spanish, e.g., *ello* 'it', *eso* 'that', which can be used to refer to something abstract, including an entire clause, rather than referring to a specific (and gendered) noun. There are cases in which a noun keeps the same formal marking but changes grammatical gender depending on who it refers to, which requires a change in agreement in associated determiners and adjectives; this is known as "common gender". For example, a witness can be male (*el testigo*) or female (*la testigo*) using the same noun with the gender indicated only on the article; examples can be found also for nouns not ending in *-o* (e.g., 'spy' *el/la espía*, 'accomplice' *el/la cómplice*; Anderson 1961: 289). There are other cases of nouns whose grammatical gender and formal marker of gender are fixed, but which can be used to refer to a living being of either sex, known as "epicene gender". Often these are types of animals, for example, *el ratón* 'mouse' and *la paloma* 'dove', again with a variety of final segments.

Harris (1991) provides one catalog of how gender is realized in various forms in Spanish. He argues that the canonical suffixes are final /-o/ in the masculine and /-a/ in the feminine, as in pairs like *muchacho* 'boy' (m.), *muchacha* 'girl' (f.) (Harris 1991: 27). However, the form of the marker does not guarantee the grammatical gender (*día* 'day' m., *mano* 'hand' f.), and he describes a greater range of available markers, taking the form of final suffixes /-o, -a, -Vs, -u, -i, -s, -e, ∅/. To provide a characterization of the data relevant to gender allomorphy without too much analysis *a priori*, I present them in form classes in (1), based on their endings, with examples from Harris (1991) for a masculine and a feminine noun for each; Harris and other researchers will reduce the number of classes needed for describing them.

(1)		ending	example, m.	gloss	example, f.	gloss
	a.	-o	domicilio	'home'	mano	'hand'
	b.	-a	día	'day'	residencia	'residence'
	c.	-Vs	Lucas	'Luke'	síntesis	'synthesis'
	d.	-u	espíritu	'spirit'	tribu	'tribe'
	e.	-i	bikini	'bikini'	metrópoli	'metropolis'
	f.	-s	tóraks	'thorax'		
	g.	-e	héroe	'hero'	prole	'progeny'
	h.	∅/-e	padre	'father'	madre	'mother'
	i.	∅	sol	'sun'	col	'cabbage'

The ending for (1h) is listed as ∅/-e because it has been analyzed in different ways, as will be discussed later on. Harris (1991) summarizes the class marker as -(V)(s), where V can be any of the five vowels of Spanish /a e i o u/. As both elements of the marker are optional, there are some nouns, adjectives, adverbs, and determiners that have no marker at all, ending either in a single coronal consonant or in a phonologically motivated [-e] (Harris 1991: 31).

Plural nouns are also usually marked with an overt suffix, although in a few cases the plural is not phonologically distinct from the singular; likewise, adjectives, determiners, and pronouns show plural agreement. The plural inflectional marker is added to bases that have a gender marker already, and there may be interactions between the two (see Section 2.3). The plural has three forms, [-s], [-es], and [∅], in most standard dialects, as shown in (2)–(5). There are also a few cases in which a singular with antepenultimate stress takes the plural suffix [-es], resulting in stress shifting to a different vowel than in the singular (6). Examples of the patterns generally considered standard are taken from Moyna and Wiltshire (2001), while some further colloquial data are provided from other sources in (7). In order to make the role of stress clear, stressed vowels are marked with an accent in (2) through (6) whether or not they are normally spelled with one. The data in (2) shows that words that end with any unstressed vowel in the singular take [-s] in the plural.

(2)		*singular*	*plural*	*gloss*		*singular*	*plural*	*gloss*
	a.	pálo	pálos	'stick'	b.	próle	próles	'offspring'
		cáma	cámas	'bed'		léche	léches	'milk'
		tríbu	tríbus	'tribe'				
		míni	mínis	'miniskirt'				

By many standard descriptions, words ending in a stressed vowel other than [é] (3a) optionally take either [-s] or [-es] (together with other nonstandard variants; cf. Lipski 1997: 572); however, Bermúdez-Otero (2013: 13–14) points out that this "optionality" hides the detail that for each individual word, most speakers have a strong preference for one alternative or the other. In the case of *mamás/*mamáes* in (3a), speakers agree on only the form with [-s]. Words ending in a stressed [é] also take only [-s], never [-es] (3b).

(3)

	singular	plural	gloss		singular	plural	gloss
a.	rondó	rondós/rondóes	'rondo'	b.	café	cafés	'coffee'
	bajá	bajás/bajáes	'pasha'		puré	purés	'mash'
	tisú	tisús/tisúes	'tissue'				
	maní	manís/maníes	'peanut'				
	mamá	mamás/*mamáes	'mom'				

For words that end in a consonant other than [s], the plural is said to be realized as [-es] (though see (7)), regardless of their stress pattern (penultimate in (4a), final in (4b)), while singular words that end in [s] also take [-es] if they are stressed on the final syllable (5b) but otherwise have no overt plural marking if they have penultimate or antepenultimate stress (5a).

(4)

	singular	plural	gloss		singular	plural	gloss
a.	árbol	árboles	'tree'	b.	papél	papéles	'paper'
	cóndor	cóndores	'condor'		motór	motóres	'engine'
	césped	céspedes	'lawn'		paréd	parédes	'wall'
					relój	relójes	'watch'

(5)

	singular	plural	gloss		singular	plural	gloss
a.	lúnes	lúnes	'Monday'	b.	revés	revéses	'reverse'
	crísis	crísis	'crisis'		holandés	holandéses	'Dutch person'
	análisis	análisis	'analysis'		váls	válses	'waltz'
	bíceps	bíceps	'biceps'				
	lápiz ['lapis]	lápices/*lápiz ['lapises]/*['lapis]	'pencil'				

When a singular is consonant-final and stressed on the antepenultimate syllable, the standard plural involves both the addition of [-es] and a stress shift one syllable to the right (6), keeping the stress in the final three syllable window (again, cf. (7) for the colloquial pattern).

(6)

	singular	plural	gloss		singular	plural	gloss
a.	régimen	regímenes	'diet'	b.	espécimen	especímenes	'specimen'

The prescriptive standard form of the plural thus generally depends on the final segment of the singular: whether it is a consonant or a vowel; if a vowel, whether it is stressed vs. unstressed; and whether the final segment is /é/ or /s/. In addition, there are lexical exceptions: individual words that belong in a given category and yet do not behave like the rest of its members (*lápiz*, pronounced ['lapis] in Latin American dialects, in (5a) has penultimate stress yet takes the [-es] plural), as well as irregular plurals such as *chisgarabís* (sg.)/*chisgarabíes* (pl.) 'meddler', which follows none of the preceding patterns.

Furthermore, colloquial usage and borrowed words complicate the description given thus far. The examples in (7) show pairs of words with similar phonological forms, the first following the standard rules and the second deviating in that words ending in a single consonant in the singular may take [-s] rather than [-es]. In cases like (7a), where the addition of [-s] also obviates the need for a shift of stress, plurals with [-s] (including *régimens*) are now argued to be the colloquial and productive norm by Bermúdez-Otero (2006: 306, 2007: 261).

(7)	*formal/standard*			*colloquial/borrowed*		
	singular	*plural*	*gloss*	*singular*	*plural*	*gloss and source*
a.	régimen	regímenes	'diet	béneton	bénetons	'Benetton' (Bermúdez-Otero 2006: 306)
b.	pan	panes	'bread'	fan	fans	'fan' (Bonet 2006: 323)
c.	sol	soles	'sun'	bol	bols	'bowl' (Bermúdez-Otero 2013: 15)
d.	rey	reyes	'king'	jersey	jerséis	'jersey' (Bonet 2006: 323)

While some examples that take only [-s] rather than [-es] are arguably recent borrowings, a word's status as foreign is not always clear; for example, Bonet (2006: 323) says that *fan*, with plural *fans*, "is not perceived as foreign or strange by native speakers", while Colina (2006a: 56) declares it foreign and outside the Spanish core. Clearly, any analysis of the plural allomorphy in Spanish will have to include some mechanism for lexical idiosyncrasies, in addition to deciding which is the regular pattern.

2. Main perspectives

Plural and gender allomorphy have each been addressed as separate phenomena but are sometimes analyzed together, so this section is divided into three parts, focusing first on plural allomorphy alone (Section 2.1), then gender allomorphy alone (Section 2.2), and finally plural/gender together (Section 2.3). The goal of generative analyses of allomorphy is to separate the predictable, which can be written as rules or constraints, from the unpredictable, which must be memorized, i.e., stored in the lexicon.

2.1. Plural allomorphy

For the plural, we saw three main variants of the affix: nothing (∅), [-s], and [-es]. One early description using generative phonology is Saporta (1965), who makes the /-es/ allomorph the elsewhere case in his plural rule, provided in (8) along with words to exemplify each alternant.

(8) Plural Rule in Saporta (1965: 220)

	s / { V_	pálo – pálos	'stick – sticks'
pl →	{é_	café – cafés	'coffee – coffees'
	∅ / Vs _	lúnes – lúnes	'Monday – Mondays'
	es / elsewhere	papél – papéles	'paper – papers'
		bajá – bajáes	'pasha – pashas'

Later generative analyses have tried to simplify and motivate the allomorphy, following two main approaches that differ on the source of the surface [e] in some plurals. In both approaches, the plural is an underlying /s/, and if it is added to a form ending in /s/, the two are contracted, thus providing for the [-s] and [∅] allomorphs. In what I will call the "apocope" approach, the [e] seen in forms like plural [paˈpeles] belongs to the underlying form of the word /papele/ and is deleted in the singular when word-final (Foley 1967; Harris 1970). In the opposite, "epenthetic" approach, the surface [e] is added in some plurals for phonological purposes (Saltarelli 1970).

For the apocope approach, Foley (1967) proposed the rule in (9), which relies on the assumption that consonant-final and stressed-vowel-final words end with an /e/ in the underlying form, which appears in the plural. An unstressed final /e/ is deleted from the singular through a rule (e.g. /papele/ → [paˈpel]) and allowed to surface in the plurals: /papele-s/ → [paˈpeles]. The apocope rule requires a preceding V(C) in the context in order to avoid deleting final /e/ from the singular form of words that end in a consonant cluster plus /e/, such as *arte* 'art' or *alegre* 'happy', but it is not clear how it would handle pairs like *cruce* 'crossing' vs. *cruz* 'cross', where both have an [e] in the plural (*cruces*) yet only one has an /e/ subject to apocope in the singular. Furthermore, Saltarelli (1970) argues against this analysis because it not only adds an extra rule of apocope but also requires the lexicon to mark every singular with a final /-e/ if the plural form appears with [-es]. He proposes instead to expand the rule of prothesis, which is required and exceptionless word-initially before sC clusters, and create a new rule (10) that adds an epenthetic [e] after a consonant or stressed vowel before the plural /s/. The underlying representations (URs) then resemble the singulars, which surface intact.

(9) Apocope Approach: Foley (1967)

Rules: Apocope $\breve{e} \rightarrow \emptyset / V(C))$__# Selected URs: /palo, papele, lunes, bajae/

(10) Epenthesis Approach: Saltarelli (1970)

Rules:
a. prothesis: $\emptyset \rightarrow$ e/#_sC
b. epenthesis: $\emptyset \rightarrow e \; / \left\{\begin{matrix}\# \\ C, \acute{v}\end{matrix}\right\}$ __s $\left\{\begin{matrix}C \\ \#\end{matrix}\right\}$ Selected URs: /palo, paˈpel, lunes, baˈja/

One weakness of this epenthesis rule is that it applies both in the context of consonant clusters at word boundaries (#__sC, C__s#) and also after stressed vowels (v́__s#) before the plural marker, and although the environments are written together formally, they seem to have little in common in terms of motivation. Harris (1970) also responds, in defense of the apocope approach, with the criticism that an epenthesis rule in the word-final context seems unlikely, given that Spanish speakers generally tolerate word-final VCs# clusters (Harris 1970: 929). Approaches developed within Optimality Theory (OT; Prince and Smolensky 1993/2004) also analyze the plural from the two perspectives of an underlying /e/ that does not always surface or a surface [e] with no underlying source. Roca (1996) sides with the apocope analysis of the Spanish plural, assuming that some singular underlying forms have a final /e/ that is deleted by an Apocope constraint, a "dispreference for word-final [e]" (Roca 1996: 223); in the plural, however, this final vowel can surface because it is no longer word-final. Roca describes two problems with an epenthesis analysis, in which the surface [e] is not present in the underlying form: (1) word-final consonant clusters are treated differently in plurals vs. singulars and (2) the surface [e] that appears in the plural in some cases is also present in the singular, while in other cases it is not. To illustrate the first problem, also raised by Harris (1970), note that the same consonant clusters that may be tolerated in singular forms appear with an intervening [e] in the plural; that is, *vals* (sg.) 'waltz' is tolerated while **sols* (pl.) is not; epenthesis does not create **vales* (sg.), so why would it be responsible for *soles* (pl.)? Additionally, consonant clusters at word boundaries that are not tolerated are simplified by the loss of a consonant, rather than by epenthesis of a vowel, as in /ˈtoraks/ 'thorax', realized as [ˈtoras] instead of *[ˈtorakes]. An example to illustrate the second type of problem Roca mentions is that the singular of *coyótes* is *coyóte* 'coyote', not **coyót*, which might be expected if an [e] in the plural is the result of epenthesis only.

Moyna and Wiltshire (2001) provide an OT analysis following the epenthesis approach, with the [e] appearing on the surface to resolve constraint conflicts when the plural is added. In answer to Roca's objections, they argue that the difference between morpheme-final clusters and clusters created by adding the plural morpheme can be addressed by taking morphological structure into account, using a constraint like O-Contiguity.

(11) O-Contiguity

The portion of S_2 standing in correspondence forms a contiguous string (i.e., do not insert material within morpheme boundaries).

(McCarthy and Prince 1995: 371)

Such a constraint prevents insertion of an epenthetic element within a morpheme in /vals/ *[ˈvales], /biceps/ *[biˈcepes], or /toraks/ *[ˈtorakes]. In forms with a plural suffix, such as [ˈsoles], from /sol-s/, the epenthetic element appears between the stem and the inflectional morpheme, thus incurring no violation of O-Contiguity. As for the second potential problem, this seems to assume that in an epenthesis analysis, all surface [e] segments that appear before the plural [-s] are the result of epenthesis, which need not be the case. There is no reason why Spanish words should not end in /e/ in the input, just as they end in other vowels, and in fact there are pairs that differ only in whether a final /e/ is present or not: the plural *cruces* can correspond to two different singular forms, *cruz* 'cross' or *cruce* 'intersection'. In their analysis, the final [e] of *cruce* corresponds to an underlying /e/ segment, whereas *cruz* ends in a consonant in the underlying form. The surface ambiguity in the plural corresponds to two distinct underlying representations, one that requires epenthesis to emerge, while the other one does not.

The major elements of the epenthesis analysis are a constraint against complex clusters in codas, and a constraint that requires some overt marker for the plural. Epenthesis, a violation of faithfulness to the input, can be used to satisfy both. Prosodic constraints on foot size and location are used to explain the stress shift cases and the tendency to add an [e] in forms with final stressed vowels. The reader is referred to Moyna and Wiltshire (2001) for further detail.

This epenthesis account thus addressed the objections from Harris and Roca, and offered further critique of the apocope approach. In the OT version of Roca, the apocope analysis relies heavily on a constraint against word-final vowels. While such a constraint can be historically motivated (cf. Penny 1991: 49–50 for Old Spanish), it is irrelevant to Modern Spanish, where word-final vowels are common. Furthermore, the apocope approach may have difficulty distinguishing pairs like *cruce-cruces* from pairs like *cruz-cruces*, where both have an [e] in the plural but only one has an [e] in the singular. To make apocope work has involved contortions such as two types of underlying /e/, only one of which is deleted word-finally (Roca 1996: 225), creating the usual problems associated with abstractness, such as learnability.

To summarize, in terms of predictable rules/constraints vs. lexical marking, the epenthesis approach favors rules that reduce the number of lexical entries that end with an /e/ in order to have a plural in [-es], while the apocope approach favors storing the extra /e/ and deleting it in singulars. Both camps critique the rules proposed by the other as being unlikely for Spanish phonology more generally.

2.2. Gender allomorphy

Anderson (1961) provides a descriptive catalogue of "gender morphemes" and their allomorphs, dividing nouns into subclasses; he then provides a generative grammar for the realization of morphemes as their allomorphs. To divide the morphemes into classes, he considers the paradigmatic alternations in nouns where a stem appears with both masculine and feminine forms, such as /xef-e/ (m.) and /xef-a/ (f.), to develop the generalizations: the masculine morpheme may have the shapes /-o/, /-e/, /Ø/, or /-a/, while the feminine may have the shapes /-a/, /-e/, /Ø/, or /-o/. Invariable nouns do not show paradigmatic alternations, remaining either masculine or feminine, but are still considered to bear class markers, such as /-o/, /-a/, or /-e/, as well. Anderson (1961) notes that the class markers are always final in a noun, occurring after suffixes such as the diminutive and augmentative. Despite their greater variety in allomorphy after noun stems, when added after suffixes, the gender allomorphs are limited to /-o/ and /-a/. He arranges stems into eight classes depending on their allomorphs:

(12) Anderson's eight allomorph classes (1961: 293–294)

		allomorph	noun	diminutive	gloss
(a)	Masc.	/-o/	líbr-o	libr-ít-o	'book'
		/-e/	ómbr-e	ombr-esít-o	'man'
		/Ø/	papél-Ø	papel-ít-o	'paper'
		/-a/	dí-a	di-ás-o	'day'
(b)	Fem.	/-a/	kás-a	kas-ít-a	'house'
		/-e/	mádr-e	madr-esít-a	'mother'
		/Ø/	muxér-Ø	muxer-sít-a	'woman'
		/-o/	mán-o	man-ít-a	'hand'

From classes such as these, the goal then is to divide the allomorphy into that which must be stored lexically as unpredictable vs. that which can be inserted by rule/constraint.

Harris (1991) provides a further comprehensive analysis of gender allomorphy, dividing words into declensional classes based on which of the seven forms or Ø provided in (1) they take. He uses the term "word-marker" for these suffixes, as they follow all derivational or inflectional suffixes apart from the plural, and therefore signal the end of the word. Harris's account distinguishes how much needs to be marked/stored in the lexicon and what can be predicted by rules by proposing an analysis in terms of lexical entries and constraints on them, rules relating gender classes to declensional classes, and rules that relate declensional classes to allomorphs. In organizing the data, he claims there are three basic classes, in a hierarchy: a prototypical inner core, in which masculine stems take the *-o* suffix and feminine stems take the *–a*; an outer core containing cases that deviate slightly from prototype and take no word markers except [e] after consonant clusters, which he argues appears for syllabification purposes; and a residue, which contains words that fit neither the inner nor the outer core and can be treated as irregular.

Along with information about the meaning, syntactic category, and underlying form of the stem, lexical entries can contain a mark for gender (f. = feminine) and/or a mark for declension class, such as]a for words with the word marker /-a/ or]Ø for words with no marker or with a phonetic [e] dependent on syllable structure. Lexical entries look something like (13); this is meant to be the stored unpredictable information.

(13) Lexical entries in Harris (1991: 43)

Meaning	'book'	'pound'	'free'	'day'
UR of stem	/libr/	/libr/	/libr/	/di/
Category	N	N	A	N
Gender		f		
Class			]Ø	]a

The default gender is masculine, so this information need not be stored for masculine nouns; adjectives are not marked for gender, as they acquire it through agreement/concord. The default class markers need not be listed in the lexicon as they will be provided by redundancy and spell-out rules, so only the]a marked on masculine nouns and the less common]Ø need be memorized. For words in the inner core, a redundancy rule (14a) states that the gender feminine is marked by]a, while a spell-out rule (14b) provides that the suffix /-a/ is added to any form marked with]a in its lexical entry, and otherwise /-o/. Inner core words, therefore, without any specified marker in the lexical entry, will be spelled out with /-o/ for masculine and /-a/ for feminine nouns. Words that have a specified marker]Ø in their lexical entry block the marker realization rule. In this analysis, the final [e] of *libre* 'free' is predictable from the phonological rules of syllabification, as a final /br/ cannot be syllabified into a coda; this epenthesis applies toward the end of a derivation.

(14) Rules in Harris (1991: 44)

(a) Feminine Marker rule: f →]a
(b) Marker Realization rule: insert suffix /a/ if stem is marked]a; otherwise, insert suffixal /o/

Harris notes that his realization rule does not refer to grammatical gender (or semantic/biological sex) but rather to the form of the marker; it is a purely morphological attribute of lexical entries. Some forms remain exceptional, such as feminine *mano*, which must be marked as f. for gender but cannot be supplied with a word marker -o by any regular rule; such exceptions must be specified with their word marker in their lexical entries. A similar treatment is provided for the small group of exceptional forms with word markers /-i, -u, -Vs, -s/, which must have their word marker listed with the root in the lexical entry.

Harris also discusses interactions with phonology, and the plural, briefly. Word markers are added to stems to make a complete prosodic word (PW), which follows a template for all nouns, adjectives, and adverbs: $[[\text{stem}](V)(C)]_{PW}$. Extending Anderson (1961), he argues that all roots, stems, and affixes for nouns, adjectives, and adverbs are bound morphemes, so that affixation is required to form a complete prosodic word. The "word marker template" adds a /VC/ to the phonological material of the lexical entry of the root, and the marker realization fills in the phonological material of the gender allomorph. Harris (1991) briefly mentions that the plural /-s/ also attaches to a C slot, and if the morphology attempts to add the suffix to a word whose word-marker VC slots are already filled, it cannot be realized (e.g., *lúnes* 'Mondays' in (5a)).

With this analysis, the form of the marker cannot be fully predicted from the gender, nor vice versa, so some information must be stored lexically. However, for feminine nouns that take a vowel form-class suffix, the word marker is usually /-a/, and for masculine it is usually /-o/, allowing the approach here to omit these markers from the lexicon and fill them in by the marker realization rule. Other markers need to be specified lexically. For further analyses and developments along these lines, see also Roca (2005a, 2005b, 2009).

2.3. Combined gender and plural allomorphy

While there are various analyses that focus specifically on the Spanish plural or gender, Harris (1970), writing on the plural, states his desire that linguists would not write articles limited to a single phenomenon:

> It would seem to me to be of great advantage to the study of Spanish, and of language in general, if the topic of "plural formation" were permanently laid to rest, and attention devoted instead to general phonological and morphological processes of the language (some of which might also happen to be relevant to plural formation").
>
> *(Harris 1970: 930)*

There is no reason, he argues, to expect that a single suffix will provide the perfect window into an understanding of the phonology for the entire language. Integrating plural and gender allomorphy into a single analysis would thus seem a step in the right direction.

Turning now to accounts that tackle gender and plural allomorphy together, we examine Bonet (2006), Bermúdez-Otero (2006), and Colina (2003, 2006a, 2006b). Bonet (2006) argues, contrary to analyses such as Moyna and Wiltshire (2001), discussed previously, that there is no epenthesis in the plural in current Spanish. Her analysis reinterprets these [-e] vowels as gender allomorphs or class markers. She also argues that *-o* is not the default marker for gender and uses an OT approach with all allomorphs available in the input, leaving it to a constraint ranking to determine, in conjunction with lexical specifications, which class markers surface.

To argue against final epenthesis, as in /libɾ/ → [libɾe] from (13), Bonet compares it with word-initial prothesis, which is documented and productive both in well-integrated loans and in new loans. In word-final position, however, epenthesis is not productive. Spanish generally tolerates only one consonant word-finally, and that consonant can come from only a limited set (such as [ð, θ, s, n, l, r, x]). Advocates of epenthesis have claimed that a final epenthetic [e] appears after impermissible single consonants or consonant clusters (e.g., /nub/ [nube] 'cloud', /part/ [parte] 'part'; Bonet 2006: 317). However, following Harris (1987) and Colina (2003), Bonet (2006) argues that final epenthesis is unproductive in new borrowings, where other strategies apply instead, such as change of place, lenition of stops, deletion, and even internal epenthesis if the cluster has rising sonority.

(15) Strategies for borrowing without final epenthesis (Bonet 2006: 317–318)

a.	assimilation	'imam'	[iˈman]	*[iˈmame]
b.	lenition/deletion	'input'	[ˈimpuθ], [ˈimpu]	*[impute]
c.	cluster reduction by deletion	'comfort'	[koɱˈfor]	*[koɱˈforte]
		'biceps'	[ˈbiθes]	*[ˈbiθepse],*[ˈbiθepes]
d.	internal epenthesis	'Al Sadr'	[alˈθaðer]	*[alˈθaðɾe]
		'single'	[ˈsiŋgel]	*[ˈsiŋgle]

The direct contrast in the location of the [e] inside a /dr/ cluster in the borrowing [alˈθaðer] for *Al Sadr* vs. after a /dr/ cluster in the native [ˈpadɾe] *padre* leads her to the conclusion that a final *-e* is not epenthetic but rather a class marker, so that *padre* is /padɾ-e/, while *Al Sadr* is /alsadɾ/. Historically, epenthesis might have been active word-finally in Spanish, but the vowel *-e* in word-final position can be reinterpreted as a class marker, especially given the independent existence of such an *e*-class. This class marker -*e* is needed because it appears after single consonants allowed in final position, as in *doce* 'twelve', etc., as well as typically in deverbal nouns such as *pase* 'pass' and *alucine* 'act of hallucinating', which could not motivate epenthesis, given that a single final coronal is a well-formed coda. The inclusion of words like *padre* in the *e*-class then has implications for the plural analysis as well as the gender allomorphy analysis.

Based on frequency, Bonet proposes a set of unmarked or preferred class markers, as in (16). For masculine words, -*o* is the default marker and is preferred to -*e* and ⊘, which in turn are more common than the rare -*a* marker. For feminine words, -*a* is the default, -*e* and ⊘ are less common, and -*o* is rare. The markedness hierarchies indicate these preferences.

(16) Preferred class markers and markedness hierarchy (Bonet 2006: 325–327)

For masculine words:	-o o > e, ⊘ > a. . .
For feminine words: -a	a > e, ⊘ > o. . .
For no-gender words: ⊘	(no gender like adverbs)

This leads her to an account in which lexical entries contain markings only if their class marker is different from the default for their gender. They may also be marked for a plural with [-e] as in the final example, which has a ⊘ in the singular.

(17) Marked lexical entries (Bonet 2006: 326)

a.	masculine words:	/poet$_{a}$/	*poeta*	'poet'
		/ombɾ$_{e}$/	*hombre*	'man'
b.	feminine words:	/man$_{o}$/	*mano*	'hand'
		/klas$_{e}$/	*clase*	'class'
		/pared⊘$_{\text{, pl. e}}$/	*pared-paredes*	'wall/walls'

The OT account then takes as input the lexical entries and the gender allomorphs and determines the best form based on the constraints and ranking in (18).

(18) Priority: Respect lexical priority of allomorphs.
Respect: Respect idiosyncratic lexical specifications.
Ranking: Respect >> Priority

As Spanish prefers to respect idiosyncratic lexical specifications (when present) over the markedness hierarchies, an entry with a marker will surface with the lexically specified allomorph. If there is no lexical specification, masculine forms take -*o*, and feminine forms take -*a*; as in Harris (1991), this is treated as predictable, while other markers, including unusual ones such as -*us*, can be treated the same way as memorized/stored in the lexicon. Bonet also treats the plurals in a similar way: if an entry is unspecified, the plural surfaces as [s], but if it is specified with a "pl: e" in the lexicon, the word takes [-es] in the plural, as will forms with the class marker -*e*. In both cases, the information that the -*e* appears in the plural is part of the lexical entry, which means that it is treated as unpredictable.

Bermúdez-Otero (2006) also provides an analysis of gender and plural allomorphy together, in his case using a Stratal OT approach (Bermúdez-Otero 2018) and arguing several novel points. Previous approaches had treated these markers as word-final and had restricted them from appearing before derivational suffixes by a morphotactic constraint. Bermúdez-Otero (2006) calls final vowels "stem formatives" instead, arguing that they are always present in underlying forms after roots but are deleted before vowel-initial suffixes. He divides nouns into three main categories based on the formative, plus a "comparatively rare" athematic class of stems with no formative (distinct from the ∅ seen in some *e*-class stems), as in (19).

(19) Classes for stem formatives (Bermúdez-Otero 2006: 279)

		sg.	pl.	gender	gloss
a.	o-stems	libr-o	libr-o-s	M	'book'
		man-o	man-o-s	F	'hand'
b.	a-stems	libr-a	libr-a-s	F	'pound'
		problem-a	problem-a-s	M	'problem'
c.	e-stems	cruc-e	cruc-e-s	M	'crossing'
		cruz-∅	cruc-e-s	F	'cross'
d.	athematic	menú	menú-s	M	'menu'
		clip	clip-s	M	'paper clip'
		virus	virus	M	'virus'

While *o*- and *a*-stems consistently bear the formatives /-o/ and /-a/ respectively, note that the *e*-stems can bear the formative /-{e, ∅}/ or /-e/, a distinction that is unpredictable. If a form bearing the -{e, ∅} options ends in a consonant that can be syllable-final in Spanish, they take the /∅/ allomorph in the singular, but before the plural marker /-s/, the /e/ is the chosen allomorph. Other forms in the *e*-class, whose final consonant(s) may or may not be syllabifiable as codas, take the /e/ in both singular and plural. Thus, in all cases the [e] appearing in the plural is an allomorph provided in the lexicon, and never epenthetic, an argument developed further in Bermúdez-Otero (2013).

Unlike previous accounts that place the class markers as word-final except for the plural suffix, in his account additional derivational suffixes can appear after the nominal stem formatives in the underlying representation; if these suffixes are vowel-initial, the stem formative is deleted by a morphophonological rule (20):

(20) Stem-final vowel deletion (Bermúdez-Otero 2006: 280):

$$V \rightarrow \varnothing / \overset{\sigma_W}{\underline{\quad}}\,_{stem}]\ [_{suffix}V$$

	(noniterative)				
sample derivation	UR	[man-o]	'hand'	[[man-o]aθ-a]	'hand-AUG'
	SR	[ˈmano]		[ma.ˈnaθa]	

Bermúdez-Otero (2006, 2013) bases his arguments for this process on the facts around depalatalization and diphthongization, and the interested reader is referred to his works for further details.

There are two other novel claims in his analysis: the positing of an athematic category, in which there is no affix, not even a ∅ stem formative, and the argument for the existence of pseudoplurals. The athematic category eliminates the need for extra class markers, as in Harris (1991), or extra lexical specifications, as in Bonet (2006). The differences between athematic, pseudoplural, and *e*-class nouns can be shown using nouns ending in /s/, which fall into three categories. Athematic nouns can end in stressed vowels or various consonants, so some end in /s/, like *virus*. The pseudoplurals are nouns that end in /-s/ in the singular due to a mismatch between syntax and morphology by which the stems subcategorize for the plural suffix /-s/; an example is *crisis*. Finally, some nouns ending in /s/ belong to the *e*-class, like *iris*. To distinguish among the possibilities, he uses two diagnostics: the plural form and diminutives, which are provided in (21), with his morphological boundaries included.

(21) Diagnostics for -s-final words (Bermúdez-Otero 2006: 298)

	gloss	'virus'	'toast'	'Socrates'	'crisis'	'iris'
a.	sg.	bíɾus	bɾíndis	sókɾat-e-s	kɾísi-s	íɾis-⊘
b.	pl.	bíɾus	bɾíndis	sókɾat-e-s	kɾísi-s	íɾis-e-s
c.	dim.	biɾus-ít-o	bɾindis-ít-o	sokɾat-ít-o	kɾis-eθít-a	iɾis-ít-o
d.	dim. pl.	biɾus-ít-o-s	bɾindis-ít-o-s	sokɾat-ít-o-s	kɾis-eθít-a	iɾis-ít-o-s
e.	class	athematic		pseudoplurals		*e*-stem

Iris is a case, like *lapiz* 'pencil', of a normal *e*-stem that has the /-{e, ⊘)/ formative, taking a singular with ⊘ because the stem-final consonant can syllabify as a coda, but taking a plural with the *-e* formative. The athematic examples, *virus* and *brindis*, and the pseudoplurals, *Socrates* and *crisis*, all have plural forms identical to the singular, distinguishing them from *e*-class *iris/irises*. The athematic stems (*bíɾus-*, *bɾíndis-*) appear in full, including their final /s/ before the diminutive suffix (*biɾusíto*, *bɾindisíto*), while the pseudoplurals (*sókɾat-*, *kɾísi-*) have no /s/ before the diminutive affix (*sokratíto*, *kɾiseθíta*), since the /s/ is attached to the stem as a plural marker that the stem subcategorizes for, rather than being part of the stem itself as it is in the athematic and *e*-stem cases (see also Bermúdez-Otero 2007 for a more extensive discussion of pseudoplurals). This analysis allows the reduction of stem formative classes to four basic types: *o*-stems, *a*-stems, *e*-stems, and athematic stems, with the *e*-stems having two subtypes: one with ⊘ in the singular and *-e* in the plural, and another with *-e* in both. All the information about how to form the plural is provided in the lexicon.

Colina (2003, 2006a, 2006b) pursues an OT analysis in which phonology continues to play the major role but in which the [-e] found in plurals is motivated by an interaction with morphology as well. She argues against final epenthesis as a general strategy for Spanish and analyzes forms that surface with a final [-e] in the singular as ending in an underlying /-e/. In forms without a final [-e] in the singular that do take plurals as [-es], she argues for an epenthesis analysis. In Colina (2003), the epenthetic [-e] in plurals is motivated in part by a constraint that morphological words require terminal elements, so that words with no terminal elements in the singular (like *sol*) take plurals with [-e] (as in *soles*); at the same time, this added vowel improves the output form phonologically relative to a candidate like *[*sols*] and provides a desired terminal element. Colina's (2006a, 2006b) analyses capture the distinction slightly differently, by appealing to a relationship between output singular and plural forms, which can be regulated in OT by output-output constraints (Benua 1997). While the relationship between inputs and outputs is constrained by Dep-IO, the relationship between the output forms of the base and affixed form are constrained by Dep-OO:

(22) Dep-IO Every segment present in the output has a correspondent in the input.
Dep-OO Every segment present in the output has a correspondent present in a related (base) output.

Colina argues that output singular and plural forms are in an output-output relationship, and that while ranking Dep-IO above coda constraints enforces a lack of epenthesis in singulars, the ranking of coda constraints above Dep-OO constraints allows epenthesis in plurals. Colina uses this difference to handle the differences between singulars that end in consonants or clusters like /ls/, which do not get epenthesis, as in (23a), vs. plural forms in /l+s/, which do result in [-es], as in (23b). The constraints on the coda that can force the [e] into the plural are themselves overruled by DEP-IO, which prevents epenthesis in the singular.

(23a) /bals/ [bals] 'waltz' (Colina 2006a: 55, tableau (10))

	MAX-IO	DEP-IO	RM	ALIGN-PL	*CODA	DEP-OO
☞ bals					*l*s	
balse		*!			*l	
bal	*!				*l	
bales		*!			*s	

(23b) /sol/ [sol] + /s/ [soles] 'suns' (Colina 2006a: 55, tableau (11))

	MAX-IO	DEP-IO	RM	ALIGN-PL	*CODA	DEP-OO
☞ soles					*s	*
solse				*!	*l	*
sol			*!		*l	
sols					*l*s!	

While this analysis seems to captures the right insights, it requires the plurals to have no access to the input of the base, an unusual position that Colina provides evidence for (2006a: 51). However, it is in contrast with Benua's original model (1997: 7), in which forms such as plurals are composed of an input (/base+affix/), so that any epenthesis in the output would violate DEP-IO as well as DEP-OO and make the correct candidates lose. I will attempt to reformulate Colina's insight in the analysis in section 3 while preserving the original model of transderivational constraints.

3. A closer look at the mysterious *e*-class

The nature of the [-e] that appears in the plurals and after some clusters in the singular has consistently been an issue in analyses of both plurals and gender. Bonet (2006) provides a nice summary of most of the options: (a) the plural has two listed allomorphs (Saporta 1965); (b) final and plural [e] is epenthetic (Saltarelli 1970; Harris 1987; Colina 1995; Moyna and Wiltshire 2001); (c) there is an /e/ underlyingly (whether part of the stem or a class marker), preserved in the plural but deleted in the singular (Foley 1967; Roca 1996); or (d) there is a class that has ⊘ in singulars and /e/ in the plural as a class marker (Bermúdez-Otero 2006). A final option is to treat it in both ways: [-e] is provided by phonological rule after some consonants or clusters but is part of the stem otherwise (Harris 1991) or, similarly, part of the underlying form in some cases and supplied by morphological and phonological interactions in others (Colina 2003, 2006a, 2006b). This question of how to deal with the [-e] relates to one of the main issues in phonological accounts of allomorphy: to what extent is information stored in lexical entries vs. generated by rules/constraint interactions?

Unpredictable information must be stored, while only predictable or default information can be generated. Epenthesis is already a rule of Spanish in word-initial position before sC clusters, and Bonet (2006) makes a case for word-internal epenthesis in borrowings like [al'θaðer] 'Al Sadr'. There are several arguments that epenthesis is not predictable when word-final or before the plural suffix. First, Spanish tolerates some word-final clusters ending in -*s* (*vals*), so that epenthesis in /sol

$+s_{pl}$/ *soles* seems unpredictable. Second, borrowed words are repaired by other strategies, notably deletion from clusters ([gran]) or lenition/place neutralization of single final consonants to create acceptable codas ([iˈman] 'imam', [ˈimpuθ] 'input'); if these strategies are the predictable ones, then forms with [-e] must be marked as behaving unpredictably. Third, when there is epenthesis in a borrowing like /alsadr/, it is internal rather than final, as has been proposed for the same cluster in *padre*. Finally, epenthesis after final stressed vowels ([tiˈsu], [tiˈsues] 'tissue(s)') has been argued to be unmotivated and unrelated to epenthesis after final consonants. Such epenthesis might be motivated as making predictable improvements to foot form, as argued in Moyna and Wiltshire (2001), but as I agree that such epenthesis is not related to that triggered by final consonants, I will focus on the latter here and see if an analysis can make one kind of epenthesis predictable: epenthesis related to final consonant clusters in the plural.

For the epenthesis that clearly does occur in Spanish, word-initially, Colina (2006c: 197) shows that the epenthetic vowel must be [e]. Can it be merely coincidence that the one class that has a ∅ marker is the *e*-stem? In agreement with Colina (2003), I treat stems that take the /-e/ marker in both singular and plural as belonging to the *e*-class, parallel to stems that take the /-o/ or /-a/ marker, which take the marker in both singular and plural. Even in cases in which epenthesis looks motivated by final clusters (*libre* 'free', *padre* 'father', *arte* 'art'), and probably was motivated historically, synchronically they belong to an *e*-class since the /e/ is present in both singular and plural. This /e/ in both singular and plural particularly needs to be memorized when it is unnecessary for syllabification (*cruce*, *cruces*), in order to distinguish these from forms that have no [e] in the singular but do in the plural (*cruz*, *cruces*). However, such forms that have been analyzed into a class or subclass that has {e, ∅} as options are the ones that can be analyzed as having phonological epenthesis; these are cases such as *sol/soles*, *pan/panes*, and *cruz/cruces*. Then we need a way to provide for predictable phonological epenthesis in such cases while not epenthesizing into *vals*, *biceps*, and *grant*.

Moyna and Wiltshire (2001) provided an analysis for the plural cases, which explained the difference with singular forms ending in -Cs without epenthesis and borrowed words repaired by deletion instead, using an O-CONTIGUITY constraint in OT (mentioned as (11) in Section 2.1) to cover the *vals* vs. *soles* difference. However, that analysis overlooked the possibility of final epenthesis to give [ˈsolse], nor did it address the new examples of Bonet (2006), in which word-final clusters of consonants with rising sonority take internal epenthesis in new borrowings ([alˈθaðer] 'Al Sadr', [ˈsiŋɡel] 'single'). Fortunately, Bonet (2006) provides an analysis for the latter that will help with the former. When epenthesis is needed for syllabification at the end of the word, the epenthetic vowel appears between the two final consonants, rather than following them due to a constraint aligning the right edge of the word with underlying material:

(24) ALIGN-R = ALIGN (MWD, R, PWD, R)

The right edge of the grammatical word has to coincide with the right edge of the prosodic word.

(Bonet 2006: 330)

While avoiding the use of output-output constraints as in Colina (2006a, 2006b), the motivation (and result) is much the same; a word-final /Cs/ cluster and a word-final /C/ followed by a plural morpheme /-s/ can have different preferred outputs. Interacting with this constraint are O-CONTIGUITY and constraints on the syllable structure of Spanish (Colina 1995, 2003, 2006c). Spanish generally allows single consonants from a limited set, word-finally, with a few exceptions of clusters allowed finally in words that are singular. These clusters have falling sonority, obeying the sonority sequencing generalization for syllable form (25a); to refer specifically to the coda I will use Colina's MARGIN SONORITY (25b). To limit coda size, Colina also uses *COMPLEXCODA (25c).

(25) a. Sonority Sequencing Generalization: Consonant clusters in the onset must rise in sonority toward the nucleus, while clusters in the coda fall in sonority (Hooper 1976; Steriade 1982).
b. MARGIN SONORITY: Complex codas have decreasing sonority (Colina 1995).
c. *COMPLEXCODA: Complex codas have no more than one segment (Colina 2006c).

Bonet (2006) combines all syllable-related constraints into the cover term σ STRUC and provides an analysis for internal epenthesis in borrowings like *Al-Sadr* using the following ranking:

(26) σ STRUC >> ALIGN-R, RESPECT >> O-CONTIG >> PRIORITY, DEP

In order for epenthesis to be the optimal result, a constraint against consonant deletion (MAX-IO(C)) also needs to outrank DEP-IO(V), but I omit the constraint and candidates with deleted consonants for reasons of space. Colina (2003) suggests forms like [boj'ko] ~ [boj'kos] 'boycott (sg. ~ pl.)' should have an underlying final /t/ because of the related verb [bojkote'ar] 'to boycott', which implies a deletion strategy in both singulars and plurals; my ranking here does not account for such deletion and would instead require distinct underlying forms for the noun and verb.

From among the syllable-related restrictions, we can break out the constraint on MARGIN SONORITY, which a final cluster such as /dr/ violates but which /ls/ satisfies, and rank this higher than the general constraint against coda clusters *COMPLEXCODA. Focusing on the phonological constraints only, compare the evaluations of an input like /sadr/ in (27) vs. /vals/ (28).

(27) Stem-final cluster with increase in sonority: repaired by internal epenthesis

/sadr]$_{MW}$/	*MARSON	ALIGN-R	O-CONTIG	*COMPLEXCODA	DEP-IO(V)
. . . dr]	*!			*	
. . . dr]e		*!			*
☞ . . . der]			*		*

As the final /dr/ cluster violates the *MARSON constraint by increasing in sonority, epenthesis is motivated; the ranking of ALIGN-R above O-CONTIGUITY forces the epenthetic vowel to be located internally. However, when the final cluster falls in sonority, as in /ls/, the cluster is tolerated in order to avoid violating either ALIGN-R or O-CONTIGUITY.

(28) Stem-final cluster with decrease in sonority: tolerated

/ vals]$_{MW}$ /	*MARSON	ALIGN-R	O-CONTIG	*COMPLEXCODA	DEP-IO(V)
☞ . . . ls]				*!	
. . . ls]e		*!			*
. . . les]			*!		*

In the case of plurals, for an input /l+s/ cluster, O-CONTIGUITY is not violated by internal epenthesis, so the cluster can be reduced to satisfy *COMPLEXCODA as well. As in the /sadr/ example, epenthesis is internal due to ALIGN-R.

(29) Final cluster created by stem-final C plus plural: repaired by internal epenthesis

/sol+s]$_{MW}$ /	*MarSon	Align R	O-Contig	*ComplexCoda	Dep-IO(V)
. . . ls]				*!	
. . . ls]e		*!			*
☞ . . . les]					*

Thus, one objection to the epenthesis approach in plurals can be dispensed with: we can predict the appearance of an epenthetic vowel before the plural suffix while not epenthesizing into stem-final *-ls* clusters.

Another objection was that there were other strategies for improving clusters in Bonet (2006), such as deletion for [ps], [ks], [nt], and, as she argues, we would not want another ranking just for borrowings. However, the literature on borrowings suggests that not all clusters are imported intact by the perceptual system; the inputs themselves may be changed, especially in cases of stops in clusters, which are harder to perceive. For the other strategies, such as place neutralization and lenition of single noncoronal sonorants, Bonet (2006) provides analyses herself, which are not incompatible with the analyses of clusters already given here.

So, if we can treat this limited set of cases as having phonologically predictable (epenthetic) vowels in the plural, what effect does that have on the classes or markers? The proposal is to have the ranking for internal epenthesis, motivated by the borrowings, as part of the synchronic phonology, and to have a separate *e*-class vs. ⊘-class (as also proposed in Colina 2003: 95).

(30)	URs	*e*-class	⊘-class
		/prol-e/	/sol/
		/padr-e/	/pan/
		/art-e/	/cesped/
		/cruc-e/	/cruz/

This results in an *e*-class more like the *o*- and *a*-classes, in having only one marker; there would no longer need to be a separate class or subclass with the {⊘, e} designation, nor any morphological work to determine whether the [e] should surface or not. Words in the ⊘-class must end in syllabifiable single consonants, but words in the *e*-class may end in the same consonants, so that alone is not enough to predict class membership. The *e*-class forms always take an [-e], while if the form belongs to the ⊘-class, forms always take ⊘ morphologically, but [e] surfaces in the plurals due to phonological necessity.

What problems does this leave us? While the preceding analysis treats epenthesis in the plurals of the ⊘-class words as the normal, productive outcome, the data in (7) show that words of similar phonological shape take a plural [-s] without epenthesis. This proposed analysis would require us to treat such forms as *fan/fans* and *bol/bols* as members of the athematic class, a fact about them which would have to be memorized and treated as the nonproductive case. If these become (or already are) the productive patterns for the plurals, then it will be the *sol/soles* cases that require some special lexical marking, and the analysis here provides only for an earlier stage of Spanish pluralization patterns.

4. Conclusions

Within generative grammar, the allomorphy seen in both plurals and gender markers is analyzed into what is predictable vs. what must be marked in the lexicon, resulting in a single underlying form for the plural affix /-s/ and a limited set of categories for the class markers. Depending on what is treated as predictable, different forms count as default, regular, or exceptional. The goal of future research will be to test claims about what information is lexically stored vs. generated, or which cases are marked as exceptional vs. which are the default/predictable. Sources for testing such claims could involve borrowings, corpus linguistics, observations of language change, or psycholinguistics.

As an example of what psycholinguistics can tell us, Eddington (2004) reviews research on the issue of whether words are recognized based on their stem or stem plus class marker, at least for words pairs with *-o* masculine and *-a* feminine. Some findings suggest that complete unparsed words, not stems, form the basis for lexical retrieval (Domínguez et al. 1999), which Bermúdez-Otero (2013: 55–57) notes in support of storing stems with their theme vowels. Unfortunately, the findings on plural words were less clear, as plurals seemed to be parsed as stem + *s* in Domínguez et al. (1999), but other work found the frequency of the whole plural form affected how quickly it was recognized, suggesting that the plural is processed as a whole rather than parsed into its stem plus suffix (Eddington and Lestrade 2002). Conflicting findings may also mean there are multiple routes of retrieval, based on stems and based on words, and while predictable information may be stored in the lexicon, there may be redundancy rules that affect speed of access, reflecting what we mean by predictability. If so, it would be worth extending the research to investigating other form classes.

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15
Spanish phonology at the syntax interface

Eulàlia Bonet

1. Introduction

One important question when considering the phonology of any language is what relationship it has with other components of grammar, like syntax. To gain important insights into this relationship, one has to consider those phonological properties that involve at least two words, that is, postlexical processes and other phonological influences between words. This chapter starts with a description of phenomena that can bear on this issue. In section 2 the implications of different accounts of these phenomena are considered, and section 3 contains a general discussion and some concluding remarks.

1.1. Segmental phonology

Several phonological processes of Spanish apply both within words and between words. These processes include nasal assimilation and spirantization (plosive/approximant alternation). The example in (1b) illustrates nasal assimilation between a prefix and a stem, with the prefix *in*-, which is underlyingly /in/, as shown by (1a), where assimilation does not occur, because the nasal is followed by a vowel.

(1) a. inaceptable
'unacceptable'

b. i[m]penetrable
'impenetrable'

In (2b) the same assimilation process applies to a verb followed by pronominal clitics, and in (2c) it applies to the same verb followed by a nonpronominal direct object; (2a) shows the form of the verb when not affected by assimilation.

(2) a. pon esto
put this

b. pó[m]melo
put.1-SG.3-masc-SG
'put it for me'

c. po[m] muchas cosas
put many things

The examples in (3) illustrate spirantization. In (3a) spirantization affects the second *b* of *babero* 'bib' because it appears between vowels but does not affect the first *b* because it is in absolute initial position. By contrast, in (3b) the last vowel of the verb *compra* 'buys' creates an environment whereby the first *b* is also affected by spirantization.

(3) a. [b]a[β]ero
'bib'

b. compra [β]a[β]eros
buys bibs

Other processes also apply within words and between words, such as glide formation (cf. *casi* 'almost' and *cas[j] oscuro* 'almost dark').

Most studies on nasal assimilation and spirantization (also glide formation) concentrate on the properties of the processes themselves, rather than the syntactic contexts in which they can apply. But a question that needs to be addressed is whether the contextual segment (a following consonant in nasal assimilation, or a previous vowel, for example, in spirantization) can be found in any syntactic configuration or whether the depth of syntactic embedding matters. Syntactic structure has been argued to be relevant for phonological processes like *liaison* in French or *raddoppiamento fonosintattico* in dialects of Italian, albeit not always uncontroversially. In general, the closer the syntactic relation between trigger and target, the easier it is to find a postlexical process being applied. Thus, for example, it is easier to see applications of a process between a determiner and a following noun or between a verb and its direct object than to see it applied when there is a relative clause, a dislocated phrase, or an adjunct. In section 2.3 it is argued that the processes illustrated thus far can apply in any syntactic context but that, being sensitive to pauses, they are indirectly conditioned by the syntax, since pauses are more easily inserted after major syntactic constituents.

1.2. Suprasegmental phonology

Phrasal stress and intonation are sensitive to both syntax and semantics, and also information structure. Main phrasal stress (nuclear stress) generally falls on the last lexically stressed vowel of a simple sentence, like the one in (4); the word with nuclear stress appears in boldface.

(4)	El	hombre	compró	**melones**
	the	man	bought	melons

Sentence (4) can be understood as having broad focus; it could, for instance, be the answer to the question "What happened?" But the same sentence, with the same nuclear stress, could be the answer to a question like "What did the man buy?", with narrow focus on the direct object *melones*. Here the position of nuclear stress and the position of the focused element coincide. However, a conflict would arise if one were to put narrow focus on the subject, as in answering the question "Who bought melons?" The canonical position of the subject is initial, yet nuclear stress should fall on the last word of the clause. Zubizarreta (1998) argues that in such cases syntactic movement of the subject to final position is triggered to meet a prosodic requirement, namely having nuclear stress on the last element of the clause (see Contreras 1976 for a similar view). The result of this movement is shown in (5).

(5)	Compró	melones	el	**hombre**
	bought	melons	the	man

Whether or not syntactic movement is necessarily involved in cases where nuclear stress and focus interact is an issue that is further discussed in section 2.1.

In nontonal languages like Spanish (as opposed to tonal languages, like Chinese or several African languages), intonation is closely tied to stress, in the sense that lexically stressed syllables constitute the location or reference point for relevant tones in intonation patterns (see, for instance, Gussenhoven 2004 for a more detailed discussion of this relationship). An utterance is generally divided into two or more prosodic phrases, each one with its own intonation pattern, depending on various factors, while very short sentences, like *Juan ve luz* 'Juan sees light', tend to be uttered in a single phrase. In longer sentences, with all else being equal, an SVO sentence will be uttered as two prosodic phrases, with the subject constituting a separate phrase: (S)(VO). This would be the case for a sentence like *Javier visitó Galicia* 'Javier visited Galicia', as shown in Prieto (2006). This phrasing reflects the closer relation between a verb and its direct object, and a larger structural distance from the subject. Syntax further influences prosodic phrasing in several respects: adjuncts, parentheticals of different sorts, and dislocated syntactic phrases constitute separate prosodic phrases; and syntactic branchingness very often motivates a separate prosodic phrasing of branching constituents. But prosodic phrasing can also be determined—or partially determined—by phonological factors. Section 2 addresses the debate over the interaction between syntax and phonology, and it is shown how the question of prosodic phrasing informs that debate.

1.3. Phenomena at the phonology-morphology-syntax interface

Some phenomena involve not only phonology and syntax but also morphology. A well-known example in Spanish is the presence of the article *el* before feminine singular nouns that start with stressed *a*, [ˈa]. The examples in (6a,b) show how in the grammar of Spanish the features [MASCULINE] and [FEMININE], respectively, are copied, through agreement, onto the definite article and the postnominal adjective. In (6c), with an initial stressed *a* on the noun *agua*, the article appears in its masculine form, at least apparently, while the postnominal adjective is feminine.

(6)	a.	la	temperatura	fría	
		the.FEM	temperature.FEM	cold.FEM	
	b.	el	clima	frío	
		the.MASC	climate.MASC	cold.MASC	
	c.	el	agua	fría	*la agua fría
		the.MASC	water.FEM	cold.FEM	

An ongoing debate in the literature has been whether the article *el* in (6c) is really the masculine article, as conveyed by the gloss, or is instead the feminine article that has adopted a shape homophonous with the masculine article through a series of phonological operations. The latter view is held by Harris (1987) and also Kikuchi (2001). Noting the historical evolution of the feminine article from Latin (ILLA > *ela* > *el/la*), Harris (1987) argues that the feminine article has the underlying representation /ella/. The form *el* is easily derived through natural-looking rules, like deletion of final /a/, adjacent to an identical vowel, plus degemination of /l/ in coda position. However, deriving the output [la] from /ella/ would require some brute force machinery (degemination plus unjustified deletion of /e/). Kikuchi (2001), within Optimality Theory (OT), also proposes a single feminine exponent, but in this case it is /la/, thus sidestepping Harris's problem with the default form of the article. Outputs like *el agua* are derived through the crucial ranking of two constraints: **la agua* is ruled out by a highly ranked constraint against sequences of identical vowels *V.V, which forces deletion of the unstressed vowel of the article, through the ranking *V.V >> MAX; then [e]-epenthesis is forced through a highly ranked constraint MSR (Minimum Size Requirement for functional words), which compels function words to be able to have their own syllable, a constraint that would be violated by an output like **l'agua*. However, the latter constraint is problematic because, in point of fact, in the grammatical output *el agua* [e.ˈla.ɣwa] the output article [el] does not belong to the same syllable. The constraint must therefore refer to the *possibility* (since it is never actually encountered) of the article and the beginning of the noun belonging to the same syllable. These strictly phonological approaches are difficult to maintain for the dialects of Spanish in which the phenomenon has extended to other prenominal elements, like the indefinite article, *un/una*; the demonstratives *este/esta*, *ese/esa*, and *aquel/aquella*; or the existential quantifier *algún/alguna*, among others (see Álvarez de Miranda 1993 for a description).

Cutillas (2003) gives up a strictly phonological analysis of the phenomenon and suggests an analysis based on phonologically conditioned allomorphy, which nevertheless cannot explain why the forms *la*, *esta*, and so on are the default. Hayes (1990) also suggests an allomorphy-based analysis of the *el/la* alternation, in which the *el* allomorph is inserted when followed by a noun starting with [ˈa]. The fact that the trigger is a noun must be mentioned because when the article is followed by an adjective starting with [ˈa], the regular *la* is selected, as in *la alta torre* 'the high tower'.

Other approaches to the phenomenon have claimed that the article that surfaces in examples like (6c) is the masculine article. This does not necessarily mean that a phonological requirement—avoiding a sequence of the type *[aˈa]—is forcing a change in gender value, a type of disagreement in the syntax. For Zwicky (1985), the change in the definite article would be the result of a rule of referral, which "sets the exponent of the feminine singular article to that of the masculine, in certain specified contexts" (p. 435); in other words, the feminine has the exponent (morph) corresponding to the masculine under certain conditions.

For nouns like *agua*, the role of syntax has become more apparent in varieties like colloquial Peninsular Spanish that have generalized masculine agreement to all prenominal elements within the Determiner Phrase (DP), while keeping feminine agreement with postnominal elements. This phenomenon has been described in Álvarez de Miranda (1993), Ambadiang (1999), *Nueva gramática de la lengua española* (RAE 2009), and also Eddington and Hualde (2008), who call the set of common nouns that trigger this asymmetry in agreement 'hermaphroditic nouns', illustrated in (7).

(7)	a.	el	nuevo	arma	secreta
		the.MASC	new.MASC	weapon.FEM	secret.FEM
	b.	todo	su	área	delantera
		all.MASC	its	area.FEM	front.FEM

In (7a) the restriction on *[aˈa] sequences would justify the use of the masculine in the prenominal adjective *nuevo* (**nueva arma* is avoided), but the same restriction cannot be held responsible for the change in the definite article, since *la* would not be adjacent to a stressed [á], since *nuevo* begins with a consonant. One could argue that *el* is used instead of *la* to avoid a mismatch in gender with the following adjective (**la nuevo*). But this hypothesis would not be consistent with example (7b), where the invariable possessive *su* neither repairs a possible mismatch in gender (*todo su*, *toda su*) nor runs into any phonological conflict with the following noun. Nevertheless, the preceding quantifier *todo* surfaces in its masculine form. It is clear then that in these dialects of Spanish what originated as a (partially) phonological phenomenon has ended up having a syntactic effect, at least to a certain extent, the original phonological effect appearing only as a fossil in the set of nouns—all starting with [ˈa]—that trigger the agreement asymmetry. This kind of prenominal-postnominal asymmetry, found also with other phenomena in Spanish and in other languages, is hypothesized in Bonet et al. (2015) to be the result of the fact that only postnominal agreement is a syntactic operation; at Phonetic Form (PF), OT constraints seek agreement (concord) throughout the DP. Asymmetries can arise because only postnominal agreement is subject to faithfulness constraints. For the particular case at hand, it is argued that a closed set of lexical items (feminine common nouns starting with stressed /a/) is subject to a postsyntactic impoverishment rule that deletes the gender feature on the noun. The postnominal feminine specifications are then the result of syntactic agreement, while the prenominal masculine agreement is the result of default assignment; it reflects lack of agreement.

Bonet et al. (2015) assume a widely accepted structure for the DP in which the noun is generated in the most embedded position (see, among many others, Picallo 1991; Cinque 1996); its surface position is the result of movement. For Bonet et al. (2015), the noun agrees with the elements it c-commands. This is the reason why postnominal modifiers agree with the noun syntactically; by contrast, prenominal modifiers cannot agree with the noun syntactically because they are not c-commanded by the noun.

2. The phonology-syntax interface: interactions and approaches

2.1. Phonology-free syntax?

Zwicky (1969) proposed the *Principle of Phonology-Free Syntax* (PPFS), according to which syntax cannot have access to any type of phonological information. In section 1 two cases were considered that could challenge this view. The second of these two cases was the *el/la* alternation with feminine singular nouns (section 1.3), where a phonological requirement (avoidance of a sequence [aá]) seems to prevent agreement, a syntactic operation, between the noun and the preceding definite article. The proposals put forth by Harris (1987) and Kikuchi (2001) attempt to avoid any reference to syntactic information by claiming that the *el/la* alternation is strictly phonological, although in Kikuchi (2001) the MSR constraint (Minimum Size Requirement for functional words) must distinguish function words from lexical words, a distinction that cannot be considered phonological. In Zwicky (1985) references to either syntax or phonological processes are avoided by claiming that a morphological rule of referral provides the feminine article with a masculine exponent. Bonet et al. (2015) analyze a different set of Spanish dialects, where all prenominal elements, not just the definite article, surface in their masculine form. For these dialects it is claimed that the original phonological condition has historically conditioned the set of nouns subject to the phenomenon; it is not a synchronically active condition. The syntax has thus become free of phonology. The syntax is also free of reference to the morphological properties of a closed set of lexical items: the syntax triggers agreement on postnominal modifiers only, and it is postsyntactically that the [FEMININE] feature in this closed set of items is deleted through a morphological rule of impoverishment that forces default [MASCULINE] to surface on all prenominal elements.

In section 1.2 another case was discussed that poses a challenge to the PPFS, namely Zubizarreta's (1998) hypothesis that syntactic movement of a narrowly focused constituent can be triggered to meet a prosodic requirement, in this case nuclear stress. The example used to illustrate this, (5), is repeated here as (8). Here the subject, with narrow focus, has moved to final position in order to be able to receive nuclear stress.

(8)	Compró	melones	el	**hombre**
	bought	melons	the	man

Prosodically motivated movement can also be found within major arguments. In (9), corresponding to Zubizarreta (1998: (105b)), the constituent with narrow focus (in boldface)—this time the direct object—has moved within the Verb Phrase (VP).

(9)	Juan	plantó	en	el	jardín	**un**	**rosal**
	Juan	planted	in	the	garden	a	rosebush

The rule responsible for nuclear stress, the C-Nuclear Stress Rule (C-NSR), reproduced in (10), mixes syntactic information (c-command relations) and prosodic information (prominence).

(10) *C-NSR* (Zubizarreta 1998: 19 (45))
Given two sister categories C_i and
C_j, the one lower in the asymmetric
c-command ordering is more prominent.

As presented, Zubizarreta's approach clearly disobeys the PPFS. The same issue arises with the OT account of the same facts in Gutiérrez-Bravo (2002), where the phonological constraint equivalent to the C-NSR is interspersed with syntactic constraints like STAY (against movement) or SUBJ (against an empty Spec,TP position).

Taking these last two authors (among others) as his starting point, Gabriel (2010) proposes a more articulated architecture that combines aspects of the Minimalist Program (Chomsky 2000, 2001) with a stochastic version of OT (Boersma and Hayes 2001). His paper is based on experimental work on two varieties of Argentinian Spanish that show optionality in the strategies used to convey narrow (informational) focus. In these varieties, in addition to the prosodic movement described and analyzed by Zubizarreta (1998), a common alternative is to realize focus *in situ*, a strategy traditionally regarded as reserved exclusively for conveying contrastive (corrective) focus; thus, nuclear stress is always realized on the focused position, even if it is not final in the clause. Similar results for varieties of Peninsular Spanish can be found in Vanrell and Fernández-Soriano (2013). In Gabriel's (2010) model of grammar, a basic syntactic structure is generated that includes theta role assignment, and assignment of pragmatic features, like [FOCUS], [+F]. At a later stage, GEN provides a list of candidates combining operations of core syntax, PF operations, and association with F_0 contours. The set of constraints relevant to the derivation of the optimal candidate include those reproduced in (11a,b) (corresponding to Gabriel 2010: (15a,d), respectively).

(11) a. STRESSFOC(SF)
$[_F$XP] bears nuclear stress.
b. STAY-PF
Phonetic material that does not belong to the verbal chain C-T-*v* is never realized below C, T, and *v*.

The constraint STAY-PF is violated in examples like (8), where the subject is realized below the verbal chain. Again, this constraint combines phonology (phonetic material) with syntactic structure. One could argue that evaluation of different options takes place at PF, not at the syntax proper. In that case, we either accept the possibility of postsyntactic movement or encounter the issue raised in the following subsection.

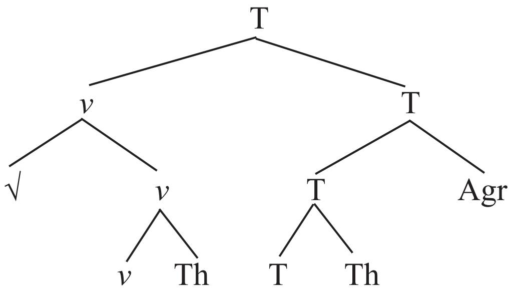
2.2. Syntax-free phonology?

The previous subsection was devoted to the question of whether the syntax has access to phonological information. But another important question is whether the phonology has access to syntactic information. Most of the debate on this end has been related to intonation and in particular whether prosodic phrasing has direct access to syntactic structure (in accordance with the so-called direct reference hypothesis) or whether, instead, syntactic structure is mapped onto prosodic structures, with the phonology having access only to this type of constituency (as per the indirect reference hypothesis). These two views are discussed in subsections 2.4 and 2.3, respectively. Here we will concentrate on a separate phenomenon, namely word stress in approaches that assume syntactic structure below the word.

From a descriptive point of view, stress in Spanish seems to work differently for verbs and nonverbs, which would mean that stress assignment has access to the syntactic category of lexical items. Some approaches have followed this line of research, while others have sought to find a unified account for nominals and verbs (see Roca, this volume). Oltra-Massuet and Arregi (2005) is one such approach; in their proposal stress assignment has direct access to syntactic information, as is briefly shown next.

Oltra-Massuet and Arregi (2005) is framed in Distributed Morphology (Halle and Marantz 1993), a framework in which words are built in the syntax from acategorial roots (√), and exponents are inserted postsyntactically through vocabulary insertion. Following Oltra-Massuet (1999), Oltra-Massuet and Arregi (2005) assume that postsyntactically a well-formedness condition causes the adjunction of a thematic node Th on all functional categories; the resulting structure for Spanish verbal forms is shown in (12). A node Th appears adjoined to *v* (the categorizer node that generates verbs), and a second node is adjoined to T. No Th is adjoined to Agr, because they assume that this node is inserted postsyntactically (hence it is not a functional category).

(12)



Some resulting verbal forms, from the past imperfective, indicative and subjunctive, are shown in (13).

