Phonological Structure and Variation in Spanish: A Contrastive Hierarchy Approach

by

Matthew Griffin

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The dissertation is approved by the following members of the Final Oral Committee:

Rajiv Rao, Professor, Spanish & Portuguese
Eric Raimy, Professor, English
Fernando Tejedo, Professor, Spanish & Portuguese
Cathy Stafford, Associate Professor, Spanish & Portuguese

For Grandma, Grandpa, and Taco.

Always in my heart.

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Abstract

This dissertation applies the Modified Contrastive Specification (MCS) framework and the Successive Division Algorithm (SDA) to the analysis of Spanish vowel and sonorant systems, with a focus on how contrastive hierarchies can account for dialectal variation. The study establishes canonical contrastive hierarchies for the five-vowel system /i e a o u/ and the major sonorant classes, which serve as baselines for examining dialect-specific reconfigurations.

Drawing on data from multiple varieties, the analysis investigates four primary case studies: velar fronting in Chilean Spanish, uvularization of /x/ in certain Peninsular dialects, glide fricativization in Argentine Spanish, and liquid vocalization and rhotic–lateral neutralization in Caribbean Spanish. Each phenomenon is analyzed in terms of its underlying contrastive structure, showing that variation follows from differences in the ordering, presence, or absence of contrastive features rather than from purely phonetic pressures. The findings demonstrate that MCS, when implemented through the SDA, offers a principled account of cross-dialectal variation by capturing how restructured hierarchies determine which features are phonologically active in specific contexts. This approach underscores the predictive value of contrastive hierarchies for explaining both shared and divergent phonological processes across dialects.

Chapter 1: Introduction

1.1 Framing the Study

Phonological theory seeks to explain how languages organize their sounds, how these sounds contrast to signal differences in meaning, and how abstract mental representations connect to physical articulation (Hualde, 2005; Carr, 2012). Traditionally, the study of speech sounds has been divided into two subfields: phonology, which investigates the contrastive units of speech (phonemes) and the systematic patterns they form; and phonetics, which examines the concrete articulatory and acoustic details of speech production (Hualde, 2005). While phonology deals with discrete, categorical units, phonetics focuses on the physical properties of speech, including differences and variation in articulation and acoustic output (2005).

This dissertation addresses these questions for Spanish, with a focus on its vowel and sonorant systems and the dialectal variation they exhibit. While the five-vowel inventory of Spanish remains constant across varieties of the language, the consonant system varies, and vowels and sonorants often interact with surrounding segments in ways that differ from dialect to dialect. Processes such as velar fronting in Chilean Spanish (González, 2014), uvularization of /x/ in some Peninsular varieties (Hualde, 2005), and glide fricativization in Argentine Spanish (Harris & Kaisse, 1999) illustrate that surface realizations are shaped not only by phonetic conditions but also by each dialect's underlying contrastive structure (Dresher, 2009). As will be discussed in Chapter 3, this emphasis on contrast rather than purely surface form aligns with the principles of the Modified Contrastive Specification (MCS) framework (Dresher, 2009; Purnell & Raimy, 2015).

Earlier approaches to phonology often described sound systems as sequences of fully specified segments. In early generative phonology, for example, phonemes were represented as bundles of binary distinctive features, and rules applied to change these feature values (Chomsky & Halle, 1968). While these models provided insights into the organization of sound systems, they also operated with the assumption that all features were equally specified. Non-linear frameworks like Autosegmental Phonology and Feature Geometry improved on this by organizing features hierarchically and allowing certain properties—such as tone or place of articulation—to be represented on separate tiers (Goldsmith, 1976; Clements, 1985). This made it possible to capture processes that extend beyond single segments and to formalize the relationships between features more explicitly. More recently, Optimality Theory (OT) shifted the focus from ordered rules to the ranking of universal constraints (Prince & Smolensky, 1993/2004) and has been applied to phenomena such as velar fronting in Chilean Spanish (e.g., González, 2014).

In this dissertation, I apply the Modified Contrastive Specification (MCS) framework (Dresher, 2009; Purnell & Raimy, 2015) to describe patterns in Spanish phonology, using it to model the organization of vowel and sonorant systems across dialects. My aim is to build on the kinds of descriptive and theoretical analyses that have been carried out in prior studies of Spanish, while focusing on the role of contrastive features in explaining variation. To my knowledge, this is the first application of MCS to Spanish, offering a new perspective on how contrastive hierarchies can account for both shared and divergent patterns across dialects.

The MCS framework treats phonological representations as abstract and modular--distinct from phonetic detail--and by specifying phonemes only for the features necessary to distinguish them in a given system. These features, or contrastive dimensions, are identified through the Successive Division Algorithm (SDA), which builds a hierarchy by parsing the inventory until each phoneme is uniquely distinguished (Dresher, 2009). In this approach, distinctive features are phonetically grounded but organized as privative "dimensions" (Avery & Idsardi 2001), each completed by a single articulatory gesture (Purnell & Raimy, 2015). For example, the dimension Glottal Width may be completed with [spread] or [constricted][1], but not both; Tongue Height and Tongue Thrust similarly define vowel height and frontness (2015). Only features that are contrastive in the hierarchy are phonologically active; redundant traits remain unspecified (Dresher, 2009).

In adopting a modular view of the sound system, this dissertation distinguishes three primary levels of representation:

- Phonological Level – contains only the contrastive dimensions identified by the SDA. These abstract, underspecified features form the basis for phonological generalizations and processes (Dresher, 2009).
- Phonetic–Phonological Level – functions as the interface where abstract dimensions are completed into pronounceable gestures. At this stage, predictable or redundant content is added via enhancement rules, ensuring that segments are both articulable and perceptually salient (Purnell & Raimy, 2015).
- Phonetic Level – implements these gestures as continuous, gradient articulations, capturing the fine phonetic variation observed in actual speech (Purnell & Raimy, 2015).

[1] Terms *such as* [spread], [constricted], and Glottal Width refer to articulatory gestures used in the Avery & Idsardi (2001) model of phonetic completion. In this framework, phonological dimensions are completed with specific gestures to produce pronounceable forms. These concepts are described in detail in §3.5.1.

Applying this model to Spanish provides a principled way to explain why certain features—such as [front] or Tongue Thrust in Chilean Spanish--trigger processes in some dialects but not in others, and why similar surface sounds may behave differently depending on their place in the hierarchy (Lee, 2012). This dissertation therefore addresses three main questions:

1. How can the Contrastive Hierarchy (CH) model account for the observed variation in the surface realization of Spanish vowels and sonorants across dialects?
2. To what extent do differences in the ordering and specification of contrastive features explain phonological processes such as velar fronting, uvularization, fricativization, and glide strengthening in Spanish dialects?
3. Can the CH approach provide a systematic, language-internal explanation for dialectal variation in Spanish, beyond what is predicted by linear or purely articulatory models?

The analysis begins with a systematic examination of the vowel and sonorant inventories of selected Spanish dialects. Following Avery and Idsardi's (2001) articulator-based model and Purnell and Raimy's (2015) implementation, segments are grouped by major articulatory dimensions such as Labial, Dorsal, and Laryngeal. Each inventory is then parsed using the SDA to determine the ordering of contrastive features for that dialect. In keeping with the principles of MCS, phonemes are specified only for features necessary to distinguish them within their system. These hierarchies are then used to interpret the behavior of specific phonological processes. Chapter 4 examines five in detail, showing in each case how the process follows from the contrastive structure rather than from phonetic detail alone.

1.2 Significance and Contribution

It is my hope that this dissertation will contribute in three main ways by demonstrating what can be learned from applying the MCS framework to Spanish phonology. While MCS has been used to examine a variety of languages, it has not, to my knowledge, been systematically applied to Spanish. In doing so, this study extends the scope of the framework and provides an opportunity to evaluate its explanatory potential in a language with a five-vowel inventory but considerable dialectal variation in both vowel and consonant realization.

The first contribution lies in refining the understanding of phonological contrast through the use of privative, dimension-based features identified by the SDA. This approach offers a formally explicit and phonetically grounded method for determining which features are phonologically active in a given system, thereby clarifying the relationship between underlying contrast and surface patterns.

Second, the analysis aims to provide a unified account of variation in Spanish vowels and sonorants across selected dialects. By deriving these differences from each dialect's hierarchy, the study shows how variable phonological processes—such as palatalization and vocalization—can be understood as predictable consequences of contrastive specification rather than as isolated or purely phonetic phenomena.

Finally, this work intends to strengthen the link between phonetics and phonology by showing how abstract, contrastive specifications are implemented phonetically in context. In doing so, it demonstrates how the MCS framework can bridge representational theory with observable data, highlighting the potential of underspecified, contrast-driven models to account for both categorical and gradient aspects of speech.

1.3 Roadmap

The dissertation is organized into five chapters, each contributing to the overarching goal of examining MCS framework:

Chapter 2 provides a descriptive overview of the Spanish sound system, establishing the empirical foundation for the analyses that follow. It outlines the segmental inventory and describes key processes affecting segments in the language. Attention is given to variation across dialects, with examples that illustrate how these processes operate in different regional varieties. This chapter serves as a baseline reference for the theoretical discussion in Chapter 3 and the CH analyses developed in later chapters.

Chapter 3 develops the theoretical and methodological foundation for the present study. It begins by describing major phonological frameworks that have been applied to Spanish—including linear, non-linear, and constraint-based approaches—providing an overview of how each has been used in prior analyses. The chapter then introduces the architecture of the MCS framework, emphasizing its modular organization and use of privative, dimension-based features. It explains the operation of the SDA for establishing contrastive hierarchies and details how this approach distinguishes between contrastive and redundant features. The chapter concludes by outlining how these theoretical tools will be applied in the subsequent analysis.

Chapter 4 applies the MCS framework and the SDA to the analysis of Spanish vowel and sonorant systems, beginning with the establishment of a canonical contrastive hierarchy for the five-vowel system /i e a o u/ and for the sonorants. This baseline hierarchy serves as a point of reference for the dialect-specific patterns examined later in the chapter. The analysis then turns to processes in which vowel specifications interact with consonantal structure, with particular attention to variation in dorsal consonants and sonorants across dialects. These include velar fronting in Chilean Spanish, uvularization of /x/ in certain Peninsular varieties, and glide fricativization in Argentine Spanish, as well as liquid vocalization and rhotic–lateral neutralization in Caribbean Spanish. In each instance, the patterns are interpreted through the lens of contrastive hierarchies, showing how variation follows from differences in the ordering or presence of contrastive features, rather than from purely phonetic factors.

Chapter 5 summarizes the main findings, evaluating the usefulness of MCS in modeling Spanish phonology and its potential for explaining cross-dialectal patterns. The chapter also reflects on the relationship between phonological representations and their phonetic realizations, considers broader theoretical implications, and suggests directions for future research on Spanish sound systems.

Chapter 2: Spanish Sound System

2.1 Introduction

Spanish, also known as *español* or *castellano* (Lewis et al., 2015), is a widely spoken language in four continents--the Americas, Europe, Asia, and Africa—and is the first language of more than 498 million speakers (Instituto Cervantes, 2023). According to the European Commission (2012), there are 38,400,000 speakers in Spain and a total population of 398,931,840 L1 speakers across the globe. In terms of L2 users, there are a reported 7,490,000 in Spain and 89,500,000 worldwide (European Commission, 2006). It is the official or national language of 21 countries and territories. In order of number of speakers, they consist of the following: Mexico, Colombia, Spain, Argentina, Peru, Venezuela, Chile, Guatemala, Ecuador, Bolivia, Dominican Republic, Honduras, El Salvador, Nicaragua, Paraguay, Costa Rica, Cuba, Uruguay, Panama, and

Equatorial Guinea (Instituto Cervantes, 2023). It can also be found spoken in the Philippines in Southeast Asia (De Molina Ortés & Hernández-Campoy, 2018).

Considering the expansive dispersion of the language across the globe, it should not be surprising the linguistic diversity that exists from one dialect to another; in addition to differences of pronunciation, there are grammatical and lexical-semantic variation that make up what we know as the Spanish language (De Molina Ortés & Hernández-Campoy, 2018). The aim of this chapter is to provide an overview of the sound system of Spanish. I will also provide a panoramic view of the language as it is spoken across the Spanish-speaking world with special emphasis on four dialects due to their treatment of consonants within certain phonetic environments or their treatment of liquids (e.g., laterals and rhotics): Castilian Spanish, Chilean Spanish, Argentine Spanish, and Caribbean Spanish. These patterns will later be examined using the MCS framework and the SDA (see Chapter 4). To begin it is first important to note the phonological and phonetic inventories of Spanish, inventories that I will currently assume to be universal across all dialects. Afterward, I will discuss phonological processes that are typical in most Spanish-speaking varieties.

2.2 Spanish Vowels

2.2.1 Phonological characterization/phonemic inventory

Vowels, in contrast to consonants, do not have any type of obstruction in the vocal tract (Ladefoged & Maddieson, 1996; Morales-Front, 2014). The main features used to describe vowels are based on tongue position and shape of the lips (Hualde, 2005). Thus, the tongue could be in a raised, neutral or lowered position, which would result in high, mid or lower vowels respectively (2005). Similarly, there are front, central, and back vowels; "in the articulation of front vowels the tongue body moves towards the front of the mouth, for back vowels the tongue is retracted, and for central vowels it occupies and intermediate position" (2005, p. 53). One last feature refers to lip rounding or spreading in the production of a vowel (2005).