(13)

√	*v*	Th	T	Th	Agr	
cant	Ø	**á**	b	a	s	'you were singing'
tem	Ø	**í**	Ø	a	mos	'we were fearing'
salt	Ø	**á**	s	e	n	'you jumped (subjunctive)'

Oltra-Massuet and Arregi (2005) argue that the future and the conditional have a more complex syntactic structure, with an extra functional node F. In these tenses the resulting forms are as shown in (14), for the conditional.

(14)

√	*v*	Th	F	Th	T	Th	Agr	
cant	Ø	a	r	**í**	Ø	a	Ø	'I/she/he would sing'
tem	Ø	e	r	**í**	Ø	a	Mos	'we would fear'

In (13) and (14) the stressed vowel appears in boldface. What the location of stress has in common in the two types of tenses is neither the type of foot it would create—because there are paroxytones ending in a vowel (*cantaría*), paroxytones ending in a consonant (*cantabas*, *saltasen*), and proparoxytones (*temíamos*, *temeríamos*)—nor its location with respect to the stem—adjacent to it in the past imperfective but not in the conditional. The common feature is that the stress always surfaces on the vowel to the left of T, whether T is phonologically realized, as seen in two of the forms in (13), or not, as in the remaining forms. Their analysis of stress is of the metrical grid type and based on Halle and Idsardi (1995). The stress algorithm they propose includes the rule in (15) (corresponding to Oltra-Massuet and Arregi 2005: (12b)).

(15) Insert a right parenthesis to the left of T on line 0.

The treatment of nouns and adjectives is similar: they have an abstract root, √, a categorizer node *n* (for nouns) or *a* (for adjectives), and, postsyntactically, a Th node. Some resulting forms appear in (16), with the stressed vowel in boldface.

(16)

√	*n/a*	Th	
m**e**s	Ø	a	'table'

v**e**rd	Ø	e	‘green’
jug	**o**s	o	‘juicy’
ver	d**a**d	Ø	‘truth’

The stress algorithm for nouns and adjectives includes the rule in (17) (corresponding to Oltra-Massuet and Arregi 2005: (45b)), which is crucial for establishing the position of stress.

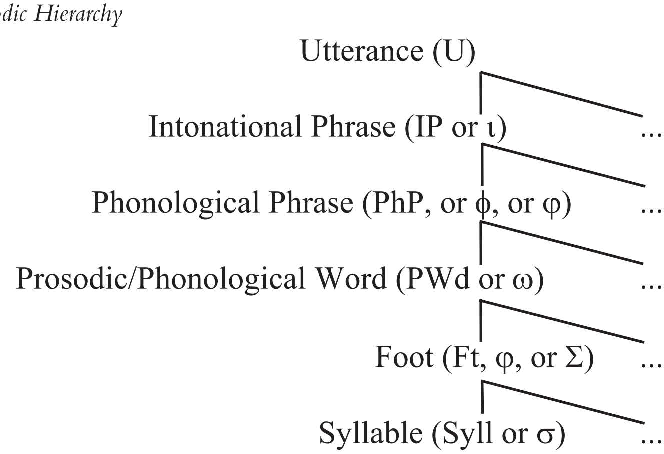
(17) Insert a right parenthesis to the right of the highest *n* or *a* on line 0.

The rules in (15) and (17) make reference to phonological information, related to metrical grid formation, but they also make reference to the functional category T, in addition to category-defining heads like *v*, *a*, and *n*.

2.3. Indirect reference approaches

Most approaches to intonation, phrasing, and postlexical phonological processes have assumed or defended models with an indirect reference to syntax. Syntactic structure is not accessed directly by the phonology but is mapped onto prosodic constituents of different sizes, and it is these constituents that are read by the phonology. The different types of prosodic constituents are organized following the Prosodic Hierarchy (Selkirk 1978, 1984; Nespor and Vogel 1986), the most widely accepted levels of which appear in (18).

(18) *The Prosodic Hierarchy*



Nespor and Vogel (1986) also included the clitic group in the hierarchy, this constituent referring to sequences that involve a lexical word plus one or more clitics, such as what we saw in example (2b), *pó[m]melo* ‘put it for me’. However, the clitic group has been rejected in most later work, because there are different kinds of relations, ranging from tighter to looser, between clitics and their hosts, and these relations can be better defined with respect to the prosodic word. Other types of constituents, like the intermediate phrase (iP), minor and major phrases, or accentual phrases, have also often been included in the hierarchy, but, in any case, it seems clear that within any given language, there are never more than two or three attested levels above the word. In the remainder of this chapter, we will ignore the levels below the word (the foot and syllable) and concentrate on the levels above it, especially the phonological phrase and the intonational phrase. The prosodic constituents that were illustrated with the sentence *Javier visitó Galicia* 'Javier visited Galicia' in section 1.2 would be phonological phrases: (*Javier*)ϕ (*visitó Galicia*)ϕ; the whole sentence would constitute an intonational phrase, and also an utterance.

The Prosodic Hierarchy is subject to the Strict Layer Hypothesis, which states, among other things, that no level can be skipped or that a constituent of a lower level cannot be shared by two constituents of an upper level. Selkirk (1995), within OT, decomposes it into the set of constraints on prosodic domination reproduced in (19) (from Selkirk 1995: (4)):

(19) **Constraints on prosodic domination** (where C^n = some prosodic category)

a. LAYEREDNESS: No C^i dominates a C^j, $j > i$.
e.g. "No σ dominates a Ft."

b. HEADEDNESS: Any C^i must dominate a C^{i-1} (except if $C^i = \sigma$).
e.g. "A PWd must dominate a Ft."

c. EXHAUSTIVITY: No C^i immediately dominates a constituent C^j, $j < i-1$.
e.g. "No PWd immediately dominates a σ."

d. NONRECURSIVITY: No C^i dominates C^j, $j = i$.
e.g. "No Ft dominates a Ft."

While LAYEREDNESS and HEADEDNESS seem to hold for all languages and would be unranked with respect to other constraints (or would be integrated in GEN), EXHAUSTIVITY and NONRECURSIVITY seem to be clearly violated in many languages. Selkirk (1995) illustrates how violations of these two constraints provide the configuration for different types of clitic-host relations. Ito and Mester (2007, 2012) propose a hierarchy with three categories above the word plus the possibility of recursion (adjunction); this would allow the possibility of having, for instance, a PhP^{max}, a PhP^{min}, or a simple PhP. The possibility of recursion has been explored in much recent work on phrasing.

While approaches like Nespor and Vogel (1986) rely on syntactic structural relations for the mapping to prosodic constituents, Selkirk (1986) and Chen (1987) propose a theory based on constituent edges, in which, through different parameter settings, the right or left edge of X^0 or XP determines prosodic constituent edges. This so-called end-based theory of prosodic domains has subsequently been adapted to OT, with Alignment constraints like the one in (20), reproduced from Truckenbrodt (2007: (6a)). In (20) p-phrase corresponds to phonological phrase.

(20) ALIGN-XP,R = ALIGN(XP, R; p-phrase, R)
The right edge of each syntactic XP is aligned with the right edge of a p-phrase.

One of the main achievements of the end-based theory of prosodic domains is that it immediately captures the observed lack of isomorphism between prosodic and syntactic constituents. Truckenbrodt (1995) adds to the Alignment constraints the constraint WRAP-XP, which assigns a violation mark for each syntactic XP that is split between two phonological phrases. Prieto (2006) concludes that this constraint must have a low ranking in Spanish because it never proves decisive.

Following her previous study on Catalan phrasing (Prieto 2005), which in turn follows previous work in Ghini (1993), Prieto (2006) shows that, for phrasing in Spanish, it is necessary to take into account the purely prosodic well-formedness constraints reproduced in (21), in addition to the Alignment constraint in (20). The constraint MAX-BIN (IP head) in (21a) corresponds to Prieto (2006: (25)) and makes reference to the length of the rightmost phonological phrase of the utterance.

(21) a. MAX-BIN (IP head)
A phonological phrase that is the head of an IP constituent must be binary (at the ω level).

b. MIN-BIN
P-phrases should consist of minimally two prosodic words.

A more appropriate definition of the constraint MAX-BIN (IP head), given its effects in the tableaux in Prieto (2006), appears in (i). As stated in (21a), the constraint would penalize not only phrases with more than two prosodic words but also phrases with one prosodic word, an undesirable result since it would rule out grammatical outputs like (22c).

(i) MAX-BIN (IP head)
A phonological phrase that is the head of an IP constituent consists of maximally two prosodic words.

The constraint MAX-BIN (IP head) seems to be equivalent to the constraint MAX-BIN-END in Prieto (2005: (15)): "P-phrases containing the main stress of the utterance consist of maximally two prosodic words."

The following two tableaux illustrate the main aspects of the analysis proposed in Prieto (2006). In (22) (corresponding to Prieto 2006: (33a)), there are two possible optimal phrasings, (22b, c). Since the sequence contains three prosodic words, it is impossible to satisfy the lower-ranked constraint MIN-BIN because one phonological phrase is bound to have only one prosodic word, except if the whole sequence is contained in a single phrase, (22a), in which case the higher constraint MAX-BIN (IP head) is violated because it contains more than two prosodic words. (22a) is possible only in fast speech, for which additional constraints would come into play.

(22)

	[Compraba [mapas [de Barcelona]$_{PP}$]$_{NP}$]$_{VP}$	MAX-BIN (IP head)	ALIGN-XP,R	MIN-BIN
	a. ( )φ	*!		
☞	b. ( )φ( )φ			*
☞	c. ( )φ( )φ			*

In (22) there are two optimal candidates because WRAP-XP is not taken into account. As already mentioned, Prieto (2006) reaches the conclusion that this constraint must be low ranked, and this is the reason why it is not relevant. But, in fact, even with a lower ranking, WRAP-XP would be decisive and would make (22b) the optimal candidate: (22b) violates it once because the VP (*compraba mapas de Barcelona*) is split between two phonological phrases; (22c) violates it twice because both the VP and the Noun Phrase (NP) (*mapas de Barcelona*) are split between two phonological phrases. Although optionality is taken into consideration in Prieto (2006), none of the common OT approaches to optionality is adopted. It is a matter for future research to examine whether optionality of this sort would be better analyzed within a grammar with partially ordered constraints (as in Anttila and Cho 1998), within a stochastic model of OT (Boersma and Hayes 2001), or in some other model altogether.

In (23) (corresponding to Prieto 2006: (33b), with one correction), which contains an additional Adjectival Phrase (AP), there are four prosodic words; for this reason, the optimal candidate is the one where each phonological phrase contains two prosodic words.

(23)

[Compraba [mapas [de la Barcelona [antigua]$_{AP}$]$_{PP}$]$_{NP}$]$_{VP}$	MAX-BIN (IP head)	ALIGN-XP,R	MIN-BIN
a. ( )φ	*!		
☞ b. ( )φ( )φ	*!		*
☞ c. ( )φ( )φ			*
☞ d. ( )φ( )φ			
☞ e. ( )φ( )φ( )φ			*

Rao (2007, 2008) has done additional, more detailed experimental work on phrasing in the Spanish of Lima and Barcelona Spanish, respectively.

More recently, Selkirk (2009, 2011) has proposed Match theory, which leaves behind Alignment constraints and WRAP-XP, to replace them with constraints that seek an exact mapping between syntactic constituents and prosodic constituents, matching clauses with intonational phrases, and phrases with phonological phrases. Kratzer and Selkirk (2007) combine this approach with Chomsky's notions of Spell-Out and phases, and include conditions like the one reproduced in (24) (corresponding to Kratzer and Selkirk 2007: (20)).

(24) The Highest Phrase Condition on prosodic Spell-Out
The highest phrase within the Spell-Out domain of a phase corresponds to a prosodic major phrase in phonological representation.

Phase-based approaches to phrasing do not seem to have been applied thus far to Spanish.

Nespor and Vogel (1986) discuss nasal assimilation in Spanish, a phenomenon that, together with spirantization, was described in section 1 and illustrated in (2). They conclude that the domain of application of the process is the Intonational Phrase (IP), since it can easily be subject to restructuring, and it often fails to apply before and after parentheticals, nonrestrictive relative clauses, or vocatives, among others. In the examples in (25), adapted from Nespor and Vogel (1986: 59a,c), the nasals that assimilate appear in phonetic transcription, while the ones that are in the right phonological context (before a consonant) but nonetheless fail to assimilate appear underlined and boldfaced.

(25) a. [Tenía[n̪] diez ca[ŋ]guros en u[m] parque muy cerca de aquí]$_I$
'(They) used to have ten kangaroos in a park very near here.'

b. [U[ŋ] gra[m] balcó**<u>n</u>**]$_I$ [como sabe**<u>n</u>**]$_I$ [puede ofrecer mucho placer]$_I$
'A large balcony, as they know, can offer much pleasure.'

In (25a) all the nasals are included in the same IP, and all assimilate. (25b) includes a parenthetical, *como saben*; this blocks the nasals at the edges of the parenthetical from assimilating, according to Nespor and Vogel (1996).

Actually, nasal assimilation can apply between two only pragmatically related adjacent clauses, as long as they are uttered without a pause between them, as in (26). The absence of pauses in (25b) would make assimilation also possible.

(26) a. No tiene pa[m]. Me voy.
'(S/he) doesn't have bread. I'm leaving.'

b. Llama a Jua[ŋ]. Comienza a llover.
'Call Juan. It's starting to rain.'

The utterance would seem to be a more adequate domain of application of nasal assimilation than the IP (the same could be said about spirantization). Using Kaisse's (1985) terminology, nasal assimilation is best characterized as a fast-speech rule (level P2 rule), or also as an across-the-board rule, a rule that is sensitive to pauses and to speech rate (in very slow speech, nasal assimilation at the end of a word can be blocked in almost any syntactic context). Since pauses are often inserted at the edges of IPs, this is what makes nasal assimilation look like a rule belonging to this level.

2.4. Direct reference approaches

There are two ways to understand the term *direct reference*. In its more restrictive sense, direct reference allows direct access to syntactic information and rejects the existence of prosodic domains. In its looser sense, it accepts both possibilities. Gabriel (2010), briefly mentioned in section 2.1, illustrates the looser view. His proposal for narrow (informational) focus within OT includes, among others, the constraints in (27), where (27b) repeats the constraint in (11b) (with (27a) corresponding to Gabriel 2010: (15b)).

(27) a. ALIGNFOCRIGHT(AFR)
The right edge of [$_F$XP] is aligned with the right edge of an intonational phrase (IP).

b. STAY-PF
Phonetic material that does not belong to the verbal chain C-T-*v* is never realized below C, T, and *v*.

The constraint in (27a) mentions a prosodic domain, the IP, while the constraint in (27b) makes reference to pure syntactic information. Moreover, these constraints belong to the same CON set; that is, outputs are evaluated for both types of constraints in the same round of evaluation. This view differs from other Minimalism-based approaches, like Dobashi (2004), for whom prosodic domain formation occurs in two steps, with the first one referring to syntax and the second one referring to prosody. Zubizarreta (1998) would probably represent the stricter view, since no domains of the prosodic hierarchy seem to play a role in her approach. Few proposals explicitly reject the existence of prosodic domains, D'Alessandro and Scheer (2015) being a recent example of such a view.

3. General discussion and concluding remarks

A strict direct reference view of the phonology-syntax interface would deny the existence of prosodic constituents, and that would certainly be a simpler model of grammar since no mapping between syntactic and prosodic constituencies would be needed. All the work could then be left to phases and the operation Spell-Out, as claimed by D'Alessandro and Scheer (2015), who lay the burden of determining phonologically relevant domains fully on syntactic heads. But this view can hardly be maintained when one considers data like those discussed in section 2.3 from Prieto (2006). In (22) and (23) it was shown that the prosodic phrasing possibilities of a VP depend on the internal complexity of that VP. The sentence *Compraba mapas de Barcelona* allows a phrasing of the type (*compraba*)(*mapas de Barcelona*), with the verb as a separate domain from the direct object. But when the Prepositional Phrase (PP) complement of the direct object contains an adjective, the verb cannot be phrased separately: (*compraba mapas*)(*de la Barcelona antigua*), *(*compraba*)(*mapas de la Barcelona antigua*). The phrasing possibilities of these examples have to do with the number of prosodic words involved, the basic syntactic structure being identically $[_{VP}$ V $[_{DP}$ N $[_{PP}$ X]]]. Prosodic domains seem to be necessary, since prosodic considerations are crucial to determine the possible and impossible phrasings.

A different question is whether reference to syntactic information is nevertheless necessary in the phonology. One approach to stress was shown (Oltra-Massuet and Arregi 2005, in section 2.2) where the stress assignment algorithm needed to have access to syntactic categories like T. Ohannesian (2005) illustrates an approach where no distinction is made between nouns and verbs, and where the differences between them are a consequence of the different kinds of paradigms they originate, the proposal being framed in the Optimal Paradigm model (McCarthy 2004). For the alternation *el/la* for the definite article, treated in section 1.3, it is also necessary to know that the following word starting with [á] is a noun (more specifically, a common noun). If the alternation is analyzed as some kind of phonologically conditioned allomorphy rather than the result of some phonological rules or constraints from a single underlying form, the interaction is driven away from pure phonology. As we have seen, the alternation has evolved into a phenomenon of a morphosyntactic nature, with asymmetric agreement between prenominal and postnominal modifiers.

Still a different question that was also considered, in section 2.1, is whether the syntax can have access to phonological information, with Zwicky's PPFS in mind. The most compelling case illustrated was narrow focus and the prosodically motivated movement proposed by Zubizarreta (1998). One possible way to reconcile Zubizarreta's insights with the PPFS would be to assume that movement applies freely in the syntax. The derivation crashes at PF only if the constituent with a feature [FOCUS] associated with the relevant constituent does not coincide with the constituent that receives nuclear stress.

A detailed overview of the relations between phonology and syntax can be found in Elordieta (2008). This chapter has shown that prosodic domains are necessary. Nevertheless, it is possible that access to morphosyntactic information is still needed.

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16

Segmental, syllabic, and phrasal stratum domains of Dominican Surprise-[s] hypercorrection

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1. Introduction

The aspiration and elision of syllable-final /s/ in nonstandard varieties of Spanish are very common weakening processes that have attracted the attention of many researchers. These phenomena occur in most Spanish speaking countries, e.g., southern Spain, the Canary Islands, and the vast majority of Latin America (Canfield 1962; Lipski 1994). In the Spanish variety spoken in the Dominican Republic (DR), which we will call popular Dominican Spanish (PDS), elision occurs more drastically since these speakers, regardless of their gender, age, and level of education, delete /s/ in coda position almost in its entirety. Terrell (1986) indicates that this phenomenon could be the result of the restructuring of the lexical representations of words containing underlying /s/.

Still, PDS speakers are conscious that elision of /s/ is stigmatized, and thus they realize [s] or its aspirate counterpart [h] in contexts where there was no /s/ etymologically. This hypercorrection phenomenon is derisively called *hablar fisno* (*hablar fino*) 'to speak in a refined manner' in the DR because these speakers are perceived as attempting to imitate the speech of those who they believe speak in a lofty, refined manner when they pronounce syllable-final /s/. Since the appearance of [s]/[h] occurs in the rhyme, regardless of following consonants, hereafter we will call it "Surprise-[s]", a term to be justified later on. This insertion process has been the topic of numerous analyses. Among other claims, Surprise-[s] has been regarded as the hypercorrection of the deletion of rhyme /s/ (Henríquez Ureña 1975 [1940]; Andrade 2009; Terrell 1986; Núñez Cedeño 1988; Harris 2002); it has been held subject to constraints on syllable position (Terrell 1986; Núñez Cedeño 1988; Harris 2002; Bradley 2006), and it has been thought to obey voicing restrictions within and across word boundaries, as well as in phrase-final position (Morgan 1998; Bullock and Toribio 2010; Bullock et al. 2014). Surprise-[s] is clearly a syllable-rhyme phenomenon; i.e., it never occurs in the onset, but analyses of new data extracted from dictionaries and from a field survey suggest that elements of earlier analyses must be modified. Our reanalysis includes the following proposals, among others, in roughly increasing order of complexity.

First, we focus our attention on Bullock and Toribio's (2010) and Bullock et al.'s (2014) hypotheses. They assert that word-medial Surprise-[s] is followed predominantly by a voiceless stop, and that this alleged distributional restriction is theoretically significant. In fact, a close examination of distributional data of abutting consonants taken from a standard Spanish dictionary as well as from the PDS lexicon show that while voiceless obstruents in onset position outnumber voiced obstruents and sonorants, thus agreeing with previous findings by Poplack (1979) and File-Muriel (2007, 2009), it is a statistically inescapable fact that the occurrence of Surprise-[s] is not due to any phonological restriction but is rather the result of the phonotactic frequencies of sequences of consonants found in Spanish in general; phonological constraints in PDS have nothing to do with it. Second, observational data obtained from a controlled survey, along with spontaneous conversations collected from media sources, are also indicative of the tendency for Surprise-[s] to occur freely in the rhyme before any permissible following consonant in PDS. In light of these data-based distributional and observational activities, we will entertain the following hypothesis: the phonotactic frequency of Surprise-[s] in the coda reflects the phonotactic frequency of lexical coda-[s] in the lexicon, word-internally. For example, within the word, Surprise-[s] will be much more frequent before voiceless stops than before voiced stops, because the lexical sequences /sp, st, sk/ have a much greater frequency than /sb, sd, sg, sn, sm, sl/. More generally, we thus take it that Surprise-[s] is equally likely in all preconsonantal contexts.

Second, no previous analysis has offered an explicit treatment of the interplay that may exist between aspiration or deletion of /s/ and Surprise-[s] across a word boundary, the assumption being that they are unrelated. While in PDS word-final /s/ may be first aspirated (or, more radically, deleted), it may also be resyllabified as the onset of the first syllable of a vowel-initial word. While our data show that /s/ may be resyllabified, Surprise-[s] appears to suppress resyllabification despite being followed by a vowel-initial word, nor can it be deleted under any circumstances. To explain the failure of resyllabification, we will argue for and adopt Selkirk's (1984) theory that there exist underlying timing effects in surface structure representations at the edge of syntactic constituents that map onto a phonological representation as silent positions, with the explicit function of converting these abstract units into phonetic representations, that is, an actual pause. We will thus advance the hypothesis that Surprise-[s] resists resyllabification because those silent positions, which are still present at the postlexical stratum, block the process from occurring, whereas a lexically derived [s]/[h] can resyllabify because there is no physically realized pause intervening between adjoining words. We therefore take it that this lack of phonation is driven by the grammar of PDS speakers.

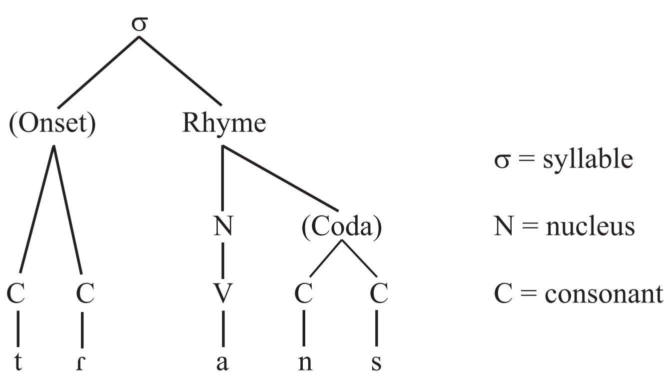
To cover the two proposals mentioned previously, in Section 2 we present an overview of the syllable as organized in PDS, making reference to its structure from general Dominican Spanish, as necessary background for all ensuing discussions. Section 3 provides the context for addressing proposal one regarding Bullock and Toribio's (2010) and Bullock et al.'s (2014) hypotheses that the insertion of Surprise-[s] is restricted to specific phonological contexts. In this section we present a quantitative, distributional account in support of our arguments and against the proposal of the authors just cited. We discuss and summarize our results, concluding that [s] can be inserted into any coda, regardless of the featural properties of the following consonants. This is followed and corroborated by the analysis of some observational facts showing that Bullock and colleagues' putatively phonological constraints are far too reductive in scope. Tied to the previous section, Section 3 examines the interface of lexical /s/ and Surprise-[s] with empirical support, which demonstrates that their resyllabification, or lack thereof, is due to the presence of an intervening pause. After confirming the existence of a pause in connected speech, Section 4.4 presents arguments to explain why Surprise-[s] fails to resyllabify. Section 5 closes the chapter with a general summary and discussion.

2. Syllabification and resyllabification in PDS

To begin with, let us assume that the consonants in (1) constitute the basic segmental inventory of general Dominican Spanish. We will also assume the constituency of the syllable structure illustrated in (2), albeit with a simplified rhyme, as the basis for syllabification in general as well as in PDS, adapted from Harris (1983: 3), which perhaps is the most common representation used by contemporary phonologists (Hualde 2014: 199).

(1) /p, t, k, b, d, ɡ, f, s, m, n, ɲ, l, ɾ, ʧ, ɟ, h, w, j, i, e, a, o, u/

(2)



The σ is the head of the syllable, which consists of a rhyme containing a vowel as the obligatory nucleus.

As in all Spanish dialects, the nucleus may branch into the semiconsonant [j] or the semivowel [i̯], which may precede or follow it, e.g., the vocoids shown in boldface in ***pie*** 'foot' and ***pei**ne* 'comb', respectively (Harris 1983: 22–25, 1993: 178–179).

The rhyme may be preceded by an optional onset drawn from any one of the consonants of the general Dominican Spanish phonological inventory shown in (1), or it may be expanded to a maximum of two consonants, the first one selected from among the obstruents /p, t, k, b, d, ɡ, f, h/, then followed by the liquid /l/ or /ɾ/.

Dominican Spanish allows for the complex onset types [tl], [dl], and [hl]; e.g., *Atlántico* 'Atlantic', *adlátere* 'close companion', and *Majluta* are syllabified respectively as [a.ˈtlan.ti.ko], [a.ˈðla.te.ɾe], and [ma.ˈhlu.ta]. In these cases it is an established fact that for most Spanish dialects the first consonant becomes the coda of the preceding rhyme (Hualde 2014: 200–204).

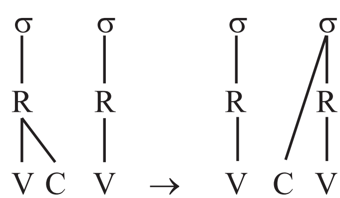
The rhyme may also be followed by an optional coda, which typically consists of one of the coronals /t, d, s, n, l, ɾ/ and at most a second consonant, which is normally /s/.

In moderate learned speech, word-internal obstruents /p, t, k, b, ɡ/ may be weakened, becoming the approximants, [ß′, ð′, ɣ′], while the most usual solution in popular speech is to delete them or substitute for various allophonic sounds, depending on sociolinguistic factors (Jiménez Sabater 1975: 120–126; Alba 2004: 99–101; Acosta 2014). Thus, lexical /apto/ 'apt', /etniko/ 'ethnic', /akto/ 'act', /obheto/ 'object', /admiɾa/ 'he admires', and /diɡno/ 'worthy' may be realized as [ˈaØ.to], [ˈe ð′/Ø.ni.ko], [ˈaɣ̣/Ø.to], [oß′/Ø.ˈhe.to], [a ð′/Ø.ˈmi.ɾa], and [ˈdi ɣ̣/Ø.no].

The sequence *trans* in *transportar* 'to transport' illustrates a syllable with complex margins in this general Dominican dialect. As in the syllable structure of most Spanish dialects, the coda cannot contain underlying palatal consonants. It is the case, however, that word-internal coda obstruents are rarely pronounced in PDS, while those found overtly in syllable-final position are only of the /n, l, ɾ/ types. Since no researcher has documented productions of lexically derived complex codas, which arguably may be absent from these speakers' lexicon, we are centering our attention on codas closed by /s/, the focus of the present study.

Another assumption we are making is that of resyllabification of coda consonants, which occurs when they are followed by vocoid-initial morphemes or words. As in standard Spanish, in ordinary speech, Dominican Spanish and PDS resyllabify the sequence . . .VC.+/#V. . ., where + and # denote the morpheme and the word boundary, respectively, as . . .V.C+/#V. . .; that is, the coda consonant moves into the onset position of a following morpheme that begins with a vocoid. For example, the word-internal /s/ in the prefix /des-/ 'un-' in /des+amara/ *desamarra* 's/he unties' and that of the determiner /las/ 'the, plural' in the phrase /las#eskinas/ 'in the corners' are resyllabified, yielding the corresponding /de.s+a.mara/ and /la.#se.kinas/. In order to account for this process, several theoretical analyses have been offered, among them the rule-based proposals by Harris (1983, 1993), Núñez Cedeño (1985), and Hualde (1992), and the optimality-oriented solutions by Roca (2003) and Colina (2009). All of them, though seemingly making different theoretical predictions and claiming various degrees of success, coincide in requiring onsets for otherwise onsetless morphemes. We go along with Harris's (1993: 182) algorithm given in (3), with the understanding that it ultimately favors the canonical CV syllable pattern.

(3) Resyllabification



As Harris notes, this rule modifies syllabic constituency such that a fully syllabified C, the coda of the first syllable in (3), passes to occupy the onset of an already existing, onsetless constituent in the following rhyme.

Having established the syllable constituency as the backdrop for the ensuing presentation, in the next section we consider Bullock and Toribio's (2010) and Bullock et al.'s (2014) assertion that the insertion of Surprise-[s] is restricted to certain phonological contexts, specifically before a voiceless stop and at the end of a word. We begin with setting the background for the presentation, followed by quantitative and qualitative surveys, which reveal that their hypothesis is too restrictive in scope.

3. The phonological context of Surprise-[s]

In their studies about the status of fricative /s/ in Dominican Spanish, Bullock and Toribio (2010) and Bullock et al. (2014) propose that Surprise-[s] is inserted in a coda followed by certain types of consonants in words that do not contain it in their underlying representation. Previous studies (Núñez Cedeño 1988; Morgan 1998) argue in favor of a more general insertion process; that is, Surprise-[s] would be inserted in any type of rhyme-plus-consonant context. Essentially, these two researchers argue for a process as reflected in the noncommittal rule of serial phonology, which we adopt in (4):

(4) $$\emptyset \rightarrow s\,/\,\underset{\mathrm{R}}{\underline{\quad\;}}$$

Rule (4) inserts /s/ in a rhyme. This process contributes to creating syllable complexity because a new segment such as /s/ is inserted where it did not exist before, i.e., in an open syllable, and also because in general closed syllables are universally more marked, and thus more complex, than open ones.

In contrast, Bullock et al. (2014) disputed the rhyme-insertion hypothesis and argued instead that Surprise-[s] appears, in the majority of cases, before a voiceless stop, both within words and in word-final positions. Concretely, the authors identified three contexts where Surprise-[s] can appear: in *sandhi* position, within the word, and before a pause. Moreover, the authors indicated that PDS speakers know the underlying form of the words, which have an /s/ in coda position and suggested that the insertion of /s/ could be due to a need to change registers.

Similarly, Morgan (1998) pointed out that Surprise-[s] happens both at the end of a syllable and at the end of the word, but it occurs more frequently word-finally. Likewise, he indicated that it was more commonly inserted before a consonant, especially before /p, t, k/ or a posttonic unstressed syllable. Morgan concluded that PDS speakers are prone to delete the fricative /s/ and, thus, are also inclined to insert an /s/. Morgan further added that these speakers arguably would never add /s/ in a context where elision cannot take place, in a structure that is not permitted in Spanish (cf. Durvasula and Kahng 2015: 386).

In a sense, Morgan's suggestion that Surprise-[s] is tied to the presence of deletion of lexical /s/ in Dominican Spanish mirrors what Durvasula and Kahng call the *Reverse Inference Hypothesis*. That is, during the perception of speech, speakers tend to "identify the best estimate of the intended underlying categories of the utterance for the incoming acoustic signal" (Durvasula and Kahng 2015: 386). Accordingly, the best estimate for PDS speakers is to insert [s] in the coda because that is the sound they perceive to be pronounced in similar contexts.

Finally, File-Muriel (2009), in a study about [s]-lenition in Barranquilla Spanish, found that phonotactic frequency was one of several important factors for predicting the production of [s] in medial position before another consonant. By extension, similar predictions could apply to the production of /s/ in coda position in PDS as well as to the insertion of Surprise-[s] in this dialect.

Given the general background on Surprise-[s] presented so far, in the following sections we want to accomplish two goals. First, in Section 2.1 we seek to determine whether the contexts in which /s/ occurs in Spanish, and the frequency of some of these contexts, could be related to the process of Surprise-[s] in PDS. In other words, we want to establish whether there exists a statistical relation between the context in which /s/ is most likely to surface and the context where Surprise-[s] also occurs the most. From this perspective, we will argue that the contexts previously proposed (Bullock and Toribio 2010; Bullock et al. 2014), instead of constituting a *bona fide* restriction, are the consequence of the high frequency in the phonotactic distribution of /s/ when followed by another consonant in Spanish generally. Second, in Section 2.2 we investigate whether Surprise-[s] is restricted in its scope of occurrence, namely, whether it is likely to surface only before voiceless consonants. To show that this claim is inconsistent with what PDS speakers do, we collected samples with Surprise-[s] appearing before voiced consonants.

3.1. Distributional survey: quantitative approach

In order to see whether the uneven distribution of Surprise-[s], appearing mostly before voiceless stops, could be related to the distribution of etymological /s/ in Spanish (cf. File-Muriel 2007, 2009), we used the *Diccionario de uso del español actual* (Grupo Sm 2003; last visited, 2016) and the *Léxico disponible de la República Dominicana* (Alba 1995, 2012). First, the *Diccionario de uso del español actual* allowed us to enter a specific sequence (e.g., /st/) in the search bar, and it automatically provided us with all words in Spanish that contain such a sequence. Table 16.1 illustrates the possible sequences of postvocalic /s/ in coda position followed by consonants in Spanish.

As the reader may have noticed, we skipped some contexts with the postvocalic /s/+palatal sequence, either because they do not exist or because they are scarce. For instances, the dictionary does not list the sequences *sñ* and *sll*. And although the sequence *sy* is found, only five instances are listed: three corresponds to the prefix *dis-* attached to the same root, as in *dis+yunción/+yuntivo/+yuntiva* 'dis+junction/+junctive'; one appears with the prefix *des-*, as in *desyerbar* 'to weed'; and the remaining one is the loanword *disyóquey* 'disc jockey'. The graphic sequence *sch* is both deceiving in pronunciation and rare, and thus was excluded. This grapheme is found only in loanwords, such as *kitsch* and *schnauzer*, in which the *ch* for the former is pronounced but not the *s*, while for the latter the *ch* is not articulated but the *s* is. Not considered either were examples with *x* before another consonant, which may correspond to the sequence [ks] in careful speech or simply [s] in casual speech, as in *exportar* 'to export', *extraviar* 'to misplace', or *excusa* 'excuse'. Since in this context *x* represents a complex coda rather than the -Vs+C sequence we are considering here, or is variably pronounced, we ignored it.

For reasons of simplicity, the contexts in Table 16.1 were divided into the consonant groups illustrated in Table 16.2. Note that the consonantal sequences in Table 16.2 are in fact spelling entries that represent the sounds illustrated on the right in Table 16.1.

The letter *c* refers specifically to the sound noted on the right, which we assume is followed by a nonfront vowel, for instance, in *escaso* 'scant' and *escozor* 'itch'.

Second, in Alba's (1995, 2012) study of the lexicon of the DR compiled in the *Léxico disponible de la República Dominicana*, we explored the distribution of these consonantal sequences in Dominican Spanish. These two studies by Alba contain the majority of the lexical items used by PDS speakers, divided by topics (e.g., body parts, food, jobs, and so on) and social class. For

Table 16.1 Contexts in which /s/ appears in coda position in Spanish

Context	*Phonological representation*
sp	[sp]
st	[st]
sc, sq	[sk]
sb, sv	[sb]
sd	[sd]
sg	[sg]
sf	[sf]
sl	[sl]
sm	[sm]
sn	[sn]
sr	[sr]

the present work we concentrated on the lexicon pertaining to lower-class Dominican speakers since, according to the literature (see Bullock et al. 2014), Surprise-[s] occurs most frequently in the speech of speakers belonging to this class.

Upon compiling the words that PDS speakers use more often, Alba (1995, 2012) asked the 106 participants to write as many words as they could for the aforementioned topics in the space of two minutes. He later determined that each speaker produced around 214 words. Hence, the *Léxico disponible de la República Dominicana* helped us uncover the distribution of /s/ in this particular dialect and in this socioeconomic group. Our ultimate goal was to sift through the distribution of /s/ not only in Spanish in general but also in the specific dialect where Surprise-[s] surfaces, PDS.

Two chi-square tests were run, one for the *Diccionario de uso del español actual* and one for the *Léxico disponible de la República Dominicana*. This particular test allowed us to assess whether there is an equivalence between the data collected from the dictionary and Alba's (1995, 2012) books and the data that we would expect to obtain if /s/ was evenly distributed across all the categories in Table 16.2.

2.1.1. Results

Table 16.3 shows the frequencies of /s/ obtained from the *Diccionario de uso del español actual* by consonant group.

In this table we can readily observe that the /s/ plus voiceless stop sequence is much more frequent than any other environment in which /s/ is found (i.e., 76.43%), thereby agreeing with previous findings for general Spanish (Poplack 1979; File-Muriel 2007, 2009). The chi-square test further confirmed that /s/ is not evenly distributed among the four consonant groups (X^2 (3, N = 7603) =11072.86, p < .05).

The same procedure was followed in the case of the *Léxico disponible de la República Dominicana*. First, as we can see in Table 16.5, we analyzed the frequencies of /s/ in the same consonantal

Table 16.2 Consonantal sequences divided by consonant group

Consonant group	*Consonantal sequences*
Voiceless stop	sp, st, sc, sq
Voiced stop	sb, sv, sd, sg
Nasal	sm, sn
Continuant	sf, sl, sr

Table 16.3 Frequencies of /s/ by consonant group according to the *Diccionario de uso del español actual*

Group	*Number*	*Percentage*
Voiceless stop	5818	76.43%
Voiced stop	254	3.34%
Nasal	1219	16.01%
Continuant	321	4.22%
Total	7612	100.00%

Table 16.4 Chi-square test by consonant group in the *Diccionario de uso del español actual*

	Observed N	*Expected N*	*Residual*
Voiceless stop	5818	1900,8	3917,3
Voiced stop	245	1900,8	-1655,8
Nasal	1219	1900,8	-681,8
Continuant	321	1900,8	-1579,8
Total	7603		

	Consonant type
Chi-Square	11072,865
df	3
Asymp. Sig.	,000

Table 16.5 Frequency of each sequence divided by consonant group in the *Léxico disponible de la República Dominicana*

Group	*Number*	*Percentage*
Voiceless stop	111	92.43%
Voiced stop	1	0.83%
Nasal	3	2.5%
Continuant	4	3.36%
Total	119	100.00%

environments. Again, in this case /s/ followed by a voiceless stop was the most frequent context (i.e., 92.43%).

Second, the chi-square test results shown in Table 16.6 further established that /s/ is not evenly distributed among the four consonant groups in the speech of speakers of PDS from lower socioeconomic classes (X^2 (3, N = 119) = 296.02, p < .05).

2.1.2. Discussion

The data from the quantitative survey suggest that Surprise-[s] can be inserted into any type of coda in PDS, provided it does not violate any restrictions on the syllable structure and prosody of Spanish (see Núñez Cedeño 1986, 1988). The examples obtained from the interviews with the informants follow those reported by other researchers who have also found instances of Surprise-[s] before both voiced and voiceless consonants (see Bullock et al. 2014 for discussion). Further, these researchers have also shown that the context of Surprise-[s] before voiceless consonants is the most frequent one.

Likewise, the results obtained from the chi-square tests in the distributional data retrieved from the Spanish dictionary and the PDS lexicon indicate that /s/ is not evenly distributed. /s/ followed by a voiceless stop is, statistically, the most frequent context in both sources. Consequently, we should not assume that Surprise-[s] is restricted to a specific environment. The higher frequency of Surprise-[s] before voiceless stops seems to be the result of the lopsided

Table 16.6 Chi-square test by consonant group in the *Léxico disponible de la República Dominicana*

	Observed N	*Expected N*	*Residual*
Voiceless stop	111	29,8	81,3
Voiced stop	1	29,8	-28,8
Nasal	3	29,8	-26,8
Continuant	4	29,8	-25,8
Total	119		

	Consonant type
Chi-Square	296,025
df	3
Asymp. Sig.	,000

distribution of /s/ in Spanish; /s/ happens to occur before a voiceless stop with a much greater frequency than before any other segment, though arguably, with Murray and Vennemann's (1983) *Syllable Contact Law* (SCL), one could conceivably characterize why Surprise-[s] emerges more frequently before voiceless stops.

The SCL claims that there are cross-linguistic tendencies that are likely to avoid rising sonority across a syllable boundary. So defined, it makes sense for the process to occur in the previously mentioned context. However, the SCL cannot be interpreted in categorical terms. It is stated as a tendency of preferred contact between consonants in heterosyllabic margins. Seen in this light, the SCL can accommodate the existence of disparity in sonority of final codas relative to the following onsets in forms like *abis.mo* 'abyss', *as.nal* 'asinine', and *is.leño* 'islander', among many others.

Our proposal offers a new alternative to the hypothesis that voiceless stops attract Surprise-[s], discussed in the preceding. In sum, Surprise-[s] may not be restricted by any phonological restrictions; instead, its higher frequency could be due to the lexical frequencies of certain consonantal sequences in Spanish, concretely /s/ plus voiceless stop. Thus, it would be worth exploring whether the higher frequency of /s/ before voiceless stops leads PDS speakers to insert Surprise-[s] in precisely that context.

3.2. Observational data: qualitative approach

Surprise-[s] is not a phenomenon that occurs commonly in the speech of PDS speakers. As indicated in the introduction, it normally comes about when these speakers want to approximate the speech of those who produce /s/ in the rhyme. PDS speakers want to impress their educated interlocutors by showing off their ability to speak with an elevated speech register. The general assumption has been that only PDS speakers produce Surprise-[s]. However, the first author of this chapter, a native speaker of Dominican Spanish, has been able to document this process in the speech of middle- and upper-class speakers, in personal conversations as well as in TV variety shows. For example, one of the guests of a popular talk show in responding to a question said, "hablando negativa**s**mente de ellos" 'talking negatively about them', where the word *negativamente* shows a Surprise-[s] before the consonant /m/. Likewise, in the same show, the host himself said, "no hay na**s**da que hablar" 'there is nothing else to say', where Surprise-[s] appears before /d/ in the word *nada*. This may be an unusually sporadic production, which nevertheless is bound to turn up among some of these educated speakers but much more profusely among PDS speakers. Therefore, in order to collect samples of Surprise-[s] from a broad spectrum of PDS speakers, we conducted the following structured, semiformal experiment.

3.2.1. Methodology

We constructed an open-ended questionnaire (see appendix) with 21 questions that we administered to 24 informants who are from different regions of the DR. The questions dealt with issues of current interest as reported in the media, such as the disappearance of wire cables off lampposts and bridges, driving a car in congested traffic, women abused by men, results of a presidential election, the best Spanish spoken in the DR, and opinions on the highest-paid professions, among others.

Of the 24 participants, 13 were women, and 11 were men, all ranging in age from 18 to 48 years. The majority of the informants, a total of 16, were first- and second-year students from the public Universidad Autónoma de Santo Domingo and from the Universidad Acción Pro-Educación y Cultura (UNAPEC), a private university. The remaining eight had some formal schooling, with two dropping out of high school when they were sophomores, five attaining at least an eighth-grade education, and one having completed high school. They were from different parts of the country.

The university students were interviewed singly by the first author in a classroom setting arranged by the dean of humanities for that purpose. Each session lasted between 5 and 10 minutes. The other informants were interviewed by two associates who were recruited for the task and were instructed to conduct recordings in their houses. This was a strategic decision because the informants, upon not finding themselves in a familiar milieu, were bound to utter formal speech samples.

One of the associates is a retired banker and lawyer, and the other is a first-year medical student. In order to elicit spontaneous but formal responses, the interviewers asked questions formally, pronouncing all /s/ where they appeared in the rhyme in the hope of prompting formal speech outputs from the informants. As expected, except for one informant, all tuned in to the formality of the speech presented to them and thus imitated the interviewers' renditions of utterances with [s] that they heard in the rhyme, either manifesting /s/ overtly or producing Surprise-[s].

The recordings were done with a DS 2 Olympus digital recorder, which was set in a mode for filtering out surrounding voices or noise. The first author analyzed auditorily all recorded sessions and concentrated on the presence of syllable-final [s] in general, selecting in particular those words that contained Surprise-[s]. The latter were then confirmed by the coauthors, who further chose a few samples for joint analysis through Praat (Boersma and Weenik 2014). The results are reported and discussed in Section 3.2.2.

A second method of data collection consisted of two auditory analyses of speeches extracted from videos that the government's office of communication (DICOM) uploads to YouTube with the objective of promoting the success of its social agenda. The utterances collected appear to contain samples of formal speech as one of the speakers, who was being videotaped and who furthermore is probably illiterate, presented evidence of overt [s] in the rhyme.

With this additional method, there were a total of 26 recorded interviews. It should be noted, however, that this is not a refined sociophonetic study, constructed with the rigor of these fields, but a semiformal fieldwork phonological research study, aimed specifically to draw Surprise-[s] from PDS speakers. To the extent that we succeeded in this enterprise, we position ourselves to test the psychological underpinnings behind the productions of the phenomenon under study.

3.2.2. Results

All university students responded to the level of formality presented by the interviewers. Students oftentimes produced the aspirate [h] or deleted [s] phrase-finally, but in general they tended to deliver a good number of outputs for underlying /s/ in the rhyme, as expected in the formal situation. Predictably, none pronounced Surprise-[s]. It follows that these educated speakers not only are conscious of the existence of [s] in the rhyme but can produce it in that context without apparent difficulty.

The story is different in some respects for PDS speakers with less formal education. Of the eight informants, three provided speech samples without a single Surprise-[s]. One of them did not even show words with either /s/ or Surprise-[s]. Because of this nonproduction, this speaker was dropped from the study. The others, like the informants with the most formal education, realized /s/ in the rhyme word-internally, as either [s], [h], or [Ø]. Except for one informant, for whom the majority of Surprise-[s] tokens appeared word-finally, the remaining four produced a total of 20 tokens of Surprise-[s] in word-internal position: 9 before voiceless consonants and 11 before voiced ones. Samples of these distributions are shown in Table 16.7. In the samples provided, our attention is centered on the core rhyme, shown in bold type, set off from the following onset by the usual syllable boundary symbol (a dot). The focused words in question enclosed in parentheses are given in traditional orthography.

The facts here are quite straightforward: none of the Surprise-[s] in the samples are lexically derived, as shown by the words in traditional orthography enclosed in parentheses. While Surprise-[s] (or [h]) occurs before voiceless consonants, as the righthand column indicates, the data on the left also confirm unequivocally its appearance before voiced consonants.

Note that the last word *bueno* uttered by Juan shows that for him insertion has not become lexicalized in almost identical contexts. As for both YouTube informants, they append a Surprise-[s] before [t]. For YouTube informant 1, we assume that rather than substituting the letter *c*, which corresponds to [k] in standard Spanish, for [h], he is inserting the latter, because in other contexts where such a stop is likely to appear in the video, he does not pronounce it.

There were also seven utterances with Surprise-[s] appearing across words before consonants. These are shown in (5); the double slashes denote a pause that can be distinctly heard in the recordings (items (5a–f) were produced by the informant Alfredo, who had finished high school; (5g) was given by the informant Juan):

(5) Surprise-[s] across words

a.	*bueno*[**s**]*//fue algo muy sorprendente para mí*	(*bueno, fue algo muy sorprendente para mí*)	'well, that was quite surprising for me'
b.	*bueno*[**s**]*//cuando llegué a Chicago*	(*bueno, cuando llegué a Chicago*)	'well, when I arrived in Chicago'
c.	*con el idioma*[**s**]*//*	(*con el idioma*[**s**]*//*)	'with the language'
d.	*para tener buena lengua*[**s**]*//*	(*para tener buena lengua*)	'in order to have a good language'
e.	*buen lenguaje*[**s**]*//hay que prepararse*	(*buen lenguaje, hay que prepararse*)	'a good language, one must prepare oneself'
f.	*una segunda lengua*[**s**]*// muy importante*	(*una segunda lengua, muy importante*)	'a second language, it is very important'
g.	*eso esta*[**s**] *muy bien*	(*eso está muy bien*)	'that is very good'

Table 16.7 Examples of the distribution of Surprise-[s] extracted from the interviews

Speaker and education level	*Before voiced consonants*	*Before voiceless consonants*
Josefina (7th grade)	*son bu*[**ez.n**]as (*son buenas*) 'they are fine'	*le han asignado camion*[**eh.t**]*as* (*le han asignado camionetas*) 'they were given semitrucks' *incluye p*[**as.t**]*ada, garr*[**os.t**]*azo* (*incluye patada, garrotazos*) 'ít includes kicks, blows with a club'
Carmen (8th grade)	*aceptar s*[**oz.b**]*orno* (*aceptar sobornos*) 'to accept bribes' *violar las l*[**ez.j**]*es* (*violar las leyes*) 'to break the law'	*recibe mucho atr*[**ah.k**]*o* (*recibe atracos*) '(it) is plagued by hold-ups'
Maria (9th grade)	*ser est*[**ih.l**]*ita . . . eso me apasi*[**oz.n**]*a* (*ser estilista . . . eso me apasiona*) 'to be a hairstylist, . . . that's my passion' *discúlp*[eh.m]*e* (*discúlpeme*) 'pardon me'	*r*[**eh.p**]*ítame la pregunta* (*repítame*) 'repeat the question'
Juan (7th grade)	*es muy bu*[**ez.**]*na* (*es muy buena*) 'that (law) is quite good' *las pen*[**az.l**]*idades* (*las penalidades*) 'penalties' *muy bu*[**ez.n**]*a* (*muy buena*) 'very good' *bu*[**ez.n**]*o . . .* (*bueno*) 'well . . . '	*hay p*[**as.t**]*rullaje* (*hay patrullaje*) 'there are more patrols out in the streets'
YouTube speaker 1		*su negocio se mantenga* [**ah.t**]*ivo* (*su negocio se mantenga activo*) 'so your business is kept active'
YouTube speaker 2		*era*[**s**] *un criadero de g*[**as.t**]*o* (*era un criadero de gato*) 'it was a breeding place for cats'

The data in (5) reveal that, for these informants, Surprise-[s] is inserted only across a word boundary when there is a noticeable pause at the end of a word, regardless of the voicing property of the following segment. In other words, voicelessness is not sufficient to trigger [s] insertion, as confirmed by (5e–f). Thus, it looks as if a pause at final rhymes may facilitate the presence of Surprise-[s].

3.2.3. Discussion

Judging from the results from the previous section, it seems clear that a following consonant does not control the occurrence of Surprise-[s], a fact that belies Bullock and Toribio's (2010) and Bullock et al.'s (2014) overarching claims that following voiceless consonants are the factors motivating insertion. The latter study even provided nine tokens of Surprise-[s] occurring before a voiced consonant (Bullock et al. 2014: 31), which strongly supports our own findings. According to Bullock and Toribio (2010: 23), the mere fact of the single, unexpected occurrence of Surprise-[s] before the word-initial [t] of *tampoco* 'neither', out of a corpus of 103 hypercorrected insertions, further suggests that a coda cannot account for its presence because it is inserted word-initially, and that a "voiceless stop, again appears to be strong 'attractor' for an epenthetic [s]". In their more recent work, Bullock et al. (2014) reiterate this claim and, instead of referring to the process as "hypercorrect-s", call it "intrusive-s", thus reaffirming the nature of the phonetic process as they understand it. We address the renaming of this process later on.

The hypothesis that voiceless stops attract Surprise-[s] appears reasonable in at least some respects. Let us first consider word-internal position. On the positive side, Bullock et al.'s (2014) quantitative analysis seems to confirm that the insertion may be predicted on the basis of the properties of neighboring sounds. Cross-linguistic studies have shown that phonetically grounded insertion tends to occur; i.e., Polish (Rubach 1987) inserts the glide [w] if there is a previous (or following) [u], so that underlying /sytuacia/ yields [situwacia] 'situation'. Likewise, Fourakis and Port (1986) report that intrusive [t] or [p] hold for English but are ordinarily inserted before voiceless obstruents sharing coronal or bilabial points of articulation, i.e., *false*, *rinse*, *hamster*, and *dreamt* emerge respectively as [fɑlts], [ɹɪnts], [hæmpstɚ], and [drɛmpt].

Murray and Vennemann's (1983) SCL could conceivably be adduced to lend further support to Bullock et al.'s hypothesis. Murray and Vennemann proposed that there are cross-linguistic tendencies to avoid rising sonority across a syllable boundary (cf. Clements 1990: 287).

Clements paraphrases the SCL this way: "In any sequence C_a \$ C_b there is a preference for C_a to exceed C_b in sonority", where \$ represents the syllable boundary and sonority is defined with respect to a scalar feature of resonance. The hierarchy in question goes from most to least sonority, which in terms of segments can be expressed in the following decreasing sequential order: vowels > glides > liquids > nasals > fricatives > oral stops.

That is, the consonant in a syllable coda should have more sonority than the consonant in the onset of a following syllable, such that the heterosyllabic sequence in [ˈaɾ.te] 'arts' is preferable to a sequence like [ˈrit.mo] 'rhythm'. A heterosyllabic sequence created by Surprise-[s] before voiceless contexts behaves in a similar fashion because [s] has more sonority than [C̥] (this symbol represents a voiceless consonant), thereby respecting the SCL. Incidentally, it ought to be noted that such a definition of sonority has been the source of ongoing current debate in phonetics and phonological theorizing (for extended discussion see Parker 2002).

On the other hand, the hypothesis that voiceless stops attract Surprise-[s] faces the difficulties we have already addressed. Previously, we have seen that Surprise-[s] has a wider range of application, surfacing before voiced and voiceless obstruents as well as before sonorants. This evidence cannot be explained by the phonetic constraint hypothesis. Regarding the intrusive stops mentioned for English, Clements (1987: 34, 38–40) maintains that this process is truly a phonological rule of English and not the reflex of a phonetic effect on two abutting consonants. He justifies the intrusion on the basis of two observations: (1) it is confined to a variety of English, that is, American English, and outside of this kind of English, it has no further transdialectal existence (if the process were driven solely by phonetics, it should apply with equal force to South African English, but it does not); and (2) it feeds other phonological processes, such as assimilating the orality node of a preceding nasal and absorbing the voicelessness of a following obstruent, both of which would yield something like [drɛm**p**t], for instance, or even introducing variably an additional preglottalic gesture before the stop in comparable contexts, as argued in Wetzels (1985). Analogously, this reasoning would also apply to Surprise-[s] in PDS. This process is a variable, mostly class-based, quasi-idiosyncratic phenomenon found only in PDS. As far as we know, there is no other variety of Spanish that exhibits this unique characteristic. In addition, the data in (5) show that speakers may realize underlying /s/ variably as either [s] or [h], which suggests that they likely have an active process of syllable-final aspiration. That is, they call into play the application of informal rule (6), shown in standard form to facilitate the discussion, again without committing to any particular theory.

(6) $$\mathrm{s} \rightarrow \mathrm{h} \,/\, \underset{\mathrm{R}}{\underline{\quad\quad}}$$

The fact that Surprise-[s] may surface both as [s] and as [h] in the coda suggests that rule (6) applies optionally. It is reasonable to assume, then, that Surprise-[s] displays an interactive, feeding relationship with (6).

The SCL is of no help either in fully characterizing why Surprise-[s] emerges more frequently before voiceless stops. This is so because the SCL cannot be interpreted in categorical terms. It is stated as a tendency of preferred contact between consonants in heterosyllabic margins. Seen in this light, we consequently can explain why the internal sequence of /s/+voiced consonant is regularly found in Spanish. To wit, the SCL would clearly account for *as.besto* 'asbestos', *des.de* 'from', *mus.go* 'moss', but not for *abis.mo* 'abyss', *as.nal* 'asinine', *is.leño* 'islander', among many others, because of the disparity in the sonority of the codas relative to the following onsets. A grammar that purports to characterize the phonology of a native Spanish speaker should be able to account for these facts.

The second problem in dealing with the hypothesis that voiceless stops attract Surprise-[s] pertains to Surprise-[s] found across a word boundary. Bullock and Toribio (2010: 20–21) affirm that its presence more frequently than not "spans an intonational phrase boundary and occurs if the following word begins with a voiceless stop". In other words, Surprise-[s] in this context could be explained by morphosyntactic and prosodic conditions. Actually, this kind of boundary seems to be correctly distributed in the majority of the sentences they provide. However, a different picture emerges with their prepositional phrase *de[s] animales* 'of animals', where Surprise-[s] closes the preposition *de* 'of' (Bullock and Toribio 2010: 21). The implication here is that such a phrase should be parsed as $_{PP}$[[des]$_{IP}$ [animales]$_{IP}$]$_{PP,}$ where the intonational boundary straddles the preposition and the following noun. This parsing seems intuitively incorrect because an isolated preposition, even when it heads a phrase syntactically speaking, cannot be parsed by an intonational boundary. This is due in part to the fact that the former in and of itself does not constitute a sense unit; that is, in order for a phrase to be an intonational phrase (IP), it must appeal to the notion of making sense. To achieve this result, it must meet the requirement criterion of the *Sense Unit Condition* in (7), proposed by Selkirk (1984: 286).

(7) *The Sense Unit Condition on Intonational Phrasing*
The immediate constituents of an intonational phrase must together form a sense unit.

According to condition (7), the entire phrase [des animales]$_{IP}$ is the intonational phrase.

This reasoning can also be extrapolated to a sentence emitted by our YouTube informant 1, illustrated in Table 16.7 He introduced Surprise-[s] in the relative complementizer *que* in the sentence *ahora que*[s] *tú me diste la vida* (*ahora que tú me diste la vida*) 'now that you (God) have given me life', whose structural intonated phrase would be [[ahora ques]$_{IP}$ [tú me diste]$_{IP}$ [la vida]$_{IP}$]]]]$_{IP.}$ Observe that the complementizer *que* ends an intonational phrase because the adverb *ahora* endows the phrase with temporal meaning, as required by the Sense Unit Condition (7). Therefore, a grammar that alludes to this meaningful context would not miss the emergence of Surprise-[s].

Now that we have dealt with the problem raised by the intonational phrase environment, just discussed, the requirement that a following consonant must be voiceless is not a robust one, as our data suggest. For example, the informant Juan in (5) produced the sentence *eso esta[s] muy bien*, which provides clear evidence of a Surprise-[s] before the nasal [m], thus casting doubt on Bullock and Toribio's overarching hypothesis. Núñez Cedeño (1986: 338–339, 1988: 323), from data collected in field research conducted in 1976, documents additional forms showing Surprise-[s] not only word-internally before voiced consonants, such as in the restructured *isno* derived from /imno/ *himno* 'hymn', but across words in the same context, as in *me encargó*[s] *do pare* (*me encargó dos pares*) 'he asked me to get two pairs (of shoes)'. Add to these counterexamples the data that they offer with Surprise-[s] before a vowel-initial word, and we have a resulting complication when attempts are made to state the grammatical process economically because, besides having to specify that it takes place at the end of words before following voiceless consonants, we will have to resort to yet another alternate context.

There are structural conditions identified by Núñez Cedeño (1986,1988) that seem to control Surprise-[s]. For instance, in the word *grúa* 'crane', syllabified as *grú.a*, [s] insertion can only occur at the end of the word, to produce *gru.as* but not **grusa*, despite the fact that the syllable *gru* is a possible environment for insertion. The reason given then to explain this blocking effect was that the process obeyed a principle of structure preservation, in the sense that it prevents the creation of structures not generated by rule.

A simple account that refers to the rhyme captures the process only within and at the end of the word, precisely because both contexts are rhymes.

To summarize, a grammar that proposes phonetic factors as motivating the insertion of /s/ not only misses an obvious generalization but is forced to formulate a rather complex machinery, i.e., postulating additional rules or constraints, to account for all available facts. The alternative, on account of its elegance and simplicity of introducing an unpredictable segment in a syllable rhyme, on Occam's razor is logically a preferable solution. It is precisely the unpredictable nature of /s/ insertion that justifies naming it "Surprise-[s]", as opposed to "s-intrusion", which in order to surface must appeal to neighboring phonetic features, as defined by Bullock and Toribio (2010). We have seen that this is not the case. Finally, while the tokens we have presented are too few to sustain conclusive generalizations from a sociolinguistic or sociophonetic perspective, a phonological explanation as discussed here is not only desirable but necessary to motivate the presence of Surprise-[s].

4. The interface of lexical /s/ and Surprise-[s] with resyllabification: the postlexical-level hypothesis

In previous sections we have examined the occurrences of Surprise-[s] within and across word boundaries, concluding that the rhyme motivates its insertion. Next, we examine its behavior more in-depth in the context where resyllabification could occur, namely, before a word that begins with a vowel. Except for Núñez Cedeño's earlier studies (1986: 340, 1988: 326), where he noticed a failure of resyllabification in such a context, none of the researchers who have worked on PDS have explicitly examined the process of resyllabification, either of lexical /s/ or of Surprise-[s].

In these two studies, Núñez Cedeño observed that one of his informants produced the sentence *yos#hago* 'I do' with Surprise-[s] in the pronoun *yo* but failing to resyllabify, a fact he attributed to the presence of a word boundary. In the following sections, we take his interpretation a step further and reanalyze this boundary as an actual pause.

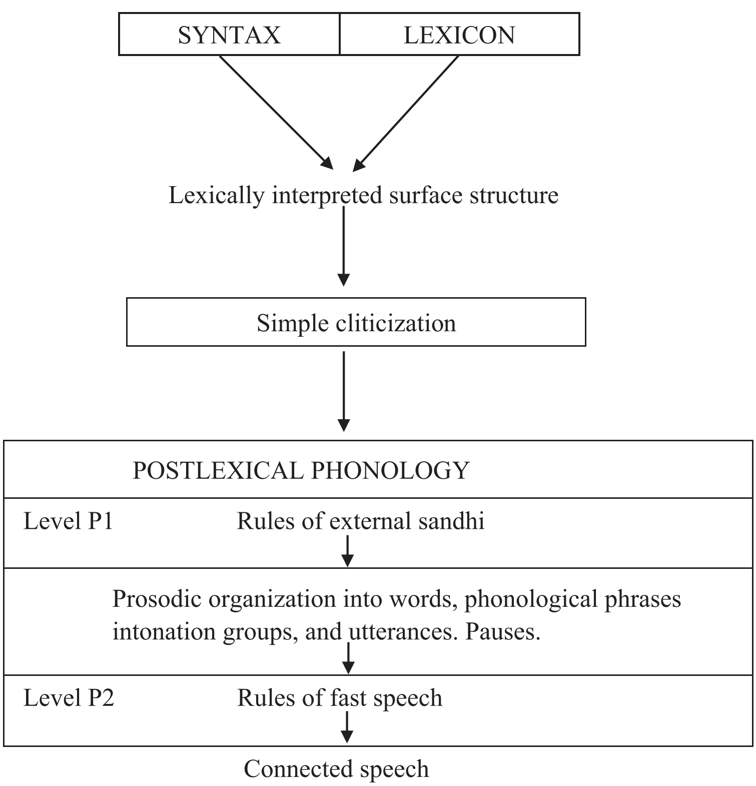
With respect to /s/ or any other coda in the rhyme, resyllabification occurs in standard Spanish according to (3), provided there is no intervening pause. It is rather surprising that this is the case in PDS, especially when it is fairly well known that /s/ deletes or aspirates, both of which have significant effects on the final output. However, Surprise-[s] cannot be deleted, nor can it be resyllabified, despite being in a fertile environment to undergo the latter process, though it may result in an aspirated output (Morgan 1998).

To explain why underlying /s/ normally resyllabifies, and why Surprise-[s] fails to do so, we will assume Selkirk's (1984) work on the interface between syntax and phonology; adopting some of her ideas, we advance the hypothesis that there are abstract timing effects, subsequently realized as real-time pauses, which block resyllabification. This hypothesis will be summarized in the next section to foreshadow Section 3.2, which is an empirical and descriptive analysis of natural sentences produced by our informants, both with resyllabified lexical /s/ and with unresyllabified Surprise-[s]. For the latter section, we select some samples and inspect them visually with the Praat editor to demonstrate that there is observable, concrete evidence that distinguishes one utterance from the other in the form of a pause, to be defined and formalized in the following.

4.1. Postlexical derivation and Surprise-[s]

To begin, let us look at Selkirk's (1984: 33–34) conceptual framework, which assumes the organization of a grammar as sketched in (8). This representation incorporates some aspects of Mohanan's (1986) and Kaisse's (1985: 23) models, bearing in mind that Selkirk's is not developed in terms of a lexical phonology model.

(8) Connected Speech



This diagram shows a first stage involving the D-structure, which works in the customary way of providing the syntactic elements for surface structure to eventually interface with phonology. This path leads to surface structure with a representation made of intonations at the point of the phrasing of a sentence; that is what Kaisse (1985) calls *lexically interpreted surface structure*. The following is the stage of simple cliticization, which Kaisse motivates for English. In addition to this structure, the surface structure also encompasses the construction of a metrical grid, which ultimately corresponds to the underlying phonological representation of a sentence. It is what Selkirk describes as "an intonated, rhymated surface structure" (1984: 34). She is careful to note that even though the phonological representation is fully established at this level, no resyllabification can occur (1984: 32), and this suggests that for this process to apply, it must do so at the following level, namely, Kaisse's postlexical stratum P1, or the stage of *Rules of external sandhi*. The last stage, P2, is the level where no grammatical information is available, nor do pauses exist between phrases.

The key focus of Selkirk's framework is the mapping of the intonated surface structure to the intonated-rhymated surface structure. She argues that in a sentence the rhythmic structure is in essence a metrical grid that has a series of grid slots aligned with syllables "giving representation to *patterns of prominence*, and silent grid positions, giving representation to *syntactic timing* or *juncture*" (1984: 22). In this chapter we will assume, then, that sentence labeled bracketing, organized into syllables and phrasal intonations, constitutes the rhythmic structure of the sentence. Hence, we will argue, along with Selkirk (1984: 299–301), that not only are segments anchored to abstract timing effects, but the pauses observed in the speech of PDS speakers, instantiated by the spectrographic evidence discussed later, come as a result of syllable-unaligned silent positions, or demibeats, introduced into the metrical grid of an utterance. These silent demibeats—possibly assigned to a preceding anchored syllable by means of spreading processes—are then changed into phonetic representations that are measured in terms of their duration as an expression of how many there are of the former. As an example, consider the metrical representation in (9).

(9)	a.			b.	
	x	x		x	x
	x	x		x	x
	x x x	x x x		x x x $\underline{x}$ $\underline{x}$	x x x
	σ σ σ	σ σ σ		σ σ σ σ σ	σ
	traveling	tomorrow	→	traveling	tomorrow (Selkirk 1984: 306)

The metrical representation (9a) illustrates the level of metrical grid construction, with the basic pattern of stress prominence provided, and syllables aligned with demibeats. Now assuming the rhythmic pattern in (9b), a rule of beat addition introduces two silent positions between the words, shown underlined. Thus, (9b) means that the first three syllables of *traveling* have a corresponding sound in time with the grid, followed by a pause that is immediately followed by the three syllables of *tomorrow*, also aligned in time with the grid. The demibeat addition reflects the abstract syntactic time of the sentence and is specified in terms of syntactic structure. This demibeat insertion is interpreted by the following principle of universal grammar, thus characterizing what an abstract pause is:

(10) A grid position not aligned with a syllable is realized in time by an absence of phonation, namely, a Pause (Selkirk 1984: 307).

Principle (10), along with the previous metrical grid construction, is taken to provide the correct representation of syntactic disjunctures.

The demibeats in (9) are then translated into a real-time value of duration at the phonetic level. That is, any given duration of one demibeat may be assigned a value of one millisecond (ms) or fractions thereof. The larger the real-time value of the demibeat, the longer the pause, and vice versa; i.e., the shorter the real-time value, the less the likelihood will be of perceiving any discernible pause. Suppose, for instance, that the demibeats in the disjuncture between the verb *traveling* and the adverb *tomorrow* equals $n/2$ ms, as opposed to 0 ms, then the former will be realized as a recognizable pause with that particular duration, whereas the latter, even when it already has a derived underlying temporal grid, would not compute phonetically into any real pause. In other words, in order to have a pause, the final edge of a constituent and the initial edge of a following one must be separated in real time by more than *n* ms. This also means that if the tempo increases, the duration will be less; if the latter decreases, the tempo value would be higher, though it is possible to have an increased tempo with a concomitant time-value expression (Selkirk 1984: 304–305).

To summarize, in this section we have adopted Selkirk's conceptual framework, which features two postlexical levels, namely, Kaisse's (1985) postlexical stage of *Rules of external sandhi* and a second stage, P2, or *Rules of fast speech*. Additionally, we also assumed Selkirk's mapping of the intonated surface structure to the intonated, rhymated surface structure. The combination of these proposals will help us explain why, in PDS, etymological [s] can be resyllabified whereas Surprise-[s] cannot.

4.2. Some basic data on resyllabification in PDS

With the theoretical framework established in the previous section in order to account for the existence of pauses, as advanced by Selkirk for English, we will next analyze sentences using Praat and argue that it is precisely those syntactic disjunctures aligned with the temporal silent grid that help to explain why resyllabification of Surprise-[s] fails to occur, while in other instances where there is /s/, resyllabification usually does apply.

Let us first consider the additional data in (11) produced by PDS speakers in the present research. In each pair the phrase in the left column corresponds to actual utterances, while the middle one is their orthographic representation. The pertinent syllables under consideration appear in square brackets. The symbol # signals a word boundary. (Utterances (11a–b) were produced by Josefina, (11c) by Carmen, (11d) by María, and (11e–g) by Alfredo.)

(11)	a.	*patrullando en* [la.s#e]*quina*	(*patrullando en las esquinas*)	'patrolling around corners'
	b.	[e.s#el] *ma difícil de superar*	(*es el más difícil de superar*)	'it is the most difficult to overcome'
	c.	*esas medida tendrán* [ma.s#e]*fectivida en los lugares pobres*	(*esas medidas tendrán más efectividad en los lugares pobres*)	'those ordinances will be most effective in poor neighborhoods'
	d.	*se cruza porque* [e.s# u]*na emergencia*	(*se cruza porque es una emergencia*)	'they cross (on a red light) because it is an emergency'
	e.	[tre.s#o]*ra*	(*tres horas*)	'three hours'
	f.	*no* [e.s#el] *nuestro*	(*no es el nuestro*)	'it is not ours'
	g.	*tengo u*[no.s#a]*migo*	(*tengo unos amigos*)	'I have some friends'

Perceptually analyzed, all utterances in (11) confirm that phrase-final lexical /s/ moves to the onset position of a following vowel-initial word. To further corroborate this impression, let us consider the spectrogram in Figure 16.1 for the phrase *más efectividad* in (11c). For more clarity in the details, the images for this spectrogram and others that follow have been expanded.

It can be observed in the middle display, and following the definition given in Section 3.1 of what constitutes an abstract pause, that there is no intervening pause between the right offset of the vowel [a] for the word *más*, the beginning and end of closure for [s], and the left onset of the following vowel [e], where [s] now occupies the word-initial onset position of *efectividad*. The acoustic cues of intensity and pitch can profitably be used to identify an existing pause, as has been claimed in pausological research in second language acquisition (Chen 2005, 2011). Thus, if there were no notable reduction in intensity, with its concomitant valley, and no break in the pitch cue, no pause would have occurred. Visually, this is precisely what Figure 16.1 displays, which also conforms to the authors' own native intuitions, thereby substantiating resyllabification. Also, noticeable in the formants between these two segments is the concentration of high energy, a characteristic of the noise production of [s], and other sibilants.

Consider, however, the final /s/ in (12), produced by the same speaker as (11c) but without resyllabification, shown here with a // to signal an intruding pause, and its spectrogram, given in Figure 16.2.

(12) *en lo sectores de* [klases//alta] *y algunos barrios de la parte pobre* (*en los sectores de clases altas y algunos barrios de la parte pobre*) 'in upper-class sectors and in some poor-class neighborhoods'

To help us identify a specific pause in this spectrogram and others that follow, we will consider the following cues, already hinted at previously: a visible valley descending toward the baseline, produced by low intensity, shown by a lighter line; a discontinuous pitch, indicated by a broken darker line (Chen 2011); and duration in milliseconds, enclosed between two vertical lines, whose minimum cutoff points are from 79 to 179 ms. These widths are in line with standard conventions adopted in the pausological literature for first and second language acquisition research (see Chen 2011; Hieke et al. 1983).

Hieke et al. (1983) address the issue of what the minimum time threshold is to determine a real-time pause, settling for 100 ms. In contrast, Figure 16.2 has a higher limit. Still, these researchers admit that lower or upper cutoffs are not only possible but "psychologically functional" as well, especially if spontaneous speech is taken into account as opposed to the reading-only approach they used (1983: 211–212). The durations in our study, based both on spontaneous productions and on Selkirk's formula of *n* ms or more (1983: 305, and discussed later), lend support to the possibility of applying either limit.

Bearing in mind these descriptive aids, as shown by the highlighted vertical bar of both the spectrogram and the waveform in Figure 16.2, there is a notable valley heading toward the baseline that occurs between the right offset of [s] for *clases* and the left onset of [a] for *alta*, with a 179-ms duration.

Given that resyllabification may occur variably even in radical PDS for /s/, we must inquire into what happens to Surprise-[s] in phrase-final position in comparison to lexical /s/ in the same position. Let us take into account the utterances in (13), which include a partial representation of (11d). Both were uttered by the same speaker.

(13) a. [e.s# u]*na emergencia* (*es una emergencia*) 'it is an emergency'
b. *como yo le dije a ute*[h// an]*teriormente* (*como le dije a usted anteriormente*) 'as I told you previously'

On the one hand, as has already been observed, (13a) shows resyllabification of lexical /s/, even when this speaker tends to exhibit a very active process of final /s/-deletion elsewhere. The highlighted bar for the spectrogram and waveform in Figure 16.3 demonstrate that [s] is fully resyllabified, judging by the reduction of voicing activity on the right boundary of the vowel [e], which is cut off by a brief pause, and the ensuing noise production proper of the fricative [s] as it becomes the onset of the following vowel [u] for *una*.

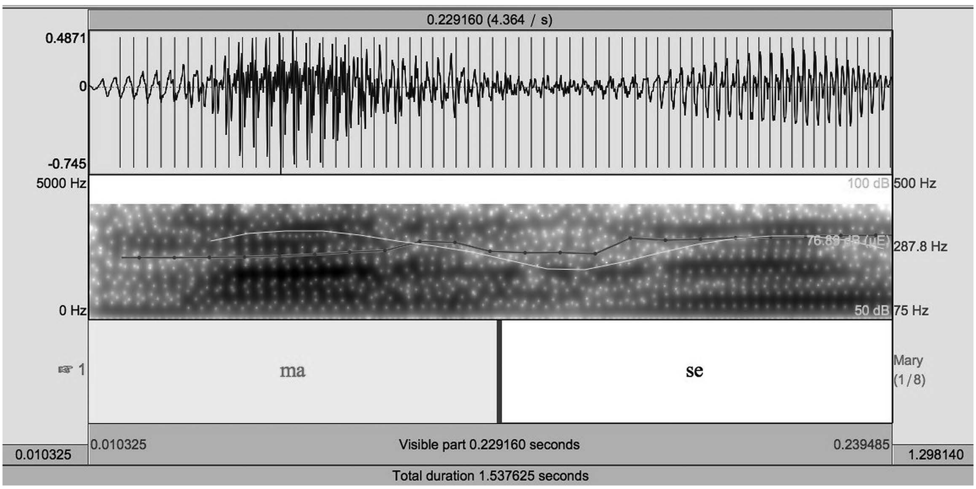


Figure 16.1 Example of resyllabification in PDS: *más efectividad*

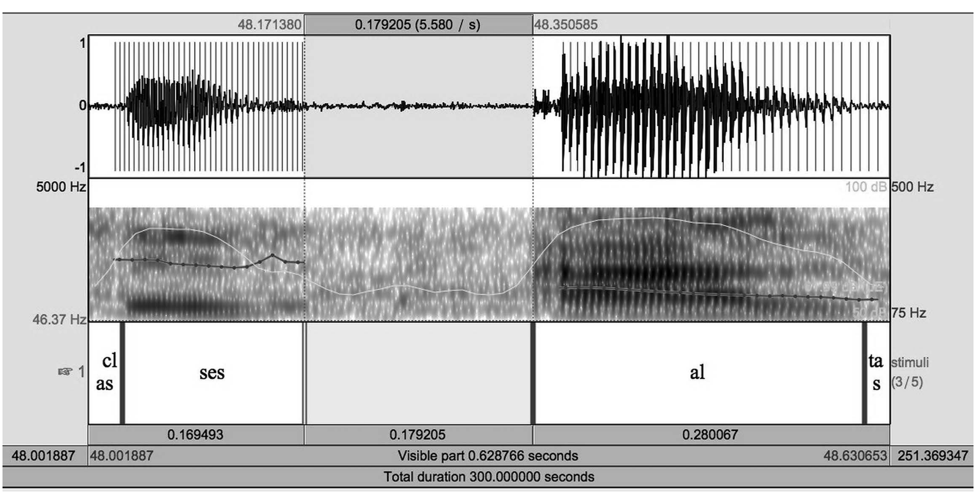


Figure 16.2 Example of non-resyllabification in PDS: *clases altas*

A recovered higher intensity for this consonant preceding this vowel confirms further the resyllabification process.

On the other hand, Surprise-[s], this time aspirated but unresyllabified in (13b), seems to support the findings of Morgan (1998: 90), who reported 32% aspiration of Surprise-[s], although his speakers, like ours, tended to realize a full [s] by a margin of 61%. However, it is not clear in his study, or for that matter in Bullock et al.'s (2014) either, whether Surprise-[s] remained in the coda or moved into the onset position. We assume the former scenario because our own data do not contain resyllabification of Surprise-[s] across a word boundary. The spectrogram in Figure 16.4 for the utterance (13b) is indicative of resyllabification not being implemented.

Notice in the highlighted vertical bar of the spectrogram that there is a gap in the noise formant, with a 79-ms duration, between the right offset of the aspirate [h] for [uteh] and the left onset of the following vowel [a] for the word *anteriormente*. This duration points to an intruding pause, which is further reinforced by the visible discontinuity in the pitch line and by the low level of intensity.

At first sight, one also could conceivably assume that this final [h] is a variant of /d/, retrievable from the plural *u*(*s*)*te*[ð]*e* for these speakers. To change /d/ to some sort of fricative is not strange in Spanish because, as Hualde (2005: 149) reports, this phenomenon is typical of Castilian Spanish, where /d/ changes to [θ], so that *salu*/d/ 'health' may be pronounced as *salu*[θ] (see Martínez-Gil, this volume). In PDS, or, for that matter, in general Dominican Spanish, such a process has not been documented. Instead, the most preferred solution for most speakers is to delete word-final /d/ (Jiménez Sabater 1975: 72). We therefore assume that the final [h] in the example in question is an actual variant of Surprise-[s], as amply documented by Morgan (1998).

That there is a clear phonetic disjuncture right after Surprise-[s] is further substantiated by YouTube informant 3, in sentence (14), whose spectrogram is provided in Figure 16.5.

Token 14 was collected from the DICOM website after the completion of our formal experiments.

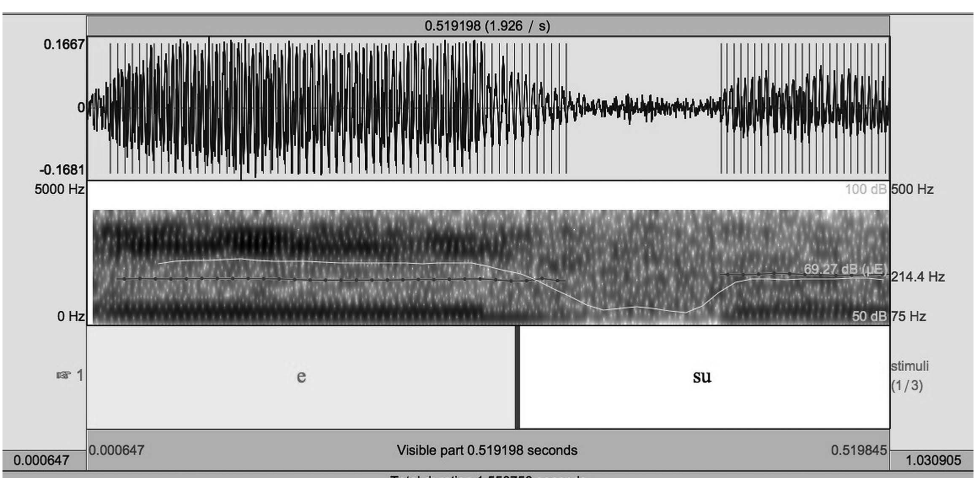


Figure 16.3 Example of resyllabification in PDS: *es una emergencia*

(14) *es una cosa muy**s**//importante para nosotros.*
(*es una cosa muy importante para nosotros*) 'it is a very important thing for us' (YouTube informant 3)

First, a word of caution in interpreting this figure. Note, for instance, that the aperiodic waveform in the upper row of the spectrogram, with an apparent corresponding pause in the midrow for formants, is merely background noise, whose carry-over effect is reflected by the presence of a continuous fluctuation of low-level intensity. Even though noise can be detected in the former, the fact that there exists a total absence of frication in the latter, and that there is a clear interruption in pitch, assures us that the segment [s] is simply not there. This assumption stems from the fact that one of the defining acoustic properties of [s] is the presence of a high concentration of energy in the upper bounds of a spectrogram (Ladefoged 2003: 152).

In Figure 16.5 it can be observed that the actual pause duration is 121 ms. This spectrogram evinces clear pausal disjunctures between the offset of Surprise-[s] and its following vowel [i], as further instantiated by by the pause's continuous intensity, coupled with a distinct disruption in the pitch cue.

Now the tokens of prepausal [s], our Surprise-[s] illustrated in the preceding, are relatively low in number, but they should serve to indicate that we have something here that cannot be easily disregarded. This is essentially what Terrell (1986: 124–125) has shown with 5 out of 24 samples of intrasentential Surprise-[s] he collected for his fieldwork research, which appear to have occurred prepausely before following vowels.

The following are examples of Terrell's research, with Surprise-[s] marked in boldface: vivo**s** en Crito Rey**s**, parte a**s**trás (vivo en Cristo Rey, parte atrás) 'I live in Cristo Rey, in the back', hay do persona que va**s** a pelear conmigo (hay dos personas que van a pelear conmigo) 'two peoples are having a fight with me', once**s** hermano (once hermanos) 'eleven brothers (and sisters)', luego aprendí**s** a tocar (luego aprendí a tocar) 'afterward I learned how to play', él me dio**s** un dinero (él me dio un dinero) 'he gave me some money'. Until proven otherwise, we assume that a pause follows a final [s].

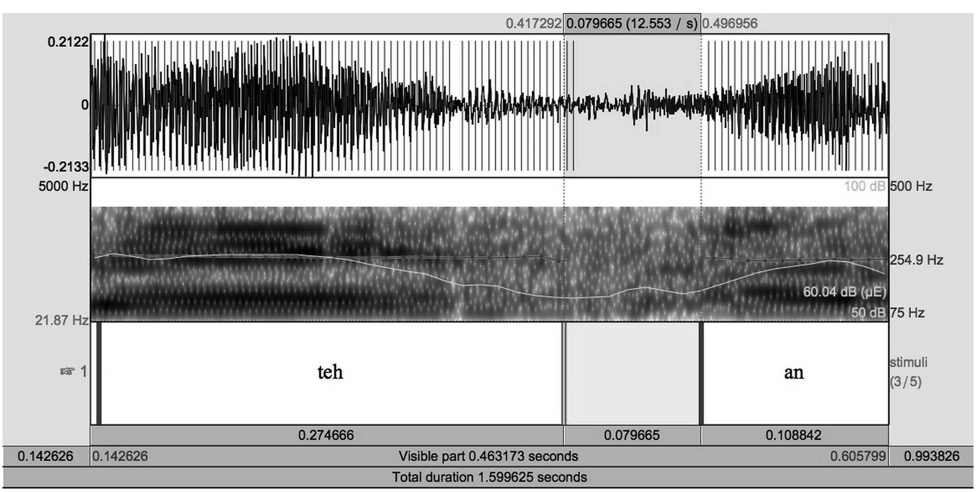


Figure 16.4 Example of non-resyllabification of Surprise-[s] in PDS: *uste[h] anteriormente*

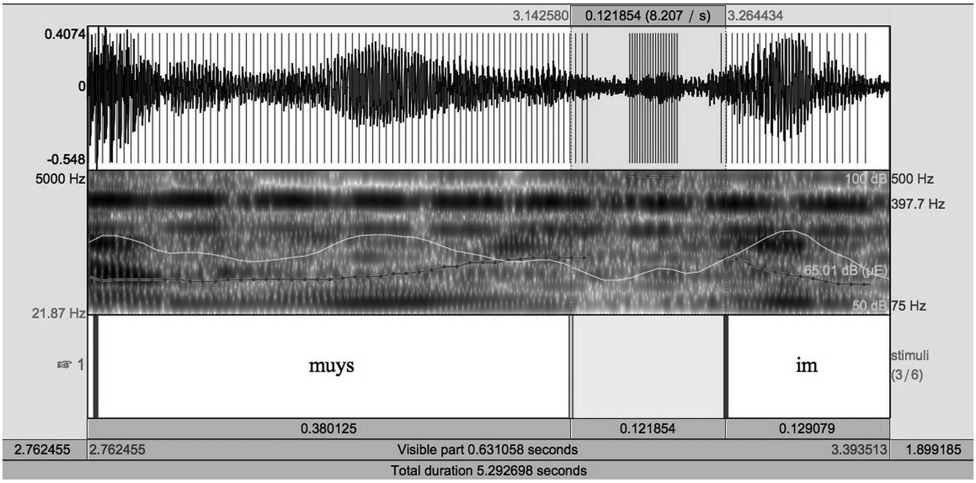


Figure 16.5 Example of non-resyllabification in PDS: *muys importante*

As we previously mentioned, this is an uncommon phenomenon, and thus collecting samples of Surprise-[s] is oftentimes an arduous task. Nevertheless, our main goal is, first, to demonstrate that the fact that it occurs in PDS is irrefutable, and, second, to confirm the different behavior of etymological /s/ (which does resyllabify) and Surprise-[s] (which does not) using the data that we have at hand. Future research should aim to collect additional tokens in order to analyze the properties of Surprise-[s] quantitatively through additional instrumentation.

It is evident in Figure 16.5 that an intervening pause blocks resyllabification when Surprise-[s] is considered, as would be expected under these conditions, a fact also validated by Figure 16.4. This blocking effect normally does not occur with a fully resyllabified etymological /s/, as has been confirmed by Figure 16.3. The unifying element for both is the realization of the grid construction and syllable alignment in the metrical grid. The analysis of Surprise-[s] for the sentence *como le dije a uteh anteriormente*, repeated in (15), with emphasis on the phrase *uteh//anteriormente*, proceeds as shown in (16). We assume the construction of a metrical grid alignment with syllables for this sentence's rhythmic structure, as seen in (9).

(15) $[_{\mathrm{CP}}$ como $[_{\mathrm{TP}}\ {}_{\mathrm{N}}[$*pro*$]$ $[_{\mathrm{VP}}$ le dije $[_{\mathrm{DP}}$ a ${}_{\mathrm{N}}[$uteh$]]$ $[_{\mathrm{AdvP}}$ anteriormente$]]]]]]_{\mathrm{CP}}$

(16)

			x				x						x	
x			x				x					x	x	
x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
como		le	dije		a	uteh				anteriormente				

(15) represents a rhymated structure with juncture separations accomplished by rules of demibeat addition, following Selkirk (1984: 299–301). The pronoun *uteh* gets one silent position by virtue of being a word, and a second demibeat because it is also a DP. The final position of

the phrase qualifies for three demibeat additions and not four. This is due to the fact that this CP is an embedded clause within a TP, obviously not the complete sentence itself. Its real-time duration was not calculated, as we are focusing only on across-word resyllabification.

Once the abstract demibeat addition occurs variably, as already shown, its actual implementation is accomplished by the phonetic process at the postlexical level by means of (17).

(17) Demibeat = $n/2$ ms
Disjuncture = a. 0 ms b. $n/2$ msc. n ms d. $3n/2$ ms (Selkirk 1984: 304)

The implementation in (17) specifies the real-time duration of the silent grid positions, such that if these contain *n* ms or more, then we have a pause realization. In (17), each silent demibeat is calculated to have a real-time duration of 28 ms, for a total duration of 56 ms. If the speed had increased, the pause might have been obliterated, though not necessarily the silent demibeats inserted at the abstract level (Selkirk 1984: 305).

Comparing (16) with the sentence *es una emergencia* in (18), we see no pausal juncture in (19) because that process is characteristically variable for PDS.

(18) [$_{TP}$es [$_{DP}$[$_{D}$una] [$_{N}$emergencia]]]

```
(19) x             x
     x             x
     x  x x x    x x x
     es una  emergencia
```

As this sentence passes on to the sandhi rules level, resyllabification (3) would apply, causing final [s] to move on to the onset position of the following word, as expected or, if preferred, an Optimality Theory (OT) solution could be invoked (Selkirk 2005, 2011).

Though it is not our intent to offer an OT account of the serial solution given here, one could possibly be conceived by suggesting a grammar that captures the difference between a sentence with a pause at a disjuncture and one without it. Such a grammar would have to take into account the syntax-phonology interface of Selkirk's (2005) study, so that the edges of a sentence in a surface structure would match up with prosodic structures through the intervention of the Wrap family of interface constraints with the Intonational Phrase constraints, or by appealing to Selkirk's (2011) Match Theory, thereby establishing a direct correspondence between syntactic constituents and prosodic markedness constraints.

To sum up, in this section we have seen that with respect to /s/ there are no factors blocking its resyllabification. In contrast, Surprise-[s] cannot be resyllabified because there is an intervening pause, a consequence of our assumed metrical grid, which blocks this process.

4.3. Some residual issues

In her theory Selkirk makes a clear distinction between function and nonfunction words in relation to placing stress and juncture in the syntax-to-phonology interface. For her, function words are not considered real, while content words are (Selkirk 1984: 336–337). This being the case, it follows, then, that function words cannot receive silent demibeats precisely because they lack primary or secondary word stress. Function words become invisible to metrical grid construction because they must comply with the so-called *Principle of the Categorial Invisibility of Function Words* (PCI), whose intent is to make rules that refer to syntactic categories unavailable to function word constituents. Pronouns such as *I*, *me*, *my*, *he*, *him*, *his*, *she*, *her*, *you*, *your*, and others (or, by the same token, the Spanish equivalents *yo*, *me*, *mi*, *él*, *lo*, *su*, *ella*, *la*, *tu*, *su*, etc.) behave like function words, though they differ in the degree of stress they can take, being either strong (personal pronouns) or weak (clitics) (Selkirk 1984: 346). In spite of this particular behavior, they are different from other function words, such as prepositions, determiners, and conjunctions, in that the pronouns constitute NPs. Endowed with the attribute of being phrases, pronouns would predictably be subject to the junctural processes we have seen. That this is so is corroborated by the sentence *yos//hago* cited before, in which Surprise-[s] appears to realize a pause right after the pronoun *yo*.

The PCI, however, may have to be turned off for Spanish because Surprise-[s] can occur after a preposition, as shown by the example *des animales*. In addition, in (14) we noticed that Surprise-[s] clearly surfaces in the determiner *muy* in the phrase *muys//importante*, produced by YouTube informant 3, thus supporting our intuition that the PCI is formulated too strongly. Similarly, we speculate that the determiner *la* 'the', or for that matter other function words, may be receptive to receiving a Surprise-[s], say, for instance, in a sentence like *vi a la amiga suya* 'I saw your friend', which could conceivably yield *vi a la**s** amiga suya*. Although this type of example has not been documented, in a study treating function words Núñez Cedeño and Acosta (2010) reported that the vocalization process affecting liquids word-finally when followed by vowels, purportedly said to affect only content words, also applied to function words. Their empirically based findings questioned the long-held view that function words were unsusceptible to the effects of the vocalization process (Harris 1983: 47–50).

4.4. The interaction of Surprise-[s] with aspiration and deletion

The picture we have drawn thus far becomes more complicated when we consider that the failure of Surprise-[s] to resyllabify interacts with other processes in PDS, such as aspiration or deletion of /s/, thereby producing some paradoxical ordering. In fact, the data in (11) demonstrate that PDS speakers may apply these two processes in the rhyme variably, so that the informal rule (6) can be collapsed with deletion as follows:

(20) /s/-aspiration/deletion

$$/\text{-s}/ \rightarrow \left\{ \begin{array}{c} \text{h} \\ \text{Ø} \end{array} \right\} / \underset{\text{R}}{\underline{\quad\top\quad}}$$

Harris (1983, 1993) even argued that the aspiration process in (20) in *s*-aspirating dialects may have resyllabification consequences at the lexical level, so that when the plural suffix *-es* is added to *mes* 'month', for instance, the coda /s/ must first resyllabify to onset position, thus producing the expected *me.se*(*h*). If the process is reversed, the ill-formed **me.he*(*h*) would obtain. In these studies Harris further maintained and demonstrated that resyllabification of other final consonants when followed by a vowel-initial word takes place at the postlexical level; a similar position was also affirmed by Hualde (1992) and Kaisse (1999). In the works cited here, Harris has convincingly argued that *s*-aspiration also applies postlexically. We take it, therefore, that resyllabification of word-final consonants as exemplified in (3) is a fairly well-established fact of Spanish in general and of PDS in particular. We extend these researchers' insight to the present study and propose that the optional processes in (20) arise in the postlexical stratum. However, the problem of interaction that we are facing is that while lexical /s/ may undergo aspiration or deletion at this level, Surprise-[s] is amenable only to aspiration and not to deletion. To examine the apparent conundrum raised by the interplay among these processes, let us illustrate how they operate by proposing a possible postlexical grammar in (21). A preconsonantal [Ø] represents a deleted /s/, while a final [Ø] stands for a deleted /d/.

(21) **Stratum of phrasal resyllabification**

[es. u.na]emergencia	como yo le dije a [us. te~~d~~] [an.] teriormente	input
	como yo le dije a [us.te**s**//] [an.] teriormente	Surprise-[s]
[e.][su.na.]emergencia	______________	resyllabification
______________	*como yo le dije a [uØ.teØ] [an.] teriormente	aspiration
______________	*como yo le dije a [uØ.teØ] [an.] teriormente	*s/h*-deletion
√[e.] [su.na]emergencia	*como yo le dije a [uØ.teØ] [an.] teriormente	output

In this grammar both sentences are operating in a single stratum. We also assume that they are represented with their respective metrical grid construction as well as with silent demibeats assigned. Graphically, the distinction is shown with pauses represented by double forward slashes in the sentence on the right. Surprise-[s] now appears, introduced by the speaker. In the next step, resyllabification applies on the left sentence, complying with the expected CV syllabic construction, but not on the right, which is blocked by the presence of silent demibeats. Aspiration comes next, applicable according to its structural requirements. The last step will delete the lexically derived [h] (or the actual /s/, if there is one) of both syllables of *uh.teh*. The result is that resyllabified lexical /s/ turns out a winner, shown with a check mark, while Surprise-[s], because it has been deleted, is a definitive loser, indicated with a star. Recall, though, that the output should be [uteh.anteɾioɾmente], with aspirated Surprise-[s]. Alternatively, *s/h*-deletion could be selected to apply before aspiration, but the results would be equally devastating, though at first blush an OT analysis could salvage the serial approach (Roca 2003).

A traditional OT-based approach would apparently fare no better in producing a good grammar at the postlexical stratum. Let us assume, for example, the ranking *s >> Onset >> Align (Wd, σ)-L >> NoCoda, Ident, an argument that Roca advocates. Because there is no distinction between lexical /s/ and Surprise-[s], the ranking would generate outputs with [s] resyllabified as onsets for both processes, good enough for the former, with the winner [e.] [su.na.] *emergencia*, but unacceptable for the latter, with the loser **como yo le dije a* [us.te.] [san.]*teriormente*. To remedy this situation, following Colina (1997), one could rerank the constraints by having Align (Wd, σ)-R dominate, which would require [s] to remain in the coda. However, this is a highly undesirable and counterintuitive option because, as Roca states it, in OT global requirements demand that a single ranking be applicable throughout a derivation.

Given that the unattested results discussed thus far are basically due to the single-layered conception of the postlexical module that we have followed so far, Kaisse's (1985) model, which we have introduced and adopted in (9), helps not only explain but also resolve the paradox we are facing. She accounts for a wide range of phonological phenomena that occur in various languages, e.g., word-final consonant liaison in French, /t, d/ flapping in English, and syntactic consonant doubling in Italian, among others. She proposes that the postlexical stratum consists not of one unique level but of at least two major strata, and possibly a third one, where those processes operate independently. One of these levels was identified as *external sandhi rules* (we will use the most theory-neutral term, *processes*, from here on), whose phonological processes are sensitive to morphosyntactic information; the other is the level of *fast-speech rules*, which refers strictly to phonological information, such as speech rate and syllabification. Once we take into account this multimodular conception of the postlexical level, the solution to the paradoxical problem is amazingly simple. We propose that Surprise-[s] is inserted at the level of processes of external sandhi, but we take it that instead of referring to morphosyntactic information, the reference is made with respect to silent positions of the metrical grid, which ultimately represent syntactic disjunctures (Selkirk 1984: 313). Phrase-final lexical /s/ has also inherited a metrical grid construction but, lacking silent demibeat positions, is accordingly assigned to the fast-speech level.

Extracting from (9) the pertinent level, Table 16.8 illustrates the workings between these strata.

It is in a bifurcated postlexical stratum where the various processes occur phrase-finally. First, the level of processes of external sandhi receives the input from the surface structure, as described previously. The underlying structure is subject to optional deletion, which eliminates word-internal /s/. Surprise-[s] applies, followed by aspiration. The aspirated-*s* cannot occupy the onset position of the following word because the presence of a pause prevents its reassignment. The output surfaces correctly once the phonetic process (17) is implemented.

Second, at the level of fast-speech processes, the speaker suppresses deletion/aspiration processes, though nothing could have prevented him/her from effecting their application. Because there are no intervening silent demibeats, resyllabification operates, yielding the correct output. Note that in this sentence, and in all others listed in (11), apparently no morphosyntactic factors or lexical features of any kind intervene in the resyllabification process. It appears that /s/-resyllabification is sensitive only to the rhyme, clearly a phonological conditioning environment, which lends support to the legitimacy of this stratum.

Table 16.8 Processes in the postlexical stratum

Postlexical phonology
Processes of external sandhi
como yo le dije a [us.te//] [an.]teriormente underlying
como yo le dije a [uØ.te//] [an.]teriormente deletion (variable)
como yo le dije a [uØ.tes.//] [an.]teriormente Surprise-[s]
como yo le dije a [uØ.teh.//] [an.]teriormente aspiration (variable)
blocked resyllabification
como yo le dije a [u.teh.//] [an.]teriormente output
Fast-speech processes
[es. u.na]emergencia underlying
_______ deletion/aspiration (variable)
[e.su.na]emergencia resyllabification
[e.su.na]emergencia output

To recap, by adopting Kaisse's (1985) double-layered conception of the postlexical module, we are able to account for the interplay of two processes that occur in the speech of PDS speakers, Surprise-[s] and deletion.

5. Conclusions

In this chapter we have examined the unique hypercorrection phenomenon in PDS of inserting [s] in an open, syllable-final position. Given its unexpected occurrence, attributed generally to overcompensating, and its absence, induced by radical deletion in the aforementioned context, we have named the process "Surprise-[s]". To explain the process, earlier studies maintained that it was subject to strict prosodic constraints, particularly to restrictions imposed by the subsyllabic constituent of the rhyme. Recent analyses have challenged this assumption and have hypothesized that Surprise-[s] is not freely inserted in any syllable but is conditioned mostly by the very specific presence of a following voiceless consonant or its location in phrase-final position.

To counter the restrictive, segmentally conditioned hypothesis, in the first part of the chapter we defended the original, default hypothesis that Surprise-[s] is inserted in the rhyme. We further examined its behavior across a word boundary when followed by a vocoid, where resyllabification would normally occur. To test these hypotheses, we conducted two surveys. The first survey was statistically oriented and was designed to test the claim that voicelessness is the driving force behind the occurrence of Surprise-[s]. The experimental design, based on corpora of thousands of syllable-final /s/ occurrences extracted from dictionaries of the general Spanish language and from the active lexicon used by PDS speakers, considered its distributional properties before consonantal segments. Chi-square statistical computations revealed that /s/ was more likely to occur before voiceless than voiced consonants. Consequentially, we have established that /s/ is statistically favored in rather significant ways in some contexts more than others, particularly before voiceless stops. This kind of evidence demonstrates that the realization of Surprise-[s] has nothing to do with the quality of the following segments but instead involves their frequency.

The second survey consisted of a qualitatively constructed test, which contained 24 Surprise-[s] forms elicited from 12 PDS informants by means of an open-ended questionnaire and recordings from YouTube. The evidence showed that Surprise-[s] manifested itself regardless of the voicing properties of the following consonants. It is inserted in the rhyme, respecting all prosodic restrictions of the Spanish language for syllable construction.

Although we do not claim to have the definitive answer to the challenge of accounting for the process of Surprise-[s], this chapter opens a new line of research that suggests that its distribution is not restricted phonetically. Future research should increase the sample of PDS in order to better determine the causality between the /s/ and the Surprise-[s] in PDS. In this way, the idea that there is a relation between the two would find further support.

In the second part of the chapter, sample sentences containing both lexical and Surprise-[s] across word boundaries before vowel-initial words, drawn from both experimental scenarios, were analyzed auditorily and instrumentally. We discovered that while underlying /s/ may undergo the regular resyllabification process of standard Spanish in the speech of PDS speakers, this process was totally blocked in the presence of Surprise-[s]. An analysis undertaken with the Praat editor further revealed that when resyllabification fails to occur in nonfinal utterances, there is a discernible phonetic pause ranging from 79 ms, visible for [s] derived from an etymological source, to 179 ms, for Surprise-[s]. To account for the difference between resyllabification and lack of it, we adopted the hypothesis that segments are arguably syllable-aligned to abstract timing units; the latter are then introduced in the metrical grid of an utterance. When there is no timing gap, resyllabification occurs. Otherwise, a timing break, represented by silent demibeats, signals that there is a pause, and thus resyllabification is effectively blocked. Because there is a distinction between the lack of phonetic implementation of resyllabification for Surprise-[s] and the variable resyllabification of underlying /s/, we endorsed the idea of the putative existence of a multistratal lexicon. We argued that, conceived in this way, Surprise-[s] is sensitive to grammatical information and thus takes place at the level of processes of external sandhi, whereas normal resyllabification eschews this information and thus occurs at the level of fast-speech processes.

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Appendix

Questionnaire to elicit Surprise-[s]

¿Qué opinas sobre las medidas del gobierno para controlar la delincuencia? 'What do you think of the government's policies for controlling delinquency?'

¿En dónde crees que tendrá más efectividad estas medidas? 'Where do you think these policies would be more effective?'

¿Qué crees de integrar las fuerzas armadas y la policía nacional? 'What is your opinion about integrating the national police with the army?'

¿Además de la delincuencia, qué opinas sobre el maltrato de algunos hombres a las mujeres? 'Besides delinquency, what are your thoughts about men who abuse women?'

¿Cuáles, en tu opinión, piensas que son los maltratos más serios con las mujeres? 'In your opinion, which are the most serious kind of abuses that women go through?'

Si fueras, juez, ¿qué tipos de penalidades se les debe imponer a los hombres que maltratan a las mujeres? 'If you were a judge, what kind of penalties should be imposed on men who abuse women?'

Siguiendo con las penalidades, ¿qué opinas de cómo se maneja en la ciudad? 'Continuing with penalties, what's your opinion on how people drive in the city?'

¿Cuál es su opinión de instalar cámaras fotográficas para los que violan la luz en rojo? 'What do you think of installing cameras to catch those who attempt to drive through red lights?'

¿Qué tipos de sanciones se les debe imponer a los que pasan en rojo? 'What kind of sanctions should drivers receive when they violate red lights?

¿Has tenido algún accidente o has visto algún accidente en las calles? 'Have you had any accident, or have you seen one in the streets?'

¿Cómo responde la gente cuando atropellan a un transeúnte? ¿Cómo reaccionas tú si alguien atropellas a una persona? 'How do people react when a pedestrian is run over? How would you react if someone runs over a person?'

¿Finalmente, has estudiado? ¿Hasta qué curso llegaste? 'Last, have you attended school? Up to what grade?'

Si tuvieras la oportunidad, ¿qué te hubiera gustado hacer en la vida? 'If you had the opportunity, what would you have liked to become in life?'

¿Cuáles son las profesiones que consideras más exitosas en la República Dominicana? 'Which are the most successful careers in the DR?'
¿Qué le recomendarías a tus hijos si fueran a estudiar? 'What careers would you recommend to your children if they decided to study?'

Muchas gracias por participar en esta entrevista. Tu nombre no se revelará y es completamente anónima. **'Thanks for participating in this interview. Your name will not be disclosed, and the interview is totally anonymous.'**

Part IV

Spanish phonology and acquisition

17

Spanish phonology and phonological development

First steps in the acquisition of focus

Conxita Lleó

1. Introduction

Part IV of this book deals with phonological acquisition in its various modalities: first language (L1), second language (L2) and heritage language (2L1 or HL). The focus of the chapter is on the acquisition of Spanish as an L1—especially intonation—by children raised monolingually in Spain or bilingually in Germany. In the latter case Spanish is acquired as the heritage language, simultaneously with German as the societal language. The notions *heritage language* and *heritage speaker* have received many definitions, with different degrees of precision. For the purpose of the present chapter, we will just use a very general interpretation, according to Benmamoun et al. (2010), which is discussed more deeply elsewhere, as in Rothman (2009) or Kupisch (2013):

> [A] heritage speaker is an early bilingual who grew up hearing (and speaking) the heritage language (L1) and the majority language (L2), either simultaneously or sequentially in early childhood [. . .], but for whom L2 became the primary language at some point during childhood (at, around, or after the onset of schooling).
>
> *(Kupisch 2013: 204)*

1.1. Phonological theories: their contribution to understanding acquisition

In the 1960s, when Noam Chomsky introduced a new way of approaching the study of language, namely Generative Grammar, syntax was taken to be the main area of study, while phonology was trying to define itself and to constrain its area of activity. Initially, phonologists like Morris Halle had tried to give phonology the same generative power that later on appeared to be reserved for syntax (Halle 1959), but soon Halle himself in cooperation with Chomsky redefined syntax as the sole generative component of the grammar, whereas phonology was only to be interpretative (Halle 1962, 1964). Once Structural Grammar and its behavioral roots had been dismissed as not being a valid theoretical basis for understanding language acquisition, especially phonological acquisition, the new generative field of inquiry bloomed.

One important aspect of this new way of looking at phonology is its mentalist nature, as it comprises "intentions and mental states," although "the lexicon is not a representation of intentions, but of knowledge, and it does not deal with types, but with tokens." In fact, "[l]inguistics is in constant flux and full of controversies" (Bromberger 1992; Bromberger and Halle 1992), which due to space limitations can only cursorily be referred to here.

The initial attempts at describing child language were vague and lacked adequate theoretical tools. Children were seen as some sort of filter receiving a rich input from the target or adult language and giving an impoverished output in return. Typically, a child acquiring Spanish, who was supposed to say *pelota* 'ball' and *chupete* 'pacifier,' often said [ˈlota] or [ˈpota] and [ˈpete] or [ˈtete], respectively, by means of truncation of a syllable (cf. Table 17.2). Or a child who was supposed to say *barco* 'ship' and *plato* 'plate' said [ˈba.ko] or [ˈpa.ko], with deletion of the medial coda consonant, and [ˈpa.to], by reduction of the consonant cluster to a single consonant in the initial onset of *plato*.

In the 1960s and 1970s, linguistic descriptions proposed from within Generative Grammar were based on *rules* and operations like those just referred to in the last paragraph. They were represented by means of processes or rules, which then came to be reinterpreted as strategies with the goal of simplifying the acquisition process for the child. However, these rules a.k.a. *strategies* lacked explanatory power, as they only rewrote the visible phenomenon of converting an input into an output. Moreover, given that the child must ultimately produce the sounds of his/her L1 without the effects of simplifying operations, he/she ultimately had to dispense with these simplifying rules.

This type of rule-oriented description was the only one possible at the time of Standard Generative Phonology. However, analyses offered an array of possibilities, as some studies were based on transcripts and intuition, but others relied on strict phonetic analyses and quantification. Soon an important theoretical turn based on Nonlinear Phonology was going to fundamentally increase the descriptive power of the theory of language acquisition. Descriptions by means of rules or strategies have been mainly maintained in the area of atypical or protracted phonological acquisition, arguably due to some researchers' and therapists' rejection of analyses held to be too abstract (but see references in favor of adopting Nonlinear Phonology in the area of speech therapy, too, e.g. Bernhardt 1992; Bernhardt and Stoel-Gammon 1994).

1.2. The role of Nonlinear Phonology in child language analysis

In the 1970s and 1980s, once behaviorism seemed definitely defeated, theory construction in phonology gave birth to Autosegmental Phonology, Metrical Phonology and Prosodic Phonology, which together built the so-called Nonlinear Phonology. These theories turned out to be crucial for child language, because they introduced new models of representation that were better equipped to capture acquisitional phenomena. With Nonlinear Phonology a whole new field entered the stage, with focus on prosody, which created its own linguistic level. Two levels were provided for the description of the child's outputs: segmental and prosodic, or suprasegmental. The child may already have the consonant /ɾ/ in his/her inventory and still not produce the coda of the Spanish word *barco* [ˈbaɾ.ko]. This may rather be due to lacking the necessary prosodic position where the coda consonant must be inserted. Development is thus taking place at the level of prosodic constructs (syllables, metrical feet, unfooted syllables, prosodic words) and at the level of segments (consonants and vowels).

In the field of acquisition, the theory of Principles and Parameters (P and P) was quite successful in accounting for variation, as it was capable of explaining the differences within parameters like the null-subject parameter (see Fikkert 1994 for an elegant way to describe prosodic structures in child language). However, the P and P theory was still based on rules and derivations, and a growing feeling of dissatisfaction with rules was emerging in the field of acquisition research. Representations took the lead, and constraints were preferred over rules in Optimality Theory (OT), which totally dispensed with rules in its descriptions. In the past three decades, most studies on the acquisition of phonology have referred to OT in order to describe the phenomena under study, one of the reasons being that OT offers some handy solutions, as, e.g., (a) markedness constraints are highly ranked at first, (b) constraints may be present but ranked low or outranked by other constraints, or (c) derivations do not have any role to play in the descriptions of phonological acquisition. However, some researchers have recently argued that OT cannot entirely dispense with serialism. This has led to "derivational" variants of OT, e.g. Derivational OT, or DOT (Hermans and Oostendorp 1999; Kager 1999; Rubach 2003), Stratal OT (Bermúdez-Otero 2018) and Harmonic Serialism (McCarthy 2010).

2. Aims of this chapter

The aims of the present chapter are twofold. First, it provides an overview of the phonological system acquired by children, including prosodic and segmental components, both in a monolingual and in a bilingual context. Children acquire the prosodic underpinnings and the segments that align with the prosodic slots. Second, we present a study of one aspect of the phonological acquisition of Spanish, both in a monolingual context and in contact with German, which will provide insight into the types of questions researchers ask to understand some aspect of the acquisition of L1 bilingual phonology. The topic of the second part of the chapter, *focus*, has been investigated in adult languages but has not received much attention yet in L1 acquisition, especially in the beginnings of phonological acquisition, namely in the expression of focus in monolingual and bilingual children.

2.1. Acquisition of segments in Spanish: vowels and consonants

Spanish is a language with a very simple vocalic system and a quite restricted system of consonants. The vocalic system comprises a set of five vowels: /i/, /e/, /a/, /o/, /u/. Unstressed vowel reduction in Spanish is rare (if existent at all), and there is no stressed vowel length distinction. Stressed and unstressed vowels are minimally different from one another, the latter being a bit shorter than the stressed ones, and their vowel quality being minimally centralized in the case of /a/, /e/ and /o/ (Kehoe and Lleó 2017). Vowels are acquired very early in life, at about 1;6, and they behave as cardinal vowels: they are considered to be simple and unmarked (Kehoe 2002).

Cardinal vowels are a set of reference vowels used by phoneticians in describing the sounds of languages. For instance, the vowel of the English word *feet* can be described with reference to cardinal vowel 1, [i], which is the cardinal vowel closest to it, according to Jones (1967). Regarding consonants, I have chosen to represent contrastive categories, as was done in structuralism, to simplify the representation, which does not commit us to considering phonemes as the basic categories of language.

Two vowels occurring in a single syllable are considered rising diphthongs: [ja], [je], [jo], [ju], [wa], [we], [wo], or falling diphthongs: [aj], [ej], [oj], [uj], [aw], [ew] (see Hualde 2005). Consonants are obstruents (stops, fricatives and the affricate /tʃ/) or sonorants (three nasals and four liquids, of which two are lateral /l/ and /ʎ/, and two are rhotic, the simple vibrant /ɾ/ and the multiple vibrant /r/). Obstruents have various possible places of articulation (PAs), which can be reduced to four basic ones: labial, coronal, palatal and dorsal. Nasals have several PAs as well, reducible to three distinct ones (labial /m/, coronal /n/ and palatal /ɲ/), and rhotics have only one PA, coronal. The voicing contrast is relevant only for stops: /p/, /b/, /t/, /d/, /k/, /ɡ/, whereas fricatives are all voiceless: /f/, /θ/, /s/ and /x/; sonorants (nasals and liquids) are all voiced.

The palatal fricative [ʒ], which only in *Porteño* Spanish has the status of a phoneme, is produced as the voiceless fricative [ʃ] by the majority of speakers today. In word-initial position it is produced as the affricate [dʒ] in Peninsular Spanish.

According to expectations based on certain phonological universals (e.g. Jakobson 1941), stops should be the first consonants to be acquired, and they should often substitute for fricatives. However, children acquiring Spanish as the societal language (e.g. in Spain or in a South American country) begin to produce stops and fricatives simultaneously, although according to some researchers (e.g. Macken 1978, 1979) stops seem to be the first consonants to be acquired. However, most infants having been reported to produce stops before fricatives (and approximants) grow up in an environment in which Spanish is not the societal language, e.g. in the United States or in Germany. In other words, these children acquire Spanish in a bilingual context, together with a Germanic language: English, German, Dutch or Swedish, and their Spanish is one type of L1, the so-called heritage language (HL: see section 1).

Rhotics are the last segments to be produced, and of the two rhotics, the multiple vibrant /r/ is the very last, often being acquired when the child is 4 years old, or at least not younger than 3 years. Consonants that are not yet acquired are generally replaced by other consonantal sounds; e.g., [l], [ð] and also [ʀ] and [ʁ] are possible substitutes for /r/ in Spanish child language.

Spanish exhibits spirantization and assimilation of nasals to the PA of the following obstruent (Lleó et al. 2003; Martínez-Gil 2012). Spirantization results in the alternation of the voiced stop allophones [b], [d], [ɡ], initially and after nasals, with the approximant allophones [β], [ð], [ɣ], after continuants. Note that in the structuralist era, spirantization departed from one of the consonantal series as the basic one (often the stops were considered to be the underlying segments, and the approximants were derived by a process of assimilation or weakening) (Rakow and Lleó 2003). PA assimilation of nasals results in various alternating nasals, namely [m], [ɱ], [n], [ɲ] or [ŋ], depending on the PA of the following obstruent. For children growing up bilingual who have Spanish as their HL in contact with German, [ʀ] or [ʁ] is the most frequent substitute for Spanish /r/. Other idiosyncrasies appearing in bilingual contexts are high percentages of stops, whereas Spanish monolinguals produce many approximants or so-called spirants, emerging from spirantization. As shown in Kehoe and Lleó (2017), cross-language interaction in HL speakers of Spanish may lead to influence of German on Spanish, resulting in the production of voiced stops for spirants. This has been dubbed *empty transfer* (Lleó 2017), because the substituting segments (i.e. the voiced stops) already existed in the language but occurred in a different context (e.g. not after vowels) and had a different status (they did not share the phonetic space with spirants).

2.2. Acquisition of prosodic structure in Spanish

Prosodic structure is organized in the prosodic hierarchy, proposed by Nespor and Vogel (1986), which has often been successfully applied to child language (Table 17.1). The smallest constituent is the mora, considered a minimal time unit; a short vowel has one mora, whereas a long vowel has two moras. Moras are relevant in languages abiding by weight distinctions, but for languages without weight distinctions, the syllable is a more adequate prosodic unit. Prosodic or phonological phrases, intonational phrases and utterances are the largest phrasal constituents. Since the children participating in this study were still very young, they hardly produced utterances longer

Table 17.1 Prosodic hierarchy

Utt	Utterance
IP	Intonational phrase
PPh	Phonological phrase
PW	Prosodic word
Ft	(Metrical) foot
σ	Syllable
μ	Mora

Source: Adapted from Nespor and Vogel (1986).

than phonological phrases. Thus, we will not consider chunks of speech larger than a phonological phrase. Moras, intonational phrases and utterances will not be dealt with here.

2.2.1. Acquisition of the syllable

Segments are organized into syllables, as shown in chapter 5 of the present volume, by Colina. The syllable is thus the first prosodic constituent besides the mora; in its simplest form, the syllable has a nonbranching onset and a nonbranching rhyme, leading to the simplest open CV syllable. A branching onset is represented as CCV, and a branching rhyme as CVC, with a consonantal coda, which turns the syllable into a closed syllable. According to Delattre (1965: 42), Spanish has about 26.5% closed syllables. Children acquiring Spanish generally begin by producing CV syllables only and soon go on to produce syllables without an onset. More complex syllables are those with a consonant cluster in the onset. If the onset has only one position available, the child will produce only one consonant in the onset. And the same is true for the rhyme: at first, the coda position is not available, and the CVC syllable is reduced to an open syllable, CV. A superficial consideration of L1 phonological acquisition of Spanish might allow the hypothesis that codas will be acquired rapidly, as the codas to be mastered are so limited in number and structure. However, this is absolutely not the case. Children acquiring German, which according to Delattre (1965) has more than 70% closed syllables, acquire codas faster than children exposed to Spanish. This is not surprising when one takes into consideration some tenets of OT (see section 2.3 for some arguments for why German infants acquire coda consonants faster than Spanish infants do).

If the child is acquiring two languages simultaneously, namely Spanish as the HL and German as the societal language, researchers asked whether having to learn both the codas of Spanish and those of German would make the enterprise more complex, such that bilinguals would probably need more time than monolinguals to acquire the codas of both languages. However, results showed that bilinguals acquired the codas of both languages in a shorter amount of time than the monolinguals acquired the codas of each language separately (Lleó 2003; Lleó et al. 2003). That is, bilinguals acquired codas faster than monolinguals, which in the case of Spanish was unexpected.

2.2.2. Acquisition of the metrical foot

If we consider the empirical evidence available about the first stages of L1 acquisition, it soon becomes apparent that children acquiring Spanish do not limit themselves to producing single syllables. This is easy to explain, since most lexical items in Spanish are disyllabic or multisyllabic (trisyllabic or quadrisyllabic), and there are very few monosyllables in young children's lexicon, limited to words like *tren* 'train,' *pan* 'bread,' *sol* 'sun' or *dos* 'two.' Lexical items in Spanish generally comprise a minimum of a disyllabic foot, with stress on the initial syllable, i.e. a trochee. It has been proposed that when they first start acquiring a language, children abide by a minimality constraint; i.e. they are limited to producing words comprising a single foot, e.g. *agua* [ˈa.ɣwa] 'water,' *coche* [ˈko.tʃe] 'car,' *casa* [ˈka.sa] 'house,' *mano* [ˈma.no] 'hand,' *brazo* [ˈbɾa.θo] 'arm,' *ojo* [ˈo.xo] 'eye,' *leche* [ˈle.tʃe] 'milk,' *mono* [ˈmo.no] 'monkey,' etc.

For Spanish, with many trisyllabic target words, this means that at first one of the syllables of the trisyllable must be truncated (see Table 17.2, which lists several target trisyllabic words comprising a trochaic foot preceded by an unfooted syllable, i.e. a syllable not belonging to any foot). The initial word structure available in the child's lexicon consists only of a single foot (Lleó 2012; Ota 2003). However, whereas children acquiring a Germanic language truncate the pretonic or unfooted syllable for quite a long span of time, children acquiring Spanish show a very short truncation stage and soon start producing the three syllables of the target.

2.2.3. Acquisition of the prosodic word

As we saw in the last section, many of the first words produced by children acquiring Spanish correspond to syllabic trochees, i.e. feet comprising a stressed syllable followed by an unstressed one (SW), or else the words are reduced to trochees by truncation (of one or more syllables). Children acquiring Spanish have a one-foot word in their prosodic system at first. But very soon this pattern or template (according to some researchers) expands by allowing the unfooted syllable of the target word to become part of the child's output word (Vihman 1992). Table 17.2 shows some examples produced with truncation at first. Later on, once the child's prosodic structure contains unfooted syllables, truncation does not occur anymore. The evolution of prosodic word structures in Spanish thus begins with a simple trochee, which will later on be preceded by an unfooted syllable. However, words can be longer than three syllables in Spanish, which means that, e.g., a quadrisyllable will be first reduced to one foot, and later on, the foot can be preceded by an unfooted syllable, e.g. *mariposa* [ma.ɾi.po.sa] 'butterfly,' produced with two syllables as [ˈbo.sa] by Miguel at 1;8, and with three syllables as [pa.ˈbo.ta] by José at 1;9. Another example is the word *calcetines* [kal.θeˈti.nes] 'socks,' produced with two feet as [ˌpa.pɛ] [ˈtsi.nɛ] by José at 2;2.

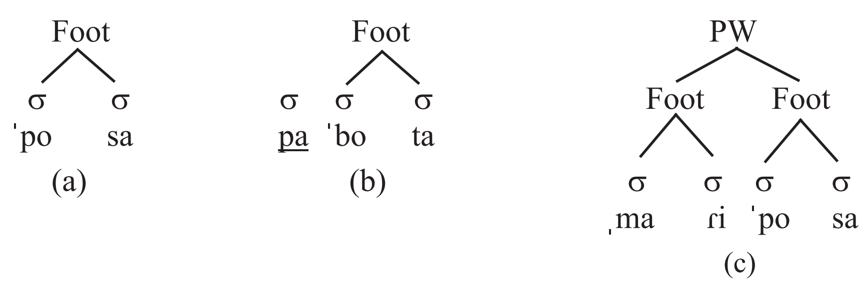

Figure 17.1 Evolution of the prosodic structures occurring in Spanish child language for the word *mariposa*: in (1a) the child has only one foot available in his prosodic inventory; in (1b) the foot is preceded by an unfooted syllable, and in (1c) both feet of the word are already available.

Table 17.2 Truncation in Spanish child language at the stage at which each phonological word comprises one single trochaic foot

Target word	*Meaning*	*Underlying form*	*Child form*	*Child (age)*
1 *pelota*	'ball'	/peˈlota/	[ˈbɔda]	Miguel (1;6,7)
2 *conejo*	'rabbit'	/koˈnexo/	[ˈðeʁo]	Miguel (1;8,23)
3 *mariposa*	'butterfly'	/maɾiˈposa/	[ˈboza]	Miguel (1;8,23)
4 *ardilla*	'squirrel'	/aɾˈðiʎa/	[ˈzijə]	José (1;7,27)
5 *Alberto*	(name)	/alˈβeɾto/	[mbæto]	José (1;9,2)
6 *espada*	'sword'	/esˈpada/	[ˈpaðə]	José (1;11,23)

Source: Simplified prosodic words produced by two monolingual boys from the project PAIDUS

2.2.4. Acquisition of prosodic or phonological phrases

Words are combined into phonological phrases, comprising various structures exemplified by the productions of the German-Spanish bilingual child Manuel, as seen in (1).

(1) Phonological phrases produced by Manuel

article + noun	[uŋ ˈko.tˢe]	'a car'
article + noun + preposition + noun	[un ˈko.tˢe. de.ˈle.na]	'a car of Lena'
article + noun + adjective	[uŋ ˈko.tʃe.peˈke.ɲo]	'a small car'
pronoun + verb	[se ka. ˈjo]	'He/she fell down'
article + adjective + noun	[ˈu.na gɾan.de.ka.mjo.ˈne.ta]	'a big van'
verb + noun	[ˈfal.tan.ˈko.tʃes]	'cars are missing'

Note that constraints on phrases are not dominant anymore, as Manuel produces lexical items of three syllables or quadrisyllabic nouns (e.g. *camioneta*). One should also note the word order of some of the phrases in (1), e.g. [pe.ˈke.ɲo.ˈko.tʃe] or [ˈu.na gɾan.de.ka.mjo.ˈne.ta]: both phrases containing an adjective preceding the noun show clear influence from German, i.e. so-called cross-linguistic interaction (CLI).

Phonological phrases comprise one pitch accent each, and they can be nonfinal, i.e. nonnuclear, or final, i.e. nuclear. Such phrases can also be combined with one or more further phonological phrases to build an intonational phrase, as intonational phrases in the prosody correspond generally to whole sentences in the syntax. The prosodic structure of such phrases has a certain intonational pattern, comprising several pitch accents and one boundary tone on the left-hand side and/or another boundary tone on the right-hand side.

Whereas in the production of words there are mismatches between prosodic positions and segments, which highlight the two levels of representation (prosodic and segmental), phrases show a match between prosody and segments. That is, phrases (e.g. article + noun) can comprise three syllables (two for the noun and one for the article).

2.3. Summary: segments and prosody

An important aspect emerging from the information in this chapter is the two-level structure discovered in nonlinear treatments of phonology. This allows us to understand the child's apparently reduced output as the natural course of acquisition of prosodic structure, which requires time and experience to develop. In this view it is not necessary postulate deletion of segments or other units from the input to the output, e.g. the /ɾ/ of *barco*, the /l/ of *plato* or the syllable [pe] of *pelota* (see section 1.1). Before prosodic structure was incorporated into phonological analysis, processes represented by rules were the formal mechanism to account for development. However, nonlinearity allows for simpler solutions, without the need of rules. All that is needed is a representation based on two levels, the prosodic layer and the layer of segments. At first, prosodic positions involving complexity—i.e. a coda position, complex onset or unfooted syllables—are not available in the child's representations, but they become accessible as the child's competence develops.

3. Research on the beginnings of intonation

Intonation and rhythm are two additional areas of prosodic acquisition that entail great complexity, both having attracted much research in prosodic development since the turn of the century (for rhythm, see Post and Payne 2018). The analysis of intonation had to wait longer than rhythm, until the Autosegmental-Metrical (AM) model was developed and applied in a successful manner to adult and also child language (Pierrehumbert 1980). The second part of this chapter deals with the acquisition of intonation, more specifically bilingual intonation of Spanish and German from birth. Besides summarizing a few studies representative of the field of simultaneous L1 acquisition of Spanish and German intonation, we will focus our attention on a small pilot study about first steps in the early development of focus.

Not long ago, researchers claimed that babies at about 3 months of age preferred to produce falling contours (Snow and Balog 2002). However, prosodic development is not so simple (Armstrong and Hübscher 2018), and recently it has been acknowledged that not all infants prefer falling contours. In a comparative study of French and German newborns' cries, only German infants showed falling contours, whereas French infants' cries were rising. The reason for such a difference has been attributed to the different prosody of the target languages, with German showing falling and French rising contours. As Mampe et al. (2009) put it, newborns' "cry melody is shaped by their native language." Another claim often made relates to the development from a few initial intonation contours to a large repertoire of contours or intonation grammar (Prieto et al. 2012). Several phonologists have proposed that the occurrence of two-word combinations is the fundamental event that accounts for the development of an intonation grammar. However, other researchers have found these two entities—intonation and two-word combinations—to be independent from one another (Branigan 1979; Lleó and Rakow 2006).

3.1. Some specific traits of Spanish intonation in a bilingual context

The majority of studies of simultaneous bilingual intonation are based on phrases produced by children exposed to two languages from birth, where there is much interaction between the two languages of the bilingual child. Researchers have found a lot of influence from one language onto the other (CLI) and even mutual influence. However, CLI is better known in relation to segmental phonology, and here we want to focus on prosodic phonology, specifically, on Spanish intonation from a bilingual perspective. Lleó et al. (2004) compared prenuclear pitch accents as produced in Spanish (rising with delayed peak) and German (falling contour) by 3-year-old monolingual children and three German-Spanish bilinguals (Féry 1993). (Data are available from the Hamburger Zentrum für Sprachkorpora (HZSK) and from CHILDES.) Whereas monolinguals produced target-like pitch accents, one of the bilinguals often substituted the falling contour of German for the rising contour of Spanish. Such substitutions have been interpreted as the result of the influence of the societal language on the HL (Lleó et al. 2004; Queen 2001).

A few recent studies investigated the intonation of children acquiring Spanish in contact with another language. Lleó and Rakow (2011) investigated *yes/no* questions as produced by two German and two Spanish monolinguals, as well as two German-Spanish bilinguals from Hamburg. The children were 2;0 and 3;0 years old. The study showed that monolingual German and monolingual Spanish children produce target-like F0 contours and correctly align the four crucial points (the first peak, falling contour, a low tone and a final high tone) before the age of 3 years. Spanish should show a higher and later first peak and a later and steeper last rising slope. However, bilinguals in Spanish tended to produce an earlier first peak and a longer final slope, which the authors attributed to CLI with the societal language (German).

Wh-questions in German and Spanish child language are investigated in Lleó (2016) on the basis of questions produced by seven 3-year-olds: three were German monolinguals, two were Spanish monolinguals, and two were German-Spanish bilinguals from Hamburg. Most aspects of such utterances seem to have been acquired by 3;0 years of age. However, bilinguals exhibit much variation. Both German monolinguals and bilinguals produced more rising contours than expected, taking into consideration that in target German and target Spanish the contours of such interrogatives resemble those of assertive sentences; i.e. they appear to be falling. Figure 17.2 shows the production of a *wh*-interrogative ending in a rising contour, produced by a child in German, whereas Figure 17.3 shows a falling contour produced by an adult in Spanish (see Henriksen 2009 as well).

CLI has been found with the influence going in both directions, from the dominant to the HL, and from the HL to the majority language, depending on several criteria, including differences and/or similarities between the two languages (Lleó 2002; Kehoe et al. 2004), frequency of occurrence of a certain category (Lleó et al. 2003) and (un)markedness and complexity of the phenomenon (Lleó 2002; Lleó and Rakow 2006).