As of current, there appears to be a consensus on the features assigned to the vocalic inventory of Spanish regardless of the phonological theory in question. Regarding the phonemic vowel inventory of Spanish, there are five vowels as illustrated below in Table 1 (Hualde, 2005, p. 54). The vowels are monophthongs that contrast meaning (Martínez Celdrán & Elvira-García, 2019).

(1)	*pipa*	/pipa/	'pipe'
(2)	*pepa*	/pepa/	'seed'
(3)	*papa*	/papa/	'potato'
(4)	*popa*	/popa/	'stern'
(5)	*pupa*	/pupa/	'scab'

Hualde, regarding roundedness of vowels in Spanish, states that "lip rounding is redundant in Spanish with respect to the back/non-back position of the tongue: the back vowels /u/, /o/ are articulated with rounded lips (are rounded vowels), the none-back vowels /i/, /e/, /a/ are not rounded" (pp. 53-54). Vowels in general are characterized as voiced segments and can be syllable nuclei. However, in Spanish, unlike in languages such as English in which laterals or rhotics can be syllable nuclei, only a vowel constitutes a syllable nucleus (Martínez Celdrán & Elvira-García, 2019).

Table 1 – The vocalic inventory of Spanish

	front	central	back
high	/i/		/o/
mid	/e/		/u/
low		/a/	
	Non-round		Round

Phonological processes that are common among vowels in Spanish occurred during its evolution; these include vowel reduction, elision, diphthongization, and vocalic assimilation (e.g., metaphony) (Hualde, 2005; Martínez-Gil, 2015). Vowel reduction occurs when the vocalic inventory of a language becomes smaller due to the merging of vowels. In the case of Latin to Spanish, there was a loss of the open mid vowels /ɔ/ and /ɛ/ through diphthongization, causing the mid vowels /e/ and /o/ to become the diphthongs [i̯e] and [u̯e] respectively. Processes of elision also occurred, such as syncope, which resulted in the loss of medial vowels, and apocope with the deletion of final /e/. Lastly, an example of metaphony, vowel rising resulted in some vowels raising in the vocalic space (Lloyd, 1987; Penny, 2002). Examples of these phenomena (Menéndez Pidal 1958; Posner 1996) are illustrated in (6)-(10) in order of discussion.

(6)	*mĕtum > miedo*	[ˈmɛ.to] > [ˈmi̯e.ðo]	'fear'
(7)	*prŏbam > prueba*	[ˈprɔ.ba] > [ˈpru̯e.βa]	'proof'
(8)	*tăbŭla > tabla*	[ˈta.bu.ɫa] > [ˈt̪a.β̞la]	'table'
(9)	*mare > mar*	[ˈma.ɾe] > [ˈmaɾ]	'sea'
(10)	*mētiōr > mido*	[ˈme.ti̯oɾ] > [ˈmi.ð̞o]	'I measure'

In (10), the glide or yod, which is articulated high in the mouth, triggered the preceding mid vowel to rise. In addition to /e/ > [i], there were cases of /a/ to [e] and /ɛ/ to [e] when in proximity to a glide (Menéndez Pidal, 1958; Posner, 1996; Penny, 2002).

In Modern Spanish, there appears to be another phonological process occurring which involves vocalic desyllabification or syllabic contraction. This is a process in which a nuclear vowel that is mid or high becomes a glide [u̯] or [i̯] when in proximity to another vowel (Hualde, 2005). The motivation for this is to avoid sequence of vowels in hiatus (2005). As illustrated in (11) and (12), the mid front vowel /e/ becomes a high front glide, resulting in the deletion of the hiatus. The same process occurs in (13) and (14), but it is the mid back vowel /o/ transforming into a high back instead.

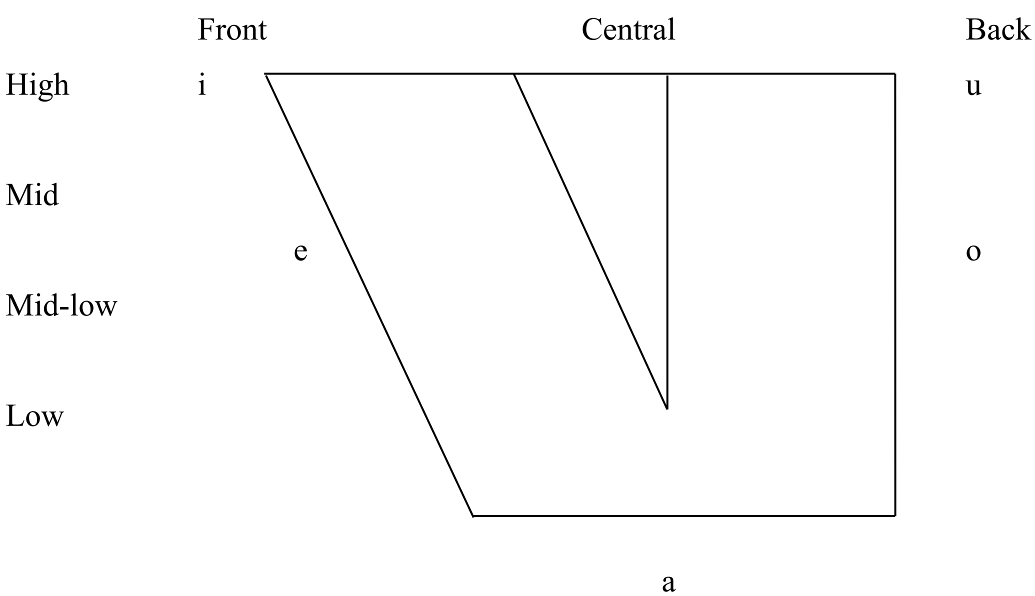
(11)	*peor*	/peor/	[pe.ˈoɾ] > [ˈpi̯oɾ]	‘worse’
(12)	*teatro*	/teatɾo/	[t̪e.ˈa.t̪ɾo] > [ˈt̪i̯a. t̪ɾo]	‘theater’
(13)	*toalla*	/toaʝa/	[t̪o.ˈa.ʝa] > [ˈt̪u̯a.ʝa]	‘towel’
(14)	*poema*	/poema/	[po.ˈe.ma] > [ˈpu̯e.ma]	‘poem’

2.2.2 Phonetic Inventory

There is contextual variation regarding production of monophthongs, but in general Spanish vowels do not present much variation; they are short and tense and any type of variation is a cause of adjacent consonants or vowels (Martínez Celdrán & Elvira-García, 2019). There are also some minor differences in duration. As noted by Marín-Gálvez (1995), stressed vowels, vowels in an open syllable in a prepausal context, and vowels before a voiced consonant, to a lesser extent.

Visual representations of Spanish vowel production by native speakers appear to be stable with little variation, at least within the variety spoken by the participants whose speech was analyzed (see RAE, 2011, p. 88, for reference). Martínez Celdrán and Fernández Planas (2007), based on acoustic analyses of the production of the Spanish vowels by male and female speakers, found that the latter had a vowel system that occupied a larger vocalic space. Martínez Celdrán and Elvira-García (2019) report that "little contextual variation" exists and variants of /e/, for example, that are reported as either open or closed are actually articulated slightly lowered or more open. The figure reports the formants and maps the five vowels of different speakers of Castilian Spanish, which clearly form distinct vocalic spaces for each phone. The Spanish vocalic inventory in Figure 1 is a visual representation that presents the vowels within the limits of the triangle (Morales-Front, 2014, p. 31).

Figure 1 – Vocalic space



The boundaries in Figure 1 attempt to account for variation in pronunciation as the equidistance between the vowels the vocalic space serves a representation as speakers may be produced outside of their respective limits (Morales-Front, 2014). However, this representation is one that is more ideal rather than truly representative of where the vowels are produced in the oral cavity. Quilis and Esgueva (1983), for example, found that Spanish [i], [a], and [u] are produced a bit further back in the mouth. Morales-Front (2014) concludes that the vowels within the vocalic space are neither absolute nor constant; a speaker may produce a vocalic segment that is articulated between two vowels, but if it is produced much closer to one of the two then the listener would perceive it as the closest vowel (2014). For example, if a Spanish speaker produces a segment that falls in between the "ideal" points for the back vowels /u/ and /o/ but is much higher, then the listener will process it as /u/. There has been previous research as early as Navarro Tomás (1918) suggesting that the mid vowels have corresponding open vowels—front [ɛ] and back [ɔ]–respectively based on syllable structure. As of recent, Ronquest (2018) admits that Navarro Tomás' observations were not off, as there are some measurable acoustic differences when considering both syllable structure and consonant context when examining vowels. Nonetheless, she defines them as "fine-graded phonetic differences" (p. 149). Therefore, for this study, I will assume that differences in the articulation of the mid vowels are minor and do not warrant positing two mid allophones across all Spanish dialects; this point is addressed further in §3. However, §2.2.3 notes predictable phonetic environments where open mid vowels do occur in some dialects.

With respect to the articulation of the Spanish vocalic inventory, the segments [i] and [e] are produced with a raised tongue that is close to the front of the mouth, with the tongue closer to the palate for [i] than it is for [e] (2014). The segments [i] and [u] are considered back vowels as the tongue approximates toward the velum for the latter and toward to the uvula and top section of the pharynx for the former. (2014). Back vowels in Spanish are also round.

Spanish also has glides–front [i̯] and back [u̯] (or palatal [j] and labiovelar [w] based on the preference of the author)–but "[they] are best considered as allophones of the corresponding high vowels, and not independent phonemes: high vowels are usually realized as glides when non-stress-bearing and adjacent to a different vowel" (Hualde, 2005, p. 55). Martínez Celdrán and Elvira-García (2019) refer to them as glides or semivowels interchangeably, however the important thing to note is that they are non-syllabic as they are not located "in central position of the syllabic nucleus" (p. 25); they are produced before or after a nuclear vowel. A nuclear vowel can be lengthened, as in the /i/ in *María*, but the /i/ in *Mariana* cannot as it functions as a glide (2019). This will be discussed further in §2.4.1.

2.2.3 Dialectal Variation in Vowel Phonetics

Unlike its sister language Portuguese, Spanish does not have distinctive nasal vowel segments; instead, we find nasalized vowels when they appear between nasal consonants (Martínez Celdrán & Elvira-Celdrán, 2019) as illustrated in (15). They can also occur when followed by a nasal consonant in coda position (Hualde, 2005) as illustrated in (16).

(15)	'semana'	/semana/	[se.'mã.na]	*week*
(16)	'canto'	/kanto/	['kãn̪.t̪o]	*singing*

This particular feature can be found across all Spanish dialects. However, there are instances in which nasalization occurs in other contexts. For example, in Caribbean and Andalusian Spanish, surrounding vowels that would not normally undergo nasalization can become nasalized through a process of vowel harmony (Vaquero Ramírez, 1996; Hualde, 2005; Martínez Celdrán & Elvira-

García, 2019). The nasal consonant that triggers nasalization may then be elided, leaving behind a nasalized vowel. Both processes are illustrated in (17) and (18) respectively.

			Vowel Harmony	Elision	
(17)	‘están’	/estan/	[ẽs.'tãn]	[ẽh.'tã]	*they are*
(18)	‘empezar’	/empesar/	[ẽm.p̃e.ˈsɑ̃ɾ]	[ẽ.pẽ.ˈsɑ̃ɾ]	*begin*

Hualde (2005) notes that nasalization in Spanish is a context-dependent and gradient process, not a phonemic contrast. Nonetheless, in casual speech it can produce near-minimal pairs, such as *pan* [pã] ‘bread’ and *pa’* [pa] (colloquial form of *para*) ‘to’. However, Torres-Tamarit (2019) argues that “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” (p. 7).

Even though Spanish is defined as having a five-vowel system, there are reported instances of dialectal variation in which we find open mid vowels. One of the more prominent features associated with Caribbean, Eastern Andalusian and Murcian Spanish is the opening of vowels when located in coda position followed by /s/ (Martínez Celdrán & Elvira-García, 2019). Earlier reports (Marrero, 1990) have suggested the opening of the mid vowels in Spanish to be minimal. Even more, Isbasescu (1968) and Alemán (1976) assert that it does not appear in Puerto Rican or Cuban varieties of Spanish. However, more recent works (e.g., Martínez Celdrán & Elvira-García, 2019) do show it occurring. The phonetic features /s/-deletion and /s/-aspiration both cause the preceding vowel to become open. Due to long-distance assimilation, vowel harmony may also occur and spread across all vowels within an utterance (2019). Both phenomena are depicted in (19)-(21).

			/s/-aspiration	/s/-deletion	
(19)	*este*	/este/	[ˈɛʰ.t̪ɛ]	[ˈɛ.t̪ɛ]	'this'
(20)	*otros*	/otɾos/	[ˈo.t̪ɾɔʰ]	[ˈo.t̪ɾɔ]	'others'
(21)	*otros ojos*	/otɾos.oxos/	[ˈɔ.t̪ɾɔ. ˈʰɔ.xoʰ]	[ˈɔ. t̪ɾɔ. ˈɔ.xɔ]	'other eyes'

Another phonetic phenomenon that can occur is the elision of unstressed vowels (Parodi, 2015). It is important to note that within the scope of this paper I am focused on dialectal variation that is not attributed, in some part, to language contact with other languages within the Americas or on the Iberian Peninsula. In the case of (22), the deletion of the unstressed vowel has been documented in the Spanish varieties found in the Mexican Plateau, central valley of Costa Rica, Colombia, the highlands of Ecuador, Peru, Bolivia, and in some areas of Argentina (Martínez Celdrán & Elvira-García 2019). This elision of the vowel can occur when the final vowel of a word is in contact with a dental segment (Lope Blanch, 1983).