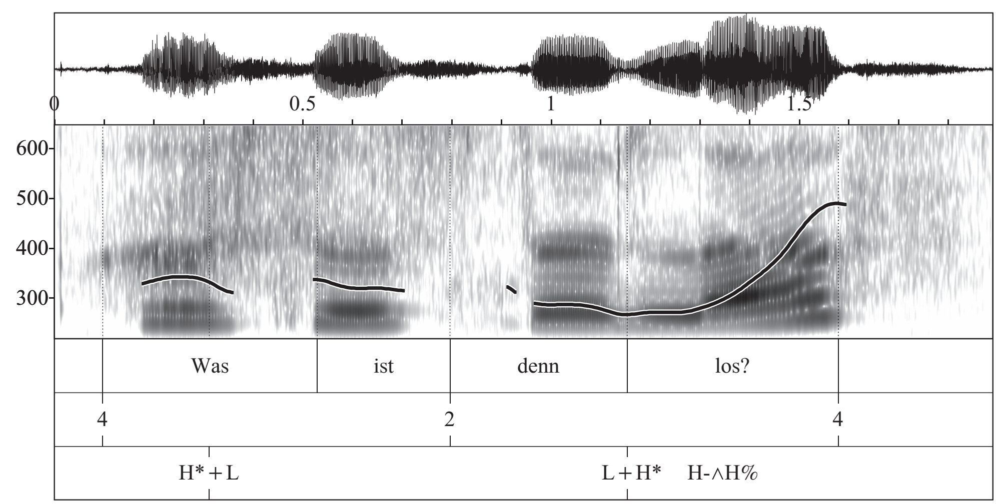

Figure 17.2 Waveform, spectrogram and F0 trace for the German *wh*-question *Was ist denn los?* 'What's going on?,' produced by the bilingual child Manuel (3;0)

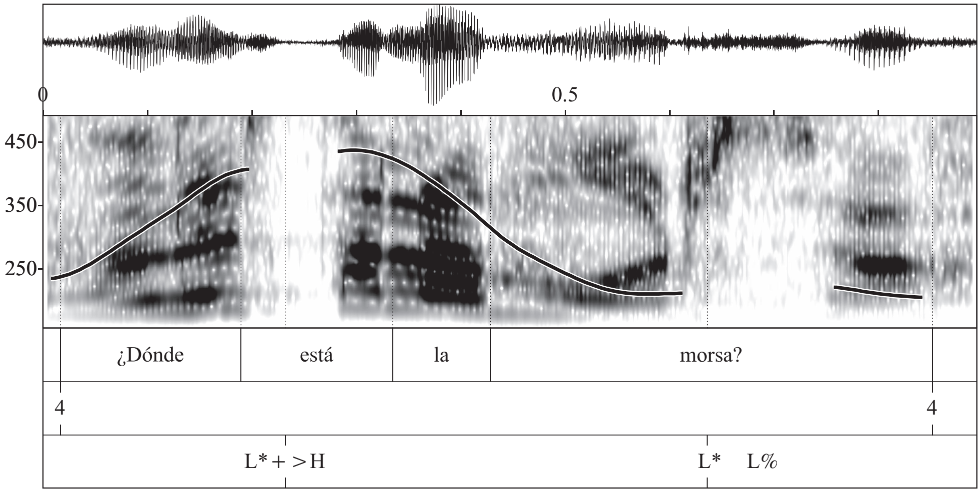

Figure 17.3 Waveform, spectrogram and F0 trace for the Spanish *wh*-question *¿Dónde está la morsa?* 'Where is the walrus?,' uttered by a Spanish adult native speaker

3.2. Prosodic accent, information structure, focus and emphasis

The study of intonation (as well as other areas of prosody) has experienced great growth in recent decades. However, numerous questions remain open to further treatment. The question as to the most adequate method of analysis seems to be provisionally settled, as the majority of intonation studies agree on applying the Autosegmental-Metrical (AM) model. This comprises pitch accents and boundary tones, both being expressed by means of two levels of tones, High (H) and Low (L). (See Hualde and Prieto 2015 for a more detailed description of the AM model applied to Spanish.) Figures 17.2 and 17.3 show typical representations of the AM model of intonation, with the following theoretical constructs from top to bottom: waveform, spectrogram and F0 contour, German words (Figure 17.2) or Spanish words (Figure 17.3), boundary tones and pitch accents.

The pitch accent studied in the second part of this chapter, H*+L, occurs in both German and Spanish. Uhmann (1991) analyzes prenuclear L*+H as a topic marker and H*+L as the default focus accent, a.k.a. new information, which is predicated of the topic. However, in child German H*+L is often produced with upstep, as H¡*+L, whereas in Spanish it is generally produced as plain H*+L expressing narrow focus (generally referring to one single noun or NP) and contrastive focus (involving a rectification). Thus, the two pitch accents are very similar, the main difference being that the tonal distance between H and L appears to be larger in German than in Spanish. Since this observation is based on human perception, it seems appropriate to test it with a more objective method based on acoustics. This is what we intend to do; that is, this pitch accent, often produced with upstep by monolingual German children, will be compared to the production of the corresponding pitch accent by Spanish monolinguals, as H*+L, without upstep. Finally, we will study the relevant bilingual data for children acquiring German and Spanish simultaneously.

A further rationale for selecting H¡*+L vs. H*+L as the topic of this study has to do with the claim that children acquiring a West Germanic language (e.g. Dutch) have not yet mastered topic nor focus accents at 4 or 5 years of age, and that it is not until they are around 8 years old that they use phonological cues to mark focus (see Chen 2011). Nonetheless, before 8 years of age, children use emphasis, in the form of strong involvement, which is generally independent of focus at first, and later on can be considered a sort of precursor of focus. Concerning young Spanish or German speaking children, it seems more appropriate to interpret their utterances as being based on *emphasis*, as this notion, compared to that of *focus*, refers to prominence in a general way (see Ladd 2008). In other words, emphasis has a smaller degree of specialization than focus. Selting (1994), who presents a very detailed study of emphasis, claims that emphasis is more-than-normal involvement, which shows several cues, of which the prosodic ones—density of accented syllables, rhythmic organization with short isochronous cadences, pitch accents with pitch peaks or greater loudness—are the most relevant for us.

In another important study on emphasis, Ladd and Morton (1997) tested whether the difference between "normal" and "emphatic" accent peaks in English is categorical rather than a continuum of gradually increasing emphasis. The authors found "good evidence of abrupt shifts in identification from normal to emphatic as pitch range increases, but little evidence of an associated peak in discriminability of stimulus pairs" (Ladd and Morton 1997: 313).

There are various ways of instantiating discourse functions. On the one hand, in a Germanic language such as German, discourse functions and so-called information packaging are expressed by means of prosody, which has been dubbed *plasticity* by some authors (Vallduví 1991). On the other hand, in Romance languages such as Spanish, prominence is expressed primarily by syntax (i.e. word order), with prosodic prominence being added (or not) to the last lexical item of the utterance. Syntax (word order) takes the lead in these nonplastic languages.

4. An empirical pilot study on emphasis and focus

I take as a point of departure the claim that children differentiate words from very early on by means of prominence. The three cues to prominence are duration, tonal height and amplitude (Kehoe et al. 1995), although their degree of prominence shows differences depending on the language and its phonological characteristics. Taking the difference between the plasticity of German and the nonplasticity of Spanish as the background frame for our study, the empirical part of this chapter focuses on the predictions involved with regard to the prosody of the two languages.

4.1. Hypotheses

It was perceptually observed that German monolingual children produced large tonal excursions in their utterances (here represented as H¡*+L), whereas Spanish monolingual children's tonal excursions were not as large as those of German. Taking this as the point of departure for our study on German-Spanish bilingualism, we hypothesized the following: (1) German monolingual children will show a more flexible prosodic marking, with larger ranges and larger F0 excursions, conveying prominence to any constituent in the sentence. (2) Only German monolinguals should produce the upstepped pitch accent H¡*+L. Moreover, (3) bilingual children will not be able to differentiate the expression of focus in the two languages, which will lead to a less flexible (or less plastic) use of prominence. Alternatively, (4) bilinguals will have a better command of intonation and its nuances, given their prosodic experience with two languages from birth (Post and Payne 2018).

The study is based on data from monolingual and bilingual children acquiring Spanish and German. H*+L is the most frequent pitch accent in German, used in declaratives, *wh*-questions and *yes/no* questions. It is the default focus accent, according to Uhmann (1991) and Grice et al. (2005). However, the form of this pitch accent most often heard in the German children's data shows upstep (H¡*+L). Thus, the expected outcome predicts the occurrence of H¡*+L only in German.

4.2. Participants, data and analysis

Table 17.3 provides children's names (pseudonyms are used) and ages at the time the data were recorded. Tables 17.4, 17.5 and 17.6 show the data of the study and the participants: three German and three Spanish monolinguals, as well as three German-Spanish bilinguals (a fourth bilingual child had to be excluded because at 3;0 years he hardly produced any Spanish). The data were part of several research projects on the acquisition of phonology, supported by the DFG (Deutsche Forschungsgemeinschaft), especially (monolingual) PAIDUS (Parametrization in German and Spanish), (bilingual) PEDSES (Simultaneous Phonological Acquisition of German and Spanish, and PhonBLA (Phonological Bilingual Language Acquisition: German and Spanish). Children were visited at their homes by two teams, a German-speaking and a Spanish-speaking one. The interviews consisted of sessions of about 30 minutes, during which the child described the images of a book, played a game or just conversed with the visitor. A minimum of two recording sessions per child were analyzed (depending on the quantity of data available in each session): the monolingual children were about 1;4 to 1;11. Bilingual data was considered at about age 3 (from 2;11 to 3;1). We aimed at selecting about 20–25 utterances per session, language and child.

In Tables 17.4 to 17.6, the information provided is limited to the hypotheses formulated in section 4.1, except for a few additional aspects about the children's utterances to be briefly considered, too. From left to right, the tables indicate the child's age at each of two recording times, and the number of utterances (n) analyzed for each child. Utterances range from single words to two-word and multiple word sentences. "Decl" gives the number of assertive or declarative sentences produced by the child and considered for analysis. "Rise" and "Fall" refer to the contours of utterances. The reason for separating them was to allow for quantification of types of contours. The following column, H¡*+L provides the percentages of upstepped pitch accents produced by each child at one time point in relation to putative utterances that admitted upstep. "Ratio Hz" was calculated in the standard way, namely the nominator was divided by the denominator. "Range" of a set of data is the difference between the highest and lowest values in the set. To calculate it, the smallest value was subtracted from the largest one. The following column "ratio dB" shows the ratio, as in the previous case ("ratio Hz"), but this time referred to amplitude instead of tone. There are several ways to compare the production of the pitch accent to be analyzed. The one chosen, by means of ratios and range, assumes that the larger tonal or amplitude distance to the maximum points of an utterance reflects the larger distance brought by the German upstep. In general, all these measurements serve to calculate the distance between the maximum and minimum number of Hz/dB of stressed and unstressed syllables. The last

Table 17.3 Ages of the monolingual and bilingual children at the time of data recording (years; months, days)

Monolinguals	*Child age*	*Bilinguals*	*Child age*
Britta Ge	1;4,30 / 1;9.5	Jens Ge	3;0,25
Marion Ge	1;4,23 / 1;11,25	Manuel Ge	3;1,9
Thomas Ge	1;5,3 / 1;10,4	Simon Ge	3;1,3
José Sp	1;5,4 / 1;6,0	Jens Sp	2;11,26
María Sp	1;6,3 / 1;10,17	Manuel Sp	3;1,8
Miguel Sp	1;5,1/1;10,18	Simon Sp	3;0,11

Ge = German, Sp = Spanish.

column (ePMLU-F) goes back to Arias and Lleó (2013)'s approach to assess children's phonological development ("F" refers to Features). Duration was analyzed in Kehoe and Lleó (2017), and has been omitted here.

The ePMLU-F is calculated on the basis of the child consonant productions compared to the adult forms. Those consonants that are produced targetlike receive 3 points (1 for Manner, 1 for Place and 1 for Voice). The total sum of points is divided by the number of consonants produced, to get the mean. The measurement is based on a proposal by Ingram (2002) on whole-word measurements. If in spite of the expansion introduced by the modified version, the ePMLU-F gives a slight advantage to Spanish over German, this can be balanced by another measure (ePMLU-S), according to which each syllable produced by the child receives 2 points; closed syllables in German (as a weight-sensitive language) get 2 extra points, and closed syllables in Spanish (as a language not sensitive to weight) get 1 extra point.

4.3. Results of the monolingual study

Children produced one-word utterances at first, and as they grew older their utterances were expanded to sentences, mainly declaratives, but also interrogatives and requests. (Descriptions of Spanish interrogatives can be found in Lleó 2016; Lleó and Rakow 2011, among others.) Most contours were falling, and a few rising. In the present study only declaratives were analyzed. Two observations should be made with regard to the production of upstepped H¡★. On the one hand, the frequency of production seems to depend on the language spoken by and to the child, as the German children produced more upstepped pitch accents than the Spanish children. On the other hand, the ratios of pitch accents in Spanish tend to be smaller than in German, and the resulting range is also slightly smaller. Moreover, the number of pitch accents produced shows development from the first to the second time point: Britta produced 9 upstepped pitch accents in the first recording session, and 21 in the second. Marion shows development, too, from 4 cases at the first time point to 10 at the second. Thomas produced 3 cases both at the first, and at the second time point.

Regarding the Spanish monolinguals, relatively few upsteps were produced, except by Miguel, who had 7 at the first time point, but this number was reduced to 0 at the second time point. José produced 4 upsteps at the first time point and again at the second; for the rest, the numbers are negligible. Recall that the main aim of this study is the comparison between the upstepped German focus marking H¡*+L and the Spanish focus without upstep. A comparison between monolingual ratios shows a tendency for Spanish ratios of the category Hz to be slightly smaller than the German ratios at the first time point: María 1.37, Miguel 1.5 and José 1.56 (in Spanish) vs. Britta 1.58, Thomas 1.67 and Marion 1.68 (in German). The German children's values at the first time point were slightly larger than those for the Spanish children. Interestingly, something similar happened in relation to amplitude, expressed by means of dBs: the German ratios were a bit larger at the first time point (Britta with 1.43, Marion 1.8 and Thomas 1.6), whereas the Spanish ones were José 1.44, María 1.5 and Miguel 1.45. These values barely changed at the second time point, with José reaching 1.64, María 1.5 and Miguel 1.6, whereas the German values experienced clear increases, with Britta reaching 2.11, Marion 1.95 and Thomas 2.1.

Student's t-tests based on the variable language, Hz (tonal height) in German vs. Spanish, showed no statistically significant difference between the German child Britta at age 1;9 and the Spanish child José at age 1;10. However, statistically significant results were found between the German child Thomas and the Spanish child Miguel, both at age 1;10, showing a p-value of .002 in two-tailed distribution and .001 in one-tailed distribution. Further significant values were found between all German monolinguals and all Spanish monolinguals, with a p-value of

Table 17.4 Utterances produced by three monolingual German children and analyzed auditorily and acoustically with PRAAT.

Child_age	*n*	*Decl*	*Fall*	*Rise*	*H¡*L*	*Ratio Hz*	*Range*	*Ratio dB*	*ePMLU-F*
Britta_1;4	38	21	31	---	31% (9)	1.58	338	1.55	3.92
Marion_1;4	27	22	17	---	22% (4)	1.68	124	1.80	3.30
Thomas_1;5	24	20	12	4	15% (3)	1.94	344	1.60	3.08
Britta_1;9	34	20	26	---	61% (21)	2.11	427	1.51	6.42
Marion_1;11	35	21	17	5	43% (10)	1.95	398	---	5.46
Thomas_1;10	28	22	15	3	13% (3)	2.10	370	1.60	5.00

Source: Boersma and Weenik 2011.

Table 17.5 Utterances produced by three monolingual Spanish children and analyzed auditorily and acoustically with PRAAT.

	n	*Decl*	*Fall*	*Rise*	*H¡*L*	*Ratio Hz*	*Range*	*Ratio d dB*	*ePMLU-F*
José_1;5-1;6	27	24	11	5	23% (4)	1.56	125	---	3.90
María_1;6	34	30	31	---	3% (1)	1.37	93	1.37	4.13
Miguel_1;5	27	22	12	10	33% (7)	1.50	133	---	4.96
José_1;10	29	26	15	3	21% (4)	1.64	128	1.43	5.45
María_1;10	33	25	27	1	6% (2)	1.37	190	---	5.26
Miguel_1;10	28	25	10	6	0% (0)	1.66	128	1.45	6.87

Source: Boersma and Weenik 2011.

.003 in two-tailed and a *p*-value of .001 in one-tailed distribution. As far as dB (amplitude) is concerned, the difference between the two languages did not result in any significant *p*-values, neither two-tailed nor one-tailed. Thus, we can conclude that whereas some of the tonal differences led to variance, amplitude did not.

Summarizing the monolingual results, we can say that there are prosodic differences between some of the children, e.g. Thomas and Miguel, at about the end of the second year of life; however, at that age the differences are not yet robust.

4.4. Results of the bilingual study

In the bilingual study our goal was answering question (3); that is, we wanted to find out whether there is CLI in the acquisition of intonation by simultaneous bilinguals. For that purpose we set up a group of German-Spanish bilingual children comprising three simultaneous bilinguals, here called Jens, Manuel and Simon. The data are displayed in Table 17.6, in a parallel way to the data displayed in Tables 17.4 and 17.5 for monolinguals; that is, the tables contain the same variables, but they vary with regard to the participants: Simon produced 10 upsteps at age 2;11, and 14 at age 3;1 in German. In Spanish, he produced 6 at age 2;11 and 3 at 3;0. Note that Simon's reduction in Spanish from 6 to 3 is on the right track, and so is Jens's reduction of the number of upsteps from 13 to 6, considering that there should be no upstep in this Spanish pitch accent. Something formally similar to the focal accent of German is produced by the bilinguals both in German and in Spanish, which means that there is some overlap between the two languages, as some upstep is produced by the bilinguals in Spanish. As far as ratios are concerned, the most

Table 17.6 Utterances produced by three bilingual German-Spanish children and analyzed auditorily and acoustically with PRAAT.

Child_age	*n*	*Decl*	*Fall*	*Rise*	*H¡*L*	*Ratio Hz*	*Range*	*Ratio dB*	*ePMLU-F*
Jens-Ge_2;11	31	19	31	3	46% (13)	1.77	152	1.69	4.74
Jens-Ge_3;0	30	28	27	2	23% (6)	1.69	217	1.94	4.65
Jens-Sp_2;11	31	19	7	3	13% (4)	1.98	502	1.70	4.27
Jens-Sp _3;1	30	28	27	2	15% (7)	1.69	186	1.70	4.65
Manuel-Ge_2;11	31	19	7	6	39% (9)	1.77	500	2.05	7.80
Manuel-Ge_3;1	32	24	19	6	41% (10)	1.96	151	1.77	5.90
Manuel-Sp_2;11	31	19	7	6	68% (17)	---	413	---	---
Manuel-Sp_3;1	29	21	19	6	51% (14)	1.79	186	1.73	6.64
Simon-Ge_2;11	32	24	4	3	27% (10)	1.80	---	1.96	4.64
Simon-Ge_3;1	31	19	18	3	23% (14)	---	307	---	5.88
Simon-Sp_2;11	32	24	24	3	22% (6)	---	319	2.20	5.37
Simon-Sp_3;1	31	19	18	3	23% (3)	1.90	88	1.90	6.64

Source: Boersma and Weenik 2011.

T-tests were applied to the languages of the three bilingual children (Jens, Manuel and Simon), and no statistically significance difference was found between the German and Spanish productions regarding tonal differences or amplitude. Summarizing again, no statistically significant differences were found in tonal height or amplitude. However, there were few participants in the analyses, which suggests the need for further studies, with more participants and also including more prosodic categories (vs. a single pitch accent).

noticeable aspect is the similarity in the two languages; that is, bilingual children do not seem to be totally receptive of the prosodic differences in the presence or absence of upstep, as their ratios of upstep are very similar in both languages. But bilinguals may be developing some sensitivity to the difference between the two languages, as shown by the reduction of the number of upsteps in Spanish over several months.

As pointed out in section 3.2, German, along with other Germanic languages, can be considered a "plastic" language in Vallduví's (1991) terminology, while Spanish is nonplastic. According to van Maastricht et al. (2016: 126), in a plastic language "intonation is used to mark the information status of a certain element by means of pitch accents [. . .] while in [a nonplastic language] this is reflected by its position in the sentence and the fact that the nuclear accent is placed at that, generally fixed, position." However, the bilingual children introduce prominence in German, and also in Spanish, more freely than is allowed in these languages. Thus, I interpret this move as transfer from the societal language into the HL.

5. Discussion

We began to study the acquisition of certain aspects of prosody with two types of questions, one about monolinguals and another about bilinguals, which we will now consider in light of the data analyzed.

5.1. Discussing the hypotheses

We had tentatively proposed that (1) monolingual German children would show more flexible prosodic marking, with larger ranges and larger excursions of F0 due to the plasticity of their target language; and thus (2) only monolingual German children, not Spanish ones, would produce upstepped H¡*+L. The answers to these questions showed a positive tendency, as upstep was mainly found in the monolingual German utterances. Interestingly, upstep production in

German experienced an increase along the temporal axis, whereas in Spanish it appeared in a few cases at the beginning but later on was strongly reduced in both languages and with a similar frequency of occurrence in both.

In relation to the bilingual children, our initial question was (3) whether they would be able to separate the two pitch accents, producing upstepped H¡*+L both in German but also in Spanish, or, alternatively, (4) whether bilinguals would exhibit more phonological experience, which would lead to a better mastery of prosody in both languages. Until about age 3;0, bilinguals implement upstep (H¡*) in the two languages, and with a similar frequency of occurrence in both languages: 46 times in German and 49 times in Spanish. This means that upstep converges, and CLI is present, transferring the German variety into Spanish. We hypothesized that in Spanish the use of upstep would first be reduced, because in this language upstep belongs to an earlier stage of intonation acquisition—more emphatic than functional or grammatical—whereas in German it would increase and there would be a transition stage, in which pragmatic functions, such as focus marking and discourse functions, would become disconnected from the emphatic proto-function of the earliest stages (Vallduví 1991; van Maastricht et al. 2016).

5.2. Implications of our findings in bilingual contexts

Transfer can affect different areas of language (segmental as well as suprasegmental). Similarly, it can be hypothesized that for bilinguals acquiring one language with prosodic focus marking and another language with mainly syntactic marking, the focus function of upstep can be acquired, maintained and transferred to the other language.

Focus marking is preferred by children acquiring German (simultaneously with Spanish), although in the target languages only German manifests focus marking associated with upstep. The variety of Spanish resulting from this treatment by German-Spanish bilinguals shares prosodic features with German, resulting in transfer from the societal or stronger language into the HL. Other cases of transfer in the prosodic domain are shown in Queen (2001), Olson (2013), Lleó (2017) and several others. Harris et al. (2015) present similar evidence about Chicano speakers. Mexican Spanish, being nonplastic, was compared to the Chicano variety of the Spanish spoken as the HL of Chicano bilinguals. These were found to speak a variety (Chicano Spanish) with a higher degree of plasticity than Mexican Spanish, which can be explained by CLI from English into Spanish.

5.3. Toward focus through emphasis

In recent decades research has shown that many languages communicate similar types of information related to intonation, such as the so-called information packaging, which although still under debate uses general categories like topic and focus or new and old information. However, it is precisely such general cross-language categories that are not present from the first stages of acquisition. For instance, information packaging is not in place until the child is beyond his/her fifth birthday (Chen 2011), and probably later.

The notion of "information packaging" was introduced by Chafe (1976: 28): "The basic idea is that speakers do not present information in an unstructured way, but that they provide a hearer with detailed instructions on how to manipulate and integrate this information according to their beliefs about the hearer's knowledge and attentional state."

Armstrong and Hübscher (2018) have shown that the cognitive content of intonation takes longer (about 10 years) than expected to be interpreted, the reason being that intonation contains internal states (beliefs, feelings and emotions), which are not transparent. The authors show that the ability to override a hypothesis by means of prosody emerges when children are about 6 years old. Obviously, the productions of our participants do involve much more detail than originally hypothesized.

Young children use intonation to convey emotions about their present state, like moaning as a mild protest, screaming to be attended to, etc. In our data the import most frequently expressed by means of upstep was new information, emphasis, positive surprise, etc. It is plausible to hypothesize that emphasis is the precursor of focus, especially of narrow and contrastive focus. At a very young age, German children use a pitch accent that formally comprises a large pitch jump, larger than the customary H to L step. Such a pitch accent may emerge at the earliest stages of phonological acquisition. This transition appears with two-word utterances, if not earlier, but only in the German children's utterances, not the Spanish ones (Lleó and Rakow 2006). In German, upstep implements the focus rule of discourse, by which attention is attracted to the new focus of the utterance, whereas in Spanish, in addition to having a smaller range, it is mainly an expression of excitement, emphasis and/or involvement on the part of the child. That is, it can be claimed that the German upstep does not have the same functional meaning as in adults, whereas the Spanish upstep is mainly related to children's emotional states but not yet based on functional or grammatical grounds; i.e., intonation in child language, such as in Spanish, is less grammaticalized than adult intonation.

5.4. The transition from child to mature language

It is widely known that the phonetic features contributing to marking prominence (vs. lack thereof in unaccented counterparts) show increases in duration and amplitude, as well as less vowel quality reduction, or in some cases more tonal height (Kehoe et al. 1995). Kehoe and Lleó (2017) found a duration increase when comparing stressed and unstressed (nonfinal) syllables in Spanish. In this study we found a limited tonal increase. Amplitude should be a further feature distinguishing stressed from unstressed vowels. According to some phoneticians and phonologists, Spanish is believed to have an intensity type of accent, and it should thus be no surprise to find support for this hypothesis in our acquisition data. However, our amplitude results do not seem to support such a hypothesis. Both measurements, ratio Hz and ratio dB, led to different results, because amplitude (also referred to as intensity or loudness) is an accompanying property, whereas fundamental frequency is an essential part of utterances, related to meaning.

The child acquiring Spanish also produces a pitch accent involving the three prominence parameters, but the distance between "normal" H and upstepped H¡ is not as large as in German. A further crucial difference lies in the meaning of upstepped H¡, which in Spanish aims at attracting the attention of the adult, expressing especially emphasis, whereas in German it seems to be the precursor of focus marking. There is thus an important difference between standard H and the H marking focus. More research is needed before we have a basis on which to begin to understand the relation between prosody and segments.

The child is constrained from several points of view: at the initial stage he/she produces only a certain number of syllables and/or words at a time. Pitch accents need syllables to associate and/or align with. Children have a better or worse mastery of certain prosodic aspects, and the same is true with regard to segments. But both dimensions are independent of one another, with some children being ahead in the segmental domain and others in the suprasegmental domain. On the one hand, something formally similar to the focal accent of German is produced by the bilinguals in German, but also in Spanish. The child who uses it most often in Spanish is Manuel (17 times at the first time point, and 29 times at the second). Interestingly, he had the best score of ePMLU-F in Spanish. Although it might be premature to see some causality between segments and prosody, it is nonetheless arguable that if acquisition is fast in one area, it may be fast in the other area as well. That is, the development of certain language domains provides the necessary support for the development of another language domain; e.g. prosodic positions provide the anchor points for segments.

6. Conclusion

Interest in the acquisition of prosody by very young children is relatively recent. In this chapter I have analyzed important aspects of monolingual acquisition of German and Spanish at about 1;5 and 2 years of age, as well as simultaneous bilingual acquisition of German and Spanish at about 3 years of age. We have observed that shortly before age 2;0 children still produce many more falls than rises, in both German and Spanish, which is related to the number of statements produced, and arguably to the falling contours of German. Such young children produce only a certain number of syllables and/or words at a time, and thus prosodic structure is also restricted to certain patterns, such as H*, H*+L and L+H*+L.

The production of upstepped H* (i.e. H¡*+L) shows a different behavior in the two languages: whereas in Spanish some children produce it and some do not, and in general the number is reduced, in German we witness clear development, as production increases from the first to the second time point. The upstepped pitch accent (H¡*) was found to be transferred from German into Spanish by the bilingual children. Some hypotheses were made regarding the near future, in order to be able to predict possible outcomes of the acquisition of a Germanic and a Romance language. However, the children's language balance is unstable, which means that predictions about the direction of cross-language interaction are difficult to make.

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18

Guiding principles for advancing experimental research on the second language acquisition of Spanish phonology and phonetics

Holly J. Nibert

1. Introduction

Over the past few decades, various researchers in Spanish phonology and phonetics have turned their attention to the acquisition of the language's sound system by adult second language (L2) learners, as noted in the review articles of Elliott (2003), Simonet (2012), and Díaz-Campos (2014). The objectives, segmental and suprasegmental units examined, and methodologies of these studies have varied, with overarching purposes ranging from assessing ultimate L2 attainment (e.g., Nibert 2005; Face and Menke 2009; Menke and Face 2010; among others), to describing approaches to L2 pronunciation instruction (Llisterri 2003; Morgan 2006; Gil 2007, 2012; Lahoz 2012; Mellado 2012; Olson 2014; Rao 2019; among others), to examining the effects of L2 pronunciation classroom instruction (e.g., Castino 1991, 1996; Elliott 1995a, 1995b, 1997; González-Bueno 1997; Lord 2005, 2010; Saalfeld 2009, 2012; Hurtado and Estrada 2010; Nibert 2012; Kissling 2012, 2013, 2014, 2015; Lord and Fionda 2014; Counselman 2015; Camus-Oyarzun 2016) and/or of study abroad (e.g., Simões 1996; Díaz-Campos 2004, 2006; Lord 2010), to testing second language acquisition (SLA) theory (e.g., Zampini 1994, 1998; Nibert 2005, 2006; Colantoni and Steele 2006, 2008; Cobb and Simonet 2015; Díaz and Simonet 2015; Zárate-Sández 2015; among others). Still, while results from these studies have advanced our understanding of the L2 acquisition of Spanish phonology and phonetics, it remains difficult to articulate a broader understanding of the facts of Spanish and their implications, due in part to a need for further studies but also to confounding theoretical and methodological variation across studies that complicates their connection and thus cumulative findings.

The purpose of the present chapter is twofold: (1) to outline five interrelated guiding principles regarding future experimental research goals and methodologies, and (2) to review a small set of model studies that illustrate these principles, with an eye toward facilitating the connection of findings as well as their practical application to L2 pronunciation instruction. Due to space constraints, the studies chosen focus on vowels (specifically, the Spanish mid vowels) and, to a lesser extent, prosody, since there are existing studies on these topics that intersect well for these stated purposes. The five guiding principles include (1) to effectively ground experimental phonetic research in L2 speech acquisition theory, a conclusion also drawn by Simonet (2012: 742) (for the purposes of this chapter, only Flege's (1995, 2003, 2007) Speech Learning Model (SLM) will be reviewed); (2) to integrate constructs from general theories of SLA and phonology with the SLM as needed; (3) to include beginner, intermediate, and advanced L2 learners as research subjects, in order to elucidate acquisition orders and developmental stages of acquisition; (4) to reconsider the linguistic profile and tasks of control groups; and (5) when classroom instruction is addressed, to include explicit details about the pedagogical techniques and tools used. It is hoped that by outlining these recommendations and reviewing a few solid models of empirical studies and results that illustrate them, this chapter will both contribute to our current understanding of the L2 acquisition of Spanish phonology and phonetics and have a positive impact on the ongoing development of the field.

2. Theoretical grounding of experimental phonetic research in L2 Spanish acquisition: an overview of Flege's SLM

The relatively recent progressive development of powerful, affordable speech analysis software for the personal computer (e.g., Signalyze, Wavesurfer, Praat) has made it increasingly feasible to engage in experimental phonetic research without the cost or need of a full-fledged laboratory (cf. Simonet 2011). This has led to an increased number of experimental studies on L2 speech acquisition for Spanish and various other languages. While this is a plus, it has also led to cases of experimental work for the sake of simply comparing data measurements across the L1 and L2, without any theoretical grounding or framework supporting the study's motivation, design, or interpretation of results. How do such measurements contribute to our understanding of L2 speech acquisition as a process and/or to the building of a theory of L2 speech perception and production? What are the implications for L2 pronunciation instruction? In order to continue to advance the field, experimental phonetic research needs to be grounded in theory related to L2 speech learning and/or SLA more broadly.

The most developed framework to date for understanding L2 speech learning (including production and perception) is Flege's (1995, 2003, 2007) SLM. It is the most cited framework thus far for experimental work on L2 phonology, including for Spanish (cf. Cobb and Simonet 2015; Díaz and Simonet 2015; Zampini 1998, 2014). Although other models exist, such as the Perceptual Assimilation Model (PAM) by Best (1995) and its later extension to advanced L2 learners (PAM-L2) (Best and Tyler 2007), continuity in research findings for Spanish requires, at least initially, a discussion of results within a common framework. A goal of this chapter is to elucidate Flege's (1995, 2003, 2007) SLM, in order to facilitate its application in future studies and thus progress our overall understanding of the SLA of L2 Spanish pronunciation. The present chapter does not intend to compare theories, although this certainly is a worthwhile goal for future work (see Cobb and Simonet 2015 for a brief comparison of the SLM and PAM).

Based on experimental findings from three decades of research by Flege and various colleagues, the SLM serves as a springboard for formulating research questions, designing experiments, and interpreting results. The SLM emerged as an exploration of why foreign accent persists in L2 speech, especially for adults who have spoken their L2 for years. Since its original formulation in Flege (1995), the framework has been further refined and elucidated, as observed in much subsequent work cited in this chapter. However, its central axioms endure, the most provocative of which is that the unconscious processes and nonautomatic mechanisms used in the successful acquisition of an L1 sound system remain intact across the life span and are available for L2 speech acquisition. Said postulate stems from robust data first reported in Flege et al. (1995b). In this study, native English listeners assigned foreign accent ratings to English sentences spoken by 240 early and late L1 Italian-L2 English bilinguals (with an age of learning (AOL), also referred to as age of arrival (AOA), ranging from 3 to 21 years and an average length of residence (LOR) in Canada of 30 years). The results revealed a near-linear relationship between AOL and degree of foreign accent. The same near-linear pattern was found in Flege et al. (1999) for 240 early and late L1 Korean-L2 English bilinguals (with an AOL ranging from 1 to 23 years of age and an average LOR in the United States of 15 years). These results strongly challenge the Critical Period Hypothesis (CPH) for language acquisition (Lenneberg 1967; Scovel 1988), at least as regards second (versus first) language acquisition and L2 speech acquisition in particular. The CPH predicts a sharp leveling-off or lack of improvement in L2 pronunciation around puberty (roughly the ages of 11–15). However, the results cited here instead reveal a gradual increase in foreign accent as AOL increases, with no discontinuity around puberty.

Various additional claims and hypotheses are made by the SLM regarding the nature of the unconscious processes and mechanisms that drive L2 speech learning. Language-specific properties of speech sounds are stored as phonetic categories in long-term memory. As an L2 learner receives L2 input (the quantity and quality of which both matter for L2 speech learning (Flege 2009, 2016)), an L2 speech sound is linked to the perceptually closest L1 speech sound, creating diaphones at a position-sensitive, allophonic level (i.e., not at the phonological level). In other words, phonetic categories are position sensitive and less abstract than phonemes. As support for this claim, Flege (1995: 239–240) cites results from Strange (1992), which show that L1 Japanese speakers of L2 English (who possess only one liquid in their L1 phonetic system) perceive and produce both English /ɹ/ and /l/ more accurately in word-final than in word-initial position. If L2 perception operated at a phonemic level, such a position-dependent difference would not be expected.

Furthermore, the SLM posits that L2 phonetic categories, just like L1 phonetic categories, guide the parallel development of language-specific implementation rules for production, which can take much time to develop. Thus, the accuracy with which an L2 sound is perceived places an upper limit on the accuracy with which it ultimately can be produced.

As the L2 develops, sensitivity to phonetic differences between diaphones either decreases (referred to as phonetic category assimilation, also termed equivalence classification by Flege (1987)) or increases (referred to as phonetic category dissimilation). In the former case, the SLM predicts a merger of the phonetic properties of linked L1-L2 sounds (because the L2 sound is perceptually subsumed by and/or is perceived to be too similar to the L1 sound) (Flege 2007: 374). A merger may result in L1 and L2 sound productions that are unlike those of monolingual speakers of either language. In the latter case (phonetic category dissimilation), the SLM posits the likely establishment of a new L2 phonetic category. The L2 sound may be pronounced in a way that differentiates it from the perceptually closest L1 sound, or the L1 sound may be modified in order to differentiate it from the neighboring L2 sound (Flege 2007: 374–375). Again, such deflection of adjacent sounds may result in L1 and L2 sound productions that are unlike those of monolingual speakers of either language. Alternatively, the establishment of a new L2 phonetic category through dissimilation may not result in the deflection of either the L2 or the L1 sound, if the new L2 phonetic category is relatively distant in phonetic space from a preexisting L1 phonetic category. Flege (2007: 375) states, "More work is clearly needed to establish the conditions under which cross-language phonetic dissimilation occurs in bilinguals." In sum, through the unconscious processes of assimilation and/or dissimilation, the phonetic system of the L2 may be affected by the L1, and the phonetic system of the L1 may be affected by the L2.

Thus, the SLM predicts bidirectional L1-L2 interference in the realm of speech perception and production, the details of which will be language-, input-, and speaker-dependent (including the speaker's AOL and patterns of L1 and L2 use). As implied earlier in this section, the SLM posits that early (prepubescent) L2 learners are more likely to form new L2 phonetic categories than are late (postpubescent or adult) L2 learners. At any age, however, the formation of new L2 phonetic categories requires many years of quality L2 input (Flege 2016). Furthermore, L2 learners who use their L2 relatively often (and their L1 relatively seldom) are more likely to establish new L2 phonetic categories than L2 learners who use their L2 infrequently and their L1 frequently (Flege et al. 1995b; Flege et al. 1997; Piske et al. 2001).

A series of studies summarized in Flege (2016: 45–48, 77–81) illustrate some of these SLM constructs, including the establishment of a new L2 phonetic category. Schmidt and Flege (1996) researched the production of L2 English /p/ in absolute utterance-initial position by 10 early and 10 late learners with L1 Spanish. As is well established, monolingual English speakers produce an aspirated [p^h] in word-initial, stressed position, with a long-lag VOT (voice onset time, the length of time that lapses between the release of the stop consonant and the onset of voicing for the following vowel). On the other hand, monolingual Spanish speakers produce an unaspirated [p] in this position, with a short-lag VOT. In Schmidt and Flege's (1996) study, the early L2 English learners produced mean VOT values that matched those of monolingual English speakers, in the range of 40 to 55 milliseconds (ms.). The late L2 English learners, however, showed high variability, with mean VOT values ranging from 13 to 67 ms. Four of the 10 late learners (subgroup "a") used short-lag variants (with mean VOT values ranging from 13 to 18 ms.), while a different set of four late learners (subgroup "b") used long-lag variants (with mean VOT values ranging from 41 to 67 ms.). (The remaining two late learners showed mean VOT values in between those of subgroups "a" and "b.") According to Flege (2016: 77–79), the SLM posits that subgroup "b" established a new phonetic category for English /p/, which subsequently guided the language-specific implementation rules for its more native-like production in English.

In further support of this interpretation, as pointed out in Flege (2016: 45–48, 77–81), Flege and Schmidt (1995) and Schmidt and Flege (1996) also examined a different language-specific feature of English /p/, namely, that speaking rate affects both its perception and its production. In Schmidt and Flege (1996), when English monolinguals shifted from a slow rate of speech to a fast one, the VOT for /p/ decreased by an average of 15 ms. When Spanish monolinguals made a similar shift in speech rate, however, there was no significant change in VOT for Spanish /p/. Thus, no speaking rate effect appears to operate for Spanish /p/. Furthermore, in Flege and Schmidt's (1995) perception study, VOT was varied in a set of slow-rate consonant-vowel (CV) stimuli and in a set of fast-rate CV stimuli (where the consonant was English /p/). When English monolinguals were asked to rate these stops for "goodness," the VOT of their "best /p/" decreased by an average of 13 ms. from the slow-rate to the fast-rate continuum. Similar perception data regarding English /p/ were also collected from the late L2 English learners with L1 Spanish discussed in the previous paragraph. Recall that subgroup "a" used Spanish-like short-lag VOT values for English /p/, and subgroup "b" showed English-like long-lag VOT values. Whereas the perception data from subgroup "a" did not reveal speech-rate-dependent processing, subgroup "b" did indeed choose "best /p/" tokens with VOT values that were lower for the fast-rate continuum than for the slow-rate one. In sum, these perception data support the claim that subgroup "b" indeed established a new phonetic category for English /p/ characterized by long-lag VOT with rate-induced effects and other English-specific implementation rules (see Flege (2016: 48) for further details).

Examples of experimental L2 Spanish phonetic work grounded in the SLM and carried out by specialists in Spanish phonology and phonetics include Reeder (1998), Zampini (2014), Cobb and Simonet (2015), and Díaz and Simonet (2015), to name a few. Due to space limitations, only Díaz and Simonet (2015) will be discussed here. Said study is an excellent example of how research grounded in the SLM can advance our understanding of the L2 acquisition of Spanish pronunciation and situate findings within a larger context. Díaz and Simonet (2015) addressed the production of the Spanish /e/-/ei̯/ contrast by two groups of late L1 English-L2 Spanish bilinguals: 6 subjects at the intermediate level and 6 at the advanced level. The same data were also collected from a control group of 6 native Spanish speakers (who themselves were late L1 Spanish-L2 English bilinguals at the advanced level). All 18 subjects produced words with Spanish /e/ or /ei̯/ in stressed position in the penultimate syllable (e.g., *pena* [pé.na] 'sorrow'; *peina* [péi̯.na] 's/he combs') or the final syllable (e.g., *mamé* [ma.mé] 'I breast-fed'; *mamey* [ma.méi̯] 'a tropical tree/fruit') (although not all recorded items represented minimal pairs such as these).

The acoustic difference between Spanish /e/ and /ei̯/ is formant stability versus change: the former is a monophthong, whereas the latter is a diphthong. The perceptually closest L1 sounds in English are the monophthong /ɛ/ (e.g., *bet*, *met*) and the diphthong /eⁱ/ (e.g., *bait*, *mate*). Thus, Spanish /e/ and /ei̯/ both represent similar phones (i.e., neither identical nor new (cf. Flege (1987)) in relation to English. Based on the SLM, Díaz and Simonet (2015) predicted two different feasible interactions regarding the bilinguals' evolving L1-L2 phonetic system: (1) L2 Spanish /e/ and /ei̯/ both link to L1 English /eⁱ/, leading to a slightly diphthongized pronunciation of both Spanish phones (unless sensitivity to phonetic differences among these three phones eventually increases and results in two new L2 phonetic categories /e/ and /ei̯/ in addition to English /eⁱ/), or (2) L2 Spanish /e/ links to English /ɛ/, while L2 Spanish /ei̯/ links to English /eⁱ/, again potentially leading to two differentiated L2 Spanish phones (if sensitivity between each pair of diaphones increases over time) but with no diphthongization of L2 Spanish /e/ predicted as a developmental stage. The first hypothesis assumes an initial creation of L1-L2 diaphones based solely on vowel quality, whereas the second hypothesis assumes their creation based on both vowel quality and formant change (or gliding).

The results of Díaz and Simonet (2015) revealed, first of all, that stressed Spanish /e/ was produced in a similar way by all three groups under both stress conditions (penultimate and final). (Surprisingly, stressed /e/ showed diphthongal formant changes in word-final position for all three groups. Data from monolingual Spanish speakers thus would be interesting for additional comparison with the late L1 Spanish-L2 English advanced bilinguals.) Since there was no statistical difference across groups, and since penultimate stressed /e/ was monophthongal, the authors concluded that L2 Spanish /e/ links to English /ɛ/ "early on in the acquisition process" (Díaz and Simonet 2015: 758–759). Since this conclusion is based on data from a small number of intermediate learners only, data from beginning learners is critical for corroboration (as well as a higher number of subjects per group in general). In other words, only beginner data can reveal whether Spanish /e/ is produced as /ɛ/ or /eⁱ/ at the earliest stage of L2 acquisition; neither path can yet be ruled out based on these intermediate-level data. The topic of beginning L2 learners will be discussed again in Sections 3 and 4.1 of this chapter.

Second, with regard to Spanish /ei̯/, Díaz and Simonet's (2015) results showed that while there were no statistical differences between the L1 Spanish speakers and the advanced L2 Spanish speakers, each of these groups was statistically different from the intermediate group, which showed less formant change in the production of Spanish /ei̯/ under both stress conditions. Thus, while L2 Spanish /ei̯/ remains linked to English /eⁱ/ at the intermediate level, a new L2 phonetic category /ei̯/ seems to emerge by the advanced level. In other words, additional years of experience with the L2 as well as increased use of the L2 in daily life (both factors used by the authors to differentiate the intermediate versus advanced levels) can lead to the creation of Spanish /ei̯/ as a new L2 phonetic category independent of English /eⁱ/.

In sum, Díaz and Simonet (2015) set up research questions, interpreted results, and framed their discussion within the SLM, making it possible to understand these within the broader context of L2 speech acquisition. Although the study is not without limitations, it establishes an initial understanding of the developmental stages followed by late L1 English-L2 Spanish learners when acquiring the Spanish mid vowels. Moreover, it sets the stage for further research involving beginners, additional subjects, and other aspects of the Spanish vowel system across L2 proficiency levels. It is an excellent example of how research grounded in the SLM can advance our understanding of the L2 acquisition of Spanish pronunciation and situate findings within a larger context.

3. Limitations of Flege's SLM: the need for framework integration

The SLM is an impressive framework based on numerous empirical studies, only a few of which have been cited here. However, the SLM also has a few limitations. First, as stated by Flege (1995: 237–238), "[t]he SLM is concerned primarily with the ultimate attainment of L2 pronunciation, so work carried out within this framework focuses on bilinguals who have spoken their L2 for many years, not beginners." In other words, previous research carried out within the SLM has focused on both early (prepubescent) and late (postpubescent or adult) L2 learners with many years of L2 experience. It has not focused on L2 learners just beginning to acquire their L2, whether early or late. Broad theories of both L1 and L2 acquisition integrate the notions of acquisition orders and developmental stages of acquisition, constructs that depend on cross-sectional and/or longitudinal data across proficiency levels (typically idealized as beginning, intermediate, and advanced). As more studies begin to elucidate how these constructs operate in L2 speech perception and production, the SLM may (or may not) need to expand or undergo further refinement in order to accommodate such constructs and any related findings.

Recent work by Flege (2016: 39–41) represents the emergence of a more longitudinal perspective in his own research by discussing data that he and MacKay collected in 2003 from the same group of L1 Italian-L2 English speakers from whom they had collected data a decade earlier, in 1992 (Flege et al. 1995a). From their original sample of 240 speakers, they rerecorded 160. They then selected three subgroups of 24 speakers, based on changes in self-reported percentage use of the L2 from 1992 to 2003, with one group reporting less L2 use in 2003, one group reporting no change, and one group reporting more L2 use. The VOT values for the English voiceless stops /p, t, k/ obtained from the three L1 Italian-L2 English subgroups across time differed significantly ($p < 0.01$), with the "more L2 use" group showing an average increase in VOT of 8 ms. (in other words, /p, t, k/ were produced in a more "English-like" way). These findings for three groups of highly experienced bilinguals speak to the impact of increased L2 use, and thus increased L2 input, on the reduction of foreign accent. They also speak to the importance of longitudinal data for better understanding L2 speech acquisition—in this case, the finding that L2 pronunciation can continue to improve even after an average LOR of 43 years. More work across developmental levels is needed, so that the constructs of L2 acquisition orders and developmental stages can be better understood for both L2 speech theory and pronunciation instruction.

A second limitation of the SLM is that it includes data from only one context of learning, namely, naturalistic L2 speech learning. In order to account for L2 speech learning in various contexts, additional data need to be considered and perhaps accommodated. Various L2 phonetic acquisition studies have been carried out for Spanish in contexts other than a purely naturalistic one; for example, in the regular L2 classroom, both with lessons in pronunciation (González-Bueno 1997; Kissling 2012, 2013, 2014, 2015; Counselman 2015; Camus-Oyarzun 2016) and without (Nibert 2005, 2006); in the specialized L2 pronunciation course (Castino 1996; Lord 2005; Nibert 2012); during study abroad in an L2-speaking country (Simões 1996;

Díaz-Campos 2004, 2006); and during study abroad preceded by a specialized pronunciation course (Lord 2010). While it is beyond the scope of this chapter to review these studies in detail, results generally indicate that L2 pronunciation instruction has a positive effect on learner progress. SLA research on morphosyntax likewise indicates that L2 classroom learning has benefits over naturalistic learning (such as a faster rate of acquisition), even though L2 instruction does not alter acquisition orders or developmental stages (cf. Lee and VanPatten 2003: 129–132). In sum, to be a complete model of L2 speech learning, the SLM needs to account for all contexts of learning, as necessary. The topic of L2 pronunciation instruction will be revisited in Section 4.3.

Finally, the third limitation of the SLM is that it focuses exclusively on L2 speech learning at the segmental or sound level (in other words, vowels and consonants), to the exclusion of L2 prosody (including stress, pitch accent, and intonation). Given these three aforementioned limitations, experimental work on L2 speech perception and production related to any or all of these three areas of limitation necessitates a reliance on other frameworks or models from, for example, general SLA theory, bilingualism, and/or theoretical phonology and phonetics.

Nibert (2006) is an example of an experimental study exploring the acquisition of an L2 prosodic unit by late L1 English-L2 Spanish beginners in the context of the university classroom. In other words, its focus happens to coincide with all three limitations of the SLM outlined here: late L2 beginners, the classroom setting, and a suprasegmental feature of L2 speech (intonation). Thus, Nibert (2006) inevitably illustrates the application of frameworks other than the SLM for theoretical grounding and an account of the developmental L2 patterns observed. By reviewing aspects of this study (along with others having a similar focus, such as Zárate-Sández 2015, to be reviewed shortly), insights into ways to accommodate the SLM's limitations may emerge.

Continuing thus, Nibert (2006) is grounded in the Autosegmental-Metrical (AM) approach to intonational phonology (Pierrehumbert 1980; Beckman and Pierrehumbert 1986; Pierrehumbert and Beckman 1988; Pierrehumbert and Hirschberg 1990). It is also grounded in generative theory (originally Chomsky's Innatist Theory of first language acquisition), within the perspective that there is full access to Universal Grammar (UG) during the L2 acquisition process (cf. White 2003). By contributing findings from L2 pronunciation to an evolving L2 theory developed and based primarily on morphosyntactic evidence, Nibert (2006) aimed to shed light on the debate over whether full access occurs with L1 transfer (the Full Transfer Full Access Hypothesis) or not (the Full Access without Transfer Hypothesis) (cf. Schwartz and Sprouse 1994, 1996; White 2003). The Full Transfer Full Access Hypothesis holds that the starting point, or initial state, of L2 acquisition is the learner's L1 grammar. Subsequently received L2 input that cannot be generated by the L1 grammar triggers a restructuring of the system, according to the options of UG (hence the term Full Access). Thus, this hypothesis predicts evidence of L1 transfer in the learner's L2 interlanguage, especially at the earliest stages of L2 acquisition. The Full Access without Transfer Hypothesis, on the other hand, claims that the starting point of L2 acquisition is the same as that of L1 acquisition, in other words, UG. Thus, evidence of L1 transfer is therefore not predicted.

With this debate in mind, Nibert (2006) collected data from 22 true-beginning L2 learners of Spanish with L1 English in order to seek phonetic evidence regarding the initial state of L2 acquisition. The age of the learners ranged from 18 to 40; however, 19 of the 22, or 86%, were between the ages of 18 and 23. The L2 prosodic unit of interest was the high phrase accent (H-), a tonal category used to mark intermediate phrasing choices in Spanish (Nibert 1999, 2000) as well as in English (Pierrehumbert and Hirschberg 1990). Given the nontransparent nature of intonation in general, coupled with the fact that this aspect of Spanish phonology is rarely taught overtly in the L2 classroom (at least within Communicative Language Teaching in the United States), a tonal category such as H- provided sound and fertile ground to examine L1 transfer. If the beginners' responses displayed an absence of knowledge (or widespread uncertainty) regarding disambiguating H- phrase accents in L2 Spanish contours, then the Full Access without Transfer Hypothesis would be lent support, since, even though the learners received no instruction about this aspect of the L2, this same tonal category is operant in the learners' L1 English. If, on the other hand, the beginners demonstrated some level of competence with the L2 Spanish contours, then the issue of L1 transfer would require further examination. Given no previous instruction, and assuming a scarcity of positive evidence from previous L2 input, L1 transfer as a learner strategy would be supported if (1) learners displayed L2 accuracy where the L1 and L2 converged in the use of a H- phrase accent, and (2) learners displayed a lack of competence in the L2 where the L1 and L2 diverged in the use of a H- phrase accent. In other words, learner behavior at the initial state of L2 acquisition is clearly attributable to L1 transfer if it reflects competence where the L1 and L2 are similar and incompetence where the L1 and L2 are dissimilar.

The L2 learners were asked to accept or reject different meanings (i.e., interpretations) paired with various intonational renditions of two texts. Each text involved two coordinated noun phrases (NPs) modified by one or two adjective phrases (APs) of potentially ambiguous scope. The first text was *lilas y lirios amarillos* (literally 'lilacs and irises yellow'), with a narrow scope of modification of the AP 'yellow' rendering the meaning 'lilacs and yellow irises' and with its wide scope rendering 'yellow lilacs and yellow irises'. The second text was *numerosos niños y niñeras leales* (literally 'numerous children and nursemaids loyal'), with two APs each potentially having a narrow or wide scope of modification. This latter structure is unsubstantiated in English, since APs cannot appear both pre- and postnominally, let alone simultaneously. The L2 learners listened to read recordings from three male native Spanish speakers (themselves late L1 Spanish-L2 English advanced bilinguals), whose renditions varied through intermediate phrasing choices involving the absence versus presence, and, when present, the location of a high phrase accent H- (for example, [[lilas y lirios amarillos]L- L%] (in the absence of H-, the AP has either scope); [[lilas]H- [y lirios amarillos]L- L%] (with the presence of H- after *lilas*, the AP has a narrow scope over *lirios* only); [[lilas y lirios]H- amarillos]L- L%] (with the presence of H- after *lirios*, the AP has a wide scope over both NPs)).

The results did indeed show evidence of L1 transfer. The L2 beginners made accurate assessments regarding the meaning of complex utterances in the L2; however, these responses occurred only where the L1 English grammar and the L2 Spanish grammar converged (i.e., where one AP locally modified its adjacent NP). When L2 utterances containing structures not instantiated in the L1 were involved (i.e., where two APs co-occurred with two coordinated NPs, and each AP had a wide scope of modification, modifying both the local and nonlocal NP), the beginners' responses were inaccurate. L1 transfer accounts for these composite patterns of response. If L1 transfer were not deemed possible and the true beginners' initial state were deemed to be UG, there would be little way to account for the sophisticated beginner knowledge already displayed, given no previous instruction about intermediate phrasing choices marked by a H- phrase accent in Spanish intonation. Thus, the results from this study lend substantial support from tonal phonology and phonetics to the view that the initial state of L2 acquisition is the L1 grammar.

Recall that Flege's (1995, 2003, 2007) SLM posits that as an L2 learner receives abundant high-quality input in the second language, L2 speech sounds are linked to the perceptually closest L1 speech sounds, creating diaphones at the allophonic level. By juxtaposing the SLM with UG as a widely accepted general framework for understanding both first and second language acquisition, it is clear that the SLM likewise aligns with the Full Transfer Full Access Hypothesis within UG: it assumes the L1 phonetic system as the initial state of L2 phonetic acquisition. Like individual sounds, it seems that individual tones from the L1 phonetic system likewise transfer and serve as the starting point for L2 tonal acquisition. Integrating the AM approach to intonational phonology, perhaps L1 tonal units, including pitch accents, link to the perceptually closest L2 tonal unit, creating diaphones (or "diatones") as do linked L1-L2 sounds. Evidence from Nibert (2006) indicates that the H- phrase accent, for example, transfers from L1 English to L2 Spanish at the earliest stages of L2 acquisition. An analysis of these results in this light points to a fairly seamless confluence of the SLM, the Full Transfer Full Access Hypothesis within UG (i.e., the first limitation related to L2 beginners), and the AM approach to intonational phonology (i.e., the third limitation related to the L2 acquisition of nonsegmental features).

Results from Zárate-Sández (2015) further corroborate this notion. Said study examined the perception and production of neutral Spanish declarative utterances by 55 late L1 English-L2 Spanish classroom learners representing three level of proficiency (namely, low, high, or very high, which corresponded to learners in their third semester, in their sixth semester, or at the graduate level of study, respectively). Their performance was compared to that of monolingual speakers of Spanish and English as well as to early L1 English-L2 Spanish bilinguals (i.e., heritage speakers). Two specific tonal units in the Spanish declarative utterances were examined: the prenuclear pitch accent (more specifically, the alignment or timing of the tonal peak corresponding to the second-to-last pitch accent in an utterance) and the final boundary tone (more specifically, its height at the absolute end of an utterance). Participants completed an imitation task (representing perceptual performance) and two production tasks (namely, sentence reading and storytelling). For the purposes of the present chapter, only the results regarding peak alignment of the prenuclear pitch accent will be discussed.

Generally, in English the tonal peak of a prenuclear pitch accent consistently aligns with or immediately after the stressed syllable with which the pitch accent is associated (Silverman and Pierrehumbert 1990). In Spanish, however, the tonal peak of a prenuclear pitch accent tends to align after the associated stressed syllable (Prieto et al. 1995). Results in Zárate-Sández (2015) likewise revealed that monolingual Spanish speakers prefer a late peak alignment. As for the three groups of late L1 English-L2 Spanish speakers in this study, the production results from the low-proficiency speakers approximated those of the monolingual English speakers. However, the results from the high- and very high-proficiency speakers showed development away from the monolingual English norm. In fact, the very high-proficiency speakers showed values that matched those of the early L1 English-L2 Spanish bilinguals, all of which reflected values in the mid range between the Spanish and English monolingual norms. Finally, a strong relationship between perception and production was found with regard to the peak alignment of prenuclear pitch accents.

Zárate-Sández (2015: 147) concludes that these results support the prediction made by the SLM regarding mergers. In other words, the L2 acquisition of a H tone in prenuclear position in Spanish involves the progressive development of peak delay as a phonetic implementation rule regarding timing. The L1 transfer of English alignment values is evident in the speech of the L2 Spanish beginners, again in support of the Full Transfer Full Access Hypothesis within UG. Just as VOT values for /p, t, k/ may develop into values that are intermediate to L1 English and L2 Spanish for both languages due to equivalence classification (cf. Flege 1987), peak alignment values may display a similar developmental pattern, whereby linking of L1-L2 high (H) tones leads to a merger of their phonetic properties (because the L2 tone is perceived to be too similar to the L1 tone), resulting in L1 and L2 tonal productions that are unlike those of monolingual speakers of either language.

In sum, by drawing from frameworks across subfields—in this case, from the SLM, UG (Innatism) applied to SLA, and the AM approach to intonation—synergies arise that advance understanding. While the SLM represents the best framework to date for understanding the acquisition of an L2 phonetic system, gaps remain that may be narrowed by drawing from other frameworks and constructs, including approaches to prosody, the notions of acquisition orders and developmental stages, and additional contexts of learning beyond the naturalistic one. By grounding L2 Spanish phonetic work in a sound theoretical framework or in a combination of these, as appropriate for the topic, results may contribute to the refinement of the SLM and have a greater bearing on the wider field of SLA. Clearly, there remains much fertile ground for future research.

4. Additional considerations for future L2 phonetic research in Spanish

The prior sections of this chapter implicitly suggest other important considerations for future L2 phonetic research in Spanish, which were explicitly stated in the introduction. The present section will make three of these considerations even more explicit, albeit in brief fashion due to space limitations.

4.1. Include beginning, intermediate, and advanced L2 learners as research subjects

In order to elucidate acquisition orders and developmental stages of acquisition, empirical work needs to examine a given feature of L2 phonetics across proficiency levels. It is widely known from SLA research on morphosyntax that an L2 learner's interlanguage shows characteristics of a learner's L1 (and any other previously acquired languages), the developing L2, and a developing linguistic system in general, including simplification and overgeneralization errors. Furthermore, the nature of a particular L1 and its intersection with the L2 may affect a developmental stage by shortening or lengthening it or by adding a new substage, relative to other L1s paired with the same L2 (cf. Lightbown and Spada 2013). There is no reason to expect that the acquisition of L2 phonology and phonetics should operate any differently. Yet, without robust cross-sectional and/or longitudinal L2 phonetic data, further details about these constructs cannot be elucidated. A better understanding of these will surely, in turn, enhance L2 pronunciation instruction.

An example of a solid study on L2 Spanish that includes both intermediate and advanced learners (but excludes beginners) has already been reviewed, namely, Díaz and Simonet (2015), which examines the acquisition of the Spanish /e/-/ei̯/ contrast. To deepen an understanding of this topic (i.e., the Spanish mid vowels), while further illustrating the need for yet concurrent challenge of including and differentiating various proficiency levels, two additional studies on the topic (namely, Nibert 2012 and Counselman 2015) will be addressed. First, however, recall that the data from Díaz and Simonet (2015) from intermediate and advanced learners suggest that monophthongal Spanish /e/ is acquired in word-medial position at least by the intermediate level. (Recall also that stressed /e/ showed diphthongal formant changes in word-final position for both L2 groups as well as the L1 Spanish-L2 English speakers.) As argued earlier, beginner data are needed to establish the full developmental path of Spanish /e/ (i.e., whether it initially links to L1 English /ɛ/ or /e^{i}/ in the mind of the new L2 learner). Fully diphthongal Spanish /ei̯/, on the other hand, is acquired as a new phonetic category separate from L1 English /e^{i}/ by the advanced level. Thus, it seems that monophthongal Spanish /e/ is acquired earlier than fully diphthongal Spanish /ei̯/, as per the relative acquisition order of these two L2 phones. Since these findings are based on only a small number of subjects (six per level), additional data are, of course, needed.

Results obtained by Nibert (2012) are consistent with the findings of Díaz and Simonet (2015) and, as will be explained, inadvertently function to fill their beginner gap. The former study examined the off-gliding of monophthongal Spanish /e, o/ in a 97-word short story read by 22 late intermediate L2 learners with L1 English. Following Olive et al. (1993), off-gliding was measured in terms of vowel duration and changes in F1 and F2 after the kernel (or initial stable section of the vowel), in order to reach a binary decision about the presence versus absence of this feature. There were 25 instances of /e/ (544 tokens) and 35 instances of /o/ (761 tokens), for a total of 1,305 tokens. The results indicated that off-gliding was much less prevalent in word-medial position (e.g., *empresa* [em.pɾé̱.sa] 'enterprise', *soplaba* [so̱.plá.βa] 'it blew') than in word-final position (e.g., *norte̱* [nór.te^{i}] 'north', *poderoso̱* [po.ðe.ɾó.so^{u}] 'powerful', transcribed here with off-gliding). Thus, the same pattern found in Díaz and Simonet (2015) emerged: the medial position precedes the final position as per the elimination of off-gliding. Furthermore, the following hierarchy emerged in Nibert (2012), listed from lesser to higher frequency of off-gliding: word-medial /e/ < word-final /e/ < word-medial /o/ < word-final /o/. What is notable is that although both Nibert (2012) and Díaz and Simonet (2015) looked at the speech of L2 learners categorized as "intermediate," diphthongized renditions of Spanish /e, o/ persisted for Nibert (2012) but not for Díaz and Simonet (2015).

Continuing, Counselman (2015) looked at the off-gliding of monophthongal Spanish /e, o/ in the speech of 28 late intermediate L2 learners enrolled in two different sections of a university-level Spanish conversation course. Both sections received ancillary, identical instruction in articulatory phonetics. One section (of 15 learners), however, subsequently engaged in production-based assignments, while the other (13 learners) engaged in perception-based assignments designed to focus learner attention on English-Spanish phonetic differences. During pre- and posttests, subjects were recorded reading a list with 22 experimental words, 12 real and 10 nonce, that included 16 occurrences each of /e/ and /o/, half of these in medial position (in the penultimate syllable) and half in final position, all with penultimate stress. Like Nibert (2012), the speech data recorded from both groups revealed a persistence of diphthongized renditions of Spanish /e, o/ at the intermediate level.

In sum, these three studies overlap in their focus on off-gliding in the Spanish speech of L2 learners classified as "intermediate." Yet the composite results reveal a developmental stage in the acquisition process that might otherwise be masked or overlooked as a discrepancy between studies. The data reported in both Nibert (2012) and Counselman (2015) suggest that at a relatively early stage of acquisition, L2 Spanish /e/ initially links to L1 English /e^{i}/ (and not /ɛ/, as indicated in Díaz and Simonet (2015)). (The former two studies likewise suggest that L2 Spanish /o/ is initially linked to L1 English /o^{u}/ (and not /ɔ/).) Together, these three studies present a fuller account of the developmental stages involved in the L2 acquisition of Spanish /e/ and /ei̯/: both /e/ and /ei̯/ link to L1 English /e^{i}/ (based solely on vowel quality, rather than on both vowel quality and formant change), leading to a diphthongized pronunciation of both Spanish phones. Furthermore, while L2 Spanish /ei̯/ remains linked to English /e^{i}/ at the intermediate level, a new L2 phonetic category /ei̯/ seems to emerge by the advanced level. Obviously, additional research is needed to verify and expand on these results, which provide some working hypotheses for further research on L1 English-L2 Spanish vowel acquisition.

The discussion of these three studies underscores the difficulty of defining L2 proficiency levels not only for the purpose of acquisition studies but in general. Yet, in order to progress in our understanding of acquisition orders and developmental stages of acquisition, empirical work needs to examine a given feature of L2 phonetics across proficiency levels. While the purpose of this chapter is not to present an overview of ways to differentiate such levels, a few of the studies discussed thus far suggest some approaches that are worth recalling. First, as stated earlier, the approach taken by Díaz and Simonet (2015) to differentiate the intermediate versus advanced levels was to consider not only years of L2 experience but also amount of L2 use in daily life.