			Maintained	Disappear	
(22)	*antes*	/antes/	[ˈãn̪.t̪es]	[ˈãn̪t̪s]	'before'

2.2.4 Spanish Non-syllabic Vowels

Diphthongs and triphthongs in Spanish consist of a strong vowel or vocalic nucleus of a syllable and one or two weak segments that serve as transitionary sounds (Aguilar, 1997). Traditionally, the weak segment that occupies the first position is considered a vowel and a semiconsonant in the second position (Navarro Tomás, 1918; Gil, 1987). The non-syllabic vowels in Spanish are the high vowels [i̯] and [u̯] (Hualde, 2005). Unlike the "true" syllabic or nuclear vowels, non-syllabic vowels cannot be lengthened (Martínez Celdrán & Elvira-García, 2019).

In Spanish, there are fourteen diphthongs, six of which are considered falling and eight raising (Alarcos Llorach, 1965). The former is illustrated in (23)-(28) and the latter in (29)-(36). The difference between falling and rising diphthongs are: “Those [diphthongs] in which the stress is strongest at or near the beginning are called falling diphthongs. (The stress falls.)" (Gleason, 1955, p. 203).

(23)	*hay*	[ˈai̯]	‘there is/are’
(24)	*aura*	[ˈau̪.ɾa]	‘aura’
(25)	*seis*	[ˈsei̯s]	‘six’
(26)	*Zeus*	[ˈseu̯s]	‘Zeus’
(27)	*coiné*	[koi̯.ˈne]	‘koine’
(28)	*bou*	[ˈbou̯]	‘trawler’
(29)	*siamés*	[si̯a.ˈmes]	‘Siamese’
(30)	*siete*	[ˈsi̯e.t̪e]	‘seven’
(31)	*estadio*	[es.ˈt̪a.ð̪i̯o]	‘stadium’
(32)	*ciudad*	[si̯u.ˈð̪að̪]	‘city’
(33)	*agua*	[ˈa.ɣ̞u̯a]	‘water’
(34)	*cigüeña*	[si.ˈɣ̞ue̯.ɲa]	‘stork’
(35)	*antiguo*	[ãn̪.ˈt̪i.ɣ̞u̯o]	‘old’
(36)	*cuidar*	[ku̯i.ˈð̪aɾ]	‘look after’

Falling and rising diphthongs can occur in both stressed and unstressed syllables (Aguilar, 1997). In Spanish, there are also triphthongs a vowel that consists of a vocalic nucleus and surrounded by two semivowels (Schwegler et al., 2010). Some example words in Spanish consist of the following:

(37)	*aliáis*	[a.ˈli̯ai̯s]	‘you (pl.) combine’

(38)	*aliéis*	[a.ˈli̯ei̯s]	'you (pl.) combine'
(39)	*hioides*	[ˈi̯oi̯.ð̞es]	'hyoid'
(40)	*guau*	[ˈgu̯au̯]	'wow'
(41)	*biaural*	[bi̯au̯.ˈɾal]	'biaural'
(42)	*guay*	[ˈgu̯ai̯]	'cool'
(43)	*buey*	[ˈbu̯ei̯]	'ox'

This inventory of diphthongs and triphthongs illustrates the range of complex vocalic sequences in Spanish, which interact with syllable structure and stress patterns in ways that will be analyzed in more detail in §2.4.

2.3 Spanish Consonants

2.3.1 Phonemic Inventory

Consonants are described as sounds "produced with some degree of constriction in the vowel tract, which differentiates them from vowel or vocoid sounds" (Campos-Astorkiza, 2018, p. 165). There are three factors used when classifying consonantal segments—place of articulation, manner of articulation, and voicing—which are based on articulatory parameters (2018).

The following table of consonantal phonemes found in Spanish is from Hualde's (2005) table of consonantal phonemes of Spanish (p. 53). Hualde, in his chart, has grouped certain places of articulation in order "[to] obtain a simpler, more systematic, table, valid for more Spanish dialects" (2005, p. 52); bilabial and labiodental are grouped into a labial category, dental and interdental into dental, and (pre)palatal into prepalatal and palatal.[2]

[2] Missing from this table is the voiceless interdental fricative /θ/ and the palatal lateral /ʎ/, which are only found in some dialects of Spanish (Campos-Astorkiza, 2018).

Oral stops or plosives are sounds that are produced with complete obstruction of the airflow somewhere in the vocal tract (Campos-Astorkiza, 2018). As listed, these include the bilabial segments /p b/, dental segments /t d/ and velar segments /k ɡ/. Spanish has a true voicing system in that stops are distinguished between fully voiced and unmarked obstruents (Ladefoged & Maddieson, 1996; Avery & Idsardi, 2001). I have illustrated these contrasts in (44)-(46). Fricative consonants, in contrast to plosives, is produced with narrowing in the vocal tract (Campos-Astorkiza, 2018). Airflow can go through with uninterrupted, which results in a frication noise (2018). Fricatives in Spanish include the labiodental /f/, alveolar /s/, and velar /x/, which are depicted in (47-49).

Table 2 - The consonantal phonemes of Spanish

		labial	dental	alveolar	(pre)palatal	velar
plosive	voiceless	/p/	/t/			/k/
	voiced	/b/	/d/			/ɡ/
affricate	voiceless				/t͡ʃ/	
fricative	voiceless	/f/		/s/		/x/
	voiced				/ʝ/	
nasal		/m/		/n/	/ɲ/	
lateral				/l/		
rhotic	tap			/ɾ/		
	trill			/r/		

(44) *patata* /patata/ 'potato' *batata* /batata/ 'sweet potato'

(45) *tos* /tos/ 'cough' *dos* /dos/ 'two'

(46) *casa* /kasa/ 'house' *gasa* /ɡasa/ 'gauze'

(47) *faro* /faɾo/ 'lighthouse'

(48)	*sol*	/sol/	'sun'
(49)	*gente*	/xente/	'people'

Affricates can be thought of a combination of stops and fricatives in that their production begins with obstruction in the vocal tract followed by a narrow opening (Campos-Astorkiza, 2018). /t͡ʃ/ is an example of an affricate that, in the symbol itself, shows a stop /t/ moving into a fricative /ʃ/. The affricates, as depicted in (50) and (51) occur in the onset of a syllable.

(50)	'chico'	/t͡ʃiko/	*boy*
(51)	'mucho'	/mut͡ʃo/	*a lot, many*

When analyzing the manners of articulation in Spanish, they are not different from those of American English (AmE) except for the rhotic tap [ɾ] and trill [r]. Whereas AmE has an allophonic flap with [t^h] or [t] in between two vowels (Carr, 2012) – the first stressed and the second unstressed – the Spanish tap is phonemic and is found in minimal pairs as illustrated in (52)-(54). This distinction is only word-medially, however.

		Tap			Trill	
(52)	'pero'	['pe.ɾo]	*but*	'perro'	['pe.ro]	*dog*
(53)	'coro'	['ko.ɾo]	*chorus*	'corro' ['ko.ro]		*I run*
(54)	'mora'	['mo.ɾa]	*blackberry*	'morra'	['mo.ra]	*top of head*

The Spanish rhotic system, in addition to having these minimal pairs, appears to be one that also has both free variation and complementary distribution; two segments are in complementary distribution if one segment can only be found in one environment and not the other whereas two segments in free variation can both appear within the same environment (Guitart, 2004). The word *calor* ‘heat’, for example, is pronounced with a tap [ka.'loɾ], but it could be pronounced with a trill in exaggerated speech with a trill [ka.'lor] (2004).

Another proposal supported by Guitart (2004), based on Harris’ (1969) analysis of the Spanish rhotic system, suggests that the language may only have one rhotic—the tap—and the trill occurs through a process of the multiplication of two adjacent taps that occurs. The evidence provided to support this hypothesis is with the dialectal pronunciation of words such as *perro* in which we find the the voiced glottal [ɦ] followed by the trill. Guitart proposes that the addition of the segment [ɦ], followed by the trill, cannot be supported if /ɾ/ and /r/ in this particular context are contrastive; the underlying motivation for this articulatory variety shows that there must be two underlying taps with one becoming a glottal and the other strengthening to a trill.

			Voiced glottal	
(55)	*perro*	[ˈpe.ro]	[ˈpeɦ.ro]	‘dog’
(56)	*carne*	[ˈkaɾ.ne]	[ˈkaɦ.ne]	‘meat’

(55) shows that underlying there could be an underlying sequence of /VɾɾV/ that is realized as [V.rV] (Guitart, 2004). (56) supports this claim as we see the tap in coda position becoming glottalized. Guitart proposes the following processes that occur to explain how we come about to [‘peɦ.ro] (p. 149):

A.	peɾɾo	Underlying form
B.	péɾ.ɾo	Result of syllabification and stress placement
C.	péɾ.ro	Derived from the process of multiplication
D.	pé.ro	Elision of the first rhotic of the pre-trill rhotic

Unlike in Hualde's (2005) table of consonant phonemes, Campos-Astorkiza (2018) lists the palatal obstruent /ɟ/ in lieu of the palatal fricative in her table of Main Spanish consonant phonemes (cf., p. 166). She notes that "in some cases, the classification of certain sounds is the subject of debate in the literature" (p. 166), most notably the latter segment. Guitart (2004) and Morgan (2010) similarly list the plosive voiced phonemes of Spanish as /b d ɟ g/. I discuss the palatal segments of Spanish further in 2.5.

Another difference to note from Table 2 is Guitart (2004) suggests that in varieties of Caribbean Spanish, the velar /x/ is /h/, which would suggest there is an underlying glottal instead of a weakening process that occurs with the velar segment. For the purposes of this paper, and for consistency, the palatal /ʝ/ and velar /x/ will be used across all dialects.

2.3.2 Phonetic Inventory

The following table, taken from Hualde (2005, p. 53), provides the allophonic inventory for the sounds found in Spanish. Many of the allophones in Spanish are those that occur because of assimilation as illustrated in (57)-(61). For example, the sonorant /n/ assimilates to the place of articulation of the following consonant. Therefore, we can find dental, palatal and velar nasal segments (2005, p. 107). There is also a dental lateral segment that occurs, but it assimilates "to a more reduced set of following consonants than nasals do" (2005, p. 107), i.e., not to labials or velars. We also see voicing assimilation in which the alveolar fricative /s/ is when it precedes a voiced consonant (2005). However, this assimilation feature is optional and the /s/ can remain voiceless or only is partially voiced (2005) as seen in (60) and (61). Further discussion on phonological processes in the language can be found in §2.6.

Table 3 - The allophonic inventory of Spanish

		labial	labiodental	dental	alveolar	(pre)palatal	velar
plosive	voiceless	[p]		[t̪]			[k]
	voiced	[b]		[d̪]		[ɟ]	[ɡ]
affricate	voiceless					[t͡ʃ]	
approximate	voiced	[β̞]		[ð̞]			[ɣ̞]
fricative	voiceless	[f]		[s]			[x]
	voiced			[z]		[ʝ]	
nasal		[m]	[ɱ]	[n̪]	[n]	[ɲ]	[ŋ]
lateral				[l̪]	[l]		
rhotic	tap				[ɾ]		
	trill				[r]		

(57) *aldea* [al̪.ˈd̪e.a] ‘small village’

(58) *fundar* [fun̪.ˈd̪aɾ] ‘found’

(59) *banco* [ˈbaŋ.ko] ‘bank’

(60) *mismo* [ˈmiz.mo] ‘same’

(61) *mismo* [ˈmis.mo] ‘same’

According to Piñeros (2009), all the fricative segments undergo voicing assimilation. The voiced counterpart of /f/, [v], is cited in his work as occurring due to voicing before a voiced segment such as in the word *afgano*. The voiceless interdental phoneme /θ/ found in Peninsular Spanish is similarly described as undergoing voicing assimilation as well, with the result being a voiced interdental or dental [ð] (not to be confused with the approximant [ð̞]. These voicing contrasts are illustrated in (62)-65).

(62)	*bizco*	[ˈbiθ.ko]	‘cross-eyed’
(63)	*diezmo*	[ˈd̪̥jeð.mo]	‘tithe’
(64)	*difteria*	[d̪̥if.ˈt̪̬e.ɾja]	‘diphtheria’
(65)	*afgano*	[av.ˈga.no]	‘Afghan’
(66)	*reloj feo*	[re.ˈlox.ˈfe.o]	‘ugly watch’
(67)	*reloj bueno*	[re.ˈloɣ.ˈβ̞u̯e.no]	‘good watch’

Piñeros suggests that /s/, as depicted in (60)-(61), is commonly voiced since it occurs more commonly in speech than the other fricatives, but it does not always undergo this process. After /s/, the order in which voicing can occur with the fricatives is /θ/, /f/ and /x/. The latter two segments are less likely to undergo voicing, as /f/ and /x/ are more likely not to be found in coda position, which would provide the phonetic environment to trigger voicing of fricatives in Spanish; this is due to “the tendency of Spanish to avoid non-coronal consonants in the coda” (p. 277). In (67), we see an example of /x/ becoming voiced [ɣ]. This segment should not be confused with the approximant [ɣ̞] resulting from a weakening of its stop counterpart /g/.

In the below above, I have provided a more comprehensive chart to reflect the voicing assimilation that Piñeros asserts occurs with the fricatives in Spanish. The fricatives, therefore, appear to parallel the plosives in that there is a voicing contrast, at least phonetically.

Table 4 – Comprehensive allophonic inventory of Spanish

		labial	labiodental	dental	alveolar	(pre)palatal	velar
plosive	voiceless	[p]		[t̪]			[k]
	voiced	[b]		[d̪]		[ɟ]	[ɡ]
affricate	voiceless					[t͡ʃ]	
approximate	voiced	[β̞]		[ð̞]			[ɣ̞]
fricative	voiceless	[f]		[s]			[x]
	voiced	[v]		[z]		[ʝ]	[ɣ]
nasal		[m]	[ɱ]	[n̪]	[n]	[ɲ]	[ŋ]
lateral				[l̪]	[l]		
rhotic	tap				[ɾ]		
	trill				[r]		

2.4 Syllable Structure

According to Hualde (2005), “a syllable is formed by a set of segments grouped together around a nucleus or peak of sonority” (p. 70). This is of particular importance to Spanish as the nucleus of a syllable is the vowel. According to O’Grady (2013), vowels appear to be an obligatory segment required in a syllable with optional consonants preceding or following the vowel. Vowels may appear alone or “may be preceded and/or followed by less open (less sonorous) segments within the syllable” (p. 70). For example, a vowel can be preceded by an onset consonant or by a consonant cluster and it can be followed by a consonant in the coda: *tajo, trajo, trajes*. The basic syllable types of Spanish, as illustrated below, occur in most dialects of Spanish (Colina, 2009, p. 11).

Table 5 – Basic syllable types in Spanish

a.	V	[ˈa.la]	*ala*	‘wing’
b.	CV	[ˈa.la]	*ala*	‘wing’
c.	CVC	[ˈpan]	*pan*	‘bread’
	CVG	[ˈsoi̯]	*soy*	‘I am’
d.	VC	[ˈũn]	*un*	‘one, a’
	VG	[aj]	*hay*	‘there is/are’
e.	CCV	[flo.ˈt̪aɾ]	*flotar*	‘float’
f.	CCVC	[ˈt̪ɾen]	*tren*	‘train’
	CCVG	[plei̯.t̪e.ˈaɾ]	*pleitear*	‘to fight’
g.	VCC	[ĩns.ˈt̪ɾuiɾ]	*instruir*	‘instruct’
	VGC	[au̯s.ˈt̪ɾal]	*austral*	‘austral’
h.	CVCC	[peɾs.pek.ˈt̪i.β̞a]	*perspectiva*	‘perspective’
	CVGC	[ˈkau̯s.t̪i.ko]	*cáustico*	‘caustic’
i.	CCVCC	[t̪ɾans.ˈpoɾ.t̪e]	*transporte*	‘transportation’
	CCVGC	[ˈklau̯s.t̪ɾo]	*claustro*	‘cloister’

Underlined syllables represent examples of the sample syllable type being illustrated. Spanish favors an open consonant–vowel (CV) syllable structure. In addition to a single vowel, a syllable nucleus “may contain a glide as a ‘satellite’ either before or after the nuclear vowel” (Colina, 2009, p. 71) and is known as a diphthong, as illustrated in *huevo* ‘egg’ or *treinta* ‘thirty.’ There are also triphthongs that contain both a prevocalic and a postvocalic glide, as in *buey* ‘ox.’

In addition to these general patterns, certain restrictions apply to how high vowels may combine with glides within the same syllable. Specifically, sequences involving a high vowel and a homorganic glide (*[ii̯], *[i̯i], *[uu̯], *[u̯u]) are unattested. Torres-Tamarit (2019) notes that /i/ and /u/ do not occur with their corresponding glides in the language. Instead, rising and falling diphthongs pair a high vowel with a different vowel quality. When two distinct high vowels occur together, they surface as rising diphthongs [ju] and [wi].

Determining whether a segment is a consonant or vowel—which is crucial for identifying a glide, and thus whether it can combine with a nuclear vowel to form a diphthong—depends not only on the presence or absence of obstruction. Vowels16

and glides) also rank high on the scale of sonority or perceptibility, as illustrated in Figure 2 (Morales-Front, 2014). The segments represented in the figure are examples and not necessarily ones found in any particular variety of Spanish. (Glides in Spanish will be further discussed in §2.4.)

Figure 2 – Sonority chart 1

sonority value	**1**	**2**	**3**	**4**	**5**
low	→	→	→	→	high
exemplars	[p],[b],[t] [d],/[k],[g]	[f],[v],[s], [z],[ʃ],[ʒ]	[m],[n]	[l],/[ʁ]	[a],[i],[o] [u],[y],[e]
mode	occlusive	fricative	nasal	liquid	vowel

Figure 3 – Sonority chart 2

stops	<	fricatives	<	nasals	<	liquids	<	high vowels	<	mid vowels	<	low vowels
1		**2**		**3**		**4**		**5**		**6**		**7**

Colina (2015, p. 25), in her sonority chart for Spanish consonants as represented in Figure 3, separates the vowels into three levels based on level of acoustic prominence. She also notes that some authors group stops and fricatives into one category but reports that this can be problematic for consonantal groups in onset position of a syllable.

According to Ladefoged and Maddieson (1996), "vowels are defined by the physiological characteristics of their having no obstruction in the vowel tract, and by their function within a phonologically defined syllable" (p. 282). A vowel, as-defined in *The Sound Pattern of English*, is [+ syllabic, - consonantal] (Chomsky & Halle, 1968). It is for certain, however, considered a phonological, rather than a phonetic, unit (Ladefoged & Maddieson, 1996; O'Grady, 2013). Syllables, or what constitutes a syllable, are important for languages such as Spanish as several phonological processes can be contributed to syllable structure (Hualde, 2005).

2.4.1 Syllable Structure and Glides

Glides are of special interest due to their treatment in different languages, thus raising the question of their phonological status (Levi, 2011). According to Levi, "glides can either be derived from vowels and thus be positional variants of vowels (derived glides) or they can exist as distinct phonemes (phonemic glide)." Therefore, she reports there to be two types of languages based on their treatment of glides, 'vocalic' languages and 'glide' languages (2011). Glide languages can differ in their treatment of glides. There are languages (Tukang Besi) that only contain high vowels that surface as syllabic, that only contain the corresponding glide of a high vowel (Deg Xinag), or that contain a high vowel that surfaces as either a vowel or a glide (2011). Vocalic languages, on the other hand, "contain high vowels in environments that would yield a non-syllabic glide realization under normal circumstances" (2011, p. 11). Ait

Seghrouchen Berber, for example, show surface variations among their high vowels, whether as syllabic or as a glide (2011). Levi considers Spanish as an example that falls under the realm of vocalic languages but appears to have two types of high vowels: those unmarked and those that surface as syllable nuclei. However, it is first important to note traditional accounts of the treatment of palatal glides in this Romance variety.

Traditionally glides in Spanish are described as allophones of their corresponding high vowels (Hualde, 2005). The palatal glides in Spanish are non-syllabic in nature and can combine with another vowel within a single syllable to create a diphthong (Hualde & Colina, 2014). In Spanish, there are two glides, a high front glide and a high back glide. Hualde (2005) mentions that the IPA offers two choices to represent glides: the exclusive use of [j] and [w] or that of [i̯] and [u̯] regardless of position in relation to the vocalic nucleus.

		Only [j]/[w]	Only [i̯]/[u̯]	Distinction	
(68)	*siete*	[sjé.t̪e]	[si̯é.t̪e]	[sjé.t̪e]	‘seven’
(69)	*seis*	[séjs]	[séi̯s]	[séi̯s]’	‘six’
(70)	*agua*	[á.ɣ̞wa]	[á.ɣ̞u̯a]	[á.ɣ̞wa]	‘water’
(71)	*auto*	[áw.t̪o]	[áu̯.t̪o]	[áu̯.t̪o]	‘car’

The latter is Hualde’s preferred choice of transcription as it indicates “the fact that the sounds in question form a syllable with an adjacent vowel by means of a subscript diacritic” (2005, p. 16). Other scholars have opted to use-[j] and [w] to represent the semiconsonant versions of these two segments when they precede a vowel and [i̯] and [u̯] to represent the same segments when they are semivowels and follow a vowel (2005).

2.5 Phonological Processes in Spanish

An interesting observation made by Aguilar (1997) in her book *De la vocal a la consonante* on the description of phonological phenomena in Spanish is that they tend to focus exclusively on processes that occur with the consonants; any other types of processes are simply observations that do not receive as much attention in terms. We can assume that Aguilar is referring to the description of vowels in that most linguistic literature describes the vocalic Spanish inventory as one that is stable, with very little variation regardless of stressed or unstressed context.

With the language manuals of Navarro Tomás (1918) and Llorach (1965) in mind, Aguilar (1997, pp. 14-16) provides the following list of phonological processes that occur in Spanish:

- Regressive place assimilation of /n/
- Regressive place assimilation of /l/
- Regressive voicing assimilation of /s/ before voiced stops and nasal and lateral segments
- Lenition (or *aproximantización* as referred to by Aguilar) of intervocalic voiced stops /b d g/
- Lenition of /b/ and /ɡ/ after a non-nasal consonant
- Lenition of /d/ after a non-nasal and non-lateral consonant

Aguilar expands on her list, but for this particular study the previous list provides an overview of phonological processes that occur across several Spanish dialects. The lenition of /b d g/ is a common process of spirantization[3]: “The voiced plosives [...] are realized without complete occlusion, as approximants, in many positions, including between vowels” (Hualde, 2005, p. 64).

[3] The lenition of the voiced stops is the norm in the field of Spanish linguistics, but there have been claims made that the underlying forms are in fact the approximants and the stops are realized through a process of fortition or hardening (cf. Bakovic, 1994 and Barlow, 2003).

Hualde goes on to state that "[t]heir degree of constriction can vary substantially" (2005, p. 64). The pairs of words in (74)-(76) show the surface forms of the voiced stops and their approximant counterparts. Note that the weakening process can occur across word boundaries.

(74)	'batata' [ba.ˈt̪a.t̪a]	*sweet potato*	'la batata' [la.β̞a.ˈt̪a.t̪a]	*the sweet potato*
(75)	'dos' [ˈd̪os]	*two*	'los dos' [loz.ˈð̞os]	*the two (of them)*
(76)	'gasa' [ˈɡa.sa]	*gauze*	'la gasa' [la.ˈɣ̞a.sa]	*the gauze*

These approximants are transcribed with a diacritic to distinguish them from the corresponding fricative segments, which are represented without it. They may also undergo a further weakening process in which the articulators make no effort to form a constriction, resulting in segment deletion (Piñeros, 2009). Although this process can occur with all three approximants, it is most common with the dental segment (2009). Such deletion is attested in many varieties of Spanish, including Caribbean and Andalusian dialects (Hualde, 2005).

The sonorants /n/ and /l/ undergo a regressive place assimilation or, in other words, the place of articulation of the segments—nasal and lateral respectively—takes on the place from the following segment (Morgan, 2010). The nasal and lateral allophones in Spanish have been provided below.

(77)	[m] voiced bilabial nasal stop	*un pico*	[ˈum.ˈpi.ko]	'a beak'
(78)	[ɱ] voiced labiodental nasal stop	*un faro*	[ˈuɱ.ˈfa.ɾo]	'a lighthouse'
(79)	[n̪] voiced dental nasal stop	*un taco*	[ˈun̪.ˈt̪a.ko]	'a taco'
(80)	[n] voiced alveolar nasal stop	*un litro*	[ˈun.ˈli.t̪ɾo]	'a liter'
(81)	[ɲ] voiced palatal nasal stop	*un chico*	[ˈuɲ.ˈt͡ʃi.ko]	'a boy'
(82)	[ŋ] voiced velar nasal stop	*un gato*	[ˈuŋ.ˈɡa.t̪o]	'a cat'

(83)	[l] voiced alveolar lateral	*el pico*	[el.ˈpi.ko]	‘the beak’
(84)	[l̪] voiced dental lateral	*el taco*	[ˈel̪.ˈt̪a.ko]	‘the taco’
(85)	[ʎ] voiced palatal lateral	*el chico*	[ˈeʎ.ˈt͡ʃi.ko]	‘the boy’

As has been illustrated, a broader phonological principle underlies many Spanish processes: assimilation is typically anticipatory or regressive, rather than progressive (Hualde, 2005; González, 2020). That is, the features of a following segment frequently spread leftward onto a preceding one. Syllable structure also plays a role: coda consonants are structurally weaker positions that often lack the ability to fully license their own features, leaving them susceptible to assimilation from the following onset (Colina, 2020). This accounts for why coda nasals consistently assimilate in place to the following consonant and why /l/ in coda position also shows regressive assimilation. Importantly, the same principle extends beyond sonorants. In Chilean Spanish, for example (see §4.3.1), dorsal consonants undergo fronting before the high front vowels /i/ and /e/, a process that can be understood as the assimilation of the [front] property from the vowel onto the preceding consonant (Hualde, 2005; González, 2014). In short, these principles explain why the pronunciation of a sound in Spanish is often shaped by the segment that follows it.

2.6 Dialects across the Spanish-speaking World

Individuals have a certain way of speaking; there may be grammatical, syntactic, and pragmatic features that distinguish these speakers from one region to another. The different varieties of speech that we come across can be categorized as dialects (Hualde, 2005). For purposes of convenience, I may refer to the Spanish spoken in Mexico as Mexican Spanish, but it is important to clarify the dialectal regions recognized by Spanish scholars based on shared phonetic and phonological traits/characteristics. In this section, I will focus on dialectal variation based on differences in pronunciation.[4]

According to the *Atlas de la lengua española en el mundo*, there are two types of Spanish that can be found across the Spanish-speaking world (Moreno & Otero, 2008): the more conservative variety (e.g., the Spanish of Castile, the interior of Mexico or the Andes) and a more innovative one (e.g., the Spanish found in Andalusia and the Canary Islands, the Caribbean, and the River Plate).