Second, as demonstrated by the Schmidt and Flege (1996) study discussed previously, another approach is to maintain a separation of data by individual participant rather than conflating the data (for example, to derive averages), at least until these are shown to be similar enough to combine. In said study, although all subjects were late L2 English learners with similar characteristics, three different data patterns emerged that categorized participants into three different subgroups at very different stages in their acquisition of L2 VOT values. Further exploration of this issue is definitely merited within the field of L2 speech acquisition.

4.2. Reconsider the linguistic profile and tasks of control groups

As stated earlier, the focus of the SLM is ultimate attainment in L2 pronunciation (Flege 1995: 237–238). Thus, native speakers of the L2 have often been used as a control group against which L2 learner progress is measured, especially at the advanced level. An important issue to consider, however, is the language background of these native speakers. Are they monolingual or bilingual (or even multilingual)? If bilingual, do they have the same L1-L2 pairing as the learners being studied, but with opposite language dominance (e.g., an L1 Spanish-L2 English control group for L1 English-L2 Spanish learners)? Recall that the SLM predicts bidirectional L1-L2 interference in the realm of speech perception and production, where the phonetic system of the L2 may be affected by the L1, and the phonetic system of the L1 may be affected by the L2. Therefore, the phonetic norms, for example, of monolingual native Spanish speakers are neither a realistic nor a theoretically sound target for advanced L2 speakers of the language, as Kissling (2013: 737) also points out. Various researchers in bilingualism have made this argument previously (cf. Grosjean 1989; Ortega 2009, 2017, 2018). Flege (2016: 119) himself now states:

> In my writings over the years I referred to the "mastery" of the production or perception of L1 phonetic segments. I now regret using this term for it implies that bilinguals might develop L2 phonetic categories that are identical to those of monolingual native speakers of the target L2. This is not possible inasmuch as bilinguals possess two phonetic systems that necessarily interact, and cannot have received the same input as L2 native speakers.

In reality, the native-speaker control groups used in various existing studies, including Nibert (2006) and Díaz and Simonet (2015), previously discussed in this chapter (as well as Menke and Face 2010; Cobb and Simonet 2015; among various others), are indeed bilingual, oftentimes at the advanced level, since subjects residing in the United States (e.g., at institutions of higher learning) are more accessible to recruit than monolinguals abroad. Until more is understood about cross-language phonetic processes in bilinguals, however, perhaps the best approach is to employ more than one control group; for example, a first one comprising monolingual native speakers of the target language and a second one of L1-L2 bilinguals with dominance in the target language, to facilitate further exploration of this issue. Even use of the latter group remains tenuous, however, since it is based on the untested assumption that L1-L2 bilinguals with opposite language dominance have developed identical (or mostly similar) L1-L2 phonetic systems. In other words, holding all methodological aspects of a study constant, the phonetic norms of monolingual Spanish speakers can be compared to those of L1 Spanish-L2 English advanced bilinguals, whose Spanish speech production and perception can be compared to that of L1 English-L2 Spanish advanced bilinguals, who may ultimately turn out to be the most appropriate control group for L1 English-L2 Spanish intermediate and beginning bilinguals (controlling for early versus late bilingualism in each case). In sum, the linguistic profile of the control group remains an important methodological and theoretical issue in the study of L2 phonetic acquisition.

Furthermore, rather than (or in addition to) comparing L2 production to control group production, L2 production needs to be subjected to control group perception. In other words, at what point or phonetic value does a monolingual native listener or a bilingual listener (with either language dominance) no longer perceive a foreign accent in the speech of an L2 learner? Where do threshold points lie for different sounds or even tones? Such an assessment is likely a more accurate and meaningful way of measuring L2 learner progress and ultimate attainment than numerical values and levels of statistical significance, which are not necessarily indicative of human language perception or of discrete developmental stages. A 9-point scale has been used in various studies to assess degree of foreign accent (e.g., Munro and Derwing 1995 and their abundant subsequent work; and Flege et al. 1999, to name a few). In sum, options beyond simply "one control group profile" and "one control group task" need to be explored until more is understood about cross-language phonetic processes in bilinguals.

4.3. Include explicit details about classroom instruction

Various empirical studies to date have examined the effect of L2 pronunciation instruction on learner gains (for Spanish, Castino 1991, 1996; Elliott 1995a, 1995b, 1997; González-Bueno 1997; Lord 2005, 2010; Hurtado and Estrada 2010; Nibert 2012; Kissling 2012, 2013, 2014, 2015; Lord and Fionda 2014; Counselman 2015; Camus-Oyarzun 2016). Results have largely shown that said instruction is beneficial to L2 production and perception and is so across proficiency levels and the curriculum. As stated in Lord and Fionda (2014: 524), future empirical studies now need to focus on the "what" and "how" of instructional details. Kissling (2013), for example, like Counselman (2015), previously discussed, applied a Processing Instruction approach to phonetics (an input-based, implicit approach to teaching grammar based on empirical research on the L2 acquisition of morphosyntax (cf. VanPatten and Cadierno 1993; VanPatten and Oikkenon 1996; and numerous subsequent studies). Kissling (2013) examined gains in L2 Spanish pronunciation by two groups, one that received explicit instruction in phonetics and one that did not, holding constant the pedagogical treatments of L2 input, practice, and feedback. The two groups improved their pronunciation equally, suggesting that explicit lessons (i.e., lectures) about phonetics were not responsible for these gains, but rather the focusing of learner attention on relevant features of L2 speech. Likewise, Counselman (2015) found that when L2 learners in his perception group were made to focus on phonetic differences in /e, o/ through targeted listening assignments, they improved their L2 pronunciation, whereas the production group (without such focused attention) did not. As Kissling (2013: 736) well concludes, there is a "need to tease apart the many elements of pronunciation instruction in order to better understand the relative contribution of each and thereby improve and tailor instructional techniques for teaching pronunciation to L2 learners."

In order for L2 instructors and learners to maximally benefit from these studies, and for researchers to be able to replicate them (as well as to test and compare pedagogical techniques and tools in general), explicit information needs to be given in each study on instruction, such as the delivery mode or nature of the instruction, the practice activities used (whether written transcription, auditory perception, and/or oral production), the type of feedback given to learners and by whom (e.g., the instructor versus peers), etc. For instance, actual lessons, practice activities, and their sequencing need to be shared, even if cited from a particular textbook edition and page. Without such information, Kissling's (2013: 736) spot-on call for this type of research cannot be fulfilled. For example, of the empirical studies on Spanish pronunciation instruction cited previously, only six (Elliott 1995a, 1995b, 1997; Kissling 2012, 2013; Camus-Oyarzun 2016) include in appendices the actual lessons and activities used in the studies.

Overall approaches to instruction also need to be shared and tested. For instance, Arteaga (2000) suggests a model for instruction but includes no actual activities. Nibert (2014), applied in Camus-Oyarzun (2016), suggests an approach to L2 phonetic instruction, along with lecture materials and activities, but this work would benefit from further empirical testing. Lord (2012), Holt and Lord (2014), and Campos-Astorkiza et al. (2016) all represent important contributions to these efforts in the form of websites showing techniques and activities for L2 Spanish pronunciation instruction. Such sharing, whether through a conference website, personal website, or the appendix of a publication, is a critical component for advancing research and practice in L2 pronunciation instruction.

5. Conclusion

This is an exciting time for research on the L2 acquisition of Spanish pronunciation. The subfield has gained much momentum particularly since the start of the new millennium, as evidenced by an increase in the number of published empirical studies as well as specialized conferences. Oftentimes, however, L2 phonology and phonetics remain separated from the larger conversation within SLA and thus theory building. Surely all frameworks accounting for human language can benefit from greater cross-subfield integration and synergies. Flege's (1995, 2003, 2007) SLM provides a solid framework on which to ground experimental L2 phonetic research. By supplementing the SLM with other models within phonology and phonetics—such as the AM approach to intonation or perhaps Distinctive Feature Theory—the SLM may be expandable in scope. By adopting constructs from SLA (for example, acquisition orders and developmental stages), bilingualism (e.g., the notions of early and late bilinguals and the nature of the bilingual brain, rather than the constructs of native and nonnative), and research-based pedagogical approaches and practices (e.g., Processing Instruction), research on Spanish L2 speech acquisition will undoubtedly benefit by gaining internal cohesion, increasing its impact on the larger field of SLA, and informing and guiding best practices in Spanish L2 pronunciation instruction. A bigger and clearer picture can emerge.

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Language contact in Patagonia

Durational control in the acquisition of Spanish and Afrikaans phonology

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1. Introduction

One of the most important tasks of phonological grammar is to regulate the temporal organization of speech. Temporal organization is present at all levels of phonological grammar, ranging from the relative timing of different articulatory gestures (e.g., language-specific coarticulatory patterns) to the regulation of the duration of individual segments (e.g., compensatory lengthening, degemination, etc.), the relation between prosodic structure and segment duration (e.g., final lengthening), and more. Although some aspects of these timing relationships appear to be general properties of all languages, the exact realization of these relationships is language-specific, and controlling the phonological grammar of a language therefore requires knowledge of the intricate temporal patterns typical of that language (cf. Davidson 2006; Gick et al. 2006; Pouplier 2012).

A primary goal of this chapter is to explore how languages that differ from each other in terms of their temporal organization patterns impact each other when they are in close, long-term contact. Specifically, we focus on an Afrikaans-Spanish bilingual community that resides in Patagonia, Argentina. Unlike many situations of language contact, this community remained functionally monolingual in their heritage language (Afrikaans) during the first two generations after arrival to Patagonia between the early 1900s and the 1950s (van Schalkwyk 1989). In the middle of the twentieth century, the Patagonian region shifted nearly completely to Spanish. The currently oldest speakers (typically over 60 years of age) are third-generation speakers who acquired Afrikaans as their first language, and Spanish as a second language upon entering school (from the age of 6 or 7 to their late teenage years). Due to the changing socioeconomic structure of the community, Spanish then became the dominant language for these speakers during early adulthood, indicating a case of late subtractive bilingualism. As we will show in the research presented in this chapter, in a situation such as this, the newly dominant L2 can have a strong impact on the L1.

2. Background and hypotheses

2.1. Durational properties of consonantal and vocalic sequences in Afrikaans and Spanish

In this section, we give an overview of aspects of Afrikaans and Spanish phonotactic patterns and phonological processes that contribute to the duration of consonantal and vocalic intervals in these languages. These differences subsequently enable us to hypothesize possible mutual influences of the two languages in the speech of the Afrikaans-Spanish bilinguals.

Phonotactics

As a prototypical Germanic language, Afrikaans has a complex syllable inventory, including syllables with onset clusters of up to three consonants (*spraak* [sprɑːk] 'speech') and codas of up to two consonants (*berg* [bærx] 'mountain'). As a consequence, consonantal sequences in an Afrikaans utterance can range in length from one to five consonants. The Afrikaans vowel inventory includes contrastively short and long monophthongs (*man* [mɑn] 'man' vs. *maan* [mɑːn] 'moon') and diphthongs (*matjie* [mɑ͡ɪ.ki] 'little rug' vs. *maatjie* [mɑː͡ɪ.ki] 'little friend'), so that syllabic nuclei can range from one to three morae in length. Since Afrikaans also allows onsetless syllables, vocalic intervals in an Afrikaans utterance can range from one up to six morae.

Spanish, in contrast, has a comparatively simpler syllable structure, with syllable onsets containing two consonants at maximum (*flor* [ˈfloɾ] 'flower'). Codas of up to two consonants are possible but rare (*perspectiva* [peɾs.pek.ˈti.βa] 'perspective'), resulting in consonantal sequences that range from one to three consonants. The Spanish vowel inventory does not include contrastively long and short vowels. The language does permit diphthongs, although they are considerably less frequent than in Afrikaans.

Because of these phonotactic differences in Afrikaans and Spanish, we expect the durations of vocalic and consonantal intervals in an Afrikaans utterance to be more variable than those in a Spanish utterance. The bilingual speakers all acquired Afrikaans first (with its more complex syllable and segmental inventory), so they should not have difficulty producing the simpler Spanish structures. We return to this issue again in section 5.2, where we will discuss this in relation to the superset/subset problem in language learning (Berwick 1985). The one exception may be in terms of the realization of phonemic vowel length differences in Afrikaans. As already mentioned, Afrikaans differentiates short and long monophthongs and diphthongs. This length contrast, however, has a fairly low functional load in Afrikaans. L1 Afrikaans speakers, who have shifted more regular language use to their L2 Spanish, may therefore lose the robustness of the Afrikaans phonemic length contrasts over time. Such a loss could be caused both by the fact that this contrast has a low functional load in Afrikaans (see Loporcaro 2015: 9, for arguments that low functional load contributed to the loss of contrastive vowel length in Latin) and by the fact that the speakers primarily function in their dominant language (Spanish), which does not use phonemic length contrasts. Attrition and contact can therefore contribute in tandem to the erosion of the length contrast for the bilingual speakers in our study.

Variation in vowel duration

In addition to these static phonotactic differences, Afrikaans and Spanish differ from each other in terms of phonological and phonetic processes that affect vowel duration. Afrikaans has phonological rules of stress-induced vowel lengthening and reduction that can result in category changes between different vowels (i.e., more than just category-internal phonetic reduction). For the purposes of the current study, the existence of such rules is more important than the details about how and when they apply (however, see Wissing 1982 for these details). The examples in (1a) show that in some words stress can condition alternation between short [ɑ] and long [ɑː] (two sounds that also contrast phonemically in Afrikaans). In turn, the examples in (1b) show that Afrikaans also has productive vowel reduction processes that, for instance, replace bimoraic [i͡ə]/[u͡ə] with monomoraic [ə]/[u] in unstressed position (again a phonological process relating sounds that also contrast phonemically). Unlike Afrikaans, Spanish does not have phonological rules that manipulate the mora count of vowels under stress, so there is less expected variability in vowel duration in Spanish than in Afrikaans.

Spanish generally lacks phonological vowel reduction. However, phonological vowel reduction has been documented for a small number of Spanish varieties that have been in close and prolonged contact with languages that do have phonological vowel reduction. Delforge (2008), for instance, shows that the Andean Spanish spoken in Cusco has vowel reduction, and ascribes this as most likely due to contact with Quechua. Similarly, Gabriel and Kireva (2014b) document phonological vowel reduction in the Spanish of a small community of speakers of Judeo-Spanish in Bulgaria, and hypothesize that this reduction was introduced into Spanish due to contact with Bulgarian.

(1) a. Stress induced [ɑ]~[ɑː] alternation ([ɑ] when unstressed, [ɑː] when stressed)

Satan	[ˈsɑː.tɑn]	'Satan'			
satanies	[sɑˈ.tɑː.nis]	'satanic'			
satanis	[sɑ.tɑˈ.nəs]	'satanist'			

b. Reduction of [i͡ə]/[u͡ə] to [ə]/[u] in unstressed syllables

profeet	[pruˈ.fi͡et]	'prophet'	*profeteer*	[prɔ.fəˈ.ti͡er]	'prophetize'
skool	[ˈsku͡əl]	'school'	*skolier*	[skuˈ.lir]	'student'

In addition to these categorical phonological processes affecting the mora count (and hence duration) of vowels, Afrikaans also has stress-related, category-specific variation in vowel duration. Considering short [ɑ] in closed syllables (a position where categorical phonological lengthening under stress as in (1a) is not possible), Wissing (2007) shows, for instance, that duration is the most reliable correlate of the difference between stressed and unstressed [ɑ]—even more reliable than intensity or pitch. Spanish does have gradient stress-induced vowel lengthening, but there is reason to suspect that this lengthening is less extreme. Hualde (2005: 273), for instance, says that the effect of stressed lengthening is "much greater in English than in Spanish." Since Afrikaans and English are closely related Germanic languages, they pattern similarly regarding stress-related vowel reduction (Coetzee and Wissing 2007), and it can therefore be expected that stress-related reduction in Afrikaans will also be greater than in Spanish (Coetzee and Wissing 2007). In comparison to Wissing's claim that duration is the primary cue for stress in Afrikaans, Hualde remarks that the "most important correlate of stress in Spanish is pitch" (Hualde 2005: 245). See also Ortega-Llebaria and Prieto (2010: 85), who report that the difference between stressed and unstressed syllables is larger in Catalan than in Spanish, and Alfano et al. (2009), who report that this difference is larger in Italian than in Spanish. Although it is expected that there are durational differences in stressed and unstressed vowels in both Spanish and Afrikaans, it is reasonable to assume that these differences are greater in Afrikaans.

As is typical of Germanic languages, Afrikaans has significant final lengthening, comparable, for instance, to what is observed in English (Coetzee and Wissing 2007). Spanish also has final lengthening, although most likely to a lesser degree. Frota et al. (2007: 135), for instance, found that final syllables are twice as long as nonfinal syllables in Italian, while they found the increase in duration for Spanish to be only 40%. Rao (2010: 75) similarly reports limited final lengthening in Spanish, with an increase of 25% in final position. By comparison, Turk and Shattuck-Hufnagel (2007: 455, Figure 19.1) found that the rime of final syllables in English is on average 73% longer than that of nonfinal syllables. This again leads to the assumption that though both Afrikaans and Spanish will display effects of final lengthening, this lengthening is likely to be larger in Afrikaans than in Spanish.

Since our study focuses on a variety of Argentinian Spanish spoken in southern Patagonia, a potential complication to consider is that Buenos Aires Spanish (known as Porteño Spanish) was influenced to a significant degree by Italian due to Italian immigration to Buenos Aires during the first half of the 20th century. Porteño Spanish therefore may show more stress-related vowel lengthening and final lengthening than other varieties of Spanish (Gabriel and Kireva 2014a; Kireva and Gabriel 2015). Although Porteño Spanish may have influenced the Spanish spoken in the southern Patagonian region on which we focus, such influence would have been minimal given the remoteness of the region—see also Virkel (2004: 176–177) for evidence that Porteño Spanish had limited impact on the rural parts of Patagonia, and on the lower socio-economic sections even of urban communities in Patagonia. In particular, Porteño Spanish influence on the speakers who are the focus of our study is expected to be minimal. When these speakers acquired Spanish as young adults in the 1950s and 1960s, the region was sparsely populated, and Afrikaans was still the most common language in the community, which was also culturally oriented more toward South Africa than Argentina. Although it can be expected that the Spanish of this region may show some influence of Porteño Spanish, and may therefore have more stress-induced and final lengthening than other varieties of Spanish, it most likely does not participate in these phenomena to the same extent as Porteño Spanish.

Since Spanish and Afrikaans differ from each other in terms of the application of productive phonological and phonetic processes that control vowel duration, it is possible that the languages of the bilingual speakers in our study may influence each other in this regard. If their L1

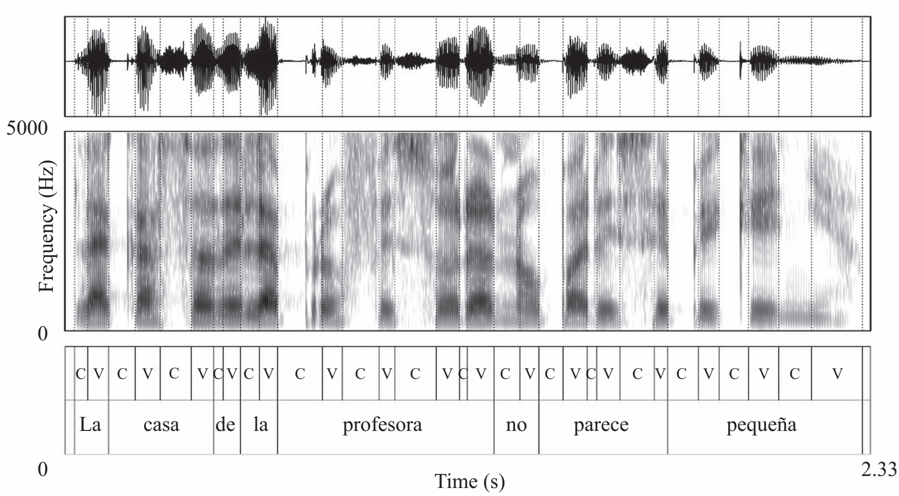

Figure 19.1 Waveform, spectrogram, and illustration of segmentation criteria for the sentence *La casa de la profesora no parece pequeña* 'The professor's house does not seem small,' produced by a Spanish monolingual speaker (female, age 53)

(Afrikaans) were to influence their L2 (Spanish), we may expect to see more variability in the duration of vocalic intervals in their Spanish than in the Spanish of L1 Spanish control speakers. However, if their dominant L2 (Spanish) were to influence their L1 (Afrikaans), we may expect less variation in the duration of vocalic intervals in their Afrikaans than in that of L1 Afrikaans speakers.

Variation in consonant duration

Neither Afrikaans nor Spanish has productive phonological processes that affect consonantal duration. Although consonants are also affected by stress-related lengthening and final lengthening, they are less susceptible to these phenomena than vowels are (Turk and Shattuck-Hufnagel 2000). Given that neither of the languages has phonological processes that control consonantal duration, and given the lower susceptibility of consonants to phonetic lengthening (e.g., Gay 1981), we do not expect to see significant influence by the two languages of the bilingual speakers on the duration of consonantal intervals in their languages. That is, we expect the variation in duration of consonantal intervals in the Afrikaans of the bilingual speakers to be comparable to that of control Afrikaans-dominant L1 speakers. Similarly, we expect the variation in consonantal intervals in their Spanish to be comparable to that of monolingual Spanish speakers.

In summary, we do not expect the consonantal phonotactic differences between Afrikaans and Spanish to result in the languages of the bilingual speakers in our study influencing each other. Additionally, given the absence of phonological processes affecting consonantal duration in both languages and the lower susceptibility of consonants to stress-induced and final lengthening, we do not expect to see mutual influence of the two languages on each other in terms of consonantal duration. Where we do expect to see influence of the languages on each other is in terms of the variability of vowel duration. First, it is possible that the phonemic length contrast of Afrikaans may be weakened in the speech of the bilinguals due to a combination of influence from Spanish (which lacks this contrast) and the low functional load of this contrast in Afrikaans. Second, given that Afrikaans has more extreme phonetic and phonological processes that affect vowel duration, we may also see influence of the languages on each other in terms of the variability of vowel duration. Specifically, if the L1 (Afrikaans) of the bilingual speakers were to influence their L2 (Spanish), we should see more variability in vowel duration in their Spanish than in the Spanish of L1 speakers. Conversely, if their L2 (Spanish) were to influence their L1 (Afrikaans), we should find less variability in the vowel duration of their Afrikaans than in that of Afrikaans-dominant control speakers. We lay out our hypotheses in clearer terms in section 2.3 of this chapter.

2.2. Bidirectional L1-L2 effects in phonology

Although most research on L1-L2 phonological interaction focuses on how speakers' L1 influences their L2, there is also a body of research that documents bidirectional influences, showing that the phonology of an L1 can also be influenced by that of an L2 (e.g., Flege 1987; Flege and Eefting 1987; Sancier and Fowler 1997; Guion 2003; Mennen 2004; Chang 2012). An early example comes from Flege (1987), who showed that L1 English speakers who are highly proficient in French produce English /t/ with voice onset time (VOT) values that differ from those of monolingual English speakers and that are in the direction of those of French monolinguals. Similarly, Flege found that L1 French speakers who are highly proficient in English produced French /t/ with VOT values that are in the direction of the English monolinguals. The L1 productions of both groups of highly proficient L2 speakers therefore showed evidence of influence from their L2. Current models of second-language speech learning predict such bidirectional influences because L1 and L2 sounds are posited to coexist in a shared phonetic space in the bilingual grammar (e.g., Flege 1995; Best and Tyler 2007).

Flege's 1987 paper, and most other research on L2-to-L1 influences (e.g., Flege and Eefting 1987), focuses on examples of prolonged and intense exposure to the L2. There is also evidence, however, that an L2 can impact an L1 rapidly and after only limited exposure. Chang (2012), for instance, documents the influence of L2 Korean on several phonetic dimensions of the English spoken by English L1 learners of Korean even during their first six weeks of Korean instruction. An L2 can therefore impact an L1 even with minimal L2 exposure and proficiency. Even so, it is reasonable to expect differing levels of bidirectional influence between an L1 and L2 based on the amount of L2 exposure and proficiency of speakers, and also based on the usage dominance relation between the L1 and L2 of the speakers. Flege (1987), for instance, found that the VOT values of L1 English /t/ as produced by English learners of French showed more evidence of influence from French for speakers with higher proficiency in and more exposure to French. Based on results such as these, it can also be expected that L1-to-L2 influence will decrease with more exposure to, higher proficiency in, and more usage of the L2. This expectation is also supported by results from Flege (1987) with regard to the L2 production of French /u/. He found that L2 learners of French who had higher proficiency in French and more exposure to French produced French /u/ with formant values that were more in the direction of L1 French speakers.

The research reviewed thus far establishes that mutual influence between the L1 and L2 of bilingual speakers is possible but focuses on aspects of consonantal articulation or the spectral properties of vowels. The main focus of the present analysis is the temporal properties of vowels, and research about mutual L1-L2 influence on vowel duration is therefore of particular relevance to our study. Robles-Puente (2014), for instance, shows that adult Spanish-English bilinguals who moved to the United States in early childhood display less variation in vowel duration in their English than do English monolingual speakers, and interprets this as evidence of their L1 Spanish influencing their L2 English. Similar results have been reported for L2 English as spoken by L1 speakers of other languages, with typically less vowel duration variation than monolingual English (e.g., Thomas and Carter 2006; see also Henriksen and Fafulas 2017). Although this research on vowel duration has documented the influence of an L1 on an L2, we hypothesize, based on the literature reviewed here, that L2 influence on L1 should also be observed for variation in vowel duration. This should be especially true for speakers who are highly proficient in their L2, who have experienced prolonged and intensive exposure to their L2, and who use their L2 substantially more often than their L1.

Our study focuses on an Afrikaans-Spanish bilingual community, and given the research reviewed in this section, it is reasonable that we may find evidence for L1-to-L2 and/or L2-to-L1 influence between the L1 Afrikaans and the L2 Spanish of this community. L2-to-L1 influence, in particular, seems likely. Not only have Spanish and Afrikaans been in prolonged and intensive contact in the community, but Spanish has been the dominant language (i.e., in terms of language use) for most members of the community for at least the past five decades (see section 3.1 for more on the community).

2.3. Hypotheses

Our hypotheses first focus on overall patterns of durational variation in Spanish and Afrikaans and then become more specific, in order to diagnose the sources of any effects found regarding general patterns of variation. Our general hypotheses focus on the extent of variability in the duration of consonantal and vocalic sequences in Afrikaans and Spanish utterances. For this purpose, we rely on the so-called pairwise variability indices (PVIs) developed by Grabe and Low (2002; see also Low et al. 2000). The PVI is the mean durational difference over consecutive consonantal or vocalic intervals, as calculated over an utterance, such that higher values correspond to more durational variability. Grabe and Low calculated both raw PVIs and speech-rate normalized PVIs (where the durational differences between consecutive intervals are divided by their mean). Based on the observation that variation in speech rate is more likely to influence the duration of vowels than consonants (Gay 1981), they proposed using raw PVI scores for consonants (rPVI-C) and speech-rate normalized PVI scores for vowels (nPVI-V)—a practice that we adopt in the current study.

Taking into account the differences between Afrikaans and Spanish discussed in the preceding sections, we hypothesize that the Afrikaans control speakers will have more variability in both consonantal and vocalic sequences than the Spanish control speakers.

Hypothesis 1 (H1): Differences between the control speaker groups
We hypothesize that, compared to Spanish control speakers, Afrikaans control speakers will have higher values for both nPVI-V and rPVI-C.

Our hypotheses with regard to the bilingual speakers are more nuanced. First, as explained in section 2.1, we do not expect the languages of the bilinguals to influence each other in terms of the duration of consonantal sequences.

Hypothesis 2 (H2): No influence between Afrikaans and Spanish in terms of variability in consonantal interval duration

We hypothesize that the rPVI-C values of the Afrikaans-Spanish bilinguals in each of their languages should be similar to those of the respective control groups.

Afrikaans and Spanish differ from each other in terms of phonological and phonetic processes that control vowel duration, so that it is possible for the two languages of the bilingual speakers to influence each other in terms of vowel duration. Whether this influence will be bidirectional, or whether only the L1 (Afrikaans) will influence the L2 (Spanish), or only the L2 (Spanish) the L1 (Afrikaans), will depend on how the specific contact situation between Afrikaans and Spanish impacts the cognitive relation between these two languages for the bilinguals.

Hypothesis 3a (H3a): Spanish influence on Afrikaans vowel duration variability
If the L2 (Spanish) of the bilinguals influences their L1 (Afrikaans), the Afrikaans of the bilinguals will show less variability in vowel duration than the Afrikaans of the control speakers. We would then expect the nPVI-V values of the bilinguals in Afrikaans to be lower than those of the control Afrikaans speakers.

Hypothesis 3b (H3b): Afrikaans influence on Spanish vowel duration variability
If the L1 (Afrikaans) of the bilinguals influences their L2 (Spanish), the Spanish of the bilinguals will show more variability in vowel duration than the Spanish of the control speakers. We would then expect the nPVI-V values of the bilinguals in Spanish to be higher than those of control Spanish speakers.

The remaining hypotheses are conditional on whether H3a and/or H3b are confirmed, and are intended to determine specific aspects of the phonetic and phonological grammars that may contribute to the influence between the languages. We first state the hypotheses that we will explore if H3a is confirmed (i.e., if we find evidence for Spanish-like Afrikaans values for the bilinguals), and then those that we will explore if H3b is confirmed (i.e., if we find evidence for Afrikaans-like Spanish values for the bilinguals). Based on the differences between Afrikaans and Spanish reviewed in section 2.1, we will focus on three possible sources of variation in vowel duration: the phonemic contrast between short /ɑ/ and long /ɑː/ (for Afrikaans only), stress-induced lengthening, and final lengthening.

Hypothesis 4a (H4a): Sources of lesser vowel duration variation in the Afrikaans of bilingual speakers
If H3a is confirmed, we hypothesize that the bilingual speakers, in comparison to control L1 Afrikaans speakers, will have less robust durational differences between /ɑ/ and /ɑː/, between stressed and unstressed vowels, and between vowels in utterance-final vs. utterance-initial syllables.

We focused on /ɑ/ since that is the only vowel for which there is a robust phonemic length contrast in Afrikaans. Most of the other long vowels of Dutch have turned into diphthongs in Afrikaans.

Hypothesis 4b (H4b): Sources of increased vowel duration variation in the Spanish of bilingual speakers
If H3b is confirmed, we hypothesize that the bilingual speakers, in comparison to control L1 Spanish speakers, will have more robust durational differences between stressed and unstressed vowels and between vowels in utterance-final vs. utterance-initial syllables.

Due to the dependency relation between H3a/H3b and H4a/H4b, we will explore H4a only if we find confirmation for H3a, and likewise we will explore H4b only if we find confirmation for H3b.

3. Method

3.1. Speakers

We collected speech data from 44 speakers: 26 Afrikaans-Spanish bilinguals (from Patagonia, Argentina), 8 Spanish controls (from Patagonia, Argentina), and 10 Afrikaans controls (from Potchefstroom, South Africa). The Afrikaans-Spanish bilinguals were recruited through social networks that we had established prior to our arrival in Patagonia. Upon interacting with the 26 speakers who self-identified as Afrikaans-Spanish bilinguals, it became clear that only 14 were sufficiently proficient in Afrikaans to conduct an interview with them. Of those 14, only 8 could read Afrikaans well enough to participate in the current study, given that data collection was based on participants having to read stimuli in Afrikaans (the bilinguals never received sustained formal instruction in Afrikaans). We therefore report data for those eight bilingual speakers only. This Afrikaans-Spanish bilingual group represents a case of late subtractive (i.e., attrited) bilingualism.

The resulting Afrikaans-Spanish bilingual group contained three men and five women, the Spanish control group two men and six women, and the Afrikaans control group five men and five women. The mean age of the bilingual group was 71.3 (range = 55–78, SD = 7.9); that of the Spanish control group was 51.8 (range = 38–64, SD = 8.4); and that of the Afrikaans control group was 71.5 (range = 65–81, SD = 7.1).

The Afrikaans control speakers were in actual fact bilinguals with English as an L2 (as is true of almost all Afrikaans speakers in South Africa). Given that Afrikaans and English have similar vowel duration grammars, we do not anticipate interference from English in the Afrikaans of these speakers (Coetzee and Wissing 2007). Additionally, although these speakers are Afrikaans-English bilinguals, they are Afrikaans-dominant and live in an area of South Africa where English has very limited social reach. We thus refer to these speakers as "control" speakers rather than straightforward "monolingual" speakers throughout this chapter.

Even though the Spanish monolinguals were younger than the Afrikaans-Spanish bilinguals, to our knowledge there is no generational shift in the durational properties of the variety of Patagonian Spanish spoken in the Argentinian province of Chubut. The Spanish monolingual speakers also come from the social circles of bilingual speakers and are therefore representative of the Spanish to which the bilingual speakers are regularly exposed.

Although Pettorino and Pellegrino (2014) documented that older Italian speakers produce overall longer vocalic intervals than younger speakers, they do not report that age differences result in a change in the variability of vowel duration. Since H1 through H3 (for which we compared the L1 and L2 Spanish speakers) focus not on the absolute duration of individual vowels, but on the variability of vowel duration across an utterance, we do not expect the age differences between the bilingual speakers and the Spanish monolingual speakers to substantially impact the results of our research.

Our aim for this group (of bilingual speakers) was to record speakers who were fluent and biliterate in Afrikaans and Spanish. Although we did not conduct formal quantitative tests of proficiency for either language with the bilingual speakers, we evaluated their proficiency in three ways. First, we included only speakers who were fluent enough in both Afrikaans and Spanish that we could have conversations with them about a range of topics in both languages (our research team contained a native speaker of Afrikaans and a native speaker of Spanish). Second, we included only speakers who were proficient readers in both Afrikaans and Spanish (due to the reading-task nature of our research design). Since all participants attended Spanish-medium schools, all could read Spanish well. Reading proficiency in Afrikaans, however, was more limited, resulting in the elimination of several potential participants from the study. Third, all bilingual participants completed the Bilingual Language Profile (BLP) (Birdsong, Gertken, and Amengual 2012), a questionnaire in which bilinguals rate themselves on questions related to language use, identity, proficiency, and attitudes. The BLP has a potential of rendering scores in the range from −180 (Afrikaans-dominant) to +180 (Spanish-dominant). All eight of the speakers whom we included in this study fell into the middle two quartiles of the BLP range. In Table 19.1 we provide demographic information for the eight bilingual speakers.

3.2. Speech materials

All speakers participated in a sentence reading task. The bilinguals read sentences in Spanish and Afrikaans, and the control speakers read sentences in their respective native languages. When reading the sentences in Afrikaans, the bilinguals interacted with the second author exclusively (who is a native speaker of Afrikaans). When reading the sentences in Spanish, the bilinguals interacted with either the first or the second author (a highly proficient L2 and a native speaker of Spanish, respectively). We followed this procedure to control for language mode and to keep any cross-language activation effects to a minimum (e.g., Antoniou et al. 2012, 2013).

The stimuli used for the analyses in this chapter were collected as part of a larger project investigating the Afrikaans and Spanish of the bilingual community. Specifically, we draw from recordings of two separate sets of sentences that we will call Set A and Set B, both of which are included in the appendix. Set A was recorded for a related study investigating the global

Table 19.1 Demographic information for the eight Afrikaans-Spanish bilinguals

Speaker	*Age*	*Age of acquisition: Afrikaans*	*Age of acquisition: Spanish*	*BLP score*
M1	73	Since birth	9	–38.4
F1	64	Since birth	8	–4.7
F2	78	Since birth	10	45.6
M2	75	Since birth	11	52.4
M3	69	Since birth	8	77.0
F3	77	Since birth	8	87.1
F4	76	Since birth	5	81.8
F5	55	Since birth	5	88.5
Average	70.9	(Since birth)	8.0	48.7

"M" and "F" in speaker codes indicate the gender of speakers. The individual scores in the BLP range from –180 (Afrikaans-dominant) to +180 (Spanish-dominant).

rhythmic patterns in the speech of the bilingual speakers (see Coetzee et al. 2015 for a full report on this project). In order to allow for comparability with other studies investigating the rhythmic properties of Spanish, we used the same sentences as Arvaniti (2012) for Spanish and constructed a comparable set of sentences for Afrikaans. Set A contained 12 sentences each for Afrikaans and Spanish (24 sentences total).

For Afrikaans and Spanish, each list of 12 sentences consisted of three subsets of four sentences each: CV sentences (with mostly "simpler" CV syllables), CVC sentences (with more "complex" CVC syllables), and uncontrolled sentences (taken from novels in Afrikaans and Spanish). This syllabic complexity difference is relevant for comparing rhythmic measures between languages. However, since our current study does not focus on rhythm, the differences between the sentences are not relevant here, and we therefore do not include sentence type as a factor in our statistical models.

Set B was collected from Afrikaans speakers only. This set of sentences was originally recorded for a project investigating the acoustic properties of specific consonants and vowels in different sentential contexts in Patagonian Afrikaans and contained a total of 16 different sentences.

3.3. Acoustic analysis

For each of the sentences in Set A (relevant for investigating H1 through H3), measurements of consonantal and vocalic intervals were made by simultaneous inspection of waveforms and wide-band spectrograms in Praat (Boersma and Weenink 2019), following standard segmentation criteria (Peterson and Lehiste 1960). Figure 19.1 shows an example of vowel and consonantal intervals labeled for the Spanish utterance *La casa de la profesora no parece pequeña* 'The professor's house does not seem small.' Following Arvaniti (2012), we relied on the phonetic properties of segments, rather than their phonological status. After this, we used a Praat script to generate rPVI-C and nPVI-V values for each sentence separately. Speaker means are therefore based on scores from individual sentences rather than all sentences combined.

In order to investigate H4, we needed sufficiently large numbers of Afrikaans vowels that differed in duration based on the Afrikaans phonemic vowel length differences between /ɑ/ and /ɑː/, between stressed and unstressed position, and between sentence-final and sentence-initial syllables. Since the sentences in Set A did not contain enough examples of the relevant vowels and contexts, we extracted examples from both Sets A and B for this purpose. In particular, for every Afrikaans speaker (from both groups), we identified 60 tokens each of phonemically long

/ɑː/ and short /ɑ/, 24 tokens each of stressed and unstressed /i ɑ ə/ (for a total of 72 stressed and unstressed vowels for each speaker), and 60 tokens of a stressed vowel from a sentence-final syllable and a stressed vowel from a sentence-initial syllable. For each of these tokens, we identified the vowel based on inspection of the spectrogram and waveform representations in Praat and then extracted the duration of the vowel using a Praat script.

Since function words in Afrikaans are often subject to severe reduction, or even deletion, we identified as the "sentence-initial syllable" the first stressed syllable of a nonfunction word in the sentence.

4. Results

We performed all statistical modeling using the MIXED procedure in IBM SPSS Statistics, Version 24. Degrees of freedom and *p*-values for approximate F- and *t*-statistics for fixed effects were computed using the Satterthwaite approximation. For the data derived from Set A to test H1 through H3, each linear mixed effect model (LMEM) included random effects of SPEAKER and SENTENCE within SPEAKER. This approach allowed us to accommodate two levels of correlations among the repeated measurements of the dependent variables: measures within a speaker from different sentences would have a constant correlation, and measures from the same sentences within the same speaker would have a different (constant) correlation.

4.1. Consonantal and vocalic variability: comparisons between control Afrikaans and Spanish speakers (H1)

Per H1, we expect Spanish control speakers to have lower rPVI-C and nPVI-V values than Afrikaans control speakers. Figures 19.2a and 19.2b represent the rPVI-C and nPVI-V data for these speaker groups and show higher scores on both metrics for the Afrikaans controls compared to the Spanish controls. In order to investigate these differences further, we fit separate LMEMs to the rPVI-C and nPVI-V, with speaker GROUP (Afrikaans control, Spanish control) as a fixed factor. Both models returned significant effects for GROUP, indicating that both PVI values were higher for the Afrikaans controls than the Spanish controls, in agreement with H1 (for rPVI-C, $F(1, 15.847) = 13.904$, $p = .002$; for nPVI-V, $F(1, 16.046) = 139.202$, $p \leq .001$).

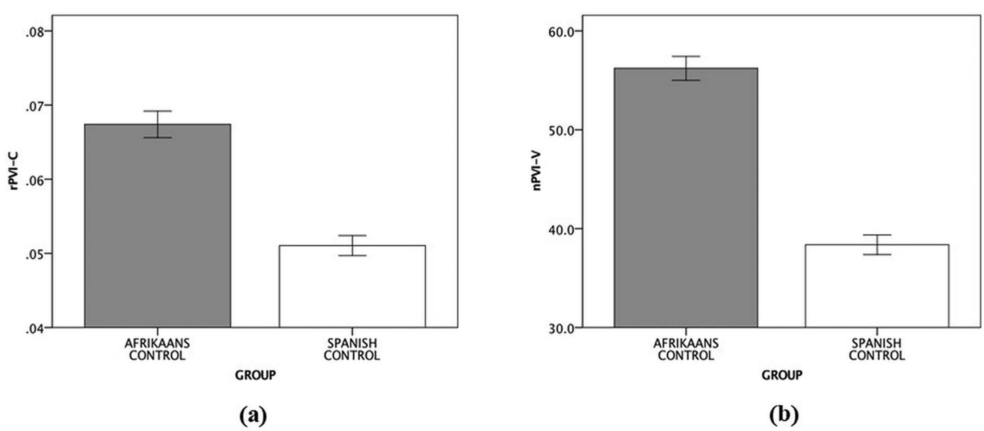

Figure 19.2 Control-group comparisons for (a) rPVI-C and (b) nPVI-V. Error bars indicate 95% confidence intervals.

4.2. Consonantal variability: comparisons of control and bilingual speakers in Afrikaans and Spanish (H2)

According to H2, we do not expect differences between the bilinguals and the two respective control groups in terms of variability in consonantal duration. Figure 19.3 shows that the expected patterns were observed in the data: the bilingual speakers displayed similar values on rPVI-C relative to the Afrikaans controls (Figure 19.3a) and also to the Spanish controls (Figure 19.3b). These patterns were investigated with separate LMEMs for Afrikaans and Spanish, respectively, with GROUP (control vs. bilingual) as a fixed factor. The LMEMs did not show a significant effect of GROUP for either comparison: $F(1, 15.770) = 0.196$, $p = .664$ for Afrikaans, and $F(1, 14.094) = 0.293$, $p = .597$ for Spanish.

4.3. Vocalic variability: comparisons of control and bilingual speakers in Afrikaans and Spanish (H3)

H3 contains two subhypotheses, each of which depends on the relation between the two languages of the bilingual speakers. On the one hand, if the L2 (Spanish) of the bilingual speakers influenced their L1 (Afrikaans), then, by H3a, we would expect less variation in the duration of vowels in Afrikaans for the bilingual relative to the control Afrikaans speakers (i.e., nPVI-V scores in Afrikaans should be lower for the bilingual than the control speakers). On the other hand, if the L1 (Afrikaans) of the bilingual speakers influenced their L2 (Spanish), then, by H3b, we would expect more variation in the duration of vowels for the bilingual than the control Spanish speakers (i.e., nPVI-V scores in Spanish should be higher for the bilingual relative to the control speakers). Figure 19.4 shows that the expected outcome was observed for H3a but not for H3b, implying that the influence between the two languages of the bilinguals is unidirectional, with their L2 influencing their L1, but not the opposite. These patterns are also confirmed by the results of LMEMs fit separately to the Afrikaans and Spanish data. For both models, GROUP (control, bilingual) was entered as a fixed factor. For the Afrikaans model, a significant effect of GROUP was returned ($F(1, 214.009) = 15.006$, $p \leq .001$), but not for the Spanish model ($F(1, 13.997) = 0.008$, $p = .929$).

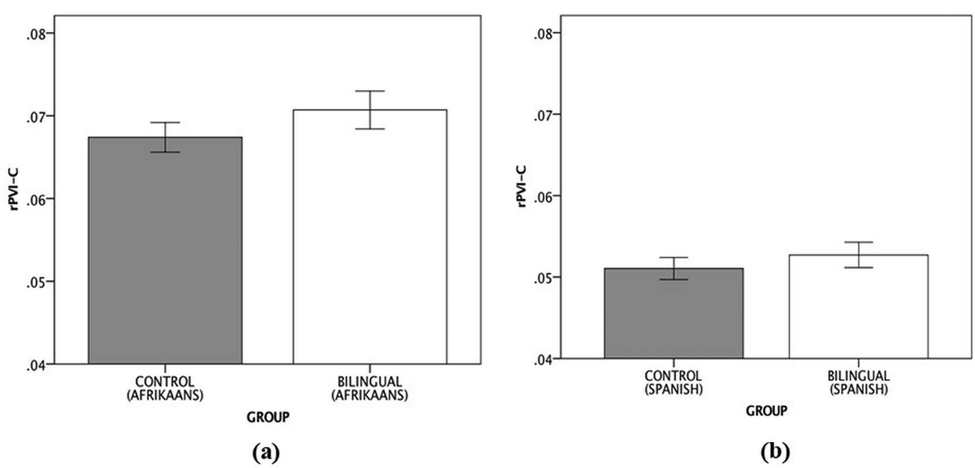

Figure 19.3 Mean rPVI-C data based on speaker group in (a) Afrikaans and (b) Spanish. Error bars indicate 95% confidence intervals.

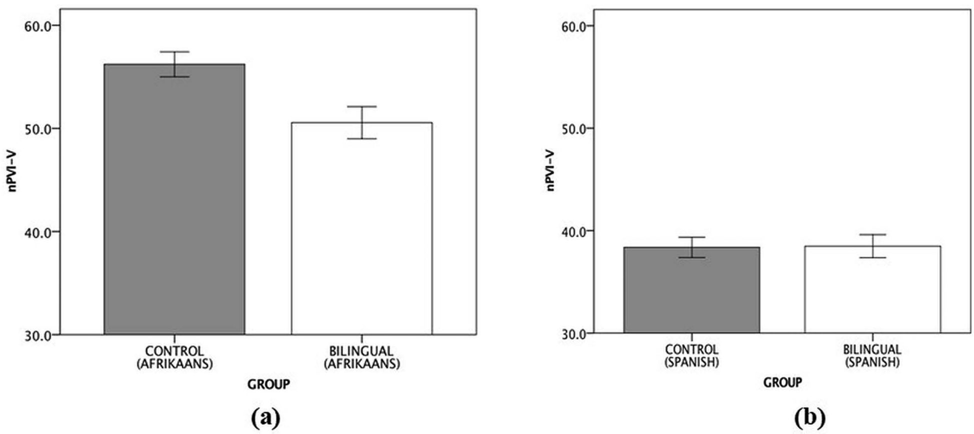

Figure 19.4 Mean nPVI-V data based on speaker group in (a) Afrikaans and (b) Spanish. Error bars indicate 95% confidence intervals.

4.4. Language-internal vowel duration differences (H4)

We found confirmation for H3a but not for H3b. Given this outcome, we explore the control and bilingual Afrikaans data in further detail in order to uncover the possible origins of the lower nPVI-V values in the speech of bilingual compared to control Afrikaans speakers. Specifically, we hypothesize (H4a) that, relative to the Afrikaans controls, the bilinguals will produce phonemic vowel length contrasts less robustly and apply stress-sensitive reduction/lengthening and final lengthening to a lesser extent. To investigate this hypothesis, we conducted three analyses to examine the local durational properties of the bilinguals' speech in Afrikaans relative to that of control Afrikaans speakers.

We relied on sentences from both Sets A and B (see section 3.2) to investigate these hypotheses. As a reminder, we extracted tokens that allowed us to compare, for each speaker, the duration of 60 tokens each of phonemically short /ɑ/ and long /ɑː/, 24 tokens each of stressed and unstressed /i ɑ ə/, and 60 tokens each of vowels from sentence-initial and sentence-final syllables. The differences between control and bilingual speakers in terms of these three phenomena were modeled with three separate LMEMs. Each model contained as fixed effects GROUP (control, bilingual) and either LENGTH (/ɑ/, /ɑː/), STRESS (stressed, unstressed), or POSITION (final, initial), as well as the interaction between the two fixed effects. The models included random intercepts of SPEAKER and SENTENCE. Figures 19.5 through 19.7 plot the summary differences between the control and bilingual speakers for each of the three comparisons (Figures 19.5a, 19.6a, 19.7a), as well as ratios comparing the two syllable types in question for individual speakers, with control speakers represented by black bars and bilingual speakers by gray bars (Figures 19.5b, 19.6b, 19.7b).

As seen in Figures 19.5a and 19.6a, although both control and bilingual speakers maintain a duration difference between short /ɑ/ and long /ɑː/, and between stressed and unstressed vowels, respectively, the differences are larger for control speakers than bilingual speakers. The individual data for long-to-short and stressed-to-unstressed ratios (Figures 19.5b and 19.6b) confirm the trends indicated by the group comparisons, showing that, in both cases, the Afrikaans control speakers typically have higher ratios than the bilinguals. The LMEM for long /ɑː/ and short /ɑ/ showed significant effects of LENGTH ($F(1, 51.440) = 46.149$, $p \leq .001$) and the GROUP-BY-LENGTH interaction ($F(1, 578.665) = 17.326$, $p \leq .001$). The interaction confirms that although

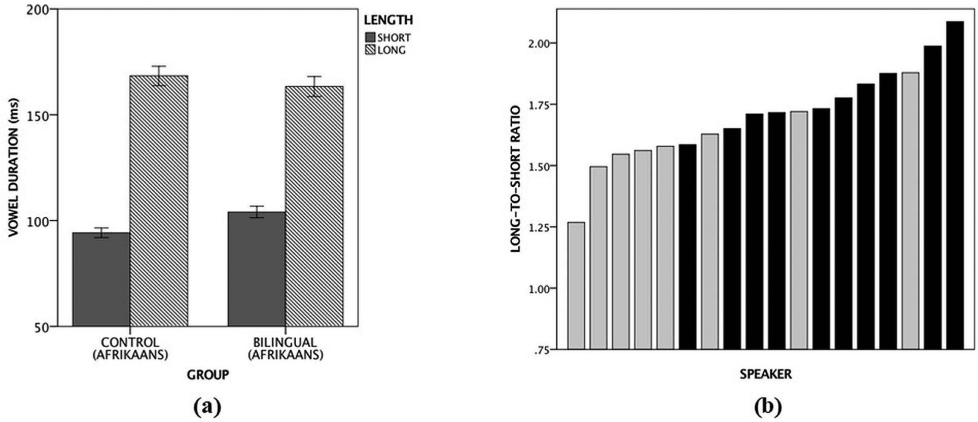

Figure 19.5 (a) Mean vowel duration (in milliseconds) for control and bilingual Afrikaans speakers for short /ɑ/ and long /ɑː/. Error bars indicate 95% confidence intervals. (b) Ratios (long /ɑː/ to short /ɑ/) for individual speakers. Control speakers are shaded in black, and bilingual speakers are shaded in gray.

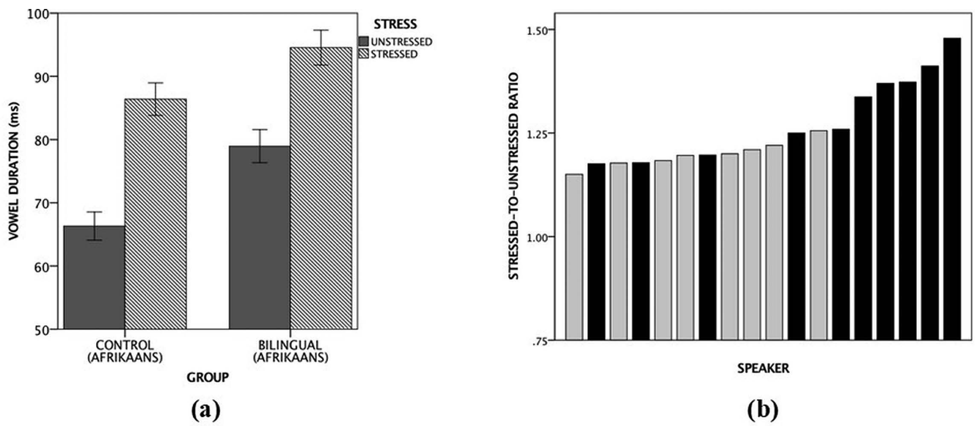

Figure 19.6 (a) Mean vowel duration (in milliseconds) for control and bilingual Afrikaans speakers for unstressed and stressed vowels. Error bars indicate 95% confidence intervals. (b) Ratios (stressed-to-unstressed vowels) for individual speakers. Control speakers are shaded in black, and bilingual speakers are shaded in gray.

both groups maintain a difference between long and short vowels, the difference is greater for the control than the bilingual speakers. The LMEM for stressed vs. unstressed vowels indicated significant effects of STRESS ($F(1, 42.372) = 9.634$, $p = .003$) and GROUP ($F(3, 698.812) = 49.524$, $p \leq .001$), and a marginally significant interaction of GROUP-BY-STRESS ($F(1, 698.812) = 3.671$, $p = .056$). The nearly significant interaction confirms that although both groups maintain a difference between stressed and unstressed vowels, the difference tends to be larger for the control than the bilingual speakers.

In terms of vowels in sentence-final vs. sentence-initial syllables, Figure 19.7a shows that the control Afrikaans speakers maintain a more robust difference between final and initial position.

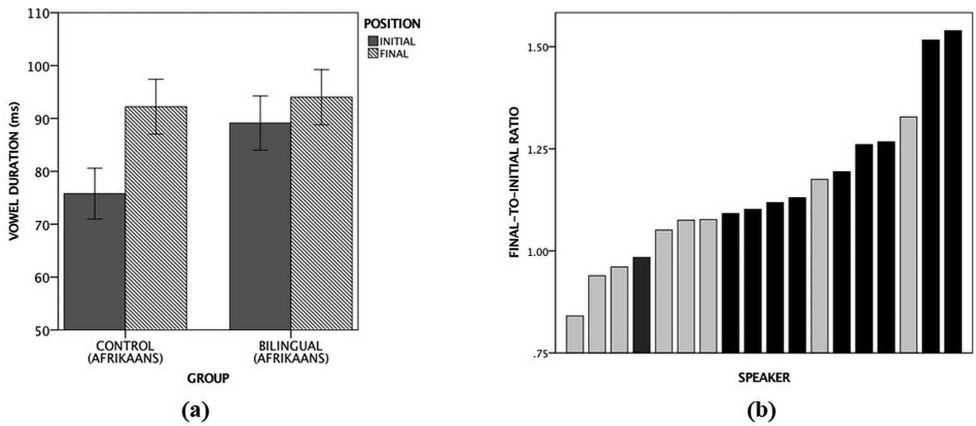

Figure 19.7 (a) Mean vowel duration (in milliseconds) for control and bilingual Afrikaans speakers in sentence-initial vs. sentence-final syllables. Error bars indicate 95% confidence intervals. (b) Ratios (final-to-initial syllable vowels) for individual speakers. Control speakers are shaded in black, and bilingual speakers are shaded in gray.

However, unlike in the short-to-long and stressed-to-unstressed comparisons, the bilingual speakers show virtually no difference between final and initial syllables. The LMEM returned significant effects for GROUP ($F(1, 618.984) = 7.897$, $p = .005$) and the GROUP-BY-POSITION interaction ($F(1, 794.556) = 5.229$, $p = .022$). As with the other two comparisons, the significant interaction shows that the control speakers realize a more pronounced difference between syllables in sentence-final and nonfinal position than do the bilingual speakers. The group effect is also confirmed by inspection of the individual speaker ratios (Figure 19.7b), which indicate that the control speakers are more clustered toward the higher end of the individual ratios and the bilingual speakers toward the lower end.

5. Discussion

Our results show that Afrikaans control speakers had higher rPVI-C and nPVI-V values than their Spanish counterparts. These findings were expected per H1, given differences in the phonotactics of the two languages (for both consonants and vowels), as well differences in the phonological and phonetic processes impacting duration (for the vowels in particular). We also found, in agreement with H2, that with regard to variation in consonantal duration, the bilingual speakers were native-like in both Spanish and Afrikaans. With regard to variability in vowel duration, however, we found that the bilingual speakers showed less variability in their Afrikaans than the control Afrikaans speakers (in agreement with H3a), but they patterned similarly to the control Spanish speakers' speech (counter to H3b). This shows, at least in terms of the specific part of the grammar controlling durational variability across vowels, that the L2 (Spanish) of the bilingual speakers influences their L1 (Afrikaans) more than the L1 does the L2. Finally, we found evidence for three of the possible sources of lesser segment-to-segment variability in the vowel duration of the bilingual speakers' Afrikaans: the realization of relative differences between phonemically long and short vowels, between stressed and unstressed vowels, and between vowels appearing in sentence-final and sentence-initial syllables in Afrikaans.

5.1. L2-to-L1 influence

In agreement with H3a and counter to H3b, we found evidence for L2-to-L1, but not L1-to-L2, influence in the durational properties of vowels in the speech of the bilingual speakers in our study. Current research on bilingual language-contact situations points to three possible explanations for these differences. One possibility is that the bilingual speakers fully acquired Afrikaans durational patterns during childhood but subsequently lost certain aspects of their Afrikaans competence due to decreased use of Afrikaans and/or contact with Spanish (i.e., attrition). A second possibility is that the input varieties to which the control and bilingual Afrikaans speakers in our study were exposed already displayed systematic differences (e.g., Escobar and Potowski 2015: 91). Yet a third possibility is that the bilingual speakers did not fully acquire those aspects of Afrikaans grammar that control vowel duration during childhood (i.e., incomplete acquisition; for review, see Montrul 2008, 2016). Although the origin of the differences between the Afrikaans of the control and bilingual speakers in our study cannot be determined definitively based on available information, the first possibility presents the most likely explanation. In other words, we attribute our finding of L2-to-L1 influence to contact-induced attrition in the Afrikaans of the bilingual speakers, especially given that these speakers have been living in a Spanish-dominant environment for at least two-thirds of their lives. The second and third possibilities are both unlikely. First, the control Afrikaans speakers in our study were recruited from the same Afrikaans dialect region as where the majority of the original Patagonian Afrikaans settlers came from, so that the caretakers of the control and bilingual speakers most likely spoke very similar varieties of Afrikaans. Second, when the bilingual speakers were acquiring Afrikaans (during the 1940s and 1950s), there was still very little contact between Afrikaans and Spanish in Patagonia, implying that the bilinguals functioned as virtually monolingual speakers of Afrikaans until late childhood or early adolescence.

5.2. What factors do and do not transfer between the languages of a bilingual?

We documented evidence that the differences between Afrikaans and Spanish in terms of vowel duration result in interference by the L2 (Spanish) of the bilingual speakers in their L1 (Afrikaans). These differences were found both in terms of the phonetic processes that affect vowel duration (stressed vowel lengthening and final lengthening) and in the difference between the phonemically long /ɑː/ and short /ɑ/. Since Spanish and Afrikaans differ in terms of the application of stress- and position-related lengthening, interference between the two languages of the bilinguals with regard to application of these processes was expected. Since the Afrikaans distinction between long /ɑː/ and short /ɑ/ is a contrast in segmental inventory, and not in the application of a phonetic or phonological process, the smaller durational difference between these two vowels for the bilingual speakers (as compared to controls) cannot be ascribed to differential application of phonetic or phonological processes. This discrepancy is more likely the result of a gradual weakening of the length contrast from the Afrikaans of the bilingual speakers. Due to the low functional load of this contrast in Afrikaans, and the limited opportunities for most of the community members to speak Afrikaans, they may not have sufficient exposure to the forms necessary to reinforce and maintain this contrast. This is compounded by the fact that Spanish, the currently dominant language for most members of the community, lacks a phonemic vowel length contrast.

Unlike for vowel duration, however, we did not find evidence that the differences in the consonantal grammars of Afrikaans and Spanish impacted the durational properties of consonantal sequences in the speech of the bilingual speakers. Possible reasons for this are that neither

Spanish nor Afrikaans has phonological processes that impact the duration of consonants, and that phonetic processes such as stress-related and final lengthening impact consonants to a lesser degree than vowels. However, Afrikaans and Spanish do differ in terms of their consonantal phonotactics (see section 2.1). Specifically, Afrikaans allows both more clusters overall and more complex consonant clusters than Spanish. Given evidence that L1 Spanish speakers simplify complex consonant clusters in an L2 such as English via vowel epenthesis (Carlisle 1998; Lipski 2016), and given the evidence that the Afrikaans of the bilingual speakers in our study is influenced by their Spanish, one possible outcome is that the bilingual speakers could have shown Spanish-like production patterns for the more complex Afrikaans clusters. Had they broken up Afrikaans consonant clusters via epenthesis, their Afrikaans utterances would have had fewer multiconsonant clusters than the Afrikaans of the control speakers (i.e., the Afrikaans bilinguals would have had lower rPVI-C scores than the Afrikaans controls).

Why does the simpler Spanish consonantal phonotactics not impact the Afrikaans of the bilingual speakers? The reason for this should most likely be ascribed to the so-called superset/subset principle in language acquisition (Berwick 1985). Applying this principle to L2 acquisition, it should be expected that learners whose L1 allows a superset of the structures allowed by an L2 should not, after acquisition of the L2, develop difficulties in producing the more complex structures in their L1. Since the originally acquired grammar allows all of the structures that are observed in the subsequently acquired grammar, the learner is not presented with any learning data from the L2 that would counter the more permissive original grammar, and would therefore not have any reason to change the grammar of the L1. Applied to the case of the L1 Afrikaans speakers acquiring Spanish as an L2, this would mean that our speakers would not have encountered any evidence in L2 Spanish that the more complex clusters of their L1 Afrikaans were ungrammatical; the mere absence of such clusters in Spanish is not interpreted as evidence that they are ungrammatical. There is hence no reason to expect that the bilingual speakers would have modified their L1 Afrikaans after learning their L2 Spanish. Had the acquisition happened conversely—i.e., had L1 Spanish speakers acquired L2 Afrikaans—we would expect such speakers to have difficulty with Afrikaans clusters and to resolve these through epenthesis (see, for example, Trapman and Kager 2009; see also Toribio 2004 for discussion relating to bilingual convergence).

5.3. The relation between local and global durational properties of speech

In this chapter we have relied on global measures of durational variability (nPVI-V and rPVI-C) to compare different languages (Spanish and Afrikaans), as well as different varieties of the same language (control and bilingual Spanish/Afrikaans). These global PVI scores, however, are not direct reflections of the durational control components of grammar but are rather epiphenomenal of more local durational mechanisms that are directly controlled by grammar, and of the syllabic complexity of the utterances over which the scores are calculated (for the latter, see Arvaniti 2012). Spanish has lower nPVI-V and rPVI-C scores than Afrikaans not because Spanish and Afrikaans grammar specify different targets for these measures, but because the languages differ in their local durational control phenomena (stress lengthening, vowel reduction, final lengthening, etc.) and in phonotactic restrictions (resulting in Afrikaans utterances on average being syllabically more complex than Spanish utterances). Whether PVI scores are used to make comparisons between two different languages or between different varieties of the same language, the utility of these metrics is limited. These metrics are best used as a primary confirmation of whether two languages or language varieties differ in terms of their durational control grammars. Critically, any global differences found in terms of PVI scores must be investigated further—as we demonstrated in section 4.4—in order to determine which local patterns in the grammars of the languages give rise to the PVI differences.

As Arvaniti (2012) has shown, discrepancies between languages in terms of these scores are influenced strongly by phonotactics, which can translate to large differences in the syllabic complexities of utterances in different languages. This complication in the use of PVI scores is avoided when varieties of the same language are analyzed using the same speech materials. The Spanish and Afrikaans sentences used in our study differed in syllabic complexity due to the phonotactic differences between Spanish and Afrikaans, contributing at least partially to differences in PVI scores between the two languages. However, we performed the PVI comparisons of control and bilingual Spanish and Afrikaans speakers based on the bilingual speakers' reading of the same sentences as their control counterparts in each language. By basing the within-language comparisons on the same test sentences, we thus circumvented the problems caused by differences in syllabic complexities between languages, pointed out by Arvaniti (2012). The disparity in nPVI-V scores between control and bilingual Afrikaans speakers that we documented (section 4.3) therefore cannot be ascribed to variation in the syllabic complexity of the sentences read by the two speaker groups. Instead, they must reflect other differences in the phonological and phonetic grammars of the two Afrikaans-speaking groups.

Related to the analysis of local durational properties, our inclusion of individual data is in line with Ortega (2016), who calls for studies that include in the design analyses of all languages by the individual multilingual speakers themselves (i.e., Afrikaans and Spanish sentences by the bilinguals), as well as representative samples of the languages from appropriate controls (i.e., Afrikaans from South Africa and Spanish from Patagonia). Having presented these data in Figures 19.5b, 19.6b, and 19.7b, we have shown that one bilingual speaker displays patterns like many of the Afrikaans control speakers with respect to the long-to-short (Figure 19.5b) and final-to-initial (Figure 19.7b) ratios. This bilingual speaker was M2, who scored 52.4 (Spanish-dominant) on the BLP. One of the reasons that M2 scored Spanish-dominant is that his spouse is a native speaker of Spanish (as are their children), and thus M2's primary language of communication is currently Spanish. Nonetheless, M2 is the only bilingual speaker who served as Argentina's Honorary Consul to South Africa and traveled to South Africa on 11 different occasions as an adult.

We would further point out that speaker M1, the bilingual with the most Afrikaans-dominant score, had traveled to South Africa only once in his life. Speaker M1 is married to another Afrikaans-Spanish bilingual speaker who did not participate in this study due to her limited reading proficiency in Afrikaans.