The atlas goes on to further break down the language into eight dialectal varieties or *geolectales*. In Spain we can find Castilian, Andalusian, and Canarian and in Latin America Caribbean, Mexican-Central American, Andean, Rioplatense, and Chilean. Some of these varieties extend outside of their given regions and encompass other areas. For example, when referring to Caribbean variety of Spanish, not only am I referencing Spanish-speaking countries in the Caribbean but also in coastal regions that border the Caribbean Sea. Grouping speakers into dialects based on country of origin can be difficult as "[…] the dialects of a language are not discrete entities with sharp boundaries" (Hualde, 2005, p. 18).

With Spain, the language can be broken down into two types: Northern-Central Peninsular Spanish and Southern Peninsular Spanish (Hualde, 2005). The latter may be referred to as Andalusian Spanish, but the dialect also includes the language spoken in Murcia and southern Extremadura (2005). Castilian Spanish is often used to refer to the Northern-Central variety due to its historical connection to the regions of Old and New Castile, "corresponding to

[4] These varieties have Spanish can be contributed to social, political, geographical and even individual differences, but for the purposes of this paper, I am focusing on strictly describing the sounds and grouping dialects based on commonly shared phonetic and phonological characteristics and not on sociolinguistic features.

the great part of the present-day region of Castilla-León, Madrid and Castilla-La Mancha" (2005, p. 20).

Within Latin America, some scholars group the dialects into two categories: *el español de las tierras bajas* and *el español de las tierras altas* (Parodi, 2015). *Las tierras bajas*, or lowlands, refer to the regions in which the majority of the Spanish-speakers that immigrated to Latin America was from the south of Spain (Schwegler et al., 2010). In *las tierras altas*, or highlands, there was more migration from central and northern Spain (2010). Unlike the former, in which the Andalusian dialect had an obsersable impact of the development of the Spanishes in *las tierras* bajas, the latter did not have significant influence from any particular dialect of Castilian Spanish (2010).

According to Rosenblat (1967), *las tierras altas* encompass areas across the American Cordillera, from the Mexican Plateau to the Andes while *las tierras bajas* are the coastal regions and plains that surround them. *Las tierras altas*, and its corresponding adjective *terraltense*, consists of two huge areas that are known for being topographically elevated in comparison to *las tierras bajas* (adjective form *terrabajense*) (Piñeros, 2009). Interesting to note, Piñeros also includes the Canarian Islands and the south of Spain strictly for their linguistic properties rather than geographic location.

Both share phonological characteristics (e.g., *seseo* and principally *yeísmo*) but have distinct phonetic inventories and/or undergo different phonetic processes (Parodi, 2015). The following table from Parodi (2015, p. 376) provides a typology of both types of Spanish based on phonological processes found in one type and not the other. This does not mean that every process will be found in a dialect of a specific type, however (2015).

Table 6 – Spanish from *tierras altas* and from *tierras bajas*

Español de tierras bajas	*Español de tierras arltas*		
1. Aspiration of /s/	Maintenance of /s/		
s → h / ___ C, ___ #			
[ˈpah.ta], [ˈka.sah]	[ˈpas.ta], [ˈka.sas]	*pasta*, *casas*	‘pasta, houses’
2. Aspiration of /x/	Maintenance of /x/		
x → h			
[ˈka.ha]	[ˈka.xa]	*caja*	‘box’
3. Velarization of /n/	No velarization		
n → ŋ / ___ #			
[ˈpaŋ]	[ˈpan]	*pan*	‘bread’
4. Loss of /d/	Maintenance of /d/		
d → Ø / V ___ V			
[kan.ˈsa.a], [kan.ˈsa]	[kan. ˈsa. ð̞a]	*cansada*	‘tired’
5. Neutralization of /r/ and /l/	No neutralization		
r → l / ___ C, #			
[ˈkal.ne], [ko.ˈmel]	[ˈkar.ne], [ko.ˈmer]	*carne*, *comer*	‘meat, eat’

The two categories above fit with the descriptions of the conservative and innovative varieties of Spanish. Parodi (2015) asserts that another typological system has been used to describe these groups: *el fuerte consonantismo* or maintenance of consonants corresponds to the former and *el consonantismo débil* to the latter (2015, p. 375).

The following four subsections delve into four dialects of Spanish that are of particular interest for this study: Castilian Spanish, Caribbean Spanish, Chilean Spanish, and Argentine Spanish.

2.6.1 General Characteristics of Castilian Spanish

Castilian or Peninsular Spanish, both terms that refer to the Spanish spoken in the Northern-Central region of Spain, is characterized by certain segments not found in other dialects of Spanish. Missing from the phonemic table in §2.3.1 is the voiceless interdental fricative /θ/ and the palatal lateral /ʎ/, which are only found in some dialects of Spanish (Campos-Astorkiza, 2018), most notably in Castilian Spanish.

The palatal lateral segment—represented by the digraph <ll>–contrasts with the segment /ʝ/—represented by the grapheme <y>—in this dialect and is known in Spanish as *lleísmo* (Morgan 2010). Other dialects of Spanish in which the two segments have merged into one are known as *yeísmo* (2010). (86)-(89) show minimal pairs or near-minimal pairs in which the two segments are distinctive.

(86)	‘vaya’	/baʝa/	*go*	‘valla’	/baʎa/	*fence*
(87)	‘huye’	/uʝe/	*escape*	‘bulle’	/buʎe/	*it boils*
(88)	‘yate’	/ʝate/	*yacht*	‘llave’	/ʎabe/	*key*
(89)	‘yema’	/ʝema/	*yolk*	‘llega’	/ʎega/	*he/she arrives*

The interdental fricative /θ/ is a segment commonly associated with dialects of northern and central Spain (Campos-Astorkiza, 2018). Unlike *seseante* varieties of Spanish which do not have a phonemic contrast between words like ‘masa’ and ‘maza’ [‘ma.sa], these Peninsular varieties of Spanish with the interdental sound show a phonemic contrast between /s/ and /θ/ (2018), represented by the graphemes <s> and <z, ce, ci> respectively.

(90)	*masa*	/masa/	‘mass’	*maza*	/masa/	‘mace’
(91)	*masa*	/masa/	‘mass’	*maza*	/maθa/	‘mace’

/θ/ is also reported to have allophonic variation in some dialects of Castilian Spanish. These environments include the cluster /kt/, in which the velar segment takes on an interdental articulation and in words with syllable, or word-final /d/ (Hualde, 2005) as illustrated in (92)-(94).

		Original	/θ/-variant	
(92)	*recto*	[ˈrek.to]	[ˈreθ.to]	‘straight ahead’
(93)	*verdad*	[beɾ.ˈðað]	[beɾ.ˈðaθ]	‘truth’
(94)	*admirar*	[að.mi.ˈɾaɾ]	[aθ.mi.ˈɾaɾ]	‘admire’

Two additional places of articulation not presented in the allophonic inventory of Spanish in §2.3.2. is [χ], which is a “variation in the articulation of /x/” (Hualde, 2005, p. 154). This segment is discussed further in §2.7.

2.6.2 General Characteristics of Caribbean Spanish

Due to features shared among them, the areas that are considered linguistically Caribbean include the Antilles, and the coastal regions of Venezuela, Colombian, Central America and Mexico (Moreno & Otero 2008). The atlas considers it one of the largest Spanish-speaking areas that is characterized by its very innovative tendencies in the language from a phonetic perspective, e.g., the weakening of consonants in coda position (Hualde 2005). Hualde concludes that “Caribbean Spanish, as a whole, has higher rates of aspiration and deletion” (p. 163). Rivera Castillo (2016) suggests that it is difficult to group together the different varieties of Spanish spoken in the Caribbean into one category; even within the same country, we will find variation. However, for the purposes of this study, I will refer to Caribbean Spanish as those dialects of Spanish spoken in Puerto Rico, Cuba and the Dominican Republic.

Within the dialectal region however there is variation with the treatment of certain segments:

> "Así, es característico de la República Dominicana vocalizar la consonante /r/ en interior de palabra ([kái-ne] 'carne') y de Puerto Rico, la velarización de la *rr* múltiple, que se pronuncia casi como la jota castellana, o la frecuente lateralización de /r/ en final de sílaba: [komél] 'comer', [pwélto] 'puerto'. En Cuba es muy intensa la pérdida de la /s/ final de sílaba, como ocurre también en la República Dominicana, sin embargo en Puerto Rico es más frecuente la aspiración." [Therefore, it is characteristic of [the Spanish of] the Dominican Republic to vocalize the consonant /r/ within a word ([kái-ne] 'carne') and of Puerto Rican Spanish to have a velarized pronunciation of the trill, which is pronounced almost like the uvular /x/ of Northern Spain, or the frequent lateralization of /r/ in coda position: [komél] 'comer', [pwélto] 'puerto'. In Cuba the loss of /s/ in coda position is very strong, much like what occurs in the Dominican Republican whereas in Puerto Rico aspiration is more common.] (Moreno & Otero, 2008, pp. 80-81).

Hualde (2005) refers to the processes involving the rhotic a type of neutralization that are varying degrees of realization in coda position. For the alveolar lateral /l/, we do not find much allophonic variation; there are few instances in Latin American (LAS) in which /l/ followed by the high-front vowel /i/ is articulated as [ʎ], thus eliminating the contrastive distinction between [li] and [ʎ] (2005). However, this is a very uncommon feature. Despite the lack of variation with the lateral segment, there are neutralization processes that do occur in the Spanish dialects of the Caribbean. The best example demonstrated by Hualde is with the word *carne* as it shows three processes that can occur: lambdacism/lateralization (or rhotacism, thus resulting in a case of free variation between /l/ ~ /r/), gemination, and aspiration.

		Lateralization	Gemination	Aspiration
(95) 'carne'	/kaɾne/	[ˈkal.ne]	[ˈka.nːe]	[ˈka^{h}.ne]

The lateralization of the tap is a common feature in Puerto Rico when it precedes a consonant. Additionally, there is a second type of pronunciation that appears to be an approximation between the rhotics and the lateral segments: [ˈka^{r}l.ne] (Hualde, 2005). In (95) we also see an example of gemination that is common in Cuba. Aspiration is a feature that appears to be common throughout the Caribbean. Another treatment of the alveolar lateral /l/ is the process of vocalization it goes through in the Dominican Republic which is discussed further in Chapters 3 and 4.

2.6.3 General Characteristics of Chilean Spanish

The Spanish spoken in Chile can be divided into linguistic varieties: northern, central, southern, and austral-southern (Wagner, 2006). These differences, reported by Rojas (2012) and Rabanales (2000), do not appear to be drastic and could come down to a few differences of intonation and morphosyntactic features. The more commonly linguistic features that can be attributed to this Spanish dialect include aspiration and loss of final /s/, the assibilation of the tap and trill, and the assibilated pronunciation of the consonant cluster /tr/ (Palacios, 2016).

Another feature is velar fronting of the segments /k ɡ x/ has been reported in different varieties of Spanish including Chilean (Quilis, 1999), Colombia, Peru, Northern Mexico, Navarra, Castile and Almeria (Zamora Vincente, 1967; Greet Cotton & Sharp, 1988). This characteristic is further discussed in Chapter 4 and again in Chapter 4. For this paper, the segment of interest is [ç] and is noted for being a palatalized realization of /x/ when it appears before /i/ and /e/ in Chilean Spanish (Quilis, 1999). The palatalized version is widespread through Chile and can alternate with its velar counterpart in speech (Wagner, 1996).

2.6.4 General Characteristics of Argentine Spanish

The Argentinian dialect, also referred to as *español rioplatense* (with the majority of Uruguay included), is the Spanish spoken in Buenos Aires and the southern regions of Sante Fe, Entre Ríos and the Patagonia (Di Tullio & Kailuweit, 2011). The linguistic features often attributed to this variety include: the realization of /ʝ/ as the voiced [ʒ] or the voiceless [ʃ] illustrated in (96) and (97); and the aspiration of /s/ in final position as illustrated in (98) (Palacios, 2016).

(96)	*talla*	/taʝa/	[ˈt̪a.ʒa] / [ˈt̪a.ʃa]	‘size’
(97)	*mayo*	/maʝo/	[ˈma.ʒo] / [ˈma.ʃo]	‘May’
(98)	*comes*	/komes/	[ˈko.me^{h}]	‘you eat’

There are intonational patterns that also make this dialect distinctly different from others in Spanish. These patterns are largely attributed to influence from Italian immigration to the area (Pešková et al., 2011).

The Argentine dialect’s treatment of the palatal segment /ʝ/ and its corresponding vowel /i/ are of special focus for this paper, as varying accounts have been provided to describe the phonological processes they undergo; the graphemes <y> and <ll> are always pronounced as an obstruent consonant, whereas the high front vowel, when operating as a glide, may be pronounced with some palatal constriction but is still acoustically distinct (Hualde, 2005). Hualde proposes that the contrast between the segments /ʝ/ and /i/ are different in Argentinian Spanish, which has developed a contrast between /ʒ/ [ʒ ~ ʃ] and /i/ [i̯ ~ ʝ]:

> Whereas the RAE provides the alternative spellings *hierba* ~ *yerba* for the same word, meaning ‘grass, weed’, in Argentinian Spanish these are two words with different meanings. The popular development [ˈʒeɾ.β̞a] has been specialized with the meaning ‘mate leaves’ and is written *yerba*, whereas for ‘grass’ the spelling *hierba* and the pronunciation [ˈi̯eɾ.β̞a] are used. It is thus clear that Argentinian Spanish has a phoneme /ʒ/ which contrasts with the nonsyllabic allophone of the phoneme /i/. (2005, p. 169)

Another perspective, as presented by Piñeros (2009), is simply a process of strengthening of /ɟ/, resulting in the creation of the voiceless alveopalatal fricative [ʒ] and its voiceless counterpart [ʃ]. Discussion of this phenomenon in further detail can be found in Chapters 3 and 4.