6. Conclusion

We tested four hypotheses on the patterns of temporal organization for L1 speakers of Afrikaans who acquired L2 Spanish in a Spanish-dominant context, L1 Afrikaans controls, and L1 Spanish controls. We showed, first, that L1 Afrikaans displays greater temporal variability in both consonants and vowels than L1 Spanish (H1). Second, we demonstrated that Afrikaans-Spanish bilinguals display native-like patterns in consonant variability in each of their languages (H2). Third, we showed that, for vowels, the L2 Spanish of the bilinguals influences their L1 (Afrikaans) more than their L1 influences their L2 (H3). Finally, we identified three possible sources of this L2-to-L1 influence: the realization of relative differences between phonemically long and short vowels, between stressed and unstressed vowels, and between vowels appearing in sentence-final and sentence-initial syllables in Afrikaans (H4). We have argued that the presence of phonetic and phonological processes affecting vowels (but not consonants), in addition to the relative (i.e., L1 vs. L2) complexity of phonotactic patterns, intervenes to yield consequences for a speaker's vocalic control grammar.

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Appendix: stimulus materials

Set A sentences (Spanish and Afrikaans)

Spanish sentences (identical to Arvaniti 2012)

CV	1.	*Mañana iré al mercado para comprar una papaya*. 'Tomorrow I will go to the market to buy a papaya.'
	2.	*El muchacho le da una rosa a su hermana cada sábado*. 'The boy gives his sister a rose every Saturday.'
	3.	*La casa de la profesora no parece pequeña*. 'The professor's house does not seem small.'
	4.	*Sara dice que la playa es muy bonita durante el verano*. 'Sara says that the beach is very beautiful during the summer.'
CVC	1.	*Un zoólogo estaba inspeccionando unos especímenes nuevos*. 'The zoologist was inspecting some new specimens.'
	2.	*Daniel, Enrique y Juan van a viajar a Japón por un mes*. 'Daniel, Enrique, and Juan are going to Japan for a month.'
	3.	*A los doctores les gusta caminar por el parque central de La Paz*. 'The doctors like to walk in La Paz's central park.'
	4.	*El ingeniero siempre parecía bastante amable*. 'The engineer always seemed rather nice.'
Uncontrolled	1.	*Esto es pecado quemarlo, con tanta gente que no tiene ni que comer*. 'This is a sin to burn it, with so many people that don't have anything to eat.'
	2.	*Se había ido sin escándalo, de común acuerdo del esposo*. 'He had left without scandal, by mutual agreement with his/her husband.'
	3.	*Es la primera vez que te oigo decir algo que no debías*. 'It's the first time that I hear you say something that you shouldn't.'
	4.	*Las oficinas estaban cerradas y a oscuras por el día feriado*. 'The offices were closed and dark because of the holiday.'

Afrikaans sentences (modeled after the Arvaniti 2012 Spanish sentences)

CV	1	*Jannie Venter sê dat die sestien boeke in sy tas sal pas*. 'Jannie Venter says that the sixteen books will fit in his suitcase.'
	2	*Bennie de Lange sê dat die kos in die pot nie lekker is nie*. 'Bennie de Lange says that the food in the pot is not tasty.'
	3	*Die wit kat sit op die kar se dak, en die swart kat sit onder die kar*. 'The white cat sits on the car's roof, and the black cat sits under the car.'
	4	*Die man op die stoel is die pa van die kind met die swart hare*. 'The man on the chair is the father of the child with the black hair.'
CVC	1	*Die onderwyser vra die kinders om na die skool toe te gaan*. 'The teacher asks the children to go to the school.'
	2	*Hierdie dorp lê aan die Atlantiese oseaan, en dit is daarom koud hier in die winter*. 'This town lies on the Atlantic Ocean, and it is therefore cold here in the winter.'
	3	*Ons voorouers het met groot skepe oor die see gevaar na Argentinië toe*. 'Our forefathers sailed with large ships over the ocean to Argentina.'
	4	*Voordat olie ontdek is, was ons mense almal skaapboere gewees*. 'Before oil was discovered, all our people were sheep farmers.'
Uncontrolled	1	*Sy was nog besig om dit te sê toe haar ma ook uitasem daar aankom*. 'She was still busy saying it when her mother also arrived there, out of breath.'
	2	*Sy het die hek heen en weer geskud sonder om te weet hoekom sy dit doen*. 'She shook the gate to-and-fro without knowing why she was doing it.'
	3	*Op die stoep moes sy eers'n bietjie stilstaan sodat haar asem kon bedaar*. 'On the porch, she first had to stand still for a while, so that her breath could calm down.'
	4	*Eers het hy vir haar gewag en later het hy na haar gaan soek*. 'At first, he waited for her, and later he went looking for her.'

Set B sentences (Afrikaans only)

1	*Drie plus sewe is tien*. 'Three plus seven is ten.'
2	*My ma se verjaarsdag is op die tiende*. 'My mother's birthday is on the tenth.'
3	*Tien plus vier is veertien*. 'Ten plus four is fourteen.'
4	*My pa se verjaarsdag is op die veertiende*. 'My father's birthday is on the fourteenth.'
5	*Ons vakansie begin oor 'n week*. 'Our vacation starts in a week.'
6	*Die skool begin weer oor twee weke*. 'The school starts again in two weeks.'
7	*Ons gaan melktert bak hierdie naweek*. 'We will bake milk tart this weekend.'
8	*Die kinders speel voetbal op die naweke*. 'The children play football on the weekends.'
9	*Ek wil die fliek weer sien*. 'I want to watch the movie again.'
10	*Ek wil ook die fliek sien*. 'I also want to watch the movie.'
11	*Die kar sal in die straat moet bly*. 'The car will have to remain on the street.'
12	*Die president sal die wet teken*. 'The president will sign the legislation.'
13	*Ek het vier seuns en twee dogters*. 'I have four sons and two daughters.'
14	*Die seuns speel voetbal*. 'The boys play football.'
15	*Jy mag nie hier sit nie*. 'You are not allowed to sit here.'
16	*Die vrou sit op die bank*. 'The woman is sitting on the couch.'

20

The phonological system of adult heritage speakers of Spanish in the United States

Rajiv Rao

1. Introduction

One of the subfields of bilingualism involves the study of *heritage speakers* (henceforth HS), or individuals who grow up with some degree of exposure to a minority language at home before entering school, after which point experience with and use of the societally dominant language continue to increase. The massive number of Spanish-speaking diaspora, which spans several generations in some communities, particularly in the United States but also in other countries, has made HS of Spanish (henceforth HSS) a popular topic of inquiry over the past two decades (see Potowski 2018 and references therein). Within the large field of studies on HSS, phonology has been, relatively speaking, a late-blooming field; however, the growth in publications within this area in recent years and the ongoing identification of research gaps show that it has garnered considerable interest and will continue to do so (see Rao and Ronquest 2015; Rao and Kuder 2016; Ronquest and Rao 2018).

On a general level, the existing body of research on the phonological system of HSS has described linguistic and extralinguistic variables that affect the perception and production of Spanish's sound system, and has shown how these variables differ when comparing HSS to both bilinguals who immigrated as adults (and are typically Spanish-dominant) and monolinguals. The majority of studies investigating these variables have been carried out through laboratory-based methods incorporating both acoustic analysis and statistical modeling, with very few existing studies being couched in frameworks of contemporary phonological theory, such as Optimality Theory (OT; Prince and Smolensky 1993, 2004; see Martínez-Gil and Colina 2006; Colina 2009; Bradley 2014 for studies on Spanish); that is, researchers have done an effective job describing heritage Spanish phonology but have not examined the underlying principles accounting for their results in much detail.

This chapter first provides an overview of research on heritage Spanish consonants, vowels, and suprasegmentals that has been carried out to date. The results from these studies are then critically evaluated with respect to data elicitation strategies, across-group comparisons, and the need for more studies incorporating phonological theory. It should be noted that while there is an existing body of literature on the acquisition of Spanish by child HS and on HSS outside the United States (see Lleó 2018 and references therein), the present chapter focuses on the Spanish-English contact faced by adult HSS in the United States due to the extensive attention this particular population has received.

2. Segmental issues

2.1. Vowels

Studies on the heritage Spanish vowel space have examined whether it reflects the triangular shape traditionally described for monolingual Spanish, and whether it exhibits evidence of the unstressed vowel reduction (i.e., centralization) typically found in a language like English. These two aspects of the vowel space have been primarily investigated by measuring the first two formant values (F1 and F2) and, in some studies, duration. The first study on heritage Spanish vowels was Willis (2005), whose narrative data from Southwest Spanish indicated that, compared to previous descriptions of Spanish vowels, /a/ was realized in a more anterior position (i.e., English-like) but was not reduced, /o/ was produced lower, and /u/ was articulated more anterior and lower. Ronquest's (2012) contribution from Chicagoland confirmed Willis's (2005) findings, while also adding two more details about the dispersion of heritage Spanish vowels as compared to that of monolingual Spanish: a more compact posterior region and a more spread-out anterior region. Ronquest (2012, 2013), Alvord and Rogers (2014), and, more recently, Solon et al. (in press) all showed evidence of unstressed vowel reduction in heritage Spanish, with the latter two studies based on data collected in Miami and New York, respectively. In terms of effects on duration, Ronquest (2013) found that, as expected, stressed vowels were longer than unstressed vowels but that the shorter length of the latter was not necessarily linked to vowel reduction. A novel aspect of the Solon et al. (in press) study is that it employed a map task to elicit and compare data from HSS and Spanish-English bilinguals who had immigrated to the United States at a later age. Interestingly, the late bilingual group also showed unstressed vowel reduction with shorter durations, meaning they resembled HSS more than monolinguals. Furthermore, Elias et al. (2017) also found evidence of vowel reduction, but unlike the previously mentioned studies, they analyzed code-switched utterances. Finally, Shea (2017) is, to date, the only scholar to have employed dominance and proficiency in a study of the vocalic system of HSS. The variation in her English and Spanish data led her to conclude that dominance and proficiency should be treated as separate yet connected variables in any facet of heritage language (HL) research.

A noteworthy comment on the results reported thus far is that many bring up the effect of task type; that is, informal tasks, or those that are strictly oral (e.g., interviews, story retelling), typically yielded more reduction effects and a more compact vowel space than controlled tasks (e.g., reading). Ronquest's (2016) study focused precisely on this issue of stylistic variation, using a more robust set of participants and three tasks varying in formality to confirm many of the results cited in her previously cited study. She also presented acoustic evidence in favor of including both formant measures and duration in studies on vowels, while making sure to tease apart these two variables because they can demonstrate distinct trends based on the vowel in question. Finally, one more study that included vowels is Mazzaro et al. (2016), whose approach to mid vowels in data from Texas should be highlighted for a couple of methodological reasons: they tested perception rather than production and looked at HSS, long-term immigrants, and monolinguals in order to shed light on cross-generational differences. Interestingly, their discrimination task results showed that HSS performed closer to the monolingual group than did the long-term bilingual group. While this finding rejected any notion of phonological attrition in HSS, the authors interpreted the results with caution given that their HSS live in a locale where Spanish is consistently a part of daily life for everyone.

A study that distinguishes itself from the previously mentioned literature in this section by using a nonacoustic approach and by addressing heritage Spanish syllabification is Shelton et al. (2017). Through a paper-based task, the authors revealed that the interpretation of Spanish diphthongs as hiatuses by HSS was significantly influenced by cognate status, the presence of a hiatus in the English equivalent of a cognate, type of diphthong, and type of glide within diphthongs. Conversely, their monolingual control participants did not demonstrate any of these effects.

2.2. Consonants

Existing literature on consonants has focused on those that are in the inventory of both Spanish and English but that demonstrate articulatory differences in the two languages. As such, investigators have looked mostly at the realization of voiced stops (lenition in some contexts in Spanish, not in English), voiceless stops (aspirated allophone with an increased voice onset time in English, not in Spanish), and liquids (a tap and a trill in Spanish, retroflex in American English; a "clear," or nonvelarized lateral in Spanish but a "dark," velarized allophone in American English). Additionally, departing from the application of English versus Spanish phonological rules, two studies on fricatives have linked their productions to issues of identity.

2.2.1. Stops

The pioneering study by Au et al. (2002), which compared heritage to L2 Spanish, found through acoustic analysis of data from read carrier phrases that the former group produced more lenited voiced stops and less aspirated voiceless stops. Both of these observations were subsequently confirmed through native speakers' perceptual judgments. In Knightly et al. (2003), members of the same research team used a similar methodology and arrived at the same general conclusions. This research team generated one more study on stop consonants, Au et al. (2008), which compared both HSS who actively used Spanish as children and those who simply overheard it to adult L2 learners and native speakers. The authors reported that production as children did not affect the results; the read and narrated productions of both groups of HSS were rated higher than those of the L2 learners. This suggests that simply receiving input in the HL during childhood plays some role in the ability to produce it in adulthood.

Inspired by this initial body of work, more recent studies have examined more linguistic and extralinguistic variables in relation to stop consonants. Kim (2011) looked at voiced and voiceless stops in heritage Spanish and in the English of these speakers, while also comparing their realizations to those of English-dominant and Spanish-dominant bilinguals used as controls. Through an acoustic analysis of a carrier phrase task, she observed that the English results of HSS matched those of English controls but that their Spanish differed from that of the Spanish controls by demonstrating English influence. Amengual (2012) discovered a cognate effect in his analysis of /t/ produced by HSS in a carrier phrase task; Spanish words with a similar form in English resulted in increased voice onset time, or more evidence of English-like aspiration. Rao (2014, 2015) explored the effects of experience with Spanish, linguistic context, task, and orthography on the production of /b/, finding that HSS generally applied Spanish's lenition rule but that less use of the HL, stressed syllables, word boundaries, and read elicitation all led to less lenited allophones. The second study also analyzed /d, g/ and found similar effects, while also adding that /b/, due to its orthographic complexity, was the stop that showed the least amount of lenition. Finally, Amengual's (2017) analysis of intervocalic /b, d, g/ productions divided HSS into "simultaneous" and "sequential" categories. He found that the sequential participants lenited more than the simultaneous participants, which implies that the increased HL input that members of the former group received during the early years of life influenced their phonological outcomes in adulthood.

2.2.2. Liquids

Three studies have addressed the rhotic productions of HSS. Henriksen's (2015) analysis of narrative data from Chicagoland compared the tap and trill productions of HSS to those of speakers who emigrated from Mexico at age 13 or later. A pattern he found is that duration, rather than number of occlusions, was crucial to conveying the tap versus trill contrast. He argued that variation in the productions of HSS stemmed from their use of phonetic detail to maintain Spanish's two-way rhotic contrast rather than from English influence. Furthermore, Amengual (2016) expanded on Henriksen (2015) by breaking his HSS from Northern California into Spanish-dominant and English-dominant groups and comparing both groups to L2 learners. Though the acoustic analysis of rhotics in these two studies was similar, Amengual elicited data through the reading of carrier phrases rather than narrations. Amengual's results showed that the English-dominant HSS patterned more closely with the L2 group; both of these groups utilized duration as a means to cue the rhotic contrast. In turn, the Spanish-dominant group did maintain the contrast through multiple occlusions, suggesting that past and present experience with the HL influences the implementation of its phonology. The most recent study on rhotics is Kissling (2018), whose most significant contribution comes from a methodological perspective. Her analysis of four speaker groups—HSS, long-term immigrants, L2 learners, and "traditional" native speakers (i.e., those who are almost monolingual and living in Mexico or who came to the United States less than five years ago, as an adult)—revealed that comparing specific acoustic variables among groups is not particularly elucidating. Kissling also reported that extralinguistic variables, such as types of identity, are particularly useful for grouping HSS and help shed light on patterns of variation in their sound systems.

Concerning laterals, Barlow (2014) addressed age-of-acquisition effects on /l/ productions in English and Spanish by young adult HSS (though she uses the term "bilinguals") who acquired English either before the age of five or after the age of six. While both groups demonstrated an influence of Spanish on their English laterals, only the latter group exhibited an effect of English on their Spanish laterals. In a recent study, Amengual (2018) incorporated dominance and language mode (i.e., monolingual versus bilingual) as independent variables in his analysis of English and Spanish lateral productions by HSS and L2 learners. He found an interaction between the variables of interest across the board; when participants were in bilingual mode, they produced less "native-like" laterals, but this was the case only in the less dominant language.

2.2.3. Fricatives

Finally, two studies on the production of consonants include analyses grounded in identity and social variables. First, O'Rourke and Potowski (2016) conducted a cross-generational examination of coda /s/ and /r/ realizations in sociolinguistic interviews in Chicago with Mexicans, Puerto Ricans, and MexiRicans (i.e., one parent Mexican and one parent Puerto Rican). The most noteworthy results were that Puerto Ricans accommodated Mexican interlocutors by reducing their use of velarized /r/, and third-generation Puerto Ricans evidenced decreased attachment to typical trends of Puerto Rican Spanish. Among MexiRicans, the use of these two sounds more closely resembled Mexican Spanish on the whole, with the exception being those who had a Puerto Rican mother. Last, Van Buren's (2017) study explored the aspiration of /f/ in agricultural communities of Mexican descent in the Pacific Northwest. Through an analysis of sociolinguistic interviews, the author revealed that younger male speakers (who qualify as HSS) were particularly prone to aspirating if they felt a tight connection to their agricultural community. In fact, the author suggested that this traditionally stigmatized variant carried prestige among the men of the community.

3. Suprasegmental issues

3.1. Intonation

Most studies on heritage Spanish intonation, which have mainly analyzed statements and questions, have been framed in the Autosegmental Metrical model (Pierrehumbert 1980; Ladd 2008) and the Spanish in the Tones and Break Indices Framework (Beckman et al. 2002; Face and Prieto 2007; Hualde and Prieto 2015). An important finding stemming from Alvord's (2009, 2010) work on intonation across generations of Miami-Cuban bilinguals was that for yes-no questions in particular, first- and third-generation speakers utilized the falling nuclear pattern typical of Cuban Spanish, but the second generation employed a final rise that is more common in American English. Based on the background data he collected from participants, Alvord claimed that social networks (among other factors) influenced his findings. Furthermore, the intonation-based section of Robles-Puente's (2014) study on bilingual prosody in Los Angeles (LA) showed varying degrees of maintenance of Mexican Spanish pitch accent and boundary tone trends in different utterance positions and utterance types in adult bilinguals who had lived in LA since childhood, children/adolescents born in LA, and adult bilinguals who came to LA postadolescence. Another large study on bilinguals that incorporates HSS is Zárate-Sández (2015), whose most significant outcomes for the current discussion are that the declarative productions of HSS and advanced L2 speakers were similar and their tonal patterns fell between those of monolingual English controls and those of monolingual Spanish controls. Next, Harris et al. (2015) used interview data to look at how Chicano HSS used intonation to convey new information and compared this group's results to those of monolinguals. Their findings confirmed influence from English in the HSS group in the form of using pitch movement, rather than word order, to cue new information. Additionally, Rao (2016) analyzed the nuclear (i.e., final) statement and question intonation of HSS using the elicitation task from De-la-Mota et al. (2010). He reported that, compared to the Mexican results in De-la-Mota et al. (2010), his speakers showed a reduced phonological inventory in statements; however, in questions, they showed a similar degree of variation to that of the Mexican speakers but through a diverse set of tonal targets. Rao concluded that language contact and sources of input were possible explanations for his results. In a study containing methodological diversity, Colantoni et al. (2016) examined the effect of tasks on the statement intonation of HSS and bilingual immigrants who have resided in the United States for several years. The authors' pitch accent analysis yielded significant differences between the two groups in a reading task but not in a narrative task, which led them to conclude that tasks similar to the latter type are more reliable ways of obtaining authentic data. They link their discussion to the educational and social experiences of HSS as well. Lastly, Kim (2018) explored the communication of narrow focus in HSS, L2 learners, and monolingual Spanish speakers. While the L2 learners preferred to express narrow focus via prosody, and the monolinguals did so via syntax, as expected based on typological considerations, the HSS blended these strategies. This suggests that HSS draw on features of both languages when communicating information structure.

3.2. Rhythm

In terms of speech rhythm, previous studies have carried out across-group comparisons involving HSS to search for evidence of syllable-timed (i.e., Spanish-like) or stress-timed (i.e., English-like) tendencies. Robles-Puente (2014) reported that his adult bilinguals who have resided in LA since childhood implemented English tendencies in both languages, while those adults who emigrated later in life demonstrated Spanish patterns in both languages. Interestingly, the group of children/adolescents born in LA made appropriate rhythmic modifications based on the language being spoken. Additionally, Carter and Wolford (2016) researched the Spanish and English rhythm of three generations of individuals of Mexican descent residing in Southern Texas. They found differences across generations; that is, older speakers distinguished the rhythmic properties of the two languages in question, while younger ones exhibited evidence of the two patterns merging. Most recently, Yakel (2018) analyzed rhythmic variation in groups of HSS in the Houston area with varying levels of dominance in Spanish and English. The overall tendency was that more balanced speakers were able to maintain a distinction between their two systems, whereas less balanced individuals displayed stronger-to-weaker language transfer effects.

3.3. Stress/prominence

The last body of literature on suprasegmentals deals with stress, or relative prominence, at both the word and sentence levels. Hoot (2012) presented an analysis of heritage and monolingual speakers' use of presentational focus, which can be realized via rightward syntactic movement of the focused element in Spanish but not English. He first proposed a well-formedness-based OT analysis of presentational focus and then experimentally tested it through a perception task with both speaker groups. Counter to what one would expect, the experiment revealed that both groups preferred leftward stress shift and that their results were similar. At the word level, Kim (2014) examined stress perception in paroxytone-oxytone pairs in HSS of different generations, L2 learners, and a control group. She found that while HSS with two parents born in Mexico displayed results similar to those of the control group (i.e., distinguished the pairs), those with one or two US-born parents perceived stimuli like the L2 learners (i.e., preference for paroxytones). Subsequently, Kim (2015) expanded her heritage versus L2 and monolingual comparisons to include both perception and production of word-level stress in controlled experiments. The results of HSS were comparable to those of the monolinguals in the perception task, but in the production task, their output reflected that of the L2 learners, who often realized paroxytones like oxytones. Finally, Kim (2016) searched for English influence in the perception and production of word- and sentence-level prominence in HSS and L2 learners and compared each group's results to those of monolingual controls. Once again, the HSS perceived stimuli similar to the monolinguals, but their productions entailed different intonational alignment and vowel-lengthening trends than those of the monolinguals. Kim posited that a higher rate of success in perception among HSS was a by-product of a reality in the United States in which the input they receive is much more extensive than the output they generate. Finally, Shelton and Grant (2018) tested the effects of syllable structure in nonce words on the placement of stress by HSS, finding that weight and literacy skills were both important for the interpretation of their results.

4. Evaluation

The collective body of research covered thus far in this chapter allows us to reach some general conclusions regarding the HL phonology of adult HSS in the United States: (i) their phonological systems differ from those of monolinguals, primarily in production; (ii) their systems also differ from those of L2 learners in both perception and production; (iii) there is less evidence of differences between HSS and bilinguals who emigrated later in life; (iv) heterogeneity is mainly due to factors such as generation, task, contact with/influence from English, past and present use of and experience with Spanish, and dominance; and (v) most of these findings have been obtained through acoustic/empirical analyses of production data and controlled stimuli in the case of perception. While scholars have done a commendable job of gaining traction in a field that spent many years undiscovered, plenty of questions remain unanswered/unexplored. In order to address such issues, crucial methodological and analytical advances need to be made. The remainder of this chapter critically evaluates existing research on heritage Spanish phonology and, while doing so, encourages progress in the field along specific avenues that will help answer more overarching questions.

4.1. Data elicitation procedures

When evaluating notions of transfer of English phonology to heritage Spanish in studies conducted in the United States, we must first think about how the data on which claims are based were collected. Studies such as Rao (2015), Colantoni et al. (2016), and Ronquest (2016) all showed that formal, controlled, and somewhat artificial tasks, which do not reflect the ways in which HSS are accustomed to using their HL, yielded distinct patterns compared to more naturalistic speech. The effects of a controlled environment are particularly crucial when considering less proficient HS, who often become more nervous in such settings because they do not use the language much, and because they feel embarrassed about their skills. Furthermore, as Colantoni et al. (2016) very aptly point out, HSS in the United States often live in a (semi-)diglossic environment in which they typically exercise much more literacy in English than in Spanish. This lack of reading in general, on top of potential anxiety related to being research participants, points to naturalistic procedures as the only appropriate method for studying HS, at least from a production standpoint (since there is increased pressure with output).

Within the realm of nonreading tasks, the studies described in this chapter have utilized approaches such as narrations, picture descriptions, and negotiation with maps. While these are more effective than reading scripted words or utterances, problems may still arise when less proficient HS do not know or cannot recall the vocabulary they need to complete these tasks. This leaves us with elicitation through open-ended questions (i.e., sociolinguistic interviews), where the level of complexity of questions can be easily modified and where speakers (and interviewers) have the freedom to guide their output in any way they please, all while speaking in a manner that is most comparable to their use of Spanish in the "real world" (as done in part of Rao 2015; Carter and Wolford 2016; and O'Rourke and Potowski 2016). In sum, for researchers, control over experimental procedures makes targeting phenomena of interest much easier, but we must be sensitive to the background of HS when designing protocols; doing so will produce the most reliable and informative results moving forward.

4.2. Comparative measures

Another noteworthy methodological issue is that if we want to propose English transfer as contributing to the results of studies on HSS, we need to test them doing similar tasks in both languages. Given that we have plenty of evidence that task type plays a role in experimental outcomes, we need to make direct comparisons between English and Spanish data within the same study (as done by Robles-Puente 2014; Carter and Wolford 2016) rather than assume that all adult HSS in the United States adhere to "standard" American English phonology, especially since their reality is not that of a monolingual English speaker (see Konopka and Pierrehumbert 2010; Bayley and Holland 2014 for relevant examples from Mexican Heritage English and Chicano English, respectively). Coupling this with comparisons to monolingual English and Spanish controls who complete the same tasks (as several studies have done) will allow us to more reliably evaluate any sort of transfer effects; that is, comparisons should be drawn between relevant features in the English and Spanish of HSS and between each language and its respective control. If the features under study are similar in both languages of the speakers, and are also more similar to English controls than to Spanish controls, we would then have a more well-grounded argument for transfer.

As we have seen, in order to support claims about variation in the phonology of HSS, many researchers have used monolingual Spanish controls as "baselines" in their experiments. If HSS differ from such baselines, then factors related to their bilingual reality have been used to account for the differences. This raises the following question: why should we compare individuals who have lived a bilingual life in the United States to those who have lived a mostly monolingual life in a country in which Spanish is the societally dominant language (inspired by Pascual y Cabo and Rothman 2012)? Comparing languages in contact in a bilingual context to a language in a monolingual context is, in essence, an "apples-to-oranges" type of scenario that is not the most useful way of furthering the field of heritage Spanish (phonology). If the unique nature of HSS in the United states is that they go through *childhood* in the United States with some degree of exposure to Spanish at home, the most relevant, "apples-to-apples" comparison to make is to bilinguals who live in the United States but emigrated from a Spanish-speaking country as teens or later. Such a comparison of two types of *bilinguals* allows us to hone in on how childhood experiences drive (or do not drive) linguistic outcomes later in life. If monolinguals are used, they should be directly compared only to late immigrants in order to observe the effects of moving from a Spanish-dominant country to one with more English influence. Some of the relatively recent work outlined in this chapter, such as Robles-Puente (2014), Henriksen (2015), Colantoni et al. (2016), Mazzaro et al. (2016), and Solon et al. (in press), has realized these points and thus has the field moving in a fruitful direction.

The lack of differences between the Spanish phonology of late immigrants and that of HSS (e.g., Colantoni et al. 2016; Solon et al. in press) suggests that perhaps the phonological system of some late immigrants diverges from that of monolinguals after residing in a language contact situation in the United States. These late immigrants then have future HSS children whose primary source of Spanish input is their parents' variety, which now differs from that of a monolingual (Pascual y Cabo and Rothman 2012); that is, some features of heritage Spanish phonology could actually be passed to HSS from their parents, and this nonmonolingual source variety may already involve effects of language contact from English. As we have seen, cross-generational work incorporating HSS has begun (e.g., Alvord 2009, 2010; Kim 2014; Henriksen 2015; Carter and Wolford 2016; Mazzaro et al. 2016), but researchers (for obvious reasons related to logistical difficulties) have yet to carry out studies in which participants of all generations come from the same lineage. In order to reach the heart of this matter, researchers need to be challenged to do fieldwork with groups of individuals belonging to different generations *within the same, close-knit family* so as to focus specifically on the source varieties of older generations to which we know younger generations are frequently exposed. Finally, use of and exposure to Spanish can change drastically after a HS moves out of his/her parents'/caretakers' home, meaning that recruiting late immigrants and their high-school-age or younger minors (see Lleó 2018) as participants would be the best way of determining the effects of source varieties on heritage Spanish phonology. Late immigrants and their adult HS children can also be used, but in such instances close care needs to be taken in collecting background information on participants due to a wider range of life/linguistic experiences.

4.3. Incorporation of phonological theory

The discussion to this point has revealed that while we have learned about effects on acoustic and statistical outcomes related to the sound system of HSS, we have almost completely ignored theoretical underpinnings. Moving forward, researchers are urged to include mainstream generative frameworks such as OT in their work as a way of increasing our understanding of the phonological grammars of HSS (see Hoot 2012). Comparisons to other speaker groups would also be quite straightforward in a framework like OT through the reranking of constraints due to changes in input. Studies on intonation have used AM theory and Sp_ToBI (Robles-Puente 2014; Colantoni et al. 2016; Rao 2016), but future work can consider incorporating more recent theoretical insights (Hualde and Prieto 2015, 2016; Mennen 2015). In an effort to spark some ideas for researchers of heritage Spanish phonology, we now consider an analysis of /b, d, g/ from an L2 perspective that implements a more multipronged approach (see Lleó 2018 and references therein for analyses of HSS in Europe grounded in phonological theory).

Cabrelli Amaro (2017) implemented OT and acoustic/statistical analyses as a means of exploring the weakening of /b, d, g/ as a function of levels of the prosodic hierarchy. This insight was suggested in Rao's (2014, 2015) discussion of heritage Spanish /b, d, g/, but has never been explored theoretically with respect to HSS. Beginner speakers in Cabrelli Amaro's data exhibited weakening at the syllable level but not at the word level, whereas intermediate, advanced, and native speakers did so at both of these levels. After explaining the differences between the relevant constraints and rankings in English and Spanish early in the paper, Cabrelli Amaro detailed her acoustic and statistical findings before proposing a final ranking of five relevant constraints that accounted for the differences observed between the beginner group and the other three groups: *APPROXIMANT/V_, IDENT(CONT), IDENT-IO ONSET PW, IDENT-IO ONSET SYLL, and *VOICED STOP/V_. Based on the acoustic findings, the author showed that the top two constraints in both hierarchies are IDENT-IO ONSET PW and *VOICED STOP/V_, but they are reordered in each; the former is higher ranking among beginners, which explains why they weaken in *agua* but not in *buena gafa*, whereas the latter is higher in the other three groups, which is why they weaken in both *agua* and *buena gafa*. In sum, more experience with Spanish leads to a reconfiguration to the second ranking. Overall, Cabrelli Amaro's study is commendable and could be used as an example of how to advance the field of heritage Spanish phonology because it provides clear and in-depth acoustic, statistical, and theoretical analyses while seamlessly unifying each area. One could extend her approach to HSS by using the same constraints and proposing rankings (based on acoustically analyzed data) for different groups of HSS, late immigrants, and monolinguals, among other possible groups. In addition to Cabrelli Amaro's work, it is recommended that researchers of HSS looking for theoretical inspiration consult Bradley's (2014) overview article and the references therein.

5. Conclusion

This chapter provided a panoramic view of the progress that has been made in the field of heritage Spanish phonology in the past two decades. It covered studies on vowels, voiced and voiceless stops, liquids, intonation, speech rhythm, and prominence. The chapter also questioned and critiqued methodological and analytical approaches implemented in studies to date, with the aim of motivating researchers to consider new ways of furthering our knowledge of the linguistic/social factors and theoretical notions that shape heritage Spanish speakers' grammars.

The latter portion of the chapter focused on a specific set of issues that need to be addressed in order to progress the field; however, other cognitive, social, and methodological issues remain relatively untouched with respect to heritage Spanish phonology. Kissling (2018) initiated a discussion of how identity should be more closely linked to heritage phonological outcomes. This would be a useful expansion on variables such as language dominance, proficiency, and use that are linked to existing work. Also, since heritage phonological grammars are dynamic systems, more longitudinal studies would be informative. Rao et al. (2017) seemed to be the first to examine the effects of a classroom setting on the heritage Spanish sound system, doing so through an acoustic and statistical analysis of pre- and postsemester narrative data. This type of longitudinal approach can be extended further in future work (e.g., travel or study abroad). Additionally, even though existing perception research has revealed heritage speakers' high level of ability, more across-group and cross-generational research using different task types and snippets of naturalistic stimuli from a wider variety of dialects (familiar and less familiar) would be beneficial. Finally, our knowledge of heritage Spanish phonology is geographically limited since nearly all research to date has been done in the United States. A glimpse at the chapters in Potowski (2018) tells us that heritage Spanish has a clear presence across the world, particularly in Europe, Australia, and New Zealand. Expanding research to a more global scale and comparing it to what we have accomplished in the United States will inform us of social context–specific factors as well as overarching issues that mold heritage Spanish phonology.

In sum, compared to other subfields of Spanish phonology, heritage studies are in a fledgling state. It is hoped that the descriptions and insights provided in this chapter can contribute to the field's continued evolution.

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Part V

Variation and change in Spanish phonology

21
Spanish phonological variation

John M. Lipski

1. Introduction

The phonetic realization of Spanish varies widely across time, space, and social strata, as documented by many of the chapters in this volume. Phonological variation, however, taken in the sense of a cohesive system of oppositions and patterns, while resulting in significant diachronic restructuring in the history of Spanish, is synchronically more constrained. The following sections survey some of the axes of phonological variation to be found across the Spanish-speaking world, both at the macro level and in some instances in microdialectal patterns, frequently the result of ongoing language contact.

2. Variation in the phonological inventory

The simplest form of Spanish phonological variation involves the phoneme inventories themselves. Nearly all of the variation involves Spanish consonants; only in the case of contact-induced reduction of the vowel space, and arguably also in compensation for coda consonant elision, to be covered in subsequent sections, is the Spanish phonemic vowel inventory affected, although considerable intra- and interdialectal variation occurs at the subphonemic level (e.g. Harmegnies and Poch-Olivé 1992; Willis 2005; Ronquest 2012; Alvord and Rogers 2014; Barajas 2014). With respect to Spanish consonants, the phoneme inventories are distributed regionally, showing little variability within the respective regions, despite the often considerable sociophonetic variation.

2.1. Presence or absence of /θ/

The Spanish voiceless dental/interdental fricative phoneme /θ/ is confined to Peninsular Spain; the distinction between /s/ and /θ/ as in *casa* /kasa/ 'house' and *caza* /kaθa/ 'hunting' is maintained everywhere except in southwestern Andalusia and variably in the area of Valencia, although the geographical range representing this distinction appears to be expanding (e.g. Narbona et al. 1998: 128–138; Ávila 1994; Lasarte Cervantes 2010; Moya Corral and Sosiński 2015; Regan 2017a). Western Andalusia, the Canary Islands, and all of Latin America as well as Sephardic (Judeo) Spanish are characterized by *seseo*, i.e. neutralization in favor of /s/: [ka.sa] can represent either *casa* or *caza*. In some rural regions of western Andalusia, the alternative is *ceceo*, in which all instances of /s/ are realized as [θ], a phonetic innovation stemming from the prior Andalusian neutralization of /s/ and /θ/ (Villena Ponsoda et al. 1995; Melguizo Moreno 2009; Santana Marrero 2016; Regan 2017b; Ruíz Sánchez 2017). In Latin America, realization of /s/ as [θ] is frequent among rural speakers in El Salvador (Canfield 1953, 1960, 1981: 53–54; Parker 2008; Raymond 2012; Quintanilla 2014). Dental or interdental realizations of /s/ can occasionally be heard in other rural regions of Latin America but do not rise to the level of a consistent dialect feature (e.g. Canfield 1981: 11, 1988: 23; Hidalgo 1990; Caravedo 1992; Moreno Fernández 2005).

In the vestigial Spanish spoken in the Philippines, the /s/-/θ/ distinction is variably maintained, given that most (noncreole) Spanish speakers in the Philippines are descendants of Peninsular Spaniards who immigrated during the 19th and early 20th centuries. Most Philippine Spanish speakers are consistent in their use of sibilant consonants, either maintaining or neutralizing the /s/-/θ/ distinction, but there is notable interspeaker variation (Lipski 1987a, 1987b, 1987c; Quilis and Casado-Fresnillo 2008). The Philippine Creole Spanish (Chabacano) varieties, spoken in Cavite and Ternate on Manila Bay and in Zamboanga on the island of Mindanao, have only /s/ for Spanish-derived words (Riego de Dios 1978; Lipski 1986a, 1986b, 1987d, 2001, 2012, 2013), as does the Spanish-lexified creole Palenquero, spoken in the Afro-Colombian village of San Basilio de Palenque (Schwegler 2013; Moñino 2014).

In Equatorial Guinea, the only Spanish-speaking nation in sub-Saharan Africa, the Peninsular Spanish dialects that provided the input during the colonial period were divided between Castile (the colonial administration) and Valencia (the cacao planters), and in contemporary Guinean Spanish maintenance of the /s/-/θ/ distinction varies at the idiolectal level, with some speakers inconsistently maintaining the distinction even when pronouncing the same words (Lipski 1984a, 1985, 1990, 2008, 2014; Quilis and Casado-Fresnillo 1995; Bibang Oyee 2002). The situation is similar in northern Morocco, where Spanish is typically learned informally from Spanish television and radio (Sayahi 2006, 2014); nearly identical results have been reported for Oran, Algeria (Moreno Fernández 1994). In the Western Sahara, despite the presence of the nearby Canary Islands, some older speakers distinguish /s/-/θ/, but neutralization to /s/ is more common (Tarkki 1995: 42–43).

2.2. Presence or absence of /ʎ/

At the time of the first diaspora beyond the Iberian Peninsula, Spanish generally distinguished the palatal lateral phoneme /ʎ/ from the palatal approximant /j/, e.g. *calló* /kaʎo/ 'became quiet' (3s) and *cayó* /kajo/ 'fell' (3s). Loss of the distinction in favor of /j/, known as *yeísmo*, is first attested in Spain in the 16th century, with sporadic earlier attestations (Lapesa 1981: 383–385). The fact that /ʎ/ is absent from Judeo Spanish, which was separated from Spain beginning in 1492, is also indicative of an earlier date (Penny 1991: 93). Currently *yeísmo* is the norm in most of Peninsular Spain; increasingly in the Canary Islands (once characterized by widespread retention of /ʎ/; e.g. Alvar 1978); in the African varieties spoken in Morocco and Equatorial Guinea (Lipski 1995: 34; Quilis and Casado-Fresnillo 1995: 121); for most Philippine Spanish speakers (Lipski 1987a), although the Chabacano (Philippine Creole Spanish) dialects retain reflexes of earlier Spanish /ʎ/ (Lipski 2001); and in most of Latin America. Remaining pockets of /ʎ/-/j/ distinction are found in the interior of Colombia, in the highlands of Ecuador and Peru, in all of Bolivia and Paraguay, and in extreme northeastern Argentina (e.g. Canfield 1962, 1981; Alvar 1996; Lipski 1994a; Moreno Fernández 2009; Bagudanch 2014; Fernández Ordóñez

2016). Some incipient *yeísmo* has been reported for some of these South American dialects (e.g. Callisaya Apaza 2012; Peña Arce 2015; Prado 2017). In most of the /ʎ/-retaining dialects the phonetic realization is a lateral [ʎ], but in central Ecuador centered around Quito /ʎ/ is realized as [ʒ] and /j/ as [j] (Argüello 1980; Gómez 2013); speakers of nondistinguishing dialects in which both /j/ and /ʎ/ are realized as [ʒ] (e.g. much of Argentina and Uruguay) may fail to perceive this distinction in these Ecuadoran subdialects.

In northeastern Argentina, /ʎ/ is normally maintained as a separate phoneme, and /j/ has not traditionally been realized as [ʒ] (or [ʃ]), as in Buenos Aires, but the alveolar "trill" rhotic /r/ is frequently pronounced as [ʒ]. With the nationwide spread of the /j/ = [ʒ] pronunciation, reinforced by internal migration and ever-present in mass media, the possibility of phonological mergers between /j/ and /r/ emerges, especially in areas where the /ʎ/-/j/ distinction is being lost, e.g. *rubia* /rubia/ 'blonde (f.)' vs. *lluvia* /jubia/ 'rain.' In fact, what is occurring is a "push-chain" reaction moving realizations of /r/ away from [ʒ] and toward a more rhotic-like articulation (e.g. Colantoni 2001, 2005, 2006a, 2006b). A similar potential merger situation is also present in the central highlands of Ecuador, although Argüello (1980) describes subtle differences between the realizations of /j/ and /r/. In Argentina the province of Santiago del Estero has also maintained a [j]-[ʒ] distinction (Canfield 1962: 70, 1981: 25; Granda 1992) as well as a groove fricative realization of /r/, although this phonologically archaic dialect zone is being overrun by more urban varieties.

2.3. Presence or absence of /v/ as an independent phoneme

Spanish merged the two voiced labial phonemes /b/ (written "b") and /β/ (written "v") around the middle of the 16th century (Lapesa 1981: 373; Lloyd 1987: 327; Penny 1991: 85–86), and despite some overzealous teachers' insistence, it has generally been assumed that no natively spoken varieties of Spanish distinguish *"v" de "vaca"* and *"b" de "burro."* Approximant allophones of /b/ do include labiodental [v] in some varieties, e.g. in Chile (Sadowsky 2010, 2015), Paraguay (Cassano 1972; Malmberg 1961; Tessen 1974; Granda 1982; Kallfell 2009), and some parts of Mexico and the southwestern United States (Lope Blanch 1988; Torres Cacoullos and Ferreira 2000), but /v/ does not have independent phonological status. In border areas in contact with Portuguese or Catalan, there is some evidence that the /b/-/v/ distinction may be creeping into local Spanish varieties, although never with the consistency found in Catalan, Portuguese, or old Spanish (e.g. Elizaincín and Behares 1980: 413; Elizaincín and Barrios 1989; Blas Arroyo 1993, 2008; Serrano Vázquez 1997; Arias 2012). Contact with English in the United States has also been implicated in the presence of [v] allophones in Spanish, and of at least partial /b/-/v/ distinction (e.g. Philipps 1972; Stevens 2000).

3. Possible emergent phonological distinctions

Contemporary Spanish exhibits a few variable phenomena that suggest emergent phonological innovations, which may or may not reach completion depending on a variety of sociolinguistic factors. Some of the more prominent cases are briefly mentioned here.

3.1. Voicing of intervocalic voiceless stops

In many varieties of Spanish, in Spain and Latin America, there is an increasing tendency for intervocalic /p/, /t/, and /k/ to be at least partially voiced (Torreblanca 1976; Trujillo 1980; Lewis 2001; Celdrán 2009; O'Neill 2010). If carried to its logical conclusion, this process could reduce the oppositions /p/-/b/, /t/-/d/, and /k/-/g/ to the feature [±continuant], with the feature [voice] becoming redundant.

3.2. Virtual emergence of intervocalic voiced stops due to (de)gemination

Along the Caribbean coast of Colombia, and occasionally in the Dominican Republic and parts of Cuba (Guitart 1978, 1994, 1997; Costa Sánchez 1984; Harris 1985; Carlson 2011; Santana Cepero 2006), coda liquids followed by voiced obstruents become voiced geminate stops: *algo* [ag.go] 'something,' *verde* [bed.de] 'green' (e.g. Nieves Oviedo 2002; Morton 2005: 209). In rapid speech the geminate simplifies to a single voiced intervocalic stop, potentially creating a new [±continuant] opposition among [+voice] consonants, e.g. *hago* [a.ɣo] 'I do' vs. *algo* [a.go] 'something' (e.g. Barrutia and Schwegler 1994: 243).

Intervocalic voiced stops can also emerge when coda /s/ is weakened to the point of elision, e.g. in Las Palmas de Gran Canaria (Almeida 1982; Lipski 1994b), Honduras (Amastae 1989), and possibly other regions (cf. also Carrasco 2008; Carrasco et al. 2012). This results in virtual minimal pairs such as *la vaca* [la.βa.ka] 'the cow' vs. *las vacas* [la.ba.ka(h)] 'the cows.'

3.3. Glottal stops as virtual word boundaries

The behavior of Spanish coda /s/—strongly sibilant in some dialects, aspirated or deleted in others—is particularly variable in word-final prevocalic position, e.g. *má**s** adelante* 'further along,' *lo**s** otros* 'the others.' Even in dialects where coda /s/ is routinely aspirated or elided, it is more resistant to weakening in word-final position when followed in connected speech by a word-initial tonic vowel, e.g. *las once* 'eleven o'clock' (Lipski 1984b, 1995). In most varieties the resistance to effacement in this environment results in retention of sibilant [s], but in a few varieties /s/ is elided and a glottal stop [ʔ] effectively marks the word boundary: [la.ʔon.se]. This glottalization occurs in Paraguay and neighboring areas of Argentina, possibly through the influence of Guaraní (Granda 1982: 146; Thon 1989; Kallfell 2009; Cerno and Radtke 2013). In these varieties glottalization of word-final /s/ is part of a more general phenomenon of hiatus-breaking by the insertion of glottal stops (e.g. Cassano 1973). More recently, the replacement of word-final /s/ by [ʔ] before word-initial tonic vowels has emerged in the Spanish of Nicaragua (Quesada Pacheco 1996: 104; Rosales Solís 2010; Chappell 2013, 2014, 2015) and Puerto Rico (Valentín-Márquez 2006; Tellado González 2007). In these dialects [ʔ] does not occur in other hiatus-breaking contexts and is in effect a phonological signaling of the word boundary rather than the more usual Spanish resyllabification of word-final prevocalic consonants. It has been argued that word-final /s/ before word-initial unstressed vowels maintains an ambisyllabic configuration (Lipski 1999), which may account for the low frequency of glottalization of word-final /s/ before atonic vowels. Replacement of elided word-final /s/ by [ʔ] has occasionally been mentioned for Andalusia (Rodríguez Castellano and Palacio 1948: 592; Uruburu Bidaurrázaga 1990: 17), but it is not a common occurrence.

3.4. Eastern Andalusian vowel laxing

In much of central and eastern Andalusia, in the south of Spain, the normally lax ([−ATR]) realization of vowels in closed syllables is retained when word-final /s/, /l/, or /ɾ/ is lost, e.g. *favor* [fa.βɔ] 'favor,' *papel* [pa.pɛ] 'paper,' *antes* [an̪.tɛ] 'before.' The retention of a laxed vowel in word-final position in effect creates minimal pairs such as *dice* [di.θe] 'say (3s)' vs. *dices* [di-θɛ] 'say (2s),' *perro* [pe-ro] 'dog' vs. *perros* [pe-rɔ] 'dogs.' Final vowel laxing variably includes vowel harmony, typically affecting vowels up to and including the stressed vowel (sometimes exempting /i/ and /u/) and even up to pretonic vowels and preceding clitics: *perros* [pɛ-rɔ], *me lo dices* [mɛ.lɔ.ðí.θɛ] 'you tell it to me' (Zubizarreta 1979; Manaster-Ramer 1989; Sanders 1994; Corbin 2006). There also is some evidence of compensatory phonemicized vowel laxing in Extremadura (e.g. Salvador Plans 1987: 26), as well as in neighboring dialects of Murcia and Alicante (e.g. Torreblanca Espinosa 1976, ch. 8; Sempere Martínez 1995: 26).

Hualde and Sanders (1995) suggest that an independent vowel contrast already existed, namely raising of final atonic /e/ and /o/. Early studies of this vowel laxing focused on the possible creation of between three and five new vowel phonemes in these Spanish dialects (Navarro Tomás 1939; Alonso et al. 1950; Alarcos Llorach 1958, 1983; Llorente Maldonado 1962; Mondéjar 1970, ch. 3; Contreras Jurado 1975–1976; Salvador 1977; Cerdà Massó 1984; López Morales 1984; Martínez Melgar 1986, 1994). More recent analyses examine the phonetic details (e.g. Sanders 1994) and the perceptual value of vowel laxing (García Marcos 1987; Sanders 1994, 1998; Carlson 2012; Herrero de Haro 2016). These studies show that rather than facing the conundrum of extra vowel phonemes, eastern Andalusian vowel laxing and harmony are best regarded as a manifestation of the phonology-morphology interface.

3.5. (Post)aspirated and affricated stops in Andalusian Spanish

In Andalusian Spanish, preconsonantal coda /s/ is normally aspirated (in effect a voiceless continuation of the preceding vowel; Hualde 1989) or deleted. For many speakers, gestural realignment of the aspiration (open glottis) before voiceless stops has resulted in a series of aspirated stops, e.g. /este/ [e.t^he] 'this,' *casco* [ka.k^ho] 'helmet' (Gerfen 2002; Torreira 2006, 2007, 2012; Bishop 2007; Parrell 2012; Ruch and Harrington 2014; Vida Castro 2016). When carried out consistently, this process results in virtual minimal pairs such as *pata* [pa.ta] 'paw' vs. *pasta* [pa.t^ha] 'pasta,' *gato* [ga.to] 'cat' vs. *gasto* [ga.t^ho] 'expense,' etc. Although essentially the result of momentary gestural mistiming, postaspiration is becoming increasingly prevalent in Andalusia and may lead to eventual phonological innovations.

As an alternative evolution of /-st-/ clusters in Andalusian Spanish, an affricated dental consonant [t^s] sometimes occurs (Moya Corral 2007; Ruch 2012, 2013; Villena Ponsoda and Vida 2017). If carried to completion, this change-in-progress could also lead to a new affricate phoneme in the dialects in which it occurs. There is also some potential overlap with the increasingly fronted realizations of the affricate /ʧ/ (e.g. Del Saz 2016), which for many speakers in Spain approaches [t^s].

3.6. Compensatory vowel lengthening: phonologically distinctive long vowels?

In much of southern Spain, deletion of preconsonantal coda /s/ is often accompanied by compensatory lengthening of the preceding vowel (e.g. Alarcos Llorach 1958; Hualde 1989; Uruburu Bidaurrázaga 1990: 45; Romero 1995; Gerfen 2002; Carlson 2012). Similar lengthening occurs, although less consistently, in some consonant-weak Caribbean dialects (e.g. Alemán 1977; Figueroa 2000; Luna 2010). As with postaspirated stops, compensatory vowel lengthening in principle opens the possibility for the phonologizing of vowel length, e.g. *pata* [pa.ta] 'paw' vs. *pasta* [pa:ta] 'pasta,' *gato* [ga.to] 'cat' vs. *gasto* [ga:to] 'expense.' As with postaspirated stops, these forms alternate with audibly aspirated coda /s/, so that complete phonological restructuring will probably not occur.

4. Ongoing partial phonological neutralizations

In addition to the previously mentioned emergent phonological phenomena, there are areas of the Spanish-speaking world in which certain phonological oppositions are partially neutralizing.

4.1. Neutralization of /ɾ/ and /r/

Most L1 varieties of Spanish maintain the distinction between the two rhotics /ɾ/ and /r/, at least in carefully monitored speech, but not always as tap vs. trill (e.g. Hammond 1999, 2000). Illustrative studies of individual dialects are found in Willis (2006, 2007), Willis and Bradley (2008), Waltermire and Valtiérrez (2013), and Henriksen (2015), among others. In Judeo Spanish varieties the two rhotics are generally neutralized in favor of /ɾ/ (Bradley and Delforge 2006; Quintana 2006). In Equatorial Guinea the /ɾ/-/r/ distinction is only tenuously maintained by most speakers, sometimes with hypercorrect [r] in place of /ɾ/ (Lipski 1985: 46, forthcoming; Quilis and Casado-Fresnillo 1995: 113–118). In vestigial Philippine Spanish the /ɾ/-/r/ distinction is maintained by some speakers, but most exhibit at least partial neutralization in favor of [ɾ] (Lipski 1987a: 41–42).

4.2. Partial neutralization of intervocalic /d/ and /ɾ/

In some Spanish varieties spoken in predominantly Afro-descendent communities, prevocalic /d/ is not realized as an approximant [ð] but rather as a short occlusive that is often alveolar and approaches [ɾ]. The /d/ > [ɾ] shift has been documented for northwestern Colombia (Montes Giraldo 1974: 413–418; Granda 1977: 37–39; Correa 2012), San Basilio de Palenque, Colombia (Morton 2005: 199, 204–207), coastal Ecuador (Ramírez de Morón 1975: 51), coastal Peru (Cuba 1996: 32–33), Venezuela (Megenney 1999: 77–78), and the Dominican Republic (Núñez Cedeño 1987; Megenney 1990: 109–110). In several Afro-Hispanic dialects (e.g. in Colombia, Venezuela, and among the *Congos* of Panama), the opposite shift of prevocalic /ɾ/ > [d] also occurs (e.g. Granda 1977: 37–39; Mosonyi et al. 1983; analyzed in Lipski 1989, 2007, 2011; Megenney 1999: 77; Correa 2012). These realizations of /d/ contribute to a possible merger with /ɾ/; in fact, Montes Giraldo (1974: 414–415) asserted that in the Chocó region of Colombia, [ɾ] is taking over the traditionally approximant [ð] realizations of /d/, effectively merging /d/ and /ɾ/, with the occlusive allophone [d] appearing phrase-initially and in syllable-initial postconsonantal positions and [ɾ] occurring elsewhere (i.e. in prevocalic and coda positions). Currently these ethnolinguistic varieties are receding, so chances of a permanent merger are slim. In Equatorial Guinea the uniformly occlusive and alveolar realization of prevocalic /d/ often results in [ɾ], which together with the unstable opposition of /ɾ/-/r/ also embodies the potential for an eventual merger. Acoustic analysis by Lipski (forthcoming) reveals that there is indeed overlap between clusters of /d/ tokens and /ɾ/-/r/ tokens, but in general subtle durational differences continue to separate the phonological representations. Finally, partial neutralization of (especially atonic) mid and high vowels has been reported for heritage varieties of US Spanish (e.g. Ronquest 2012, 2013), perhaps an extension of the widespread raising of final atonic /e/ and /o/, found, e.g., in Puerto Rico, New Mexico, and other varieties.

4.3. Partial neutralization of /i/-/e/ and /u/-/o/

Most monolingual varieties of Spanish maintain the five-vowel system with little or no phonetic modifications. In much of the Andean region, however, since earliest colonial times Spanish has been in contact with Quechua and Aymara, languages with only three vowel phonemes: /a/, a front unrounded vowel /ɪ/, and a back rounded vowel /ʊ/. In regions where the Quechua dialects have the uvular phoneme /q/, the nonlow vowels exhibit mid allophones [e] and [o], respectively, when following [q], hence *quechua* [qe.ʧwa]; in most other contexts, tokens of /ɪ/ are closer to [i] and tokens of /ʊ/ cluster around [u] (Pérez Silva et al. 2008; O'Rourke 2010). In Ecuador, where the local Quechua dialects (known in Ecuador as Quichua) have no uvular consonants, lower-mid allophones occur only sporadically (Guion 2003; Lipski 2015). Experimental work conducted among Quechua-Spanish bilinguals in Peru (principally Cuzco and Ayacucho) and Ecuador (Imbabura province) reveals that more Quechua-dominant speakers are effectively reducing the Spanish five-vowel system to only a three-way distinction, with tokens of /i/ and /e/ as well as /u/ and /o/ significantly overlapping in exemplar clouds that preclude robustly maintaining the mid-high distinction (Cerrón-Palomino 1975, 1989: 153–154; Zavala 1999: 41; Guion 2003; Pérez Silva et al. 2008; Pérez Silva and Zavala Cisneros 2010; Napurí Espejo 2011; Lipski 2015; Sabo 2014). The failure to consistently distinguish the production of Spanish mid and high vowels is the source of continued criticism and sociolinguistic discrimination in the Andean speech communities. A similar reduction in the Spanish vowel inventory is potentially possible in northern Morocco, since Moroccan Arabic contains only the vowel phonemes /i/, /a/, and /u/, although knowledge of French, with its rich vowel inventory, acts as a counterbalancing force (Sayahi 2006).

5. Conclusion

Most of the Spanish phonological system has remained stable and unchanged for at least two centuries, with only subphonemic regional and social variation. At the same time, a number of ongoing processes point toward emerging phonological distinctions as well as the further erosion of existing phonological oppositions. Some of the phenomena surveyed in the present chapter reflect language contact and may not coalesce among fluent Spanish speakers, while other traits are found in monolingual speech communities and warrant further scrutiny as harbingers of a potential Spanish yet to come. The overview given here is far from exhaustive and exemplifies the need for continuous observation of microdialectal variation, which embodies the possibility for permanent changes to Spanish phonological structures.

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22
Sociolinguistic variation

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1. What is phonetic and phonological variation?

This chapter offers an introduction to the study of phonetic variation in the diverse and multi-dialectal Spanish-speaking world. No matter what our native language is, we have probably noticed some differences in pronunciation that correspond to diatopic (i.e. regional), diastratic (i.e. social), or diaphasic (i.e. stylistic or individual) factors. For example, in some regions in the south of Spain, an interdental or postdental voiceless fricative [θ] may alternate with the dorso-dental voiceless fricative [s]: *caza* 'hunts-3sg' can be produced as [kaθa] or [kasa]. This can be said mostly about eastern Andalusia (e.g. Málaga and Granada), which is traditionally characterized by the use of *seseo*. However, these regions show an alternating pattern nowadays, favoring the distinction between [θ] and [s] with features related to southern Peninsular varieties (Villena Ponsoda and Ávila Muñoz 2012). Not only is *seseo* diminishing, but traditional areas where *ceceo* used to be predominant, such as Huelva, are now adapting to the distinction under the influence of the variety of Spanish spoken in central and northern Spain (Regan 2017). In other cases, a community may develop differences in pronunciation that reflect its social stratification. For example, the variable production or omission of syllable-final /ɾ/ shows social stratification in the Spanish of Caracas, Venezuela, and of Alcalá de Guadaíra in Andalusia (Díaz-Campos and Ruiz-Sánchez 2008). Much literature on the topic uses the terms *phonological variation* and *sociophonological variation* as synonyms for *phonetic* and *sociophonetic variation*. Generally, phonetics is the study of the sounds of a language, while phonology looks at sounds as functional elements of an interconnected system. However, without going into much detail about the differences that derive from the use of one term over the other as applied to variation, it is possible to associate a certain type of theoretical framework with the use of each one. In both cases, the reference is to pronunciation phenomena that show linguistic or sociolinguistic conditioning. Specifically, the term *sociophonological variation* emphasizes the implications that a phenomenon could have for the sound system of a language; in the case in question here, the consequences of variation for the Spanish sound system: that is, the loss of a contrast as a result of a reduction of the phonological inventory or the introduction of a new element into the system. The term *phonetic variation* emphasizes changes that happen in pronunciation, such as sound alternations. Some of the basic linguistic processes operating in Spanish include lenition or weakening, articulatory strengthening, syllabic coda weakening, syllabic restructuring, and neutralization, as well as a series of vocalization and consonantization processes, among others. It is obvious that these divisions are rarely independent, given that phonetic variation has implications of a phonological nature and, in some cases, implications for the grammatical level that can only be distinguished methodologically. This is why phonological variation often leads to language change. One of several exemplary cases discussed in this chapter is the aspiration and elision of syllable-final /s/, as the variable use of /s/ has grammatical implications (see the work of Cedergren 1973; and Poplack 1980, among many others). We will first introduce the basic notion of a sociolinguistic variable with illustrative examples from different varieties of Spanish, all featuring diatopic, diastratic, and diaphasic levels of variation. The second half of the chapter offers an overview and illustration of typical forces behind sociophonological variation in Spanish (phonetic/phonological, grammatical, and sociolinguistic conditioning factors), specifically from the quantitative variationist perspective.

2. Sociophonological variables

Quantitative sociolinguistics employs the concept of the **(socio)linguistic variable** in order to study phenomena that show alternations, defined as two or more ways of saying the same thing. In other words, it is a study of linguistic, social, and stylistic factors that condition variation in the production of the same linguistic unit (e.g. production of syllable-final /ɾ/ as [ɾ], [l], [j], or Ø). In this way, a sociolinguistic variable is conceived of as a unit that is correlated with linguistic, sociolinguistic, and stylistic factors. Díaz-Campos (2014) highlights the characteristics that Labov (1972) signals to be indispensable attributes of a sociolinguistic variable as defined by the first wave of variationist studies (a macro-methodological approach to the study of sociolinguistic variation). First, a variable suitable for analysis must be frequent in the speech of the studied community. Its common usage allows for a solid quantitative analysis, necessary for making generalizations. Second, Labov (1972) stresses that variables with structural implications are more interesting because we can observe patterns that affect the phonological or the grammatical system of the language we are studying. The last characteristic of a sociolinguistic variable is the fact that it must obviously have some level of stratification within the groups that make up the community. This type of conditioning, ever since the first wave of variationist research, intends to reflect the symbolic value that the variants possess and the perceptions that speakers associate with such productions. In terms of the social meaning of such variables, the studies of social networks in the second wave of variationist studies are specifically concerned with the local factors at play in any given community, and the third wave, a micro-methodological approach proposed by Eckert (2012), maintains that stylistic markers are often used iconically not only to reflect the social reality of a community of practice but also to actively reinforce it. Finally, it can be said that this last wave approximates the cognitive sociolinguistics perspective that conceptualizes variables as phenomena that can be explained by taking into account cognitive factors related to a speaker's perception (cf. Caravedo 1990).

Starting with the Labovian tradition, the first Spanish sociophonetic studies focused on such variables as the Venezuelan syllable-final liquids (D'Introno et al. 1979), Panamanian syllable-final weakening phenomena (Cedergren 1973; Cedergren et al. 1986), Argentinean *zheismo* (Fontanella de Weinberg 1989), Costa Rican final vowel raising (Rojas 1986), and various European Spanish phenomena such as coda /s/ weakening in the Canary Islands (Samper Padilla 1987) and others as reviewed by Moya Corral (1979), among many others. What follows is a closer look at three contemporary sociophonological variables, namely lateralization, elision, and gliding of liquid consonants to illustrate diatopic, diastratic, and diaphasic types of variation.

The case of syllable-final /ɾ/ is an excellent example of a sociophonological variable. Syllable-final /ɾ/ is produced variably in Caribbean varieties of Spanish (i.e. in Cuba, Puerto Rico, the Dominican Republic, Venezuela, Panama, and the Colombian coast) as well as in southern Spain. The varied productions that have been identified reflect the general tendency toward coda weakening and differ by region (i.e. diatopic variation). For instance, among the possible pronunciations of the word *cantar* 'sing-inf,' are the following variants:

- a lateral variant [l] [kan̪tal]
- elision or complete sound deletion [kan̪ta]
- liquid gliding [kan̪taj]

Medina Rivera (2011), for example, reports on the linguistic, stylistic, and sociolinguistic factors conditioning **lateralization** of syllable-final /ɾ/ in the Spanish of Caguas, Puerto Rico. For the purpose of quantifying this variation and determining its statistical significance, the statistical measure of factor weights indicates favoring tendencies above the .5 level, and stronger predictors are accompanied by wider ranges between the lowest and the highest weights of their corresponding variants. Linguistically, the lateral variant appears favored in contexts without morphemic status with a weight of .52 (e.g. *<u>mar</u>* 'sea' as opposed to *habl-a-<u>r</u>* 'speak-inf'), a stressed syllable with a weight of .57 (e.g. *<u>par</u>que* 'park' as opposed to *por<u>tón</u>* 'gate'), and the highly frequent word *porque* 'because' (weight = .57), which exemplifies both of the preceding contexts. Socially or diastratically, lateralization is favored among speakers who are familiar with the interviewer (.58) and those who have a college education (.57). Finally, the type of discourse and type of situation are examined as stylistic or diaphasic dimensions, with the contexts favoring lateralization being dialogue (.59) and narrative (.58) genres, as well as group conversation (.66) and interview (.54) situations. According to Medina Rivera (2011), the ranges of variation suggest that the stylistic dimension (range = 50) plays the greatest role in the variable production of syllable-final /ɾ/. Linguistic and social dimensions follow as the second-best predictors of lateralization, each with a range of 19. These results indicate that lateralization in Puerto Rico may be viewed as an in-group marker of solidarity in less formal interactional contexts.

Díaz-Campos and Ruiz-Sánchez (2008) present a comparative study on the Spanish of Caracas, Venezuela, and that of Alcalá de Guadaíra, Andalucía, that reveals the following tendencies: sonorants, vowels, and pauses in the following context are reported to favor *elision* in both dialectal varieties. The authors find that, in both dialects, elision is very common in infinitives, which is the most frequent category. No difference is reported between Alcalá de Guadaíra and Caracas with respect to instances of the following clitic (e.g. *comerlo* 'to eat it' vs. *comer* 'eat-inf'), given that elision is frequent in the infinitives regardless of this differentiation. The lexical frequency of words with syllable-final /ɾ/ emerges as relevant to the explanation of the cases that favor elision. Specifically, more frequent words show greater levels of omission, consistent with what is known as lexical diffusion. Regarding the social distribution of the phenomenon, most speakers from Alcalá de Guadaíra favor elision, except for older women (over 56 years old) and middle-aged men (35–55 years old). Based on the evidence that young people employ this local trait, it can be argued that this phenomenon is advancing in the community. In contrast, the Caracas data show that elision is favored by speakers 61 years of age and older. This profile indicates that this phenomenon has stabilized in Caracas. This is a clear example of how sociophonological variation affects language change.