2.7 Current Account of Processes

Within the four aforementioned dialects of Spanish, there are phonological processes that occur that have been examined in previous literature. These processes include uvularization, palatalization, vocalization, and spirantization.

Uvularization is a feature characteristic of Northern-Central Peninsular Spanish that results in "a retracted pronunciation of /x/ as a strident postvelar fricative" (Hualde, 2005, p. 154) or voiceless uvular fricative (p. 156). The examples he provides are illustrated in (99) and (100).

(99)	'jota'	/xota/	[ˈχo.t̪a]	*the letter j*
(100)	'ajo'	/axo/	[ˈa.χo]	*garlic*

Interestingly there is little research on the production of this uvular segment as an allophone of /x/ in Spanish despite its description in both linguistic literature and Spanish phonetics textbooks. Different texts propose its realization in a variety of prevocalic positions. In Lyons' (1981) *Language and Linguistics: An Introduction*, there is a footnote that states, "In Castilian Spanish, however, the so-called jota-sound in forms like *hija* 'daughter' is commonly pronounced as a post-velar, or uvular, fricative; IPA [χ]" (p. 76). Therefore, the one prevocalic environment presented here is before the central vowel /a/. Guitart (2004) describes it as a segment that occurs in some dialects of Castilian Spanish in word-initial position in words such as *gente* and *julio,* which adds two more vowels that can trigger this surface variant: /e/ and /u/. Hualde's (2005) description and examples do not shed any further light on this phenomenon as it adds /o/ as another vowel that can trigger the articulation of [χ]. In Schwegler et al. (2010), /i/ is also listed as a proceeding vowel that can trigger the backing of /x/ as in the word gitano 'gypsy' [χi.ˈt̪a.no]. Therefore, all vowels have been reported to cause the retraction of the velar /x/ to a post-velar or uvular point of articulation.

To complicate matters, the following description from Gutiérrez-Rexach (2016) appears to suggest that the uvular segment is a phoneme instead of an allophone according to both the description provided as well as the use of the slashes to indicate a phoneme: "En cuanto a los fricativos dorsales, en ciertos dialectos del español europeo, en vez del más frecuente /x/, aparece el uvular /χ/" [Regarding the dorsal fricatives, in certain dialects of European Spanish, instead of the more frequent /x/ we found the uvular /χ/] (p. 16295). For this study, I will assume that a process of backing occurs when the velar /x/ is followed by the back vowels /o/ and /u/, resulting in the realization of the uvular segment. This assumption is also shared by Martínez Celdrán, Fernández Planas and Carrera-Sabaté (2003). The opposite process of fronting occurs in Chilean Spanish with the vowels /i/ and /e/ therefore this assumption appears to be a sound one on which to stand. Any other reported instances in which the uvular fricative occurs could be reported to be stylistic variation.

Another phonological process is often associated with the Northwestern region of the Dominican Republic known as Cibao, famously known in LAS literature for a particular phonetic process involving liquids: vocalization (Lipski, 1994). The vocalization of the liquids /l/ and /r/ in the Spanish-speaking world is not very common; other possible regions where vocalization might occur, albeit sporadically, are in parts of Spain (Hualde, 2005). The explanation of how this variation came about is one that is purely phonologically driven as Lipski (1994) admits himself that the origins of the development of this phenomenon are still unclear.

Proctor (2009) asserts that vocalization of liquids in the world's languages is not uncommon. British English, German and Portuguese are some commonly referenced examples. In the case of Portuguese, we know that the lateral liquid /l/ is vocalized to the high-back glide [w] at the end of syllables (Barbosa & Albano 2004). Similarly, in the Spanish of Cibao, the liquids are vocalized to another high glide, [j]. In (101) and (102), we see that vocalization happens when a liquid occurs in word-final position of a stressed vowel and in in a preconsonantal coda position.

(101)	*mujer*	/muxer/	[mu.ˈhej]	*woman*
(102)	*algo*	/algo/	[ˈaj.ɣ̞o]	*something*

Another process of interest is the spirantization we see in Argentine Spanish of the palatal segment /ʝ/ but not of its glide counterpart. Based on the examination of the surface forms of minimal pairs, Harris and Kaisse (1999) concluded that there must be two underlying high vowels that could account for the palatal fricative [ʝ] in some environments and the palato-alveolar fricative [ʒ] in others.[5] In the following table, tokens have been provided with the underlying phones /i/ and /i./ and their surface forms in both Castilian and AR.

[5] Another possible pronunciation would be the voiceless counterpart of [ʒ], which is [ʃ]. Fontanella de Weinberg (1995) documented this feature as one used and promoted by women in Buenos Aires during the 1970s.

Table 7 - Underlying /i/ and /i./ and surface forms

	Underlying /i/	Castilian [i] / [j]	AR [i] / [ʒ]
piso ‘flat’	/piso/	[‘pi-so]	-
tieso ‘stiff’	/tieso/	[‘t̪je-so]	-
cebolla ‘onion’	/seboia/	[se-’β̞o-ja]	[se-’β̞o-ʒa]
yendo ‘going’	/iendo/	[‘jen̪-d̪o]	[‘ʒen̪-d̪o]
	Underlying /i./	**Castilian [j] / [ʝ]**	**AR [j] / [ʝ]**
paranoia	/paranoi.a/	[pa-ra-’no-ʝa]	-
hiato	/i.ato/	[‘ʝa-t̪o]	-

Both *cebolla* and *paranoia* can be pronounced in Castilian with a palatal glide. However, in AR, only *cebolla* can go through a process of becoming the palato-alveolar fricative [ʒ] while *paranoia* could only surface as a palatal glide or palatal fricative. On the surface, Harris and Kaisse suggest that the marked /i./ prevents *paranoia* from going through a process of coronalization whereas unmarked /i/ (as in the example of *cebolla*) will result in [ʒ].

Within Chilean Spanish, there is a process of fronting known as palatalization that occurs with the velar consonants. For this dissertation, the segment of interest is [ç] and is noted for being a palatalized realization of /x/ when it appears before /i/ and /e/ in Chilean Spanish (Quilis, 1999). The palatalized version is widespread through Chile and can alternate with its velar counterpart in speech (Wagner, 1996).

González’s (2011) offers an OT analysis of velar fronting in this dialect. The paper focuses on prevocalic advancement phenomena in Chilean Spanish and “the stages of velar fronting and palatalization are considered to be triggered by the assimilation of features [-back] and [+front] respectively, formalized through agreement constraints for each feature” (p. 291). In other words, the vowels /i e/ are specified for both [-back] and [+front] in order to account for the palatalization of /x/ in one step versus a two-stage process as depicted in Figure 4 (2011, p. 283).

Table 8 – Possible processes from velar to palatal

First stage: Velar fronting	[-back]	k → k̟	g → g̟	x → x̟
Second stage: Palatalization	[+front]	k̟ → c	g̟ → ɟ	x̟ → ç
Palatalization in one step	[-back], [+front]	k → c	g̟ → ɟ	x → ç

The processes outlined above provide essential background information and will serve as points of analysis within the framework introduced in Chapter 3. That chapter begins by reviewing key theoretical approaches to Spanish phonology before turning to the Modified Contrastive Specification (MCS) framework and the Successive Division Algorithm (SDA). Drawing on Dresher's (2009) work on CH, it outlines the motivation behind MCS and examines studies that have applied elements of the framework to analyze the vowel systems of languages such as Paiwan, Seediq, Old English, German, and Portuguese. This descriptive foundation, together with the theoretical tools presented in Chapter 3, provides the basis for establishing the hierarchy for the Spanish vowel system and for explaining why the processes described here occur in some dialects but not in others.

Chapter 3: Spanish Vowels and the MCS

3.1 Introduction

When describing the last four decades of research into sound change, Oxford (2015) asserts that several perspectives have been taken into account to describe this linguistic phenomenon, namely the role of phonetic factors (e.g., Greenlee & Ohala 1980, Ohala 1981), the relationship between phonetic factors and synchronic phonology (e.g., Blevins 2004), central notions of phonological theory such as markedness and symmetry (e.g., Lahiri 2000), and the triggering and spread of changes (Labov 1994, 2001, 2010). However, he argues that a simpler approach could be adopted to describe sound changes over time: contrast.

The "explanatory power of contrast" (Oxford, p. 308), which he uses to describe diachronic change, can similarly be used to provide synchronic descriptions of phonetic variation. Furthermore, it can provide us a framework with which we can examine the surface differences across different dialects of Spanish, such as velar fronting in Chilean Spanish and uvularization in Peninsular Spanish, and at the same time provide a phonological account for said phonetic variation. This emphasis on contrast provides a foundation for synchronic analyses as well, which is where the Modified Contrastive Specification (MCS) framework becomes particularly relevant.

In the following chapter, I will go into further detail on this particular framework. The study aims to expand on this phonological approach, which employs the Contrastive Hierarchy (CH) to allocate phonetic characteristics among the phonemic inventory. This method involves distinct levels of representation in the sound system.

Before defining the CH and its applications, I will first outline previous models of Spanish vowel phonology. These earlier frameworks, particularly those rooted in generative phonology, often struggle to account for the processes driving variation across seemingly similar dialects. By addressing these gaps, the MCS approach provides a more nuanced and systematic analysis of the Spanish vowel phonology across different dialects.

3.2 Linear Accounts of Spanish Vowel Phonology

3.2.1 Early Descriptive Models

One of the first accounts to approach Spanish vowel phonology from a descriptive perspective provides a useful starting point for understanding their articulatory nature. Navarro Tomás's (1918) *Manual de la pronunciación española* builds on this tradition by offering a detailed articulatory description of the Spanish vowel system. He presents them in a vowel triangle with the high vowels [i] occupying the palatal angle (or *vértice palatal* in Spanish) and [u] occupying the velar angle (or *vértice velar*) respectively (p. 37). The vowel [a] occupies the lower angle with [e] and other intermediate palatal vowels falling in between [a] and [i] and [o] falling in between [a] and [u] (p. 37). He goes on to describe the timbre distinctions between the five vowels and acknowledges that the orthographic representation of these vowels—<a e i o u> and <y> in some circumstances—not only represent the vowels of an average timbre but also represent the open and closed varieties (p. 40).

He acknowledges that these differences in pronunciation do not have any "significant valor" nor do they follow any historical or etymological patterns, meaning that they do not contribute to any functional or meaningful contrasts within the language (p. 41). Furthermore, these differences do not align with historical or etymological patterns, emphasizing their nature as surface-level phenomena arising from contextual articulatory conditions rather than systematic phonological processes (p. 41). However, despite this affirmation, he goes on to mention examples of phonetic variation that historically had closed vowels—specifically in the first syllable—are pronounced open and vice versa (pp. 41-42), among other vocalic changes that occurred during the development of Modern Spanish. In his summary of Spanish vowels, Navarro Tomás describes the different surface variation that occurs in spoken Spanish:

> Las cinco vocales ordinarias aparecen bajo tres modalidades distintas. La ***a*** puede ser media, **a**; velar, **ạ**[6]; relajada, **ɐ**. Las demás vocales pueden ser cerradas, **e**, **i**, **o**, **u**; abiertas, **ę**, **į**, **ǫ**, **ų**; relajadas, **ə**, **ɪ̣**, **o**, **u**. Las diferencias que distinguen entre sí las tres modalidades de cada vocal son relativamente pequeñas. Entre las abiertas **ę**, **ǫ** y las cerradas **e**, **o**, la diferencia es más perceptible que entre **į**, **ų** y sus correspondientes **i**, **u**. En este sentido la **a** media y la **ạ** velar se hallan aproximadamente entre sí a la misma distancia que **e** de **ę** y **o** de **ǫ**. [The five ordinary vowels appear under three distinct forms. The vowel ***a*** can be mid, **a**; velar, **ạ**; or relaxed, **ɐ**. The rest of the vowels can be closed, **e**, **i**, **o**, **u**; open, **ę**, **į**, **ǫ**, **ų**; relaxed, **ə**, **ɪ̣**, **o**, **u**. The differences that distinguish the three forms from one another are relatively small. Between the open vowels **ę**, **ǫ** and closed **e**, **o**, the difference is more perceptible between **į**, **ų** and its corresponding **i**, **u**. In this sense, mid **a** and velar **ạ** are located approximately the same distance from one another as are **e** from **ę** and **o** from **ǫ**.] (p. 71; my translation)

By understanding these different modalities (e.g., mid, lax, closed, etc.), we gain insight into both the articulatory mechanics of vowel production. In his work, he also provides a description of glides, which he separates into two categories: semivowels [i̯] and [u̯] and semiconsonants [j] and [w]. He explains the semivowel [i̯] as a segment that is pronounced slightly more open than the open and close variants of /i/ (p. 39). Its semiconsonant counterpart, [j], is described as a more closed segment, or one that starts in a relatively closed position and then opens (p. 40). When /i/ appears syllable-initially in diphthongs, such as in the words *hiedra* [yéđra] ‘ivy’ (IPA

[6] These are the PHONETIC SYMBOLS used in Navarro Tomás (1918) and have been maintained for this paper. These SYMBOLS may not correspond to different sounds in the IPA.

[ˈɟeðɾa] and *hiel* [yél] 'bile' (IPA [ˈɟel], it is pronounced as the fricative [y] (IPA ʝ], which often becomes the affricate [ŷ] (IPA ɟʝ) in "strong pronunciation" (p. 40).

The semivowel [u̯] is articulated more briefly and quickly compared to the vowel [u] (p. 51). Its semiconsonant counterpart, [w], similarly starts almost as closed as a fricative consonant and ends as a vowel (p. 52). When /u/ occurs syllable-initially, as in the words *huevo* 'egg' and *fatuo* 'conceited', it is pronounced as the semiconsonant [w]. However, Navarro Tomás notes that the sound may take on a more consonantal quality when articulated with the lips closing, resulting in a labialized [ǥ] (IPA ɡʷ) or a velarized [ƀ] (IPA bˠ), or even complete occlusion. For example, the word *huevo* could be pronounced as [ˈweβo] or with a more consonantal articulation [ˈɡʷeβo], [ˈbˠeβo] or [ˈɡweβo] (p. 52).

By understanding the different modalities (e.g., mid, lax, closed, etc.) discussed in his work, we gain insight into both the articulatory mechanics of vowel production. The distinctions between these vowel qualities, though small, are perceptually significant and help define the phonological identity of different Spanish varieties, as well as broader phonetic processes like vowel reduction and assimilation.

3.2.2 Generative Phonology and Distinctive Feature Matrices

The shift in phonological theory during the 1950s marked a pivotal departure from earlier views of phonemes as "la unidad primitiva e indivisible del análisis fonológico" [the primitive and indivisible unit of phonological analysis] (Martínez-Gil, 2016, p. 35019). Prior to this period, phonology was largely concerned with identifying the most basic, atomic elements of sound that could be used to distinguish words and meanings across languages. However, Chomsky and

Halle's *The Sound Pattern of English* (1968) fundamentally challenged and redefined this approach by emphasizing the role of distinctive features—specific phonetic properties shared across languages—as the core components of phonological analysis (2016). This shift was particularly influential for Spanish phonological analysis, as it provided a framework to describe the phonemic system of Spanish in terms of binary features, capturing the systematic organization of consonants and vowels. For instance, Spanish vowels could be categorized using features such as [high], [low], [retracted], and [rounded], as demonstrated in Table #. From that point, "the phonetic properties of sounds—referred to as distinctive features—would now be considered the universal elements of phonic substance used to organize the structure and guidelines that configure the phonological systems of human languages" (2016, p. 35019). This is where we see the birth of generative phonology. Its introduction provided a framework that allowed linguists to account for both universal patterns in the sound systems of languages and the unique variations that arise in different linguistic environments.

According to this framework, phonemes are simply groupings of those very basic phonetic properties, which we refer to as distinctive features (2016). Features are binary and can have a + or a – value based on whether a phoneme has that feature or not (O'Grady, 2013). For example, the phoneme /p/ can be described with articulatory descriptors as a voiced bilabial nasal stop. However, it can also be described using a bundle of features, e.g., [+consonantal], [+sonorant], [+nasal], and [+voiced] (2013). The order in which the features are presented, normally in a feature matrix, is arbitrary because it does not influence the phonological interpretation or analysis of a segment. The features themselves are what matter, as they represent the specific articulatory and acoustic properties of a sound, but their order within the matrix is merely a representational convenience. For example, let us examine the Spanish word *pan* 'bread' using a traditional generative model based on Martínez-Gil (2016, p. 35019):

Table 9 - Underlying Representation of 'pan' (bread)

/p	a	n/
[+consonantal]	[-consonantal]	[+consonantal]
[-syllabic]	[+syllabic]	[-syllabic]
[-sonorant]	[+sonorant]	[+sonorant]
[-high]	[-high]	[-high]
[-low]	[+low]	[-low]
[-back]	[+back]	[-back]
[-coronal]	[-coronal]	[+coronal]
[+front]	[-front]	[+front]
[-voiced]	[+voiced]	[-voiced]
[-continuant]	[+continuant]	[-continuant]
[-nasal]	[-nasal]	[+nasal]
[-strident]	[-strident]	[-strident]
[-rounded]	[-rounded]	[-rounded]
…	…	…

Features are described using articulatory properties/traits—except for the feature [strident] — which appeared to carry over from the seminal works of Jakobson and Halle (1956) to distinguish sibilant segments from other consonants (Martínez-Gil, 2016, p. 35019).

This approach to feature classification extends beyond consonantal segments and applies equally to vowels, where a distinct set of phonological features is used to differentiate them. Just as consonants are categorized based on articulatory properties, vowel phonemes in Spanish can be systematically analyzed using a specific set of distinctive features. In the following table adapted from Martínez-Gil's (2016) work (p. 35036), the following distinctive features characterize the vocalic phonemes of Spanish using high ([diffuse]), low ([dense]), retracted ([deep]), and rounded ([flat]).

Table 10 - Distinctive features of Spanish vocalic phonemes

Vowel	**High**	**Low**	**Retracted**	**Rounded**
/i/	+	–	–	–
/u/	+	–	+	+
/e/	–	–	–	–
/o/	–	–	+	+
/a/	–	+	+ (–)	–

As noted earlier, on the phonological level, distinctive features are binary with a + marking a trait for which a segment is specified and a – for its absence. The feature high marks vowels with a raised tongue position, such as /i/ and /u/, while low identifies /a/ with a lowered tongue position. The retracted feature distinguishes back vowels /u/ and /o/ from their front counterparts, /i/ and /e/. Additionally, the feature rounded differentiates vowels with lip rounding, such as /u/ and /o/, from unrounded vowels like /i/, /e/, and /a/. The combination of these features highlights how each vowel occupies a distinct position in the phonological space, emphasizing the systematic organization of the Spanish vowel system.

These distinctive features do not simply serve classificatory purposes; they also play a central role in expressing phonological rules that govern surface realizations. For instance, one common rule in Spanish involves nasal assimilation, where the nasal phoneme /n/ takes on the place of articulation of a following consonant (Hualde, 2005). In a word like *banco* [baŋ.ko] ‘bank,’ the /n/ is realized as [ŋ] before the velar /k/. This rule can be formalized using binary feature matrices and a simple generative rule, as shown below:

Rule: Nasal Assimilation (Place)

+nasal,+consonantal → αlabial,αcoronal,αdorsal / ___ αlabial,αcoronal,αdorsal

Segment	+nasal	+consonantal	+coronal	+dorsal
/n/	+	+	+	–
/ŋ/	+	+	–	+
/k/	–	+	–	+

Here, the underlying /n/, specified as [+nasal, +coronal, –dorsal], assimilates to [+dorsal] under the influence of the following velar /k/. The output [ŋ] reflects this change in place features driven by the phonological environment. A similar process can be seen in voicing assimilation of /s/, where the voiceless fricative /s/ becomes voiced [z] between voiced segments, as in mismo [ˈmiz.mo] ‘same.’ This alternation can also be formalized with binary features, illustrating how voicing spreads from one segment to another:

Rule: Voicing Assimilation

−continuant,+strident,–voice → [+voice] / [+voice] ___ [+voice]

Segment	+continuant	+strident	+voice
/s/	+	+	–
[z]	+	+	+

In this case, the underlying segment /s/ is specified as [–voice], but because it appears between two voiced segments — the vowel /i/ and the nasal /m/ — it surfaces as the voiced [z]. The feature matrix reflects this shift in voicing, showing how a single distinctive feature can be altered in response to phonological context.

Another description of the Spanish vocalic inventory, as provided by Hidalgo Navarro and Quilis Merín (2004), claims that all of the vowels have the features of vocalic*,* not consonantal*,* continuant and voiced. They go on to present their vocalic opposition in the following table (2004, p. 162):

Table 11 - Features of Spanish Vowels

Vowel	Acoustic Features	Articulatory Features
/i/	vocalic, not consonantal, not heavy, weak, not deep, high	high, front
/e/	vocalic, not consonantal, not heavy, not weak, not deep, high	mid, front
/a/	vocalic, not consonantal, heavy, not deep, not high	low, central
/o/	vocalic, not consonantal, not weak, not heavy, deep	mid, back
/u/	vocalic, not consonantal, weak, not heavy, deep	high, back

Based on both charts, there appears to be a consensus among Spanish phonologists that Spanish is a five-vowel language unlike closely related Romance languages such as Portuguese or Catalan, which have a seven-vowel phonemic system with the open vowels /ɛ/ and /ɔ/. However, Navarro Tomás (1977) echoes Navarro Tomás from the early 20th century by stating that the mid vowels /e/ and /o/ have the open variants [ɛ] and [ɔ], respectively, on the surface level; they can be found when they are in contact with trill [r] and before velar [x] and in coda position if closed by a consonant. We can see these differences with the two front mid vowels [e] and [ɛ] in the following examples:

(103) pecho	[pe.t͡ʃo]	'chest'
(104) perro	[pɛ.ro]	'dog'
(105) letra	[le.tɾa]	'milk'
(106) lejos	[lɛ.xos]	'far'

However, despite this claim, Martínez Celdrán & Fernandéz Planas (2007) and Campos-Astorkiza (2012) argue that no acoustic evidence has provided enough support to back up these claims; therefore, there are no systematic distinctions in degree of openness for /e/ and /o/. The latter goes on to state that "the articulatory data show that there is no significant difference in openness according to the contexts mentioned by Navarro Tomás. Based on these results, the authors conclude that the allophonic distinction between open and close mid vowels exists in Spanish, although it is not manifested in the acoustic analysis" (p. 90). This statement highlights a key finding: while articulatory data confirm that Spanish mid vowels have distinct open and close allophones depending on their phonetic context, this distinction does not produce significant acoustic differences that can be measured or observed in spectrograms. Hualde and

Colina (2014) suggest that even if these vowels are more open in these particular contexts that they are not as open as those found in other Romance languages such as Portuguese and Catalan.

Another important area of analysis within early generative phonology is the treatment of glides, particularly the palatal [j] and labial [w]. In traditional structuralist accounts, such as those of Navarro Tomás (1918), these segments were often treated as transitional sounds or allophones of high vowels, lacking independent phonemic status. However, Harris (1969) argues that glides in Spanish behave phonologically as true consonants, especially when considering rule interactions such as voicing assimilation and nasal place assimilation. For instance, in forms like *los huevos* [loz.we.βos], the glide [w] conditions voicing of the preceding /s/, just as a consonant would. In contrast, nasal assimilation does not occur in forms like *un huevo*, where the glide is not treated as consonantal at the relevant stage of derivation. However, in *un hielo* [uɲ.je.lo], the nasal [n] assimilates in place to a palatal [ɲ] before the glide [j], indicating its behavior as a consonant. These patterns suggest that glides are not simply vowel variants but can occupy structural positions typically reserved for consonants. From a generative perspective, Harris's treatment reflects an effort to align phonological rules with surface phonetic regularities while maintaining systematic representations across derivational levels.

The generative model is not without limitations, however. While this traditional model offers a systematic way to analyze phonological structure, it has limitations in accounting for surface variation and dialectal differences, particularly because it does not distinguish between contrastive and redundant features (Dresher, 2009; Oxford, 2015). Fully specified models assign all segments a complete set of binary features, regardless of whether those features are phonologically active. This becomes especially problematic when attempting to explain why similar sounds behave differently across dialects. For instance, a vowel like /i/ may trigger palatalization in one dialect but not in another; unless some feature is contrastively specified—as I will get into in Chapter 4-- such behavior cannot be predicted or accounted for. Models that identify only contrastive features are better equipped to reflect the internal structure of phonological systems and to explain why certain features participate in processes while others do not.

3.3 Nonlinear Analyses of Spanish Vowels and Sonorants

While generative phonology was the breakthrough in the theory of phonology with distinctive features and segmental analysis, it was still constrained within its linear model. It treated phonological processes as operating on linear strings of segments, which made it poorly suited to account for suprasegmental phenomena such as tone, stress, and vowel harmony. This need for a more dynamic and flexible system resulted in the formation of non-linear phonology, which moved beyond the constraints of segmental linearity to better describe the hierarchical, multi-level nature of phonological processes.

The representational approach adopted here assumes a non-linear phonological model, consistent with autosegmental phonology and feature geometry. This allows segmental and suprasegmental features — such as tone — to be represented on separate tiers and governed by association lines. These structures are particularly useful in analyzing phonological processes where tone and segmental quality interact, as we see in the following sections.

3.3.1 Autosegmental Phonology and Feature Geometry

Generative phonology primarily focused on segments and their sequential ordering within an utterance. Within this framework, segments could be described based on their features (Goldsmith, 1981). Additionally, it lacked the explanatory power to account for tonal phenomena in tonal languages, vowel harmony, and nasal assimilations (1981). This is where autosegmental phonology, and eventually feature geometry, came into play.