Liquid gliding of syllable-final /ɾ/ (e.g. [komej] vs. [komeɾ] *comer* 'eat-inf') in the Dominican Republic has been documented by several researchers since the 1970s (Golibart 1976; Guitart 1981; Harris 1983; Alba 1988; Bullock and Toribio 2009). Golibart (1976) has proposed that, historically, this phenomenon may have been brought to the Caribbean colonies from the Canary Islands, where it was typical of sailors and fishermen. Although this is not without contestation (de Granda 1991), that diastratic association was reflected in the language of peasant characters in theatrical works of the 1800s (Golibart 1976). Interestingly, at the end of the 20th century, Alba (1988) continued to observe liquid gliding in older speakers and within the lower social class, which suggests its status as a *linguistic stereotype* with a negative social value in Santiago, Dominican Republic. Two decades later, Bullock and Toribio (2009) still found a constant presence of liquid gliding among rural Cibao speakers and, most particularly, among children. These authors explained that vernacular variants such as liquid gliding are generally predicted by social factors such as region, social class, education, register, etc. Variable pronunciation of syllable-final liquids is often manifested in a range of hypercorrected pronunciations of words such as *aceite* 'oil': [aselte] or [aseɾte]. Bullock and Toribio (2009: 61) argued that some of the productions "have a relatively free distribution in some words," but they also point out that, in other cases, there are lexical and phonological restrictions predicting possible variants. Further research should examine the linguistic and sociolinguistic factors conditioning this variation.

These previous studies constitute solid examples that demonstrate the variable nature of speech. Variation predominates when speech is analyzed in its vernacular expression in oral situations. It is important to highlight that the exemplified phenomena are in line with the underlying propensity toward coda weakening in Spanish and prove to be consistently conditioned not only by linguistic factors but also by social factors, including age, socioeconomic level, gender, ethnicity, and style, as well as other variables that can be used in characterizing social groups within their communities.

3. How is sociophonological variation studied?

The fundamental objective of quantitative sociolinguistics is the study of oral language in everyday situations for the sake of establishing generalizations about variation and linguistic changes due to internal and external conditioning factors. For this reason, collection of oral samples using methods such as sociolinguistic interviews is fundamental. Once the interviews are completed, one identifies the variable that one desires to study and observes the contexts in which it occurs in order to form a hypothesis about the factors that condition the occurrence of the variants under study. Variationist methodology ensures the empirical testing of the hypotheses that are incorporated as independent variables in the analysis. Each independent variable assumes a certain kind of hypothesis that helps to explain the studied phenomenon. This section specifically illustrates phonetic-phonological, grammatical, and social factors identified by previous studies as major influences on sociophonological variation.

3.1. Phonetic-phonological conditioning

Multiple studies have continuously pointed to the pressures exerted by usage, coarticulation, and system-internal factors such as syllabic structure and distributional frequency effects on phonetic and phonological variation. What follows is a sample of studies that illustrate each of these conditioning factors.

Consider the research that has been done on the effect *usage* has on segments and structures in production and in perception and on how such units are stored in our memory (e.g. Bybee 2001, 2010). The evidence presented suggests that frequent units tend to suffer reduction processes due to automatization that affects their production and, gradually, their mental representation. Words that are used more frequently and that are part of highly predictable chunks favor processes of phonetic reduction, given that they are easily accessible from a cognitive point of view. One way of capturing this observation is a quantitative analysis that consists of defining an independent variable that measures the frequency of the contexts or lexical units where the phenomenon in question appears. Alba (2006) analyzes hiatus resolution and maintenance at the a#V word boundary in conversational New Mexico Spanish and shows multiple frequency effects, including the token frequency of two-word strings as well as the relative frequency of vowel sequences and stress. String frequency (e.g. verb+preposition, article+noun, etc.) was operationalized in binary terms as high and low, based on a total of 2,778,332 words from two combined corpora: the *Corpus Oral de Referencia de la Lengua Española Contemporánea* (Marcos Marín 1992) and the interviews collected from nine cities across Latin America and Spain through the *Macrocorpus de la Norma Lingüística Culta de las Principales Ciudades de España y América* (Lope Blanch 1967; Samper Padilla et al. 1998). These corpora were used to establish token frequencies for different string types and served to classify the 1,912 tokens of the word-boundary hiatus collected in New Mexico by Alba (2006). The New Mexico strings were organized in order from highest to lowest frequency and split at the 70%–30% point with the topmost tokens considered high frequency and the bottom 70% classified as low frequency. The results reveal that high-frequency sequences favor hiatus resolution, a type of syllabic restructuring, significantly more (504/589, 86%, factor weight = .59) than the low-frequency strings (920/1323, 70%, factor weight = .46). Besides this direct measure of frequency, the variable rule analysis of multiple conditioning factors reveals that hiatus resolution is additionally favored by following low and mid vowels (more frequent than high vowels) and unstressed syllables (more frequent than stressed syllables). These factors show the greatest magnitude of effect (ranges = 31 and 30, respectively). String class (±constituent) and priming are also contributing factors (ranges = 13 and 12, respectively), while syllable type and a series of other variables are not significant. These results expose the effect of usage on the advancement of variation in vocalic sequences in high-frequency phonetic and syntactic environments before the variation is extended to other less frequent contexts.

File-Muriel (2007) includes an analysis of frequency with regard to the elision of syllable-final /s/ in oral speech in Cali, Colombia. In his analysis, File-Muriel defines frequency in terms of the numbers reported in the *Corpus of Reference of Modern Spanish* (CREA), hosted by the Real Academia Española. For the purposes of quantitative analysis, File-Muriel establishes a classification that considers two types of lexical units: high-frequency and low-frequency units. Those items that appear 100 times or more are taken as high-frequency and those appearing less than 99 times are classified as low-frequency. The variable rule analysis presented by File-Muriel (2007) shows that frequency is the factor with the greatest degree of magnitude, above any other linguistic factor. Aspiration and elision of syllable-final /s/ are highly favored in frequent items, with a weight of .65, but disfavored in words of low frequency, with a weight of .34.

Both Alba (2006) and File-Muriel (2007) empirically demonstrate the effect that *lexical* frequency has on processes of variation and phonetic and phonological change. These studies provide evidence that supports the model of usage-based phonology (Bybee 2001, 2010), according to which phonetic change usually progresses faster in items of higher frequency (i.e. lexical diffusion).

It is common practice in research on phonological variation to study the environment in which the analyzed segment is produced. The assumption underlying this practice is the presence of coarticulation processes driven by common production and perception processes. From the point of view of phonetic research, it is important to mention the hyperarticulation and hypoarticulation theory (Lindblom 1990), which takes into account the tension that exists between the economy of effort in production and the need for perceptual distinction. According to Lindblom (1990), the systematic nature of intraspeaker phonetic variation reflects more general evolutionary and selection processes, whereby listeners must adapt to the variability in the signal to achieve sufficient discriminability, and speakers must adapt their output along a continuum of hyper- and hypospeech. This dynamic adaptability is explained in terms of simultaneous physiological and cognitive constraints on production and social and communicative constraints on perception. This theory is likely to be instrumental for the study of the forces motivating sociophonological changes, giving rise to various weakening and strengthening phenomena (see Lindblom 1990 for more detail). Among the studies that adopt Lindblom's theory are those of Sessarego (2012a, 2012b).

Delforge (2010) presents findings that can be interpreted as a product of coarticulation effects in her study of vowel devoicing in Andean Spanish. The results of her investigation indicate that the process of devoicing is more common when the phonetic environment contains an /s/, where /s/ is characterized as a voiceless alveolar fricative. This effect is even greater when the vowel forms part of an unstressed syllable and when the /s/ is the syllabic coda. Consequently, consideration of the phonetic environment allows us to explain phenomena of linguistic variation and change when they are motivated by coarticulation forces.

Not all variation phenomena at this level are conditioned by factors of a phonetic nature. The sound structure of Spanish (or any other language of interest) can explain some variation processes observed across the Spanish-speaking world. Brown (2006) and Bongiovanni (2016) constitute an example of how the phonotactic structure of Spanish is used to explain the case of consonant backing. Pronouncing the word *Pepsi* as [peksi] instead of [peβsi] or [pepsi] (emphatically) is considered to be a case of backing, or velarization, since the underlying labial segment [β] is produced as the velar [k]. Brown (2006) proposes that speakers of the varieties where this phenomenon occurs use their knowledge of Spanish syllabic structures and the lexicon, in which the sequence [. . . C_{velar}\$C. . .] is much more common than the sequence [. . . C_{labial}\$C. . .]. In other words, the velar consonant [k] is much more frequent in that position than consonants such as [p, b] and [t, d]. Some representative examples of the sequence [. . . C_{velar}\$C. . .] include words like *acción* 'action,' *acto* 'act,' *actualidad* 'actuality,' etc. Table 22.1 summarizes Brown's (2006) results.

Table 22.1 reports the type and token frequencies of labial and velar consonants. Brown's (2006) data reveal that there are 87,462 tokens of -kC- in the analyzed sample; this more frequent and more productive phonotactic pattern in Spanish is then imposed by analogy in other contexts.

Table 22.1 Type and token frequency of labial and velar consonants in the syllable coda

	Labial		*Velar*	
	-bC-	*-pC-*	*-gC-*	*-kC-*
Token frequency	5,895 (5.6%)	7,335 (7.0%)	4,537 (4.3%)	87,462 (83.1%)
Total: 105,229	**13,230 (12.6%)**		**91,999 (87.4%)**	
Type frequency	112 (9.0%)	148 (11.9%)	112 (9.0%)	875 (70.2%)
Total: 1,247	**260 (20.9%)**		**987 (79.1%)**	

Source: Adapted from Brown (2006).

Bongiovanni (2016) extends this study of variation to preconsonantal dental stops by showing an additional effect of the following consonant. Based on a stratified sample of sociolinguistic interviews from Mérida, Venezuela, the higher frequency of velars (n = 1,700 out of 2,002 instances of syllable-final stops) over labials (228 out of 2,002) is confirmed and compared to an even lower frequency of dentals in a preconsonantal context (74 out of 2,002). Most important, however, both velars and labials share a distributional preference for following /t/ and /s/ consonants, whereas dental stops are more commonly followed by /m/. This explains why speakers overextend velarization to labial domains but not to dental ones. Bongiovanni (2016) demonstrates that it is important to consider the features of both coda and onset consonants in a phonotactic analysis, along with type and token frequency effects, in order to better account for the asymmetry in the velarization of consonant clusters in Spanish. Taken together, Brown's (2006) and Bongiovanni's (2016) accounts constitute an example of how an analysis of phonetic variation is insufficient without referencing syllabic structure and distributional frequency effects.

3.2. Grammatical conditioning

Sociophonological variables in some cases show structural implications that involve morphology or syntax. From the traditional generative linguistics perspective, the distinction that is outlined in this section could be framed as part of the so-called phenomena of lexical and postlexical phonology. Table 22.2 presents Coetzee and Pater's (2011: 402) summary of this distinction, which was originally proposed by Kiparsky (1982).

According to this model, it is imperative to distinguish phonological alternations that are lexically dependent and those that operate after the word-formation processes are complete. The former description reflects a universalist conception, according to which the syntactic component provides input for further processing by the phonological component with the goal of generating a surface structure that is ultimately produced by the speakers and perceived by the hearers. In early versions of generative theory, the underlying structure and the surface structure were connected by means of rules that specified the segments comprising the utterance. It is worth noting that this kind of understanding of phonology did not take into account sociophonological variation, ignoring stylistic and contextual factors. Precisely in the pioneering models, the rules were considered to apply categorically. Nevertheless, variationist sociolinguistics,

Table 22.2 Characterization of phonological phenomena subject to lexical vs. postlexical restrictions

Subject to lexical restrictions	*Subject to postlexical restrictions*
• Conditioned by morphology due to direct interaction with the lexicon	• Not conditioned by morphology
• May include exceptional cases conditioned by the lexicon	• No exceptions
• Produce categorical changes (the lexicon only contains categories)	• Produce noncategorical changes
• Limited to the level of the word	• Can occur between words (utterance as a unit)
• Not conditioned by phonetic factors such as speech rate	• Conditioned by phonetic factors such as speech rate

Source: Adapted from Coetzee and Pater (2011: 402).

founded by Labov (1966, 1969, 1972,) proposes the notion of a variable rule, which is probabilistic and involves specification of the effects of internal and external conditioning factors on the variants of a sociolinguistic variable. In his initial versions, Labov (1969) introduced the use of symbolic mechanisms to indicate optional application of a rule. The probabilistic treatment was at the heart of developing the variable rule program VARBRUL, specifically designed to study variation, as detailed by Cedergren and Sankoff (1974). Cedergren and Sankoff propose that variation is inherent in linguistic competence and cannot be considered representative of marginal phenomena of performance, as it was typically treated in the initial generative models. Today, the concept of the variable rule is not necessarily tied to the notion of the generative linear rule but rather to the probabilistic model that reflects multiple factors conditioning a sociolinguistic variable.

This traditional understanding of phonological systems was brought under scrutiny by usage-based and cognitive theories that conceive of the structure of common words and phrases (together with nonlinguistic aspects) as part of the information that speakers store about phonology and language structure in general. A cognitive representation presupposes a network of connections based on similarity in form and content. The word in this case is central to the cognitive representation, not as an isolated element but rather as a deeply embedded part of the linguistic structure (see Bybee 2001, 2010). Consequently, the division between lexis and postlexis loses validity in the usage-based model: there is no strict division between components, but rather there is a complex network of relationships according to usage and similarity in form and content. This network is referred to as the exemplar model that reflects the linguistic experiences of an individual.

Poplack's (1986) results involve three variables that serve as an example of grammatical conditioning: syllable-final /s/ elision, syllable-final /n/ elision, and final /ɾ/ elision—all manifestations of the larger coda-weakening tendency in Spanish. Syllable-final /s/ occurs in contexts where it functions as a plural marker (e.g. *tarjetas* vs. *tarjeta* 'card(s)') or a verbal second-person singular suffix (e.g. *cantas* 'sing-2sg'). Syllable-final /n/ also serves as a plural marker on verbs conjugated in the third person plural (e.g. *cantan* 'sing-3pl,' *comen* 'eat-3pl,' etc.). Finally, syllable-final /ɾ/ appears in contexts where it functions as an infinitival marker (e.g. *comer* 'to eat,' *cantar* 'to sing'). Among the factors conditioning complete elision, the subset of factors with morphological value is of particular interest. Poplack (1986) adopts a functionalist perspective following the ideas of Kiparsky (1982), according to which the semantically relevant information would tend to be maintained in the surface structure. Following this hypothesis, the /s/, /n/, and /ɾ/ would tend to be retained at the end of a word when they represent morphemes. It is important to note that one of Poplack's (1986) results shows a difference in the elision patterns for word-final /s/ and /n/ in contrast to word-final /ɾ/. The explanation offered for this trend is that the elision of /ɾ/ does not entail loss of meaning even in the case of infinitives. The distinctive syllable-final stress of the infinitives prevents them from being confused with other verb forms. Poplack's (1986) results show that /ɾ/ elision in infinitives is conditioned by the following phonetic context, and since it produces no ambiguity, its quantification is not relevant in the statistical analysis. Table 22.3 summarizes Poplack's (1986: 99–101) findings for the maintenance of the redundant elements (e.g. repetition of the information contained in the morphemes {s} and {n} in an utterance).

The interpretation of the data, according to Poplack (1986), supports in certain measure the functionalist analysis, by which segments that contain semantic information tend to be retained in the surface structure. In the case of the plural {s}, the contexts favoring elision are those in which plurality is a redundant feature. Similarly, it is evident from Table 22.3 that the first position and determiners favor the elision of {s}, which can be interpreted as preservation

Table 22.3 Contextual factors when the semantically rich morphemes {s} and {n} present redundant information

Factors	*Probabilistic weight*
Elision of the plural {s}	
Type of information	
Morphological and nonmorphological	.59
Morphological	.59
Nonmorphological	.54
Absent (none)	.29
Position within the phrase	
Third word in the noun phrase preceded by elision	.75
First word in the noun phrase	.33
Grammatical category	
Determiner	.29
Adjective	.62
Noun	.60
Elision of the verbal {s}	
Pronoun expression	
Implicit	.39
Explicit	.61
Elision of the verbal {n}	
Position of redundant information	
After the verb	.82
Before the verb	.56
Before and after the verb	.59
Absent (none)	.0

Source: Adapted from Poplack (1986: 99–101).

of the first morphological mark of plurality in the utterance. Something similar happens with {s} and {n} as verbal morphemes: they are preserved in nonredundant contexts and elided in redundant contexts. Another example of the functionalist perspective is Hochberg (1986), who presents evidence to support the compensation hypothesis, which predicts that elision of /s/ in verbs would be accompanied by an explicit pronoun *tú* 'you' in order to avoid ambiguity with third-person singular verb forms (e.g. *tú sabeØ* 'you know' in place of *sabes* 'know-2sg'). The functionalist view of such variation is not uncontroversial, however, and alternative perspectives on /s/ deletion in Andalusian Spanish have been addressed by Seklaoui (1988) and Ranson (1993). Furthermore, the work of File-Muriel (2007) and Brown (2009) provides an analysis of syllable-final /s/ deletion and aspiration based on frequency effects, following a cognitive linguistic approach (Bybee 2001, 2010).

The examples that are presented in this section illustrate sociolinguistic variables with interesting connections in terms of their grammatical conditioning. Such examples indicate not only the structural implications of the discussed phenomena but also the diverse theoretical perspectives that have been adopted in their analysis. The final section presents examples of variables that are more directly conditioned by social factors.

3.3. Sociolinguistic conditioning

Sociolinguistics research explores linguistic phenomena by studying the social contexts in which they occur. Labovian variationism has insisted on the quantification of variables that reflect the properties of individuals and their respective communities. The inclusion of social context in the analysis is fundamental, in the sense that an integral view of linguistic phenomena is adopted that separates sociolinguistics from the more traditional perspectives that conceive language as an idealized and context-independent object of study. Among the variables commonly included in sociolinguistic studies are age, socioeconomic level, education level, ethnicity, and sex (or gender, depending on the method), as well as various forms of identifying individuals in more detailed studies of communities, such as those defining social networks (Milroy 1980) and communities of practice (Eckert and McConnell-Ginet 1992).

The study of social variables allows us to understand the community structure based on the extent to which the studied phenomena reflect social divisions within a community and attitudes that are associated with certain ways of speaking (what is considered prestigious or vernacular). The different ways of speaking and their association with diverse groups are indicative of the social barriers raised by social class, age, sex, ethnicity, etc. In turn, the analysis of these variables empowers us to make predictions about the advancement of linguistic phenomena in the community. The variants that show the greatest progress, for example, tend to be favored by women, those of high socioeconomic status, and younger speakers. Usually these progressing variants are associated with positive values that reflect the linguistic identity of the community.

Figures 22.1 and 22.2 present a couple of examples illustrating retention of syllable-final /ɾ/ and of intervocalic /ɾ/ in the *para-pa* 'for' alternation in the Spanish of Caracas, Venezuela. Both

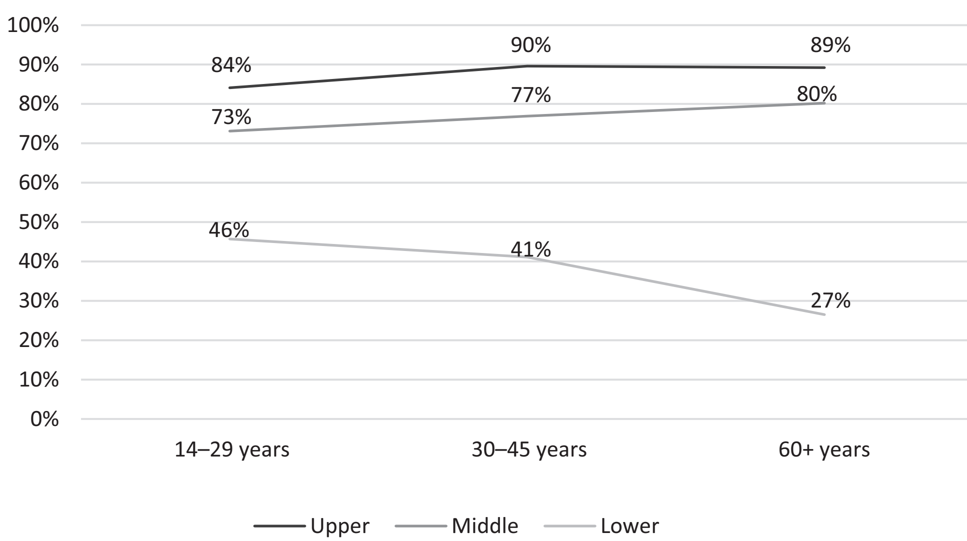

Figure 22.1 Retention of the syllable-final /ɾ/ in Caracas Spanish by age and socioeconomic level

Source: Adapted from Díaz-Campos et al. (2011: 72).

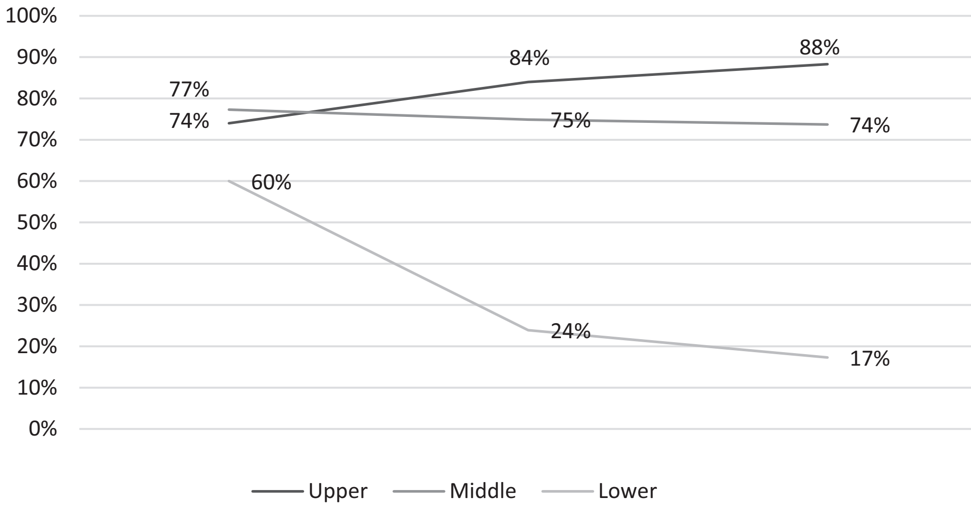

Figure 22.2 Retention of intervocalic /ɾ/ in alternation between *para* and *pa* in Caracas Spanish by age and socioeconomic level

Source: Adapted from Díaz-Campos et al. (2011: 73).

figures make evident the social stratification of the variants according to age and socioeconomic status of the speakers.

The results related to syllable-final /ɾ/ in Caracas Spanish clearly show social stratification, whereby higher retention rates occur in upper socioeconomic groups, followed by middle socioeconomic groups. In contrast, subjects from lower socioeconomic groups show the lowest levels of retention, implying higher rates of deletion. Nevertheless, observing the behavior by age reveals that younger groups at the low socioeconomic level show more retention. Díaz-Campos et al. (2011) argue that this change reflects the fact that lower-class youth have higher education levels than previous generations and have greater access to work opportunities that result in the use of a more normative variant. This research presents evidence based on the demographic data of the analyzed corpus, as well as sociohistorical data on Venezuela, covering the period of the recordings, namely 1960–1990. Similar results to Figure 22.1 are also observed in Figure 22.2, which corresponds to the study of the reduction of *para* 'for.'

The pattern of retention of intervocalic /ɾ/ in the alternation between the two forms of the word meaning 'for,' *para/pa*, is similar to that already described. In this case, the social stratification manifested in the variable points to the possible interpretation of retention as a positively valued variant in Caracas. With respect to age, a similar pattern emerges of greater retention among younger groups at the lower socioeconomic level in comparison to older generations at the same level. This is interpreted by Díaz-Campos et al. (2011) by means of the same argument of greater access to educational and employment opportunities for younger generations during the period 1960–1990.

In summary, the two discussed variables show interesting patterns of social stratification: in addition to the expected high retention levels among speakers at upper socioeconomic levels, unexpected differentiated tendencies appear in the lower socioeconomic groups that show heterogeneity by age. The young speakers make use of the normative variants more than do older speakers, as a product of the social environment of the period, reflecting greater educational and job opportunities (cf. Díaz-Campos et al. 2011).

4. Conclusion

The purpose of this chapter was to define and illustrate the concept of a sociophonological variable as a function of diatopic, diastratic, and diaphasic aspects of variation across Spanish-speaking communities. The main focus has been on the quantitative variationist methodology that has proven effective in uncovering some of the typical forces behind sociophonological variation and language change, including phonetic/phonological, grammatical, and social conditioning. Given the considerable level of linguistic diversity of Spanish and the ever-changing nature of language, this brief overview is merely a glimpse of the current state of Spanish sociophonology and also a promise of a rich research agenda in the field going forward.

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23

A survey of Spanish diachronic phonology

Gary K. Baker and D. Eric Holt

1. Introduction

The present chapter aims to provide an overview of many theoretical concepts and approaches to the study of Spanish diachronic phonology, and in the process explores a number of the changes that characterize the phonological evolution of Spanish from Latin. These include treatments of (inter)related phenomena that affect segments (vowels and consonants), both individually and in combination and contact, as well as issues related to the evolution of syllable and prosodic structure from Late Spoken Latin through Hispano-Romance to Old and Modern Spanish. Arguably, it is changes in Late Spoken Latin related to syllable structure that drive most subsequent phonological changes in Hispano-Romance, and these may be seen to fundamentally interact with structural and systemic factors that are often listener-based, driven by perceptual biases, or that can be better understood with a subtle understanding of the articulatory and acoustic dynamics behind inherent variation. From this perspective, a model of language change benefits from the integration of more phonetically detailed components and can shed light on why particular variants come to dominate over time.

As Goldsmith (1995: 1–3) points out in his overview of phonological theory, what brings together most research(ers) is a desire to understand three overarching issues: the **conditions on well-formed** words (phonotactics, the combinatorics of segments into syllables, syllables into words, etc.), the **nature of alternations** in the realization of morphemes (with context varying along phonological and morphological dimensions), and the **phonetic differences** that are **contrastive in a given language** (deeply connected to phonemic theory). What changes over time for the analyst is the **tools** with which these questions are addressed. These conceptual tools fall into three areas: the **representations** that are posited to exist (autosegmentalism, metrical structure, prosodic categories; feature geometry and its implications for limitations on kinds of assimilation; degree of specification), the issue of **levels** (matters of abstractness, issues of stratal organization, nature of the lexicon), and **rules** (taken neutrally to refer to ways of accounting for the relationship between different levels of representation; metrical theory, rule- vs. constraint-based implementation; equation of phonotactics and alternations; feature-filling/structure-building vs. changing, etc.). Here we survey a variety of contemporary approaches to Spanish historical phonology, both rule-based and constraint-based, including treatments that rely on nonlinear and geometric representations of features, that make use of various levels of prosodic and metrical constituency, and that adopt multiple functional considerations.

2. Overview of major approaches to historical change in Hispano-Romance

Regarding studies of historical change, Romance is one of the best-studied language families, and the earliest investigations of it (e.g., Diez 1874; Meyer-Lubke 1895; and particularly for Hispano-Romance, Menéndez Pidal 1982, 2005; Lapesa 1986; Lloyd 1987; Malkiel 1963–1964; and Penny 1991) provided invaluable collections of data and revealed many insightful observations that still serve as the foundations on which many investigations build. Historical change came to be characterized as follows, building on the approach of early generative grammarians (Hartman 1974: 123):

> Kiparsky (1965) and King (1969)—with the impetus of Halle (1962)—have given us a theory of language change that differs from earlier theories in that it implies that language history is two-dimensional: that is, a historical grammar is not simply a list of sound-change laws in chronological order, but a diachronic series of synchronic grammars. Each synchronic grammar consists of a list of ordered rules, and historical changes include not only rule addition, but also rule loss, rule reordering, rule simplification, and restructuring of underlying forms. It is these additional types of change—principally rule reordering and simplification—that make phonological history different from synchronic phonology and thus interesting in its own right.

Under such an approach, only rule addition (innovation) could affect adult grammars, because these presumably applied at the end of the application of the system's rules; this would ensure that the rule would have only its effect and would ensure continued communication with speakers who lacked the innovated rule; loss and reordering of rules was supposed to occur between generations of language speakers in the acquisition process. Examples from diachronic Spanish would include the palatalization of /l/ to [ʎ] after /k, g/ (as a partial assimilation of the tongue body to the posterior position of the velars), the lexicalization of palatal *ll* from the initial clusters *pl*, *fl*, *cl* (VL *PLOVERE, cf. CL PLUERE > *llover* 'to rain', FLAMMA > *llama* 'flame', CLAVE > *llave* 'key'), or the creation of [ʧ] from these same clusters postnasally (AMPLU > *ancho* 'wide', INFLARE > *hinchar* 'to inflate', MAC(U)LA > *mancha* 'stain'), where devoicing appears to have occurred as well (see Holt 1996, 1997 for an optimality-theoretic treatment); subsequently, these rules ceased to apply, as these phenomena do not occur in Modern Spanish (e.g., *clase* 'class', *ancla* 'anchor' are stable and do not tend to *ll*- or -*ch*-). Rule reordering is seen in the dialectal treatments of coda /s/-aspiration and /n/-velarization and phrasal syllabification: e.g., in some dialects syllable-final /n/-velarization appears to occur before syllabification across words (/son esos/ 'it is those' > [só-ŋé-sos], with velarization, then resyllabification), while in others resyllabification bleeds velarization (e.g., [só-né-sos]). Restructuring and simplification of the grammar and lexicon are also important loci of language change. These are usually presumed to occur in the process of acquisition by children, since language learning involves grammar creation and lexicon building, and children may end up formulating a different set and application of rules. This may have a profound effect on the underlying forms posited, consistent with Postal's (1968) Naturalness Condition, which requires that underlying representations be identical to surface representations unless evidence dictates otherwise.

While Chomsky and Halle (1968: 49) believe that underlying representations are fairly resistant to historical change and that the same system of representation for underlying forms will persist for long stretches of time, this seems implausible psycholinguistically. An example found in Harris (1969) is the positing for Modern Spanish *leche* 'milk' of the underlying representation /lakte/, identical to its Latin etymon. Harris formulates modern synchronic rules of vocalization, palatalization, and vowel raising that recapitulate the evolution this word underwent, in essence telescoping diachronic processes into a synchronic analysis. Later approaches employed Lexical Phonology and Morphology (LPM; e.g., Kiparsky 1995) and sought to explain both actuation (why a change begins) and transmission (how it spreads) and assume a less abstract analysis where underlying and surface forms are similar, with the rules of a grammar integrating phonology and morphology at lexical and phrasal levels. In this manner, LPM traces a pathway through which sound changes are incorporated into the synchronic grammar via a two-stage theory in which "late" phonetic variation is integrated into the grammar and transmitted to successive generations via language acquisition (Kiparsky 1995: 642). Some more recent work in Optimality Theory (OT; Prince and Smolensky 2004 [1993]; McCarthy and Prince 1995) mimics this approach as well, positing a hybrid model of phonology with a stratal organization of constraint-based levels (e.g., Kiparsky 2000; Gess 2003; Jacobs 2003) that aims to yield a more restrictive and well-defined constraint inventory. Bradley and Delforge (2005), for instance, call for a stratal model couched in Dispersion Theory (see section 4) that better allows for the incorporation of changes first at the phrasal level, then at the lexical level, in their analysis of the diachrony of Spanish sibilant voicing.

Under a constraint-based approach, if there are no rules and if all constraints are universal, it must be their relative ranking that determines dialectal variation and historical change. Additionally, differences in underlying forms will play a role, and the restructuring/reanalysis of surface forms will impact the cues the learner makes use of in determining the correct ranking of faithfulness, markedness, and other constraints, with the OT principles of lexicon and grammar optimization capturing these generalizations: "[O]f all the possible underlying representations that could generate the attested phonetic form of a given morpheme, that particular underlying representation is chosen whose mapping to phonetic form incurs the fewest violations of highly ranked grammatical constraints" (Inkelas 1995, based on Prince and Smolensky 2004 [1993]: 225–226). The implication for historical change is that forms are not inherited genetically but are eliminated from the lexicon as surface forms come to be reinterpreted as underlying forms, which leads to a more harmonic grammar (in the sense of reducing faithfulness violations). In other words, language change is not a matter of derivation but of substitution of one input for another. Taking again the example of Modern Spanish *leche*, it seems highly unlikely that [leʧe] would be the optimal output for /lakte/ (*pace* Harris 1969). Despite the morphological relationship with words like *lácteo* 'lactic' and *lactar* 'to lactate', the phonological shape of the historical source is too far removed. Moreover, as argued by Hooper (1976: 10–11), Harris's rules are no longer productive today. Modern forms such as *actor* 'actor', with medial /k.t/, serve as counterevidence to a possible ranking that would yield *leche* (cf. **achor*) from a similar input, thus failing to support such "historical recapitulation." Instead, /leʧe/ would be posited, avoiding an excessive degree of abstraction.

Hooper's (1976) Natural Generative Phonology (NGP; also Vennemann 1972, *inter alia*) proposes *via rules* to formalize the morphosemantic bonds between related but historically divergent lexical items. Via rules are not meant, importantly, to suppose a common underlying representation (UR) between such words—in line with the NGP program's emphasis on closer, more natural mapping of URs to surface forms—but rather to reflect the fact that speakers are undoubtedly aware of such relationships. Even outside rule-based frameworks, these insights remain valid, and one might view via rules and other such lexical correspondence statements as recognizing the common morphemic (i.e., nonphonological) content linking the underlying allomorphs in question.

In terms of changes to the constraint hierarchy (somewhat analogous to the notion of rule reranking), typically, candidates deemed "nearly optimal" according to the evaluation of the constraint hierarchy of one historical stage subsequently become optimal when constraints are reranked. Tesar and Smolensky (2000) argue for a learning algorithm where only constraint demotion is possible, though for certain historical changes recourse to constraint promotion may be required (see, e.g., Holt 1997, chs. 2–3; and Lleó 2003, who suggests that constraint promotion may be available only in the case of external or foreign influence on a language).

3. Development of conceptual tools, and sample analyses of diachronic phenomena

There are also many studies where matters of **representation** have played a role. For example, developments in approaches to **featural organization** may lead to additional insights into issues of diachrony, and an understanding of the hierarchical nature of prosodic categories and their primitives may allow better characterizations of certain phenomena. To take the case of **sonority**, Zec (1995) develops a theory of the relation between **moraic theory** and sonority classes, which Holt (1997, 1999, et seq.) employs in the analysis of the collapse of distinctive vocalic quantity in Latin, which is argued to have significant repercussions for the development of both the vocalic and consonantal systems of Hispano-Romance. The reanalysis by the listener of phonetic differences led to loss of contrastive vowel length, which leads to the stepwise elimination of the mora-bearing ability of consonants (i.e., both geminates and coda consonants), in turn eventually leading to the recovery of systemic balance in the distribution of long segments, which over time are entirely eliminated. The result is that Old Spanish and Galician/Portuguese come to have consonant inventories composed entirely of simple segments, having no mismatch with those segments that could be distinctively long (vowels and consonants in Latin, only sonorants in Early Hispano-Romance, none in Old Spanish and Galician/Portuguese). Examples include first obstruents (CUPPA > *copa* 'cup'; GUTTA > *gota* drop'; BUCCA > *boca* 'mouth') and then later sonorants (ANNUM > *año* 'year', BELLA > *bella* 'beautiful', with palatal [ʎ]), as well as cases of weakening and loss of syllable-final consonants (TRUCTA > Moz. *truhta* > Sp. *trucha* 'trout'; MULTU > *muito* > *mucho*). This is modeled via the gradual reranking of constraints on moraicity vis-à-vis faithfulness, and accounts as well for the vocalization of syllable-final obstruents, as well as syllable-final /l/.

This final change, coda *l*-vocalization, requires some additional explanation, since /l/ is more sonorous than the obstruents, and intervocalic moraic sonorants (that is, geminate *nn*, *ll*) did not undergo change until later. Here, an innovation in featural organization, that of feature geometry, in this case specifically of liquids (Walsh-Dickey 1997) and appealing to the articulator group hypothesis (Padgett 1995), points the way. Liquids are argued to have a primary consonantal place of articulation of [coronal] (at which place /l/ is [−cont]) and a secondary vocalic place of articulation of [dorsal] (at which place /l/ is [+cont]). This allows us to understand that the consonantal lenition that affected the syllable-final obstruents did not target obstruents per se but feature values that contributed to their low sonority, in this case [−cont]; in this way, the vocalization of coda /l/ falls out from the targeting of its [−cont] feature, which is absent in the resulting higher-sonority glide. (See also later in this section for discussion of Colina's (2010) approach to rhotics.)

Further, this organization not only accounts for the ambiguous behavior of the lateral in lateral-obstruent assimilation and spirantization but also provides an account for several historical changes (fleshed out in detail in Holt 2002): the delateralization of [ʎ] (< [lj]) to [ǰ] (e.g., ALIUM 'garlic' > [aʎo] > [aǰo] (> [aʒo] > [aʃo] > MSp. [axo] *ajo*); the creation of [ʧ] from palatalized *muta cum liquida* sequences via delateralization and assimilation in voicelessness, reanalyzed by the listener as [ʧ] (also sketched in the preceding); and so-called intrusive stop formation (see also Martínez-Gil 2003) in forms like Sp. future *sal(i)r* + *á* > *sal**d**rá* ('leave' 3p.sg. future) (and similarly with nasals: *pon(e)r* + *á* > *pondrá*, 'put' 3p.sg. future), where attempted linking between the sonorant and the [+cont] *r* that follows yields a transitional element interpreted and then lexicalized as /d/.

Other matters of representation are employed by Martínez-Gil (2010) in his exploration of the relevance of **prosodic minimality** to develop a unitary account of three historical developments, previously considered unrelated, in Hispano-Romance. These are the preservation of a word-final nasal (e.g., *con*, *tan*, *quien* ('with', 'so', 'who') vs. *amaba(m)*, *casa(m)* ('love' 1/3p. sg. imp., 'house')), the change /ee/ > /ej/ (e.g., REGE > *ree* > *rey* 'king' vs. DIGITU > *deedo > *dedo* 'finger'), and yod augmentation in the present tense forms *soy*, *doy*, *voy*, and *estoy* ('I am', 'I give', 'I go', 'I am'), a set of phenomena that Martínez-Gil attributes to compliance with a minimal word requirement to have a bimoraic (not disyllabic) foot. This allows for an understanding of the failure of both word-final -*m* deletion and simplification of identical vowels as obtaining whenever the result would have been a subminimal lexical word. Thus, -*m* is retained because (that is, when) its moraic weight is required to maintain minimality, and glide formation occurs so that the moraic weight of the original second vowel contributes to minimality, while at the same time avoiding hiatus. Similarly, the accretive *y* of *doy* and other forms arises only in those cases where the weight of the yod is necessary to satisfy minimality. In both cases (LEGE > *lee* > *ley* 'law', not **le*, and *voy* 'I go'), the falling diphthongs are maintained where otherwise they were reduced in Spanish from an early period (e.g., *beiso*> *beso*; *outro* > *otro*).

Various types of vowel loss may result from **phonotactic** concerns that respond to prosodic/metrical influences. In Lief's (2006) treatment of syncope (e.g., COMP(U)TARE > *contar* 'to count'), an enhanced set of constraints is employed that includes perceptually or positionally based ones that better model those phonetic contexts that favor the loss of unstressed vowels. (We return to this sort of approach later in this chapter.) Lleó (2003) likewise deals with syncope, as well as apocope, and finds and models foreign influence. The greater incidence of syncope in Old Spanish (OC(U)LUS > *ojo* 'eye') results from the influence of the stress-timed characteristics of Germanic phonology, which impacted the prominence of stressed and unstressed syllables; the later increase of (so-called extreme) apocope (SECUNDU > *segund* or *segunt* 'second', subsequently recovered in *segundo*, though cf. also *según*) is argued to result from later French influence. This is modeled via the interaction of constraints concerning prosody and phonotactic constraints on complex codas, with additional morphological conditioning that disfavors deletion of lexical material. (See also Hartkemeyer 2000.) In sum, prosodic representation clearly is relevant to a deeper understanding of certain diachronic phonological changes.

Additional issues of featural organization are raised in Colina's (2010) approach to rhotics, which also advocates for a functional/systemic approach that invokes Dispersion Theory (see next section) as well as lexicon (and grammar) optimization. She locates the origins of the tap ~ trill distinction and their skewed distribution in Spanish not in an underlying geminate */ɾɾ/ (proposed in Harris 1983) but rather as a historical artifact: Spanish /ɾ/ and /r/ contrast only in word-internal intervocalic position because it is only in that position that geminates occurred (and thus contrasted with singletons) in Latin. Like other Latin geminates, Latin -*rr*- underwent simplification over time, avoiding merger with singleton /ɾ/ through a change in manner (trill; Penny 1991). Similarly to what is proposed for *nn* and *ll* (Holt 1997, 2003, 2006; see later in this chapter), a constraint that militates against geminates becomes dominant, and NoMERGE—militating against loss of phonemic contrast—favors an output [ka.ro] over nondistinctive [ka.ɾo]. As a matter of learnability, lexicon optimization favors the reanalysis of [ɾ] as (phonemic, nongeminate) /r/. Thus, there are no geminates in Modern Spanish.

Colina accounts for the presence of trills after heterosyllabic consonants (e.g., *en*[r]*edo* 'entanglement', *al*[r]*ededor* 'around') by a fortition process of tap *r*. (After obstruents, where a complex onset can form, [Cr] is posited to be disallowed due to the trill's significantly lower sonority vis-à-vis the less tense flap; [Cr] provides insufficient **sonority distance** between members of the onset, unlike the licit [Cɾ].) She moreover appeals to assimilation of place/aperture features: after heterosyllabic consonants, the rhotic is claimed to assimilate in place and, following Steriade's (1993) proposal, aperture (dominated by place) to the preceding consonant. Thus, the aperture zero (A0) of /n, l/ (recall the latter's posited complex status, discussed earlier in this chapter) favors the trill, also posited to be A0, over the tap.

Other phonotactic concerns include the results of syllable contact, likewise influenced by issues of prosody. Like the intrusive stop formation already discussed, metathesis effects in Old Spanish may be analyzed in terms of more felicitous sonority sequencing among concatenated segments. Syncope sometimes led to situations of "phonotactic distress": CAT(E)NATU > ka<u>dn</u>ado, for example, which resolved as *ca<u>nd</u>ado* 'padlock'. In other cases, morphological concatenation likewise leads to (variable) "repairs" (*dezid#lo* > *dezildo* 'say' 2p.pl. imperative + 'it' masc.) that improve the articulatory and perceptual transition between syllables. Holt's (2004) OT treatment of these historical reflexes involves the interaction of constraints such as the SYLLABLE CONTACT LAW, MINIMAL DISTANCE IN SONORITY, SONORITY SEQUENCING PRINCIPLE, ALIGN, and faithfulness constraints, primarily LINEARITY.

4. Importance of functional considerations, revisited, and analyses of additional diachronic phenomena

Turning again to **functional considerations**, we have seen that some authors find it illuminating to employ more **phonetically-based approaches** and to consider **systemic factors**. Dispersion Theory (DT)—building on Liljencrants and Lindblom (1972); Steriade (2001); Flemming (1995/2002), and many others—is meant to provide "a full account of facts of markedness, segment realization, contrast and neutralization" (Padgett 1997: 71). Reified and incorporated into the OT architecture as constraints targeting acoustic-auditory space (e.g., SPACE), margins of perceptual distinctiveness (e.g., MINIMUMDISTANCE), and neutralization avoidance (e.g., NOMERGE), DT considers sound change in terms of systemic contrast and markedness. Examples from Spanish diachronic phonology include sets of related segments that seem to have evolved in a fashion that not only maintains but also enhances contrasts within the system, even as it also allows for the possibility of merger and phonemic loss.

An example comes from Baker (2006), who applies the DT model to an array of historical changes to the Spanish stop inventory. Whereas widespread lenition in Western Romance—simplification of Latin geminates, voicing of obstruents, spirantization of voiced stops—might well have led to massive neutralization, he shows that both duration- and voicing-based distinctions persisted. Former geminate ~ singleton and voicing distinctions were maintained in weakened segments in pull chain fashion as lenition effects took place. The exclusive approximantization of voiced occlusives observed in Modern Spanish further enhanced these distinctions with changes in manner of articulation. This is not to suggest teleology but rather to illustrate a systemic reaction to lenition effects; whereas mergers certainly do occur, speakers are aware of phonemic distinctions and may adjust their linguistic behavior to preserve meaningful contrasts even in the face of rampant weakening. DT thus offers a means of modeling and understanding the phonetic and phonological bases of these changes. Approximantization of /b, d, g/, for example, seems to create less commonly observed, more marked segments; yet in terms of *systemic markedness*, the Spanish stop inventory's internal contrastiveness is enhanced.

Another example is the treatment given by Holt (1997, 2003) of the emergence of the palatals *ñ* and *ll* from their Latin geminate sources (/nn, ll/). Holt argues, as sketched earlier, that the loss of geminate consonants is tied both to the erosion of syllable-final consonants and to the collapse of distinctive vocalic length (as the result of a gradual loss in the mora-bearing ability of segments). Systemic factors favoring perceptual distinctiveness while also eliminating geminates lead to the creation of new palatal /ɲ, ʎ/, which remain distinct from original /n, l/. In Galician/Portuguese, in contrast, intervocalic /n, l/ were largely lost, and while the same pressures favored simplification of Latin NN, LL, no featural change was needed to ensure continued contrast, and new cases of /*n*, *l*/ result. (While Baker's approach to lenition does not treat degemination as related to the loss of contrastively long vowels in Late Spoken Latin, the two are not incompatible, and the changes in the vocalic system may have provided additional motivation for the chain shift.)

Dispersion considerations are also argued to motivate well-known additional changes to the Spanish fricative inventory. Baker (2003) analyzes the resolution of the "sibilant turmoil" of Medieval Spanish, in which three pairs of strident fricatives existed in the inventory: dental /s̪/ ~ /z̪/ (the results of deaffricated /t̪ˢ/ ~ /d̪ᶻ/), apicoalveolar /s̺/ ~ /z̺/, and alveopalatal /ʃ/ ~ /ʒ/. Following the loss of voicing distinctions (which Baker attributes to the universal markedness of voiced fricatives and especially stridents; for a more in-depth analysis see Bradley and Delforge 2005, discussed later on), the Castilian system was left with three voiceless fricatives, all occurring in a relatively small articulatory and acoustic window: apicoalveolar, predorsodental, and alveopalatal sibilants. This three-way distinction evolved further as place features shifted. The point of articulation of the predorsodental /s̪/ advanced to the modern interdental /θ/, while the alveopalatal /ʃ/ velarized to /x/. As a result, the articulatory window spanned virtually the whole oral cavity, from the velar to the interdental. These changes also served to enhance distinctiveness in a way that cannot be accidental. Baker points out that the acoustic features targeted in these changes are precisely those perceptual factors shown to aid most in discriminating place of articulation among fricatives: the frication noise properties of frequency locus, spectral shape, and intensity (Ali et al. 2001). Adapting Flemming's (1995/2002) indices of Noise Frequency (NF; related to spectral peak locations) and Noise Intensity (NI; relative amplitude, affected by presence or absence of stridency), he shows that velarization of /ʃ/ to /x/ augments contrastiveness with /s̺/ in both NF and NI, with contrastiveness between /s̺/ ~ /θ/ and /s̺/ ~ /s̪/ increased in terms of NI. The resulting system thus distinguishes the high-intensity sibilant from the velar and the interdental; both historical changes (/s̪/ > /θ/; /ʃ/ > /x/) result in the loss of stridency. The velar and interdental are further distinguished by the feature [+diffuse]: /x/ has a pronounced, lower-frequency spectral peak, while /θ/ has a flat spectrum. We would stress that these changes are not readily explicable as discrete, input-output type phenomena. Without reference to a *system of contrasts*, the shift from common, highly perceptible sibilants /s/ and /ʃ/ to more marked /θ/ and /x/ is difficult to motivate. One might try to explain /ʃ/ > /x/ or even /s/ > /θ/ in terms of lenition, yet these changes largely occurred in syllable- and word-initial, i.e., prosodically prominent, environments. The dispersion approach is more intuitive and captures a generalization: changes fall out in an integrated fashion that takes into account the phonetic details underlying facts of production, perception, and (systemic) markedness.

A reviewer justifiably wonders about the failure of dispersion in Andalusian Spanish. First, we must point out that DT, as implemented in the OT architecture, cannot precisely be said to *fail* here. Different rankings of the posited constraints do indeed predict Andalusian reflexes: a focus on a greater margin of contrast in both NF and NI results in the /s, x/ of the

Andalusian inventory (i.e., MinDist >> MaintCont). Another (and non-DT) perspective comes from Penny (1991), who claims merger was due to the absence of alveolar fricatives in Andalusia under Mozarabic or Arabic influence, where coronal fricatives were dental. Merger would have been practically automatic upon deaffrication of /tˢ/, resulting in near-identical dental fricatives. Here, we would stress that DT is presented as one component of sound change. Clearly, extra-systemic factors are in play: significant immigration to post-Reconquista Andalusia likely made for a chaotic array of coronal sibilant articulations (see Lloyd 1987: 336–342) that may well have favored leveling and merger even as it drove articulatory and acoustic distancing with /ʃ/.

Bradley and Delforge (2005) focus on the loss of voicing distinctions and subsequent merger among the medieval fricatives: e.g., [detˢiɾ] 'to descend' and [dedᶻiɾ] 'to say' both become [desiɾ]; [oz̺o] 'bear' merges with [os̺o] 'I dare'; [fiʒo] 'son' merges with [fiʃo] 'fixed'. They note that such merger in intervocalic position is remarkable because it goes against the trend of intervocalic voicing characteristic of Western Romance lenition (discussed previously), and it involves neutralization in the syllable onset, a position that usually favors contrast preservation. Bradley and Delforge advocate for a DT account based on explicit reference to articulatory and perceptual detail, while also limiting the range of possible phonological contrasts. The paradox of losing contrast in syllable-initial position is resolved by integrating into the DT apparatus the fact that voiced sibilants are marked both articulatorily and perceptually. A **featural representational** assumption they adopt is that some sibilants (and obstruents more broadly) bear a phonological specification of [voice], while others are targetless for this feature and assume the laryngeal attitude of a neighboring sound. A further distinction they adopt is structural, employing a **stratal organization** of lexical and postlexical phonological levels that allows them to account for the dialectal phrasal behaviors that emerge precisely in those contexts where [s] and [z] were contrastive in Medieval Spanish. (Ongoing dialectal variation exists today with voicing of intervocalic /s/ in Andean and Costa Rican dialects—see, e.g., García 2015—but is not addressed here.)

Finally, a phonetically driven approach has been applied to the examination of another type of **metathesis**, that of **rhotics** (Russell Webb and Bradley 2009; they treat both French and Spanish, but only the latter will be mentioned here). Their **gesture-based analysis** of leftward simple metathesis (dialectal *abarcar* > *abracar* 'to encompass', *dormir* > *drumir* 'to sleep') advocates for separate production and perception grammars: in production, constraints favor complete overlap of adjacent rhotic and vocalic gestures, which yields indeterminacy for the listener regarding their linear order; this indeterminate and variable output then serves as input to the perception grammar, leading to perceptually induced shifts.

5. The importance of acoustic and auditory detail and the notions of variation and emergent grammar in providing insight into historical sound change

As we have seen in the preceding survey, a major development in the phonological analysis of diachronic sound change in the past few decades has been the integration of fine-grained phonetic detail to provide additional insight into the mechanisms underlying sound changes and thereby motivate phonological effects over time. (See also Ohala 1993a, 1993b; Browman and Goldstein 1989, 1990, 1991, 1992; Blevins 2004; Blevins and Garrett 1998, 2004; Hayes and Steriade 2004; *inter alia*.) Bybee (2001, 2006, 2016) and Blevins (2004) in particular argue for a bottom-up approach to language change, stressing that apparently natural phonological change is indeed only natural insomuch as it reflects natural phonetic processes. In a Labovian-style scenario (Labov 1972), arrays of variants reflecting subtle articulatory variation across speakers, registers, phonetic contexts, and the lexicon arise "under the radar" of phonology but may well over time achieve a level of salience sufficient to motivate phonological change and be encoded into the grammar. Grammar, then, is an emergent, plastic phenomenon (as are phonemes) (Bybee 2001), and sound change over time is gradual as phonetic cues are incrementally altered and skew the general percept derived from an exemplar cloud of variant realizations. From this perspective, a model of language change benefits from the integration of more phonetically detailed components, as understanding the articulatory and acoustic dynamics behind variation can shed light on why particular variants come to dominate over time.

5.1. The development of palatal sonorants in terms of gestural overlap and timing effects: an extended sketch

We offer here an analysis that integrates phonetic detail in a gestural model and the notion of competing variants within an "acoustic soup" that treats the advent in the Spanish inventory of a new palatal class of sounds, [ʝ, ʎ, ɲ, ʧ], which arise from Late Spoken Latin. (For reasons of space, we largely limit our discussion to the palatal lateral [ʎ] and nasal [ɲ].) These sounds arose from a variety of sources, but the yod arising from Latin atonic front vowels [i, e] is a key trigger in many of these changes:

(1) a. HISPANIA > Sp. *España* 'Spain' b. ARANEA > Sp. *araña* 'spider'
c. FOLIA > *fo[ʎ]a > fo[ʒ]a > Sp. *hoja* 'leaf' d. ALIU > *a[ʎ]o > Sp. *ajo* 'garlic'

These changes are widely considered assimilatory, as the preceding consonant's point of articulation drew closer to that of the phonetic glide [j]. Assimilation, however, could serve to mask the underlying mechanisms at play. That is, coarticulatory phenomena may well be considered the phonetic antecedents to eventual assimilatory changes evident in (phonemicized) sound change. A gestural breakdown of the coarticulation evident in the changes in (1) provides for a perspicuous, nuts-and-bolts treatment. Our goal here is to offer an extended sketch of a phonetically informed analysis of the change in terms of gestural overlap as a speaker-driven phenomenon (i.e., production-oriented), while also recognizing a more purely phonological role on the part of prosody in helping drive, direct, and constrain the change. By employing the concept of articulatory gestures as phonological primitives in the sense of Browman and Goldstein (1989, 1990, 1991, 1992) and following further elaborations of the model in Gafos (2002), we show that the advent of the palatal sonorants arose as an effect of intergestural timing and overlap, with prosodic forces contributing to the particular outcomes in Spanish.

In this way, our analysis views the phonetics of a change as the mechanism through which the change occurs, even as the phonological system informs its extent and direction. That is, while phonetics provides a means of understanding the nature of a given historical change, a model that seeks to motivate a change rather than just describe it must take into account system-based influences. However, we hope through an articulatory approach to avoid any hint of teleology or speaker intention driving change; rather, changes occur gradually (and likely filter gradually through the lexicon; see Bybee 2012) over time as speaker variation provides an array of variants ("acoustic soup") that incrementally shift the phonemic target, privileging some cues over others. Felicitous change may take place when some aspect of newer variants facilitates production or perception in such a way as to favor that variant's survival (cf. the results of the resolution of "sibilant turmoil" sketched previously). This outcome is not certain; the palatal lateral [ʎ] is a fairly marked segment cross-linguistically that has been subject to widespread *yeísmo* (delateralization) and other changes in Romance varieties. Change is ongoing and may well serve to obliterate previous changes.

We limit our discussion here to the earliest origins of the changes in question; subsequent developments producing an array of (alveo)palatal segments in the language (e.g., [ɟ, (ʧ), ʤ, ʃ, ʒ]) are not discussed, though we recognize the clear role in many of these developments of prosodically driven fortition processes. Zampaulo (2013, this volume) offers a phonetically informed treatment of these segments with an emphasis on the role of the listener.

Regarding yod, we take the process whereby unstressed high and mid vowels in hiatus in Latin become yods to be gliding, creating vocoids that form part of branching nuclei with the following vowel, in accord with the sonority-based syllable dynamics laid out in Zec (1995). With regard to the articulatory and acoustic characteristics of the high palatal vocoid, yod crucially involves a high, fronted tongue body. The large contact zone and tongue dorsum involvement in the yod make for a relatively massive articulatory maneuver. This accounts for the fact that the yod tends to exert significant anticipatory coarticulation: Recasens (1999) directly associates anticipatory effects with salient lingual gestures. Furthermore, tongue dorsum engagement in the formation of constriction is also directly related to coarticulatory resistance (Recasens 1984, 1990), which has itself been related to degree of coarticulatory influence (Farnetani 1990; Recasens and Espinosa 2009).

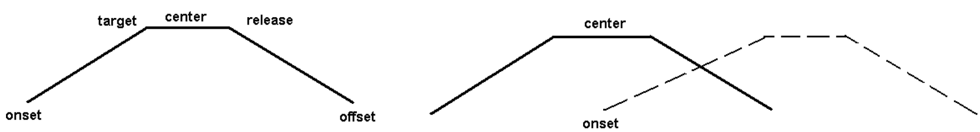
Consistent with the work of researchers such as Ohala (1993a), Browman and Goldstein (1991), Blevins (2004), Blevins and Garrett (1998, 2004), and Zampaulo (2013), sound change is analyzed as originating from phonetic ambiguity in speech transmission, with listener (mis-)perceptions potentially motivating changes to an underlying form. Blevins's (2004) CHANCE involves ambiguity that occurs due to the difficulty of localizing the source of certain long-distance cues—e.g., palatalization—in the stream of speech. Ohala (1993a) likewise analyzes dissimilatory changes as the result of *hypercorrection* of strings in which some feature that manifests itself "over fairly long temporal intervals" is misparsed by the speaker (Ohala 1993a: 251). While not questioning a role for listener-based sound change, this analysis also acknowledges the role of production: yod anticipation in production is claimed here to be the basis for the eventual palatalization of the segments in question. The origins of the phenomena are therefore coarticulatory in nature, the result of anticipatory retiming of the massive tongue body gesture described previously. Such overlap depends on the different phasing strategies associated with consonants and vowels, and the CV coarticulation evident in the change from [lj] to [ʎ] reflects the superimposing of consonantal gestures onto the large tongue body gestures involved in the production of vowels. While degrees of compatibility differ across consonants, this general concept of consonant-on-vowel coordination provides a clear path through which the yod gesture was coordinated with the consonantal gestures of /l/ and /n/ to set up the eventual changes observed historically.

Not dealt with here are the potential V2-to-V1 effects that may obtain due to extreme yod overlap. The V-to-V cycle, a sort of vowel melody onto which consonantal gestures are superimposed, provides the potential for anticipatory effects (both production- and perception-oriented). The historical vowel raising observed in Spanish metaphony could well have its origins here, whether in production, perception, or (likely) both: e.g., *dormir* 'to sleep' > d<u>u</u>rmiendo, d<u>u</u>rmió; *mentir* 'to lie' > m<u>i</u>ntió, m<u>i</u>ntiendo.

The palatal effects observed historically in (1) are argued here to reflect speaker variation at the gestural level that led to grammatical change. Specifically, we argue that a focus on intergestural timing—how concatenated gestures are timed with respect to each other—provides the most insightful means of modeling the historical changes. Gestures, as posited by Browman and Goldstein (1989, 1990, 1991, 1992, *inter alia*), are abstract units underlying the various oral, velic, and pharyngeal maneuvers that comprise segments. Gestures prescribe the various locations and degrees of constriction that differentiate segments and constitute the phonological primitives making up the sounds of human speech. Browman and Goldstein (1991) show that gestural coordination can effectively model much sound change through the mechanisms of gestural overlap and masking in the stream of speech. Timing is an implicit part of the model; gestures are conceived as dynamic, changing over time.

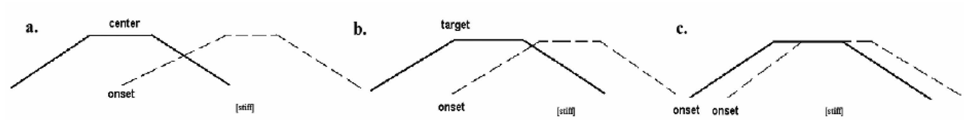
Gafos (2002) focuses on intergestural timing, mapping the internal temporal structure of gestures and the temporal relations between them in terms of *landmarks* in gestures: *onset* of articulatory movement, *target* as articulators reach their place of articulation, *center* when constriction is maintained, *release* when the articulators move away from the target, and *offset* marking the end of articulator activity. (2a) details the temporal model of the gesture, while (2b) shows gestural overlap under Alignment in an OT framework.

(2) a. The "life" of a gesture b. Overlapped CV under ALIGN$_{\text{(C, center, yod, onset)}}$



In Gafos's (2002) model, alignment constraints govern intergestural timing. The ALIGN constraint in (2b) synchronizes the onset of the following yod gesture (in dotted lines) with the center of the preceding consonant. Interspeaker variation may alter gestural timing and give rise to historical change. For example, timing that aligns the target of yod with the release of the consonant, or any point before, would involve overlap of the "plateaux"—the portion between target and release—of the two gestures. Under such conditions, articulators seek to achieve different targets simultaneously, leading to gestural blending and potential merger as characteristics of both gestures are approximated (Browman and Goldstein 1992: 165). Where intergestural timing is thus altered across enough speakers, contexts, and registers, language change may result. (3) shows /n/ + yod sequences under a range of ALIGN constraints:

(3) Variant intergestural CV timing



ALIGN$_{\text{(C, center, yod, onset)}}$ percept: [nj] ALIGN$_{\text{(C, target, yod, onset)}}$ [percept: [nʲ] ALIGN$_{\text{(C, onset, yod, onset)}}$ percept: [ɲ]

Gafos's model allows us to represent cross-linguistically attested degrees of gestural overlap rather neatly. The gradual shift of Latin /n/ + /j/ (similarly for /l/ + /j/) (3a) to a posited secondarily palatalized consonant (3b) to a more or less fully overlapped palatal segment (3c) displays increasing degrees of gestural overlap as the two segments are timed more and more closely together. (3a) shows typical CV timing: the yod gesture reaches its target well after release of the preceding consonant. Where the yod's target is timed closely following the consonant's release (3b), a secondarily articulated [nʲ] is produced, as in phonemic palatalization in Slavic languages. Closer timing, as in (3c), partially merges the plateaux of the two gestures; the consonant in effect releases directly into the yod's linguopalatal constriction gesture and results in the palatal nasal. This suggests a path of progressive tightening of intergestural timing in the order. Indeed, Recasens et al. (1995: 267) view the change of [nj] to [ɲ] as a coalescence process that is not categorical but rather gradual, involving different degrees of overlap between tongue front and tongue dorsum gestures. They hypothesize that shortening of the time interval between the two lingual gestures in /nj/ may cause gestural blending, in line with Browman and Goldstein (1989), and that simultaneous activity of the tongue front and dorsum may result in complete gestural blending, at which point the palatal nasal may acquire phonological status (Recasens et al. 1995: 268).

Importantly, glide-vowel sequences in Spanish do not generally have greater duration than singleton Vs and are far briefer than high vowels in hiatus with a following vowel (see, e.g., Fernández Planas 2013: 303). Being briefer and lacking the steady state of vowels, the glide can thus be characterized as a more rapid articulatory movement that achieves its target faster than the vowel. We argue that the rapidity of the yod in onglides contributes to its tendency toward anticipatory coarticulation. The articulation of the yod (and of palatal consonants in general) involves a relatively large fronting and raising gesture on the part of the tongue body. In the case of the glide [j] versus the vowel [i], this transition involves comparable spatial characteristics but is achieved in a shorter amount of time, constituting an effortful transition. This moreover seems consistent with the greater degree of constriction generally attributed to glides over their vocalic counterparts (see Chitoran and Nevins 2008 and references therein). Anticipatory coarticulation (i.e., leftward spread) in these segments represents an articulatory timing strategy that minimizes effort by beginning the fronting/raising gesture in advance. There is thus an articulatory basis for the phenomenon. Indeed, we would suggest in the interest of a nonteleological analysis that this is the origin of the changes. The fact that coarticulation may also serve to spread acoustic cues over a larger domain, thus enhancing perception, is fortuitous. This perceptual aspect may well favor the propagation of the change and its eventual reanalysis into the grammar by listeners but cannot be argued to motivate the original change.

If articulatory factors indicate a path of change, we propose that prosodic ones are responsible for the widescale yod anticipation that must have taken place for the eventual phonologization of the effects illustrated in (1). The yod in the VCjV environments would have been subject to the demands of syllable structure dynamics. Work by Zec (1995) in sonority-based syllable dynamics finds that a syllable nucleus should exhibit no rise of sonority but rather begin immediately at fullest sonority. We therefore assume that the palatal onglide in the glide-vowel sequences is *temporally constrained*, such that a relatively large tongue body gesture must be made in a restricted amount of time. Leftward spreading, i.e., anticipatory coarticulation of the gesture, is an articulatory strategy to reduce this effort.

Also according to the sonority cycle in syllabification, onsets preferentially display lower sonority, that is, greater consonantal strength. In light of this, fortition processes tend to take place in positions of prominence (syllable-, word-, and phrase-initially; in tonic syllables) and are characterized articulatorily by greater degrees of obstruction and, perceptually, by more salient cues (aspiration, stridency, etc.). By the same token, any process that serves to drive greater gestural overlap and synchronization may well be viewed as a fortition process, defined as a maneuver that produces, articulatorily, a segment with a greater degree and scale of obstruction and/or, acoustically, a segment that is more perceptually distinct. Gestural timing, then, joins magnitude and duration as a means of gauging the nature of a change. The greater degree of overlap and synchronization of the tongue tip and tongue body gestures present in the /l/ + /j/ and /n/ + /j/ sequences therefore evinces fortition. This is not, on the face of it, intuitive, since it goes against the commonly understood motivation for assimilation—easing of articulation either of a segment or of a sequence of segments—and the sequences in question would appear to reflect the assimilation of the sonorant to the palatal's place. We argue, though, that the complexity of the resultant segments and the significant degree of linguopalatal contact, in addition to the precision required of its apical component, suggest a fortified segment. We therefore posit that the close timing of the dorsal and laminal/apical gestures seen in the change of [lj] and [nj] to [ʎ] and [ɲ] reflect a prosodic drive to provide a strong onset. We formalize this with the constraint HarmonicOnset (HOnset) from Baker and Wiltshire (2003) and expand its purview to the gestural level:

(4) HOnset: A stronger onset is a more harmonic onset in terms of gestural magnitude, duration, and/or synchronization.

HOnset thus militates for more harmonic onsets in gestural terms. With it ranked above the Align constraints (5a), the most closely overlapped gestural sequence is the most harmonic (5b), giving rise to the palatal nasal and lateral.

(5) a. HOnset ≻ Align b. ʎ, ɲ ≫ nʲ lʲ, nj lj

The segments /ʎ, ɲ/ have been subject to a degree of "remediation." Widespread *yeísmo* in Western Romance essentially obliterates the lateral portion of /ʎ/, leaving the palatal fricative (or approximant) /ʝ/. Other reflexes involve further fortition to alveopalatal fricatives (e.g., Argentinean /ʃ, ʒ/) or affricates that both minimize linguopalatal contact and produce highly salient strident realizations. The palatal nasal has proven more resilient, though some reanalysis of the segment to [nj] observed in Argentina also serves to resolve their articulatory complexity.

5.2. Interim discussion and conclusions

This account of the advent of the palatals in Spanish reflects a bottom-up approach to grammar: changes at the most basic level of the system stemming from coarticulatory variation among speakers percolate up to affect higher-level organization. In line with current thought concerning the plastic, emergent nature of grammar, once a particular online strategy achieves enough salience in a speech community, it may be adopted by a majority sufficient to ensure that it persists into the "grammar of the moment." In the terms of exemplar theory, a sufficient number of productions arise in the language in everyday use that those productions take on a greater degree of psychological reality for speakers, and new segments arising from those productions become the basis for the underlying representation. Here, speaker variation in the motor processes coordinating the gestural structure of speech sounds eventually leads to the appearance of a new class of sounds: the palatal sonorants [ʎ, ɲ], as well as the alveopalatal affricate [ʧ], and the palatal obstruents [ʝ, ɟ]. These are argued to have arisen as increasing degrees of gestural overlap and blending took place over time and eventually reached a degree of saturation amid the exemplar cloud that enabled them to take on phonological reality for speakers. While a degree of chance surely plays a role in some historical change, we argue that the direction of change here was motivated by prosody (fundamental pressures in the speech act). Indeed, this approach allows for a nuanced look at syllable structure dynamics, as segments in strong positions display a more tightly coordinated gestural array, while weak positions may license less synchronization and thereby a greater tendency toward lenition. The prosodic pressure to strengthen syllable and word onsets is argued here to have driven these originally coarticulatory effects to take on phonological relevance. The increasing degree of synchronization of the laminal and dorsal gestures involved in the /n/ + /j/ and /l/ + /j/ clusters pushed toward the creation of the palatal sonorants. We would argue that syllable-initial clusters -*gl*- and -*kl*- follow suit: the occlusives—perhaps already weakened intervocalically prior to the syncope that created the new clusters—lost their occlusive element, to leave only a tongue body gesture that could be synchronized to the lateral under pressure to more tightly synchronize these gestures.

There are a number of advantages to the current analysis. First, it recognizes a role for production in diachronic change. While a great deal of sound change has been convincingly shown to arise from listener misperceptions and reanalyses such as lexicon optimization, this analysis posits that change may also arise as speakers produce variant sounds in line with mechanical constraints on the articulatory system in the concatenation of segments and the gestures that comprise them. Universally shared articulatory mechanisms allow for grounded, consistent analyses of changes taking place cross-linguistically. This does not undermine listener-based change but rather informs and complements it: some listener reanalysis occurs from the face-value perception of real, phonetically driven cues (cf. Ohala's 1993a *hypocorrection*). Second, this analysis is nonteleological: a bottom-up approach that locates the origins of variation and potential change in the gesture-level mechanics of speech production makes no claims that speakers actively seek to improve the communicativity of language through change. Markedness constraints do indeed target motor activities that may ease production, but with no reference to communication. Under different constraints, new gestural configurations may arise that through repetition are taken up but may suffer ongoing change. Indeed, these processes may create unwieldy, ultimately unviable segments that are reanalyzed over time; consider the further fortition that the palatal lateral undergoes historically to affricates and palatal fricatives. Third, the analysis is phonetically detailed: the focus on articulatory detail allows for a grounded approach. Finally, it is consistent with an emergent, nontargeted view of phonemes and grammar: the phoneme is, within limits, anything displaying or encompassing a particular set of cues; the crystallizing or condensing of the various gestures in the C + yod sequence reflects a prosodic tendency to make strong onsets and consolidate cues for greater articulatory efficiency, even as it may well create segments that prove to be unstable over time.

6. Final remarks

This chapter both summarizes and contributes to a growing body of work that shows that phonological change is often best analyzed by taking into account both the phonetics (articulatory, acoustic, auditory) informing a change and the phonological organization underlying it. Early representations of segments and their constituent features remain pertinent even as current frameworks (OT, DT) integrate an increasing degree of phonetic detail and recognize the origins of much change in language use and speaker interaction. Some change nevertheless remains best understood in light of the systemic relationships within a grammar rather than in terms of discrete, piecemeal processes. The reconciliation of synchronic effects and diachronic change also continues apace, positing cohorts of surface variants competing for primacy over time, with historical language change modeled as successive synchronies. The analyses sketched here highlight the role of both articulatory (the emergence of Spanish palatal sonorants) and acoustic phonetics (e.g., the evolution of the Medieval Spanish sibilant inventory) in understanding language change and underscore the importance of the phonetics ~ phonology interface. We expect that future research will continue along these lines and alongside ongoing developments in frequency- and exemplar-based models and, beyond phonology, sociolinguistic frameworks.

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24

The historical emergence of Spanish palatal consonants

André Zampaulo

1. Introduction

The history of Romance languages showcases a wealth of evolutionary pathways taken by their vowel and consonant inventories from shared roots in Latin. In particular, the emergence of the palatal order of consonants is of utmost interest for historical linguists working with this language family, since it is well known that Latin displayed only labial, dento-alveolar, and velar consonants (Vincent 1988: 29). Thus, the emergence of palatals represents a phonological innovation that is critical to understanding the current composition and manifestation of the consonant inventories of Romance languages. Because of their variability, complexity, and, in many respects, unique diachronic paths, Spanish palatals constitute a challenging case study worth the attention of Romance and general linguists alike.

This chapter reviews the origins of such segments and presents a formal account that builds on the insights of previous proposals. Specifically, it provides a constraint-based analysis that focuses on the initiation of a change event during the interaction between a speaker and a listener-turned-speaker in spoken communication. A sound change is formalized as the difference in constraint ranking between the faithful realization of the speaker's input and the listener-turned-speaker's reanalysis (as input) of one of the unfaithful realizations to the original speaker's input. It is important to note that the word 'palatal' in the present analysis is used as a cover term for a range of sounds whose passive place of articulation includes not only the palate itself but also the postalveolar region. As such, the emergence of sonorants [ʎ, ɲ] and obstruents [ɟ, ʝ, ʒ, ʃ, tʃ] in the history of Spanish will be discussed. Historical data are gathered from Menéndez Pidal (1968, 1977), Lapesa (1981), Lloyd (1987), Penny (2002), Ariza (2012), and Alkire and Rosen (2010).

This chapter is organized as follows. Section 2 provides an overview of the historical data and sources of the aforementioned sounds. Section 3 summarizes key issues raised in previous proposals, while Section 4 presents a formal account of the emergence of Spanish palatals. Section 5 offers concluding remarks.

2. Historical background and data

2.1. The emergence of palatal sonorants

With regard to the palatal lateral [ʎ], the documented chronological development of its Latin sources, coupled with the various results they produced in the history of both Western and Eastern Romance languages, allows us to characterize its emergence within two separate stages in the history of Spanish, namely a first stage [ʎ] (henceforth ʎ$_1$)—assumed to have appeared already in spoken Latin, given its documentation in the history of nearly all Romance languages—and a second stage [ʎ] (henceforth ʎ$_2$), whose scope is limited to a few languages in the Romance-speaking world. While the evidence for the presence of ʎ$_1$ in the history of Spanish is rather scarce, the overwhelming evidence from other Romance languages strongly supports the reconstruction of this consonant at some point in the development of Proto-Spanish. Its emergence, then, would have stemmed from the palatalization of an alveolar lateral [l] by assimilation to a palatal glide [j] and from the evolution of intervocalic [-k.l-, -g.l-], which are assumed to have been heterosyllabic after the loss of intertonic U from the Latin sequences -CUL-, -GUL- (Menéndez Pidal 1977: 47, 159; Ariza 2012: 27, 34). The velar consonants in the latter sequences would have vocalized into a palatal glide [j], which, in turn, would have palatalized the following lateral [l]. The data in (1) exemplifies the emergence of ʎ$_1$ in Proto-Spanish.

(1)	Latin	Proto-Spanish	Modern Spanish	
	A[lj]ENU >	**a*[ʎ]*eno*	(> *a*[x]*eno*)	'foreign, alien'
	A[lj]U >	**a*[ʎ]*o*	(> *a*[x]*o*)	'garlic'
	CI[lj]A >	**ce*[ʎ]*a*	(> *ce*[x]*a*)	'eyebrow'
	FI[lj]U >	**fi*[ʎ]*o*	(> *fi*[x]*o*)	'son'
	FO[lj]A >	**fo*[ʎ]*a*	(> *fo*[x]*a*)	'leaf'
	ME[lj]ORE >	**me*[ʎ]*ore*	(> *me*[x]*ore*)	'better'
	MU[lj]ERE >	**mu*[ʎ]*ere*	(> *mu*[x]*ere*)	'woman'
	PA[lj]A >	**pa*[ʎ]*a*	(> *pa*[x]*a*)	'straw'
	TA[lj]ARE >	**ta*[ʎ]*are*	(> *ta*[x]*are*)	'to cut'
	API[k.l]A >	**abe*[ʎ]*a*	(> *abe*[x]*a*)	'bee'
	LENTI[k.l]A >	**lente*[ʎ]*a*	(> *lente*[x]*a*)	'lentil'
	NOVA[k.l]A >	**nava*[ʎ]*a*	(> *nava*[x]*a*)	'knife, razor'
	ORI[k.l]A >	**ore*[ʎ]*a*	(> *ore*[x]*a*)	'ear'
	O[k.l]U >	**o*[ʎ]*o*	(> *o*[x]*o*)	'eye'
	VERMI[k.l]U >	**berme*[ʎ]*o*	(> *berme*[x]*o*)	'bright red'
	VE[k.l]U >	**vie*[ʎ]*o*	(> *vie*[x]*o*)	'old'
	COA[g.l]U >	**coa*[ʎ]*o*	(> *coa*[x]*o*)	'curdling'
	RE[g.l]A >	**re*[ʎ]*a*	(> *re*[x]*a*)	'plowshare'
	TE[g.l]A >	**te*[ʎ]*a*	(> *te*[x]*a*)	'tile'

As for ʎ$_2$, its emergence is due to the palatalization of the Latin lateral geminate [-lː-] and the evolution of word-initial obstruent and lateral clusters [pl-, kl-, fl-] in some words, where the lateral would have palatalized and remained as the initial consonant after the obstruents were eventually dropped. The data in (2) illustrates the emergence of ʎ$_2$ in Spanish.

(2)	Latin	Modern Spanish	
	[pl]AGA >	[ʎ]*aga* (> [ɟ]*aga*)	'wound'
	[pl]ANU >	[ʎ]*ano* (> [ɟ]*ano*)	'plain'
	[pl]ANCTU >	[ʎ]*anto* (> [ɟ]*anto*)	'lament'
	[pl]ANTA >	[ʎ]*anta* (> [ɟ]*anta*)	'wheel rim'
	[pl]ENU >	[ʎ]*eno* (> [ɟ]*eno*)	'full'
	[pl]ICARE >	[ʎ]*egar* (> [ɟ]*egar*)	'to arrive'
	[pl]ORARE >	[ʎ]*orar* (> [ɟ]*orar*)	'to cry'
	[pl]UVIA >	[ʎ]*uvia* (> [ɟ]*uvia*)	'rain'
	[kl]AMARE >	[ʎ]*amar* (> [ɟ]*amar*)	'to call'
	[kl]AUSA >	[ʎ]*osa* (> [ɟ]*osa*)	'enclosed field'
	[kl]AVE >	[ʎ]*ave* (> [ɟ]*ave*)	'key'
	[fl]AMMA >	[ʎ]*ama* (> [ɟ]*ama*)	'flame'
	[fl]ORETU >	[ʎ]*oredo* (> [ɟ]*oredo*)	(toponym)
	ANE[lː]U >	*ani*[ʎ]*o* (> *ani*[ʝ]*o*)	'ring'
	BE[lː]U >	*be*[ʎ]*o* (> *be*[ʝ]*o*)	'beautiful'
	CABA[lː]U >	*caba*[ʎ]*o* (> *caba*[ʝ]*o*)	'horse'
	CAPI[lː]U >	*cabe*[ʎ]*o* (> *cabe*[ʝ]*o*)	'hair'
	CASTE[lː]U >	*casti*[ʎ]*o* (> *casti*[ʝ]*o*)	'castle'
	GA[lː]U >	*ga*[ʎ]*o* (> *ga*[ʝ]*o*)	'rooster'
	MEDU[lː]UM >	*meo*[ʎ]*o* (> *meo*[ʝ]*o*)	'marrow'
	PO[lː]U >	*po*[ʎ]*o* (> *po*[ʝ]*o*)	'chicken'
	STE[lː]A >	*estre*[ʎ]*a* (> *estre*[ʝ]*a*)	'star'
	VA[lː]E >	*va*[ʎ]*e* (> *va*[ʝ]*e*)	'valley'

Ariza (2012: 204) points out that the palatalization of Latin intervocalic [-lː-] must be a relatively late phenomenon in the history of Spanish, since it is not observed in the evolution of all Ibero-Romance languages. Furthermore, the fact that the evolution of [-lː-] into [ʎ] does not merge with the reflexes of Latin word-initial [pl-, kl-, fl-] in all words provides us with further motivation to separate $ʎ_2$ from the earlier, pan-Romance $ʎ_1$.

(3)	Latin	Modern Spanish	
	ARA[nj]A >	*ara*[ɲ]*a*	'spider'
	CU[nj]A >	*cu*[ɲ]*a*	'wedge'
	HISPA[nj]A >	*Espa*[ɲ]*a*	'Spain'
	PI[nj]A >	*pi*[ɲ]*a*	'pineapple'
	SE[nj]ORE >	*se*[ɲ]*or*	'sir'
	SOM[nj]U >	*sue*[ɲ]*o*	'dream, sleep'
	VI[nj]A >	*vi*[ɲ]*a*	'vineyard'
	A[nː]U >	*a*[ɲ]*o*	'year'
	CA[nː]A >	*ca*[ɲ]*a*	'cane'
	GRU[nː]IRE >	*gru*[ɲ]*ir*	'to growl'
	PA[nː]U >	*pa*[ɲ]*o*	'cloth'
	INSI[ɡ.n]ARE >	*ense*[ɲ]*ar*	'to teach'
	LI[ɡ.n]A >	*le*[ɲ]*a*	'firewood'
	PU[ɡ.n]U >	*pu*[ɲ]*o*	'fist'
	SI[ɡ.n]A >	*se*[ɲ]*a*	'sign'
	STA[ɡ.n]ARE >	*resta*[ɲ]*ar*	'to stanch'
	STA[ɡ.n]U >	*esta*[ɲ]*o*	'tin'
	TAN MA[ɡ.n]U >	*tama*[ɲ]*o*	'size'

With regard to the palatal nasal [ɲ], its main historical sources are the palatalization of an alveolar nasal [n] followed by a palatal glide [j], the palatalization of Latin nasal geminate [nː], and the evolution of the intervocalic sequence [-ɡ.n-], where the velar consonant would have vocalized into a palatal glide [j], which, in turn, palatalized the following nasal [n]. The data in (3) illustrates the emergence of [ɲ] in Modern Spanish.

In some cases, the palatal nasal [ɲ] has also evolved from the Latin sequence [ŋ.ɡl], such as in SI[ŋ.ɡl]ARIU > *se*[ɲ]*ero* 'lone' and U[ŋ.ɡl]LA > *u*[ɲ]*a* 'nail'. Likewise, scholars have also questioned the nature of the Latin pronunciation of -GN-, arguing that it may have been realized as [ŋn] (cf. Lloyd 1987: 140; Wireback 2010). It is possible, then, that the emergence of [ɲ] may not have stemmed solely from the palatalization of alveolar [n] by a surrounding palatal glide [j] in all instances.

2.2. *The emergence of palatal obstruents*

With regard to the palatal obstruents [ɟ, ʝ, ʒ, ʃ, tʃ], their origins and emergence in the history of Spanish are, in many ways, interconnected with those of ʎ$_1$ and ʎ$_2$. The obstruent [ɟ] arose from multiple Latin sources, mainly from [j-, -dj-, -ɡj-, -jː-, ɡé-, ɡí-, έ-], and also from [-bj-] in a handful of cases, as illustrated in (4).

(4)	Latin	Modern Spanish	
	[j]AM >	[ɟ]*a*	'already'
	[j]ACET >	[ɟ]*ace*	's/he lies'
	[j]ACOBE >	[ɟ]*agüe*	(anthroponym)
	[j]UGU >	[ɟ]*ugo*	'yoke'
	[j]UNCTA >	[ɟ]*unta*	'yoke of oxen'
	PO[dj]U >	*po*[ɟ]*o*	'hill, bench'
	RA[dj]ARE >	*ra*[ɟ]*ar*	'to scratch, score'
	EXA[ɡj]U >	*ensa*[ɟ]*o*	'essay'
	FA[ɡj]A >	*ha*[ɟ]*a*	'beech tree'
	FU[ɡj]U >	*hu*[ɟ]*o*	'I escape'
	MA[jː]ORE >	*ma*[ɟ]*ore*	'greater'
	[ɡé]NERU >	[ɟe]*rno*	'son-in-law'
	[ɡé]LAT >	[ɟe]*la*	'freezes'
	[ɡé]MMA >	[ɟe]*ma*	'yoke'
	[ɡí]PSU >	[ɟe]*so*	'plaster'
	[έ]QUA > [jé]*gua* >	[ɟ]*egua*	'mare'
	[έ]RBA > [jé]*rba* >	[ɟ]*erva*	'grass'
	HA[bj]A >	*ha*[ɟ]*a*	'there is/are-Pres. Subj.'
	FO[bj]A >	*ho*[ɟ]*a*	'hole'

The fricative [ʝ] emerged subsequently from a contextual lenition process incurred by [ɟ], particularly after a vowel and a fricative consonant, and from the delateralization process that ʎ$_2$ began to incur around the late 16th century.

As for the voiced postalveolar fricative [ʒ], its emergence plays a crucial role in the development of palatal consonants because it derives from the evolutionary pathways of

λ_1 as well as from most Latin words with initial [j-]. In particular, word-initial [j-] evolved into [ʒ] when followed by a back vowel. By the 16th century, [ʒ] had undergone a devoicing process with all of the other sibilant fricatives in Spanish (cf. Joos 1952; Kiddle 1977) and thus gave rise to its voiceless counterpart [ʃ], which subsequently became the velar [x] around the 17th century. The examples in (5) illustrate the emergence of [ʒ] and its devoicing into [ʃ].

(5)	Latin	Proto-Spanish	16th c. Spanish	Modern Spanish	
	[j]OCU >	[ʒ]*uego* >	[ʃ]*uego*	(> [x]*uego*)	'game'
	[j]OVIS (-DIE) >	[ʒ]*ueves* >	[ʃ]*ueves*	(> [x]*ueves*)	'Thursday'
	[j]UDAEU >	[ʒ]*udío* >	[ʃ]*udío*	(> [x]*udío*)	'Jewish'
	[j]UDICARE >	[ʒ]*uzgar* >	[ʃ]*uzgar*	(> [x]*uzgar*)	'to judge'
	[j]UDICE >	[ʒ]*uez* >	[ʃ]*uez*	(>[x]*uez*)	'judge'
	[j]UNCU >	[ʒ]*unco* >	[ʃ]*unco*	(> [x]*unco*)	'reed'
	[j]USTU >	[ʒ]*usto* >	[ʃ]*usto*	(> [x]*usto*)	'just, fair'
	[j]UNIU >	[ʒ]*uño* >	[ʃ]*uño*	(> [x]*uño*)	'June'
	[j]UNCTU >	[ʒ]*unto* >	[ʃ]*unto*	(> [x]*unto*)	'joined'
	[j]URARE >	[ʒ]*urar* >	[ʃ]*urar*	(> [x]*urar*)	'to swear'
	[j]UVENE >	[ʒ]*oven* >	[ʃ]*oven*	(> [x]*oven*)	'young'
	FI[lj]U > **fi*[ʎ]*u* >	*fi*[ʒ]*o* >	*hi*[ʃ]*o*	(> *hi*[x]*o*)	'son'
	FO[lj]A >**fo*[ʎ]*a* >	*fo*[ʒ]*a* >	*ho*[ʃ]*a*	(> *ho*[x]*a*)	'leaf'
	ME[lj]ORE > **me*[ʎ]*ore* >	*me*[ʒ]*or* >	*me*[ʃ]*or*	(> *me*[x]*or*)	'better'
	MU[lj]ERE > **mu*[ʎ]*ere* >	*mu*[ʒ]*er* >	*mu*[ʃ]*er*	(> *mu*[x]*er*)	'woman'
	O[k.l]U > **o*[ʎ]*o* >	*o*[ʒ]*o* >	*o*[ʃ]*o*	(> *o*[x]*o*)	'eye'
	TE[g.l]A > **te*[ʎ]*a* >	*te*[ʒ]*a* >	*te*[ʃ]*a*	(> *te*[x]*a*)	'tile'

Additional sources also gave rise to the voiceless fricative [ʃ], namely the heterosyllabic intervocalic sequence [k.s] (the velar segment of which first vocalized into [j], which, in turn, palatalized the following [s]) and the palatalization of word-medial [sː] by [j], alongside word-initial [s-] in a handful of words, as shown in (6).

(6)	Latin	16th c. Spanish	Modern Spanish	
	A[k.s]E >	*e*[ʃ]*e*	(> *e*[x]*e*)	'axis'
	DI[k.s]I >	*di*[ʃ]*e*	(> *di*[x]*e*)	'I said'
	MATA[k.s]A >	*made*[ʃ]*a*	(> *made*[x]*a*)	'skein'
	MA[k.s]ILLA >	*me*[ʃ]*illa*	(> *me*[x]*illa*)	'cheek'
	[s]YRINGA >	[ʃ]*eringa*	(> [x]*eringa*)	'syringe'
	[s]ABONE >	[ʃ]*abón*	(> [x]*abón*)	'soap'
	[s]UCU >	[ʃ]*ugo*	(> [x]*ugo*)	'juice'
	BA[sːj]ARE >	*ba*[ʃ]*ar*	(> *ba*[x]*ar*)	'to lower'
	RU[sːj]U >	*ro*[ʃ]*o*	(> *ro*[x]*o*)	'red'

Finally, the affricate [tʃ] emerged from multiple sources, namely from the heterosyllabic intervocalic sequences [-k.t-] and [-l.t-] in most cases (following the vocalization of coda [k] and [l] into [j] and the subsequent palatalization of [t]) and also from the evolution of the consonant clusters [pl, kl, fl] in word-medial position after a nasal or fricative consonant, as illustrated in (7).

(7)	Latin	Modern Spanish	
	DIRE[k.t]U >	*dere*[tʃ]*o*	'straight'
	FA[k.t]U >	*he*[tʃ]*o*	'fact'
	LA[k.t]E >	*le*[tʃ]*e*	'milk'
	LU[k.t]A >	*lu*[tʃ]*a*	'fight'
	NO[k.t]E >	*no*[tʃ]*e*	'night'
	STRI[k.t]U >	*estre*[tʃ]*o*	'narrow'
	MU[l.t]U >	*mu*[tʃ]*o*	'much'
	CU[l.t]ELLU >	*cu*[tʃ]*illo*	'knife'
	AM[p.l]U >	*an*[tʃ]*o*	'broad'
	IM[p.l]ERE >	*hen*[tʃ]*ir*	'to fill'
	CON[k.l]AVARE >	*con*[tʃ]*abar*	'to link'
	IN[f.l]ARE >	*in*[tʃ]*ar*	'to inflate, swell'
	*MAN[k.l]A >	*man*[tʃ]*a*	'stain'
	*MAS[k.l]U >	*ma*[tʃ]o	'male'

3. Previous perspectives on critical issues

While a comprehensive literature review on the evolution of Spanish palatals is impractical due to space limitations, a few remarks on key issues raised in previous accounts are in order. The emergence of new palatal consonants due to the effects of a palatal glide or vowel on adjacent [t, d, s, l, n, ɡ] should not offer much controversy from an articulatory standpoint. However, the sources and pathways of palatalization of other sequences are not as straightforward and thus are worth considering before embarking on a formal account. In the case of [-k.l-, -ɡ.l-] > ʎ$_1$, for example, the most generalized view is held by Romanists and language historians such as Menéndez Pidal (1968), Lapesa (1981), Lloyd (1987), and Penny (2002), among others. According to this view, both [k] and [ɡ] were left in coda position after the syncope of [u] in the original Latin sequences -CUL- and -GUL- and weakened into *[x] and *[ɣ], respectively, before further vocalizing into a palatal glide *[j]: i.e. [-k.l-, -ɡ.l-] > *[-x.l-, -ɣ.l-] > *[-j.l-]. The resulting glide then would have palatalized the adjacent lateral [l] and given rise to [ʎ]. The main argument for these stages derives from a similar pathway taken by other consonant groups in Hispano- and Luso-Romance, such as [-k.s-] and [-k.t-], as previously mentioned, which in many words gave rise to the affricate [tʃ].

This view, however, presents potential problems that have been further explored by other scholars. Wireback (1997), for example, proposes that [-k.l-, -ɡ.l-] were both tautosyllabic (i.e. [-kl-, -ɡl-]) and first evolved into the sequences *[-kʎ-, -ɡʎ-] in all Romance varieties. Both velar consonants would then have eroded due to lenition in Ibero-Romance until they finally disappeared, leaving [ʎ] as a result in intervocalic position. Wireback centers his proposal on two hypotheses: (i) [k] and [ɡ] most likely would *not* have been in coda position after the syncope of [u] but would have been resyllabified instead with the following lateral and formed the syllable onsets [kl] and [ɡl], and (ii) by assuming that [kl] (in both word-initial and word-medial position) evolved into a putative *[kʎ], then the same evolution would have to be proposed for [-ɡ.l-].

A few problems are at hand with proposing *[kʎ, ɡʎ] as an initial stage for both Western and Eastern Romance. For example, word-initial [kl-, ɡl-] and word-medial, postconsonantal [-Ck.l-, -Cɡ.l-] never palatalized in French and Catalan (cf. CLAVE > French *clé*, Catalan *clau* 'key'; MASCULU > French *mâle*, Catalan *mascle* 'male'). If one accepts Wireback's proposal, then one would also need to suggest the emergence of *[kʎ-, gʎ-, -Ckʎ-, -Cɡʎ-] in these languages and propose an additional ad hoc mechanism of depalatalization, whereby these sequences would have gone back to their original state in such languages. Given the available evidence, these additional steps would seem counterintuitive and unlikely. Foreseeing this criticism, Wireback argues that the reason Latin [kl-, ɡl-] did not palatalize in French and Catalan is because word-medial [-Ckl-, -Cɡl-] never palatalized either; therefore, the latter could "not transmit the palatalized variants to the Latin groups" (Wireback 1997: 87). However, no explanation is offered as to why the latter did not palatalize in those languages in the first place. Furthermore, Wireback's proposal excludes the fact that in some varieties of Italo- and Balkan Romance, such as Italian and Romanian, intervocalic [-k.l-] most likely did palatalize into *[-kʎ-] (cf. AURIC(U)LA > Italian **ore*[k.kʎ]*o* > *ore*[k.kj]*o*, Romanian **ure*[kʎ]*e* > **ure*[kj]*e* > *ure*[c]*e* 'ear'), but intervocalic [-ɡ.l-] remained unchanged or never emerged (cf. TEG(U)LA > Italian *te*[ɡol]*a*, Romanian *ți*[ɡl]*ă* 'tile'). The most accepted proposal of velar obstruent vocalization in the intervocalic sequences [-k.l-, -ɡ.l-], by Menéndez Pidal (1968) and others, thus still proves to be the most likely diachronic path. Assuming that degrees of lenition, such as obstruent voicing and spirantization, eventually affected obstruents in postvocalic environments, it is conceivable that at some point [-k.l-] (< -CUL-) might have voiced into *[-ɡ.l-] and then followed a similar (albeit not coetaneous) evolution to that of original [-ɡ.l-] (< -GUL-) in Western Romance, namely by spirantizing into *[-ɣ.l-] and eventually vocalizing into *[j.l].

Another complex issue in the historical phonology of Spanish represents the change of Latin initial groups [pl-, kl-, fl-] into $ʎ_2$. Lloyd (1987: 224) points out that [pl-, kl-, fl-] appeared in a great variety of Latin words, which gave rise to multiple results mirroring "a number of different linguistic forces [. . .] affecting their development." Lausberg (1965: 332–335), on the other hand, indicates that the lateral segment of those clusters probably had a different pronunciation in some areas, which then could have given rise to different evolutionary patterns. By considering data from Italian and Romanian, Lloyd (1987: 224–225) suggests that this "different pronunciation" was, indeed, a palatalized lateral, which initially resulted from the coarticulation between [k] and [l]. Given that in Romanian only [kl-] incurs some type of change, Lloyd (1987: 224–225) and Repetti and Tuttle (1987: 57) hypothesize an initial set of [pl-, kʎ-, fl-] clusters, with the palatal lateral of [kʎ] later spreading to the other groups by phonetic analogy (Tuttle 1975: 407–408). Although the authors do not provide any concrete evidence for the proposed stage */kʎ/ in Spanish, they suggest that [pʎ-, kʎ-, fʎ-] are still found in Upper Aragonese, which is "known for its preservation of other archaic features" (Lloyd 1987: 225). Indeed, Echenique Elizondo and Sánchez Méndez (2005: 152) report the occurrence of such clusters in Medieval Upper Aragonese, in words such as *pllano* 'plain' (< PLANU), *cllau* 'key' (< CLAVE), *fllama* 'flame' (< FLAMMA), etc. In Modern Upper Aragonese, however, these pronunciations are kept only in the region of Ribagorza, while in other areas the lateral consonant tends to vocalize, e.g. [pʎ]*orá* > [pj]*orá* 'to cry' (Martín Zorraquino and Fort Cañellas 1996: 300). Recently, Müller and Mota (2009: 1698) tested the palatalization of /l/ when preceded by stop consonants using experimental data from speakers of Catalan and Occitan. Their results confirm the hypothesis that velar plosives favor /l/-palatalization in onset clusters more than labial plosives, as "velar + lateral and velar + yod clusters may resemble each other during the first few milliseconds of the sound." The results of this study provide, then, preliminary experimental evidence for Lloyd's (1987) and Repetti and Tuttle's (1987) hypothesis. This scenario is particularly revealing when one considers comparative evidence from Italo- and Gallo-Romance areas, where in those languages and dialects in which /pl-, fl-/ palatalize, so does /kl-/; however, the opposite does not occur; i.e., in languages where /kl-/ palatalizes, one does not necessarily observe the palatalization of /pl-, fl-/, such as in the case of Romanian.

In the next evolutionary stage of *[pʎ, kʎ, fʎ], Penny (2002: 71) argues that the initial obstruent consonants assimilated to the following [ʎ] and eventually disappeared. Lloyd (1987: 225), on the other hand, maintains that the obstruents were simply dropped in Old Spanish due to the heavy articulatory nature of the clusters. Further evidence from documents of the 11th and 12th centuries may present a more revealing explanation that takes into account the process of obstruent lenition. Menéndez Pidal (1968: 238) cites cases of orthographic representations indicating that the voiceless stops in /pl-/ and /kl-/ may have weakened their pronunciation by that period, e.g. *flausa* (< CLAUSA), *flano* (< PLANU), *aflamare* (< ADCLAMARE). Indeed, Torreblanca (1990: 319–324) points out confusion of CL- with FL- and PL- in Leonese (e.g. CLAUSA > *plosa*, *flausa*, *flosa*), which leads to the proposal that [kʎ-] started to be first pronounced as [pʎ-]. Once [kʎ-] changed to [pʎ-], Old Spanish would have the sequences [pʎ-, fʎ-]. Tuttle (1975: 408–409) then connects the simplification of [pʎ-, fʎ-] into [ʎ-] as part of—and in a similar fashion to—the general weakening and loss of word-initial [f-]: the voiceless plosive [p] would first have lenited into a bilabial fricative *[ɸ] and then into a glottal fricative [h], coinciding with the debuccalization of prevocalic initial [f-], as in [f] > [h] > Ø (cf. FILIU > *hijo* [í.xo] 'son'). Evidence for this proposed evolution of original /pl-/ is found in Leonese toponyms such as *Hllantada*, *Hlantada* (< Latin PLANTATA), where <*H*> seems to suggest some kind of aspirated sound (Torreblanca 1990: 324–325).

Finally, based on Menéndez Pidal's work, many scholars have proposed the direct change ʎ$_1$ > [ʒ] in Old Spanish without providing an explanation for the specific mechanisms that led to this change event. Some have relied on the very articulation of [ʎ], while others have taken into account the functional load of this segment within the overall consonant inventory of Spanish. Lloyd (1987: 44), for example, argues that [ʎ] developed a fricative component in its articulation, while Alonso (1961: 180) considers that such a component is inherent in the pronunciation of [ʎ]. However, other authors endorse the hypothesis that a direct change ʎ$_1$ > [ʒ] took place to prevent the former from merging with ʎ$_2$ (< [pl-, kl-, fl-, lː]). According to this view, the putative fricative component of ʎ$_1$—which should have been nondistinctive until then—would have emerged as distinctive between the two palatal laterals. Although such an account seems feasible and can fit the Old Spanish data well, it fails to provide a reason for the merger between ʎ$_1$ and ʎ$_2$ in other Ibero-Romance varieties, such as Catalan, Navarro-Aragonese, and a few dialects of Leonese (cf. Lapesa 1981: 159). Thus, it is difficult to argue for a direct change from [ʎ] to [ʒ] with no intermediate steps, despite the hypothesis that if ʎ$_1$ had delateralized into *[j] or *[ʝ] first, it would have *necessarily* merged with its coetaneous [ɟ]. Zampaulo (2013), however, provides chronological, comparative, and dialectal evidence to argue that the palatal lateral resulting from [-lj-, -k.l-, -ɡ.l-] likely followed an evolution similar to that of [ʎ] resulting from [pl-, kl-, fl-, -lː-], namely with a loss of laterality and the development of a central palatal segment that crucially preceded the change toward [ʒ] in Old Spanish, while still maintaining a phonological contrast with the coetaneous palatal obstruent [ɟ]. More specifically, the author points out that the delateralization of [ʎ] is the most common evolutionary step in the diachrony and synchrony of Romance varieties, including dialects of contemporary Spanish (cf. Colantoni (2004) for Corrientes Spanish and Caravedo (1995, 2013) for Amazonian Peruvian Spanish). Thus, it is reasonable to suggest that ʎ$_1$ likely did not change directly to [ʒ] in Old Spanish but incurred a delateralization process similar to its diachronic and synchronic counterparts in many parts of the Romance-speaking world.

4. The emergence of Spanish palatal consonants: a phonetically based formal proposal

The emergence of palatal consonants in the history of Spanish has been the subject of different theoretical accounts. Due to the unfeasibility of reviewing them all in this contribution, the reader is referred to a sample deemed thorough in their proposals and treatment of the data under the Optimality Theory (OT) machinery, including Holt (1997, 2003) and Baker (2004). What follows is a constraint-based account of the emergence of palatals modeled on the role of the speaker and the listener-turned-speaker in the initiation of sound change, following Ohala's (1981, 1989, 2012) notion of reanalysis by hypo- and hypercorrection and taking into account articulatory patterns and differences in constraint ranking.

From the consonants that are palatalized due to the effect of [j], let us take alveolar [l] as an example, while assuming that a similar palatalization process takes place with other consonants. Considering the articulatory characteristics of both [l] and [j], it is possible that a regressive place assimilation process may take place, which eventually leads to palatalization of [l] in the sequence [lj]. If the listener fails to interpret the acoustic effect of such palatalization as how the speaker intended it to be (i.e. two segments, [l] + [j]), the listener may eventually interpret it as one segment, e.g. [ʎ]. This reanalysis represents not only one of the mechanisms for the historical emergence of [ʎ] but also a process that is still productive, as suggested by regular orthographic mistakes by native speakers of Spanish and Portuguese, such as *familla* (cf. standard Spanish *familia* 'family') and *familha* (standard Portuguese *família* 'family') (Lipski 1989; Stein 2011).

To provide a formal account of this process, let us first assume that the interaction between [l] and [j] may be perceived by the listener as regressive place assimilation when the articulatory effort to produce the target consonant [l] incurs at least some degree of gestural weakening in the speaker's production of [lj]. Speakers' weakening of an articulatory gesture—which may or may not lead to place assimilation—follows from the conflict between two opposing forces, namely ease of articulation and ease of perception (Lindblom 1983). The minimization of effort during sound production conflicts with the maintenance of redundant perceptual cues that ensure the transmission of information in spoken language. This conflict is widely attested in the literature (cf. Martinet 1955; Kirchner 2001, 2004; Flemming 2002, 2004, etc.). To formalize the drive to ease articulation in the current analysis, I invoke Jun's (2004: 70–71) constraint family WEAKENING, as defined in (8):

(8) WEAK(ENING): Conserve articulatory effort in the production of a segment.

As WEAK constraints militate for the minimization of articulatory effort, violations of these constraints are evaluated according to the effort cost incurred by the articulation of a given candidate. In order to measure articulatory effort—and thus account for both complete and partial gestural reduction—Jun (2004: 80) subdivides WEAK into continuous constraints that reveal the possibility of a gradient weakening of gestures, as stated in (9):

(9) WEAK(ENING)_m: Do not produce an articulatory gesture whose effort cost is at least *m*.

Assuming that the drive to lenite more effortful gestures is stronger than the drive to lenite easier ones (Kirchner 2001, 2004), the fixed ranking of constraints follows from the most effortful (i.e. complete gestures) to the least effortful, as represented in (10) (Jun 2004: 80):

(10) $\text{WEAK}_{1x} >> \text{WEAK}_{0.9x} >> \text{WEAK}_{0.8x} \ldots >> \text{WEAK}_{0.5x} \ldots >> \text{WEAK}_{0.1x}$,

where *1x* represents the effort cost for the *complete gesture* of a segment, *0.9x* represents the effort cost of *nine-tenths* of a complete gesture, etc. The "complete gesture" of a segment is assumed to represent 100% of the phonetic realization of the input. WEAK constraints may apply to different gestures, such as tongue tip, tongue body, glottal gesture, etc. I extend Jun's (2004) model, however, by proposing that WEAK can also make reference to gestures in different syllabic positions, such as onset and coda, in line with positional markedness and faithfulness models well known in the OT literature (e.g. Steriade 1995; Beckman 1999; Lombardi 1999; Walker 2001). For example, candidates that present the effort of a complete gesture of their input segment in coda position will incur one violation of $\text{WEAK}_{1x(\text{coda})}$. Thus, while the constraint family WEAK represents a force toward conserving articulatory effort in gestures through a fixed ranking, its gradient nature helps us to account for cases of partial gestural reduction (as opposed to complete gestural elimination), especially in cases of partial place assimilation. However, the drive to conserve articulatory effort conflicts with the push for maintenance of the perceptual cues of input segments. In Jun's model, this force is formalized in the Faithfulness constraint family PRESERVE, as defined in (11):

(11) PRES(ERVE): Preserve perceptual cues of input segments.

PRES militates for a maximal preservation of input cues, such as those related to place of articulation, manner of articulation, voice, etc. The preservation of cues may also present a gradient character, which motivates the possibility of a further subdivision of PRES into continuous constraints, as stated in (12):

(12) PRES(ERVE)_n: Preserve at least *n* percent of the perceptual cues of input features.

In (12) *n* represents a percentage between 100 (i.e. maximal preservation of input cues) and 1 (i.e. minimal preservation of input cues), as illustrated in (13):

(13) PRES_{100} >> PRES_{99} >> PRES_{98} . . . >> PRES_{75} . . . >> PRES_{1}

For example, $\text{PRES}_{100(\text{place})}$ requires the preservation of 100% of the place cues from an input segment (which entails their complete gesture), while $\text{PRES}_{99(\text{place})}$, $\text{PRES}_{98(\text{place})}$ . . . $\text{PRES}_{1(\text{place})}$ involve the preservation of a lower percentage of place cues.

Thus, in the interaction between WEAK and PRES, WEAK_{1x} is expected to be in direct conflict with PRES_{100}, as the former militates against the complete gesture of segments, which, in turn, would preserve all segment cues, hence satisfying PRES_{100}. Therefore, it becomes impossible to satisfy both constraints at the same time, and one of them must outrank the other. In the case of regressive place assimilation, WEAK outranks $\text{PRES}_{(\text{place})}$. However, because the manner cues of the input segment are maintained, this means that $\text{PRES}_{(\text{manner})}$ must outrank both WEAK and $\text{PRES}_{(\text{place})}$, as formalized in the following ranking: {PRESERVE constraints for manner cues} >> WEAKENING >> {PRESERVE constraints for place clues} (Jun 2004: 72).

In the specific case of the interaction between [l] + [j], the regressive place assimilation targeting the first segment indicates that $\text{PRES}_{(\text{palatal})}$ and $\text{WEAK}_{1x(\text{alveolar})}$ must outrank $\text{PRES}_{(\text{alveolar})}$. In other words, at least *some* reduction of the alveolar gesture takes place, while the palatal gesture is preserved in the production of /l/ + /j/. To account for the place assimilation of the target consonant [l], I infer that its articulation undergoes *partial* gestural reduction, while still maintaining some degree of its original gesture, which for the present purposes may arbitrarily be set at 75%

(i.e. three-fourths of its articulatory gesture). The constraint ranking in (14) motivates the partial regressive assimilation observed in the speaker's production of /l/ + /j/ as [ʎ]:

(14) PRES$_{100(\text{palatal})}$ …>> PRES$_{75(\text{palatal})}$ …,WEAK$_{1x(\text{alveolar})}$ …>> PRES$_{100(\text{alveolar})}$ …>> PRES$_{75(\text{alveolar})}$ …>> WEAK$_{0.75x(\text{alveolar})}$ . . ., WEAK$_{1x(\text{palatal})}$ . . . >> WEAK$_{0.75x(\text{palatal})}$

Notice that, as the input manner is maintained, PRES$_{(\text{manner})}$ is assumed to be highly ranked and does not appear in (14). The ellipsis indicated assumes lower values of the same constraint family; i.e. "PRES$_{100(\text{palatal})}$ . . . >> PRES$_{75(\text{palatal})}$ . . . " entails all fixed values of PRES$_{(\text{palatal})}$ constraints, from 100 to 1.

The selection of the candidate [ʎ]—one of the possible productions of speakers' /lj/—is illustrated in (15). (The boxes in each candidate represent the articulatory gestures encoding the input place features, while their manner is indicated inside each box. 'TT' refers to the 'tongue tip' gesture, while 'TB' denotes the 'tongue body' gesture. Phonetic symbols represent the acoustic effects of gestures.)

(15)

/l/ + /j/	Articulation	Acoustic effect	PRES (palatal)		WEAK (alveolar)	PRES (alveolar)		WEAK (alveolar)	WEAK (palatal)	
			100	*75*	*1x*	*100*	*75*	*0.75x*	*1x*	*0.75x*
1.	TT lat TB appro	[lj]			*!			*	*	*
2. ☞	TT lat TB appro	[ʎ]				*		*	*	*
3.	TT TB appro	[j]				*	*!		*	*
4.	TT lat TB	[l]	*!	*	*			*		
5.	TT lat TB ap	[lʲ]	*!		*			*		*

In (15), candidate 1 is ruled out for its complete tongue tip gesture, which crucially violates WEAK$_{1x(\text{alveolar})}$. Candidates 4 and 5 are also ruled out because they present a full articulation of the alveolar lateral (hence violating WEAK$_{1x(\text{alveolar})}$) and do not preserve 100% of the cues of input /j/. Thus, they fatally violate PRES$_{100(\text{palatal})}$. On the other hand, candidates 2 and 3 satisfy both PRES$_{(\text{palatal})}$ and WEAK$_{1x(\text{alveolar})}$, so the winner will be determined according to how many of the alveolar cues are preserved. Candidate 2 is then selected as the most harmonic output because it preserves at least 75% of the alveolar cues of the input (hence satisfying PRES$_{75(\text{palatal})}$), while candidate 3 does not and must then be ruled out.

The constraint ranking in (15) represents only *one* of the possible outputs produced by the speaker, and so other outputs are also likely. If /lj/, then, is realized as [ʎ], this means that the speaker produced a segment chosen according to a constraint ranking that differs from the ranking that selects the faithful realization to the input, i.e. that of [lj]. This derives from the inherent unstable nature of constraint rankings (Bernhardt and Stemberger 1998; Morris 1998). If the listener then interprets /ʎ/ as the input from the acoustic signal, it means that the constraint ranking of the faithful realization to the input internalized by the listener is now the constraint ranking of [ʎ], not that of [lj] (whose constraint ranking represents the faithful realization of the original speaker's input). While the speaker then has the input /lj/, the listener internalizes one of the speaker's nonfaithful realizations to the original input /lj/. In this case, the listener internalizes /ʎ/ as the input by virtue of Lexicon Optimization (Prince and Smolensky 2004 [1993]). Therefore, in the present account, the sound change /lj/ > /ʎ/ is captured by a difference in the constraint ranking between the realization that is faithful to the speaker's input and the listener-turned-speaker's interpretation (as input) of one of the speaker's realizations that is unfaithful to the original input, as schematized in (16):

(16) /lj/ > /ʎ/

Speaker's input: /lj/
Faithful output: [lj], determined by $\textsc{Pres}_{(palatal)}$, $\textsc{Pres}_{(alveolar)}$ >> $\textsc{Weak}_{(alveolar)}$, $\textsc{Weak}_{(palatal)}$
Other possible, nonfaithful outputs:
E.g. [ʎ], determined by $\textsc{Pres}_{100(palatal)}$ . . . >> $\textsc{Pres}_{75(palatal)}$ . . ., $\textsc{Weak}_{1x(alveolar)}$ . . . >> $\textsc{Pres}_{100(alveolar)}$ . . . >> $\textsc{Pres}_{75(alveolar)}$ . . . >> $\textsc{Weak}_{0.75x(alveolar)}$ . . ., $\textsc{Weak}_{1x(palatal)}$ . . . >> $\textsc{Weak}_{0.75x(palatal)}$., etc.

Listener's input: /ʎ/
Faithful output: [ʎ], determined by $\textsc{Pres}_{100(palatal)}$ . . . >> $\textsc{Pres}_{75(palatal)}$ . . ., $\textsc{Weak}_{1x(alveolar)}$ . . . >> $\textsc{Pres}_{100(alveolar)}$ . . . >> $\textsc{Pres}_{75(alveolar)}$ . . . >> $\textsc{Weak}_{0.75x(alveolar)}$ . . ., $\textsc{Weak}_{1x(palatal)}$ . . . >> $\textsc{Weak}_{0.75x(palatal)}$ in the original speaker's grammar, which represents an unfaithful realization to the speaker's input /lj/

With regard to the palatalization of lateral geminate /lː/—and, by extension, that of /nː/—Straka (1979: 305) provides evidence that the long duration of this segment may increase the raising of the tongue body, generating a palatal quality to its overall production. This 'palatal quality' in the production of /lː/ is interpreted here as the activation of a tongue body gesture (in addition to the tongue tip gesture in the alveolar region), which may give rise to an actual palatalized lateral [lʲ] that, in turn, may eventually become a fully articulated palatal lateral [ʎ]. Moreover, if we take into account the fact that the duration of Spanish [ʎ] is usually 33% longer than the duration of its alveolar counterpart [l] (Lavoie 2000), it is reasonable to infer that in the palatalization process [lː] > [ʎ], part of the long duration of the original lateral geminate is also preserved. In a formal analysis, palatalized realizations would comply with the constraint $\textsc{Pres}_{duration}$, while the singleton [l] would violate it. A candidate whose acoustic effect is [lʲ] satisfies $\textsc{Pres}_{(duration)}$ and $\textsc{Pres}_{(palatal)}$, although it still violates *some* $\textsc{Pres}_{(alveolar)}$ constraints, as per the reduction of the original tongue tip gesture from the input /lː/. The force to conserve articulatory effort during the production of geminates is formalized here as the constraint $\textsc{Weak}_{(geminate)}$, which will penalize gestures of both the tongue tip (i.e. WEAK$_{\text{(geminate, alveolar)}}$) and the tongue body (i.e. WEAK$_{\text{(geminate, palatal)}}$). The constraint ranking in (17) determines the selection of [lʲ]:

(17) PRES$_{\text{(duration)}}$, PRES$_{\text{(palatal)}}$ >> WEAK$_{1x\text{(geminate, alveolar)}}$ . . . >> WEAK$_{0.8x\text{(geminate, alveolar)}}$ . . . >> PRES$_{100\text{(alveolar)}}$ . . . >> PRES$_{80\text{(alveolar)}}$ . . . >> WEAK$_{0.5x\text{(geminate, alveolar)}}$ . . . >> WEAK$_{0.3x\text{(geminate, alveolar)}}$ . . ., WEAK$_{1x\text{(geminate, palatal)}}$ . . . >> WEAK$_{0.8x\text{(geminate, palatal)}}$

Under this ranking, singletons would fatally violate highly ranked PRES$_{\text{(duration)}}$, while faithful realizations to the input /lː/ would violate higher values of WEAK$_{\text{(geminate, alveolar)}}$. If the listener then interprets the palatal quality in [lʲ] as an inherent characteristic of the lateral in question, then a sound change may occur. In the present analysis, this is captured by the difference in constraint ranking between the faithful realization of the speaker's input (i.e. [lː]) and the listener-turned-speaker's interpretation (as input) of one of the speaker's realizations that is unfaithful to the original input (i.e. [lʲ]). Next, the sequence [lʲ] is free to evolve into [ʎ] along similar lines to the analysis illustrated in (16).

For a different proposal, see Baker (2004: 175), who views the palatalization of /lː/ as a result of his proposed CONDENSE constraint outranking the markedness constraint *PALATAL.

As for the emergence of [tʃ] in word-medial, postconsonantal position, a possible phonetic motivation stems from the cluster containing the velar segment, i.e. [kʎ], assuming the delateralization of [ʎ] in this case and the lack of obstruent lenition due to the consonant preceding the velar segment. Studies have shown that the palatalization of [kj] into [tʃ] is common in the languages of the world (Chang et al. 2001), while a palatalization of labials is less likely. Thus, considering that velar clusters were more frequent than labial clusters (Tuttle 1975), we assume that /pj-, fj-/ followed the evolution of /kj-/ by analogy, hence regularizing all three clusters, which eventually evolved into /tʃ/. Although analogical processes are not formalized here, it is worth illustrating how the palatalization process in /kj/ > /tʃ/ was possible in the first place. By considering the interaction between /k/ and /j/, it is possible to hypothesize a regressive place assimilation, whereby the target segment, i.e. /k/, first fronts its articulation toward the palate, generating the acoustic effect of a voiceless palatal affricate *[c͡ç]. The subsequent fronting of this affricate toward the prepalate would then have represented a stronger pronunciation because of the inherent sibilant character of this region, in which case its realization would have resembled that of a postalveolar affricate [t͡ʃ].

If we consider that consonants in onset position hold great perceptual importance (Beckman 1999; Fougeron and Keating 1997), then we can better understand the motivations for the strengthening of (a nonsibilant) [c͡ç] into (a sibilant) [t͡ʃ-]. Indeed, Baker and Wiltshire (2003: 36–37) propose the constraint HONSET to formalize the force toward making input onsets maximally strong: "HONSET is a gradient constraint that compares the sonority of different candidates [. . .] and militates for candidates of lesser sonority (hence greater strength) in onsets." HONSET is defined in (18):

(18) HONSET: Be strong in onsets (Baker and Wiltshire 2003: 37).

If it is right to assume that a consonant strength hierarchy represents roughly an inverted sonority hierarchy (Lavoie 2000: 213), we are able to establish a fixed gradient ranking for HONSET. For example, if vowels have the highest sonority value and stops have the lowest, we can propose an HONSET ranking as indicated in (19):

(19) HONSET$_{\text{stops}}$ >> HONSET$_{\text{affricates}}$ >> HONSET$_{\text{fricatives}}$ >> HONSET$_{\text{nasals}}$ >> HONSET$_{\text{liquids}}$ >> HONSET$_{\text{glides}}$ >> HONSET$_{\text{vowels}}$

The fixed ranking in (19) captures the tendency for onsets to be obstruents (i.e. stops, affricates, and fricatives). Additionally, if it is right to assume that sibilants are 'stronger' segments than nonsibilants (within a sonority scale), then it is reasonable to subdivide HONSET$_{\text{affricate}}$ into HONSET$_{\text{sib-affricate}}$ and HONSET$_{\text{nonsib-affricate}}$, and HONSET$_{\text{fricative}}$ into HONSET$_{\text{sib-fricative}}$ and HONSET$_{\text{nonsib-fricative}}$, respectively. It is important to note, however, that HONSET can be applied to onsets at different prosodic levels, i.e. in utterance-initial position (HONSET$_{|u}$), word-initial position (HONSET$_{|w}$), foot-initial position (HONSET$_{|f}$), and, last, general syllable-initial position (HONSET: Be a strong onset), regardless of its position within the prosodic hierarchy.

In the present analysis, we can formalize the strengthening process */c͡ç/ > [t͡ʃ] by ranking PRES$_{\text{(manner)}}$ constraints over HONSET and PRES$_{\text{(palatal)}}$, as indicated in (20) and (21):

(20) PRES$_{\text{(stop)}}$, PRES$_{\text{(fricative)}}$ >> HONSET$_{\text{stop}}$ >> HONSET$_{\text{sib-affricate}}$ >> HONSET$_{\text{nonsib-affricate}}$ . . . >> PRES$_{\text{(palatal)}}$

(21)

*/c͡ç/	Articulation	Acoustic effect	PRES (manner)		HONSET			PRES (palatal)	
						affricate			
			stop	*fricative*	*stop*	sib	non-sib	*palatal stop closure*	*palatal fricative release*
1.	TB sto TB fric	[c͡ç]			*	*!			
☞ 2.	TB sto TB fric	[t͡ʃ]			*		*	*	*
3.	TB sto	[c]		*!		*	*		*
4.	TB fric	[ç]	*!		*	*	*	*	

A sound change such as */cç/ > /t͡ʃ/ can then be understood in terms of a difference in constraint ranking between the faithful realization to the speaker's input (i.e. [c͡ç], determined by PRES$_{\text{(manner)}}$, PRES$_{\text{(palatal)}}$ >> HONSET) and the listener-turned-speaker's interpretation (as input) of one of the speaker's realizations that is unfaithful to the original input (i.e. /t͡ʃ/, determined by PRES$_{\text{(stop)}}$, PRES$_{\text{(fricative)}}$ >> HONSET$_{\text{stop}}$ >> HONSET$_{\text{sib-affricate}}$ >> HONSET$_{\text{nonsib-affricate}}$ . . . >> >> PRES$_{\text{(palatal)}}$ in the original speaker's grammar, which represents an unfaithful realization of the speaker's input /c͡ç/).

In the emergence of the palatal obstruent /ɟ/ from word-initial /j-/, we observe a straightforward process of consonantization, by which the glide strengthened and became a noncontinuant segment. This process is determined by the effects of a highly ranked HONSET$_{|w}$. In the present analysis, we motivate this process by ranking PRES$_{\text{(palatal)}}$ over HONSET$_{|w}$, which, in turn, dominates PRES$_{\text{(approximant)}}$ and WEAK, as indicated in (22):

(22) PRES$_{\text{(palatal)}}$ >> HONSET$_{|\text{w stop}}$ . . . >> HONSET$_{|\text{w fricative}}$ . . . >> HONSET$_{|\text{w glide}}$ . . . >> PRES$_{\text{(approx)}}$, WEAK

Given the constraint ranking in (22), we expect the output to preserve the palatal place of articulation of the input /j/, by satisfying PRES$_{\text{(palatal)}}$. Next, we predict the strongest segment in onset position to be a stop, rather than a fricative or a glide, as these would violate HONSET$_{|\text{w stop}}$. Any candidate that does not preserve the manner of the input (i.e. approximant) will violate PRES$_{\text{(approx)}}$, while any reduction in the realization of the input will violate WEAK. The selection of the palatal stop [ɟ-] from the input /j-/ is illustrated in (23).

(23)

/j-/	Articulation	Acoustic effect	PRES (palatal)	HONSET$_{\|\text{w}}$ stop	HONSET$_{\|\text{w}}$ fricative	HONSET$_{\|\text{w}}$ glide	PRES (approx.)	WEAK
1.	TB: appro	[j]		*!	*			*
2.	TB: fric	[ʝ]		*!		*	*	*
☞ 3.	TB: stop	[ɟ]			*	*	*	*

The fortition /j-/ > /ɟ-/ is then formalized as a difference in constraint ranking between the faithful realization of the speaker's input (i.e. [j-], determined by PRES$_{\text{(palatal)}}$, PRES$_{\text{(manner)}}$ >> HONSET$_{|\text{w stop}}$ . . . >> HONSET$_{|\text{w fricative}}$ . . . >> HONSET$_{|\text{w glide}}$ >> WEAK) and the listener-turned-speaker's interpretation (as input) of one of the speaker's realizations that is unfaithful to the original input (i.e. [ɟ-], determined by PRES$_{\text{(palatal)}}$ >> HONSET$_{|\text{w stop}}$ . . . >> HONSET$_{|\text{w fricative}}$ . . .>> HONSET$_{|\text{w glide}}$ . . .>> PRES$_{\text{(approx)}}$, WEAK in the original speaker's grammar, which represents an unfaithful realization of the speaker's input /j-/). A similar evolutionary pathway can be proposed for Latin /ɛ́/ and /-jː-/, as the glide that emerged from the diphthongization of /ɛ́/ into /jé/ and the intervocalic geminate /-jː-/ were both found in onset position.

With regard to the emergence of [ʒ] from the delateralization of $ʎ_1$, it is likely that the emerging glide *[j] may have displayed different degrees of constriction in its articulation, leading to its coexistence with a fricative *[ʝ] in free variation at some point. While the faithful output [j] would be determined by top-ranking PRES$_{\text{palatal}}$ and PRES$_{\text{approx}}$ above all WEAK and HONSET constraints, the selection of the fricative [ʝ], in contrast, would follow from the ranking of PRES$_{\text{(approx)}}$ below WEAK and HONSET constraints, as in (24):

(24) PRES$_{\text{(palatal)}}$ >> WEAK$_{\text{palatal (stop, lateral)}}$ >> HONSET$_{\text{stop, fric, nasal, lateral}}$ >> PRES$_{\text{(approx)}}$

Once the variation between [j] and [ʝ] eventually settles in favor of the fricative, the ranking in (24) becomes more frequent. The subsequent evolution of /ʝ/ into /ʒ/ reveals, then, a fortition process by the acquisition of sibilance, while still preserving its fricative manner. Thus, PRES$_{\text{(manner)}}$ must outrank HONSET$_{\text{stop}}$ and both HONSET$_{\text{sib-fricative}}$ and HONSET$_{\text{nonsib-fricative}}$. Assuming that [ʒ] has a more fronted articulation than [ʝ], it is reasonable to propose that [ʒ] would incur a violation of lowly ranked PRES$_{\text{(place)}}$. The ranking in (25) and the tableau in (26) indicate this scenario.

(25) PRES$_{\text{(manner)}}$ >> HONSET$_{\text{stop}}$ >> HONSET$_{\text{sib-fricative}}$ >> HONSET$_{\text{nonsib-fricative}}$ >> PRES$_{\text{(place)}}$

(26)

/ɟ/	PRES manner	HONSET stop	HONSET fricative		PRES place
			sib	nonsib	
1. [ɟ]		*	*!		
☞2. [ʒ]		*		*	*
3. [ɟ]	*!		*	*	

When the listener interprets /ʒ/ as the input from the acoustic signal, a sound change derives from a difference in constraint ranking between the faithful realization of the speaker's input (i.e. [ɟ], determined by PRES$_{(manner)}$, PRES$_{(place)}$ >> HONSET$_{stop}$ >> HONSET$_{sib\text{-}fricative}$ >> HONSET$_{nonsib\text{-}fricative}$) and the listener-turned-speaker's interpretation (as input) of one of the speaker's realizations that is unfaithful to the original input (i.e. /ʒ/, determined by PRES$_{(manner)}$ >> HONSET$_{stop}$ >> HONSET$_{sib\text{-}fricative}$ >> HONSET$_{nonsib\text{-}fricative}$ >> PRES$_{(place)}$ in the original speaker's grammar, which represents an unfaithful realization of the speaker's input /ɟ/).

Voiced fricatives are, however, inherently more difficult to produce, because "high volume velocity is needed to produce the turbulent noise characteristic of fricatives, and [at the same time] the vibrating vocal cords [generating voicing] impede the flow of air through the vocal tract" (Johnson 2003: 124). Thus, we may infer that during the production of a voiced fricative like [ʒ], the need for turbulence conflicts with the need to maintain voicing. Throughout the evolution of Spanish, this conflict is often resolved in favor of the need for turbulence, the result of which produces the devoicing of fricatives, illustrated in the devoicing of /ʒ/ into /ʃ/ in the diachrony of Spanish, as well as in synchronic varieties such as Rioplatense Spanish. In the present approach, it is possible to formalize the need for the maintenance of voicing as the faithfulness constraint PRES$_{(voicing)}$, which may present gradient values in the same spirit as PRES$_{(place)}$, as indicated in (27):

(27) PRES$_{100(voicing)}$ >> PRES$_{99(voicing)}$ >> PRES$_{98(voicing)}$ . . . >> PRES$_{1(voicing)}$

As the place and manner of articulation in a change such as /ʒ/ > /ʃ/ are preserved, we infer that PRES$_{(place)}$, PRES$_{(manner)}$, and WEAK must all be highly ranked. Thus, it is necessary to bring other constraints that conflict with PRES$_{(voicing)}$, i.e. constraints that militate for the turbulence of noise in fricatives to be voiceless. As Smith (1997) and Widdison (1997) point out, voiceless sibilants tend to be preferred over voiced sibilants, as the former are more perceptually salient because of their longer duration and higher noise intensity. If we recall that consonants are also more perceptually salient in onset position (Beckman 1999), we can conclude that sibilants in that position will tend to be voiceless. I invoke, then, Bradley and Delforge's (2006: 32) markedness constraint σ[s, as formalized in (28):

(28) σ[s: A sibilant in syllable-initial position is [−voice] (Bradley and Delforge 2006: 32).

This constraint militates for sibilants in onset position to be voiceless and thus will rule out any candidates that display some degree of voicing (hence, we expect it to conflict directly with PRES$_{(voicing)}$). As the history of Spanish shows, a voiceless postalveolar [ʃ] emerged from its voiced counterpart. In the present approach, a voiceless realization of input /ʒ/ can be motivated by top-ranking σ[s over PRES$_{(voicing)}$, as indicated in (29):

(29) σ[s >> PRES$_{100(voicing)}$ . . . >> PRES$_{50(voicing)}$

This ranking predicts that any candidate with complete or partial preservation of voicing in the output will be ruled out by highly ranked Σ[s. Thus, [ʃ] should emerge as the selected output, given the dominance hierarchy in (29). The change of /ʒ/ into /ʃ/ is, then, formally captured by a difference in constraint ranking between the faithful realization to the speaker's input (i.e. [ʒ], determined by $\textsc{Pres}_{100(\text{voicing})}$ . . . >> $\textsc{Pres}_{50(\text{voicing})}$ >> σ[s) and the listener-turned-speaker's interpretation (as input) of one of the speaker's realizations that is unfaithful to the original input (i.e. /ʃ/, determined by σ[s >> $\textsc{Pres}_{100(\text{voicing})}$ . . . >> $\textsc{Pres}_{50(\text{voicing})}$ in the grammar of the original speaker, which represents an unfaithful realization of the speaker's input /ʒ/).

5. Concluding remarks

This chapter has considered the emergence of palatal consonants in the history of Spanish and presented a formal analysis of the change processes that gave rise to these segments by invoking a small group of constraints (i.e. Weakening, Preserve, Honset, and σ[s) and assuming the interaction between the speaker and the listener-turned-speaker during spoken communication and their respective roles in the initiation of a change event. Although we acknowledge that not every sound change may be phonetic in nature, the current approach has illustrated how the use of phonetically based constraints helps us capture the inherent gradient character associated with most of the discussed changes. By the same token, it has also shown that the emerging nature of constraints and their (re)ranking can bring together the analysis of both diachronic and synchronic change patterns.

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