Autosegmental phonology is a non-linear approach, meaning it decouples features like tone and vowel harmony from individual segments and represents them on independent tiers. It accounts for tone and vowel harmony by addressing processes that extend across multiple segments or tiers simultaneously. Tone, for example, can be considered a property of a whole word rather than the property of an individual vowel. By shifting focus to tiers and larger structures, this model offers a better explanation of cross-segmental processes that earlier linear models could not capture. For example, as demonstrated in the feature matrix in Table 12, the vowel /a/ is specified for a combination of segmental and -tonal- features (Rao, 2013, drawing on Chomsky & Halle, 1968). It is classified as [-consonántico], [+silábico], [+sonante], [-alto], and [+bajo] at the segmental level, indicating its status as a low, sonorant, syllabic vowel. On a separate tonal tier, it is marked for [+tono alto] and [-tono bajo], which specify a high tone. The autosegmental model separates the tonal traits and presents them on a different level or tier, effectively decoupling tones from segments and allowing for a more flexible representation of phonological phenomena (Rao, 2013). The tonal traits constitute “un autosegmento” – or, in other words – an independent part of the segment (2013). Figure 4 (adapted from Rao, 2013) illustrates this principle: when a vowel such as /á/ is deleted, its tonal autosegment [+tono alto] survives and reassociates to the following vowel—in this case /ì/—yielding /î/.

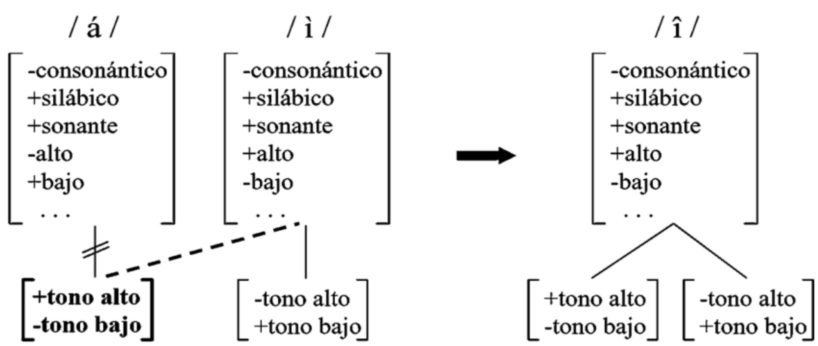
Table 12 - Feature representation of the Spanish vowel /a/

/á/

[-consonántico]
[+silábico]
[+sonante]
[-alto]
[+bajo]
…

[+tono alto]
[-tono bajo]

Figure 4 – Phonological rules in the autosegmental model



This reassociation demonstrates how tone, represented on its own tier, is preserved independently of its original segment and can attach to a new host.

This approach laid the groundwork for feature geometry, which further organizes phonological features into hierarchical structures, allowing for the analysis of more complex processes. While autosegmental phonology revolutionized the analysis of tone and vowel harmony through its tiered representations, it left open questions regarding how features themselves are organized. Feature geometry extends this model by providing a structured hierarchy of features, thereby expanding the descriptive power of the autosegmental approach to include segmental processes such as nasal and lateral dissimilation (Broe, 1993).

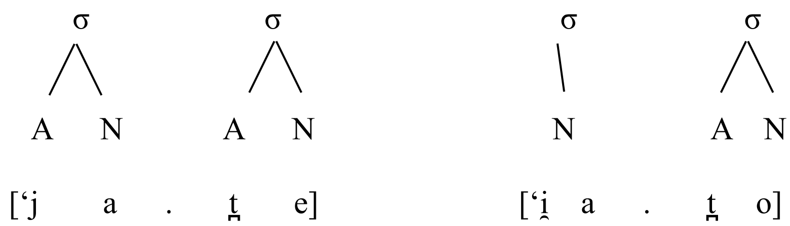
This framework proves especially effective in accounting for the behavior of segments that resist neat classification as either vowels or consonants. One area where feature geometry is especially useful is in how it describes segments the blur the vowel/consonant distinction, e.g., semivowels and semiconsonants. These segments cause difficulties for linear models as they are both vocalic and consonantal depending on their context. The treatment of glides and semivowels in this framework also reinforces the complexity of vowel representation itself, highlighting that vocalic segments are not limited to nuclei but can surface in transitional, non-nuclear contexts with their own phonological behavior. Feature geometry explains the context-dependent alternations in a structured manner through its hierarchical organization of articulatory features. This is especially relevant in Spanish, where the structure of the syllable systematically conditions the phonological status of glides.

3.3.1.1 Representing Glides and Semivowels in Spanish

Building on the preceding discussion of autosegmental phonology and feature geometry, this section examines the representation of glides and semivowels in Spanish within a non-linear theoretical framework. The analysis highlights the non-linear, hierarchical nature of these representations, which separates segmental and suprasegmental features and accounts for their behavior more effectively than linear models. I follow Piñeros (2009), who distinguishes semivowels and semiconsonants based on their syllable position and structural role. Although Piñeros does not explicitly frame his analysis within a single non-linear theory, his approach is consistent with autosegmental and feature geometry models in emphasizing positional and hierarchical structure. This perspective helps explain the alternations and phonological patterns of Spanish glides in ways that linear approaches cannot.

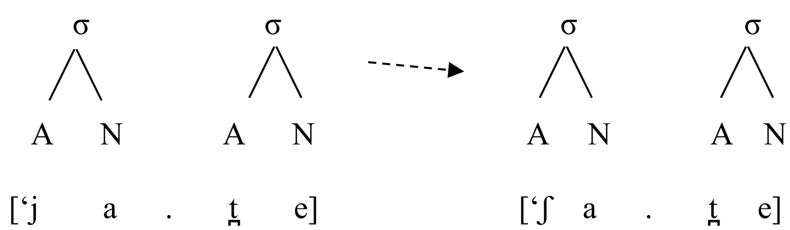
One clear example of this is the contrast between semivowels and semiconsonants, which presents a useful test case regarding how syllable structure and feature representation interact. Piñeros (2009) offers an analysis of the Spanish semivowel system, drawing a clear distinction between the semiconsonant [j] and the semivowel [i̯] based on their position within the syllable: "la semiconsonante [j] se ubica en el ataque, que es la posición prototípica para las consonantes (p. ej., *yate* [ˈja.t̪e] 'yacht'). En contraste, la semivocal [i̯] se comporta más como una vocal porque la posición silábica donde se ubica es el interior de un núcleo compuesto (p. ej. ***h**iato* ['i̯a.t̪o] 'hiatus'" (p. 203). [The semiconsonant [j] is located in the onset, which is the prototypical position for consonants. In contrast, the semivowel [i̯] behaves more like a vowel because the syllabic position where it is located is in the initial position of a compound nucleus.] These distinctions are represented in Figures 5-6(Piñeros, 2009, p. 202):

Figure 5 – Syllabic position of [j] and [i̯]



a. *yate*: [j] is in the onset b. *hiato*: [i̯] is in the nucleus

Figure 6 – Allophonic variation of onset /j/



These figures show that glides and semivowels are not just differentiated by segmental properties, but also by position within structure, once more upholding the need for a non-linear, tiered theory of representation.

Besides syllable position, also evident in dialectal alternations is how glides participate in greater phonological processes—generally in ways consistent with their treatment as featurally substantial, non-minimal segments. One dialect that supports this theory is Uruguayan in which the semiconsonant /j/ can go under phonological processes that cannot occur to the semivowel (Piñeros, 2009). One of these processes allows the semiconsonant phoneme to become the postalveolar fricative [ʒ], which can then be devoiced to derive [ʃ]. This is depicted in Figure # (2009, p. 203). According to Piñeros, “by virtue of being a fricative, this variant has a lower sonority value than that of [j], which makes it able to have a greater contrast in sonority with the syllable nucleus" (2009, 203). The semivowel, however, does not encounter this change as it is part of the nucleus and "it is important that it maintains its higher sonority value" (2009). There are minimal pairs to show this contrast.

		Semivowel			Semiconsonant	
(107)	*hierro*	[ˈi̯e.ro]	'iron'	*yerro*	[ˈʃe.ro]	'error'
(108)	*hierba*	[ˈi̯eɾ.β̞a]	'weed'	*yerba*	[ˈʃeɾ.β̞a]	'yerba mate'

To summarize, the treatment of the semiconsonant and semivowel within the framework of autosegmental phonology highlights their distinct roles in Spanish syllable structure. This analysis provides insight into the behavior of the palatal glide, particularly its ability to surface in forms such as [i j ʝ ɟ ʒ d͡ʒ].

For the purposes of this dissertation, the treatment of the semiconsonant and semivowel will be used especially when we consider its ability to explain the surface forms that the palatal glide in Spanish can take. These forms are [i j ʝ ɟ ʒ d͡ʒ], with [j] and [ʝ] found in all major dialects (Harris & Kaisse, 1999). Aguilar (1997) offers a bibliographic reference chart for the distribution of these segments with most of the surface forms appearing within the same phonetic environments. Hualde (2005) states that the surface forms of the glide represent 'stylistic variation' and merely denote degrees of constriction. The IPA, as Hualde goes on to point out, "sometimes has distinct symbols for differences in pronunciation that are not contrastive in the language under study. In these cases, a choice must be made among two or more alternatives" (2005, p. 16).

When examining the syllable structure of Spanish, it is important to consider the treatment of the palatal glide and its underlying representation in Spanish. Hualde (2005) initially states that "Spanish glides are best considered allophones of the corresponding high vowels and not independent phonemes (p. 55). However, in his phonemic chart of Spanish consonants, /ʝ/ is accompanied by a note stating that it has a questionable status as a phoneme. Morgan (2010) agrees with the conclusion that the palatal segment takes on a variety of phonetic realizations within the Spanish-speaking world and even with the same Spanish speaker. However, he designates the underlying phoneme of the consonant represented by the graphemes <y> / <ll> as the palatal obstruent /ɟ/. Therefore, there still appears to be an uncertainty of what occurs at the phonological level. Two hypotheses to account for the underlying form, as presented by Hualde (2005), are the following:

1. Phonemic distinction between /i/ and the voiced palatal consonant /ʝ/
2. Elimination of /ʝ/ in favor of one underlying form, /i/

The first account makes a clear distinction between the high vowel /i/ (and its corresponding glide) and the palatal consonant. The second account has /i/ playing multiple roles: its vocalic variant; as a glide; and a consonant allophone that occurs on word or syllable initial position. Furthermore, the consonant allophone could have two allophones, [ʝ] and [ɟ]. Table 13, as depicted by Hualde (2005, p. 167), provides the distribution of the allophones of /i/. Hualde suggests that there are some difficulties with this analysis, however. In the example of *con yeso*, there should be resyllabification of the segment /n/ thus resulting in *[ko.ˈnie.so].

Table 13 – Allophonic inventory of /i/

Allophone	Example	Context
[i]	*piso* /piso/ [ˈpi.so] *bahía* /baia/ [ba.ˈi.a]	
[j]	*tieso* /tieso/ [ˈtje.so]	non-stress bearing and adjacent to different V
[j̞]	*de yeso* /de-ieso/ [de.ˈj̞e.so] *Mayo* /maio/ [ˈma.j̞o]	nonstress bearing and adjacent to different V and word or syllable initial
[ɟ̞]	*con yeso* /kon-ieso/ [konʲ.ˈɟ̞e.so] # *yeso* /ieso/ [ˈɟ̞e.so]	non-stress bearing and adjacent to different V and word or syllable initial and after nasal/lateral or (optionally) after pause

Harris and Kaisse (1999)'s proposal made in their study on Argentine Spanish, in contrast, is like that of Hypothesis 2. However, they offer a third explanation. The researchers examined Spanish glides because of "the special properties of high vocoids in [the] language" (p. 117) to determine their underlying form(s) and came to the conclusion that there are two phonemes: non-syllabic /i/ and syllabic /i./. The following pandialectal contrast presents this theory (1999, p. 144).

Figure 7 - Pandialectal representation of Spanish glides

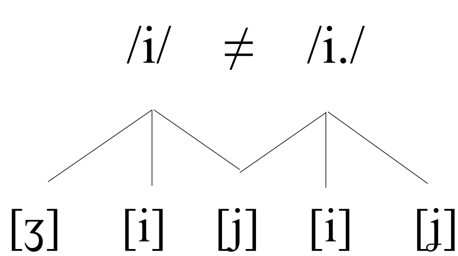


Table 14 - Derived glides from non-syllabic /i/ and syllabic /i./

/i/ ≠ /i./

a. Non-syllabic		b.Syllabic	
viˈc[ja]ba	'he/she vitiated'	vac[i.ˈa]ba	'he/she emptied'
ˈb[oj]na	'beret'	m[o.ˈi]na	'annoyed'
ˈz[we]co	'wooden shoe'	s[u.ˈe]co	'Swedish'
ˈc[wi]da	'he/she cares'	<h>[uˈi]da	'fight'

Harris and Kaisse argue for a distinction between two types of high vowels: (a) those that are unmarked and show predictable glide/vowel alternations; and (b) those that must surface as syllable nuclei. As illustrated in #, as presented in their article (1999, p. 123), provide near-minimal pairs for non-predictable vowels and (predictable) 'derived' glides. Figure # is based on that provided in Harris & Kaisse's article on Argentinian glides (1999, p. 121) with alterations made to omit non-glides and implement symbols used by the IPA for palatal glides and obstruents.

These alternations represent one of the fundamental results of CH theory: segments are language-specific and context-dependent featurally specified. By opposing [j] and [j] in a contrastive relation, we can represent their distribution within a broader system that emphasizes structural representation over phonetic description.

3.3.2 Optimality Theory and Other Constraint-Based Approaches

Whereas feature geometry and autosegmental phonology organize phonological representations through hierarchical structures, Optimality Theory (OT) offers a constraint-based model for evaluating possible outputs. Unlike these earlier representational theories, OT does not aim to describe the internal structure or typology of vowels and consonants per se. Instead, its focus is on how output forms are selected based on the interaction of ranked constraints, often abstracting away from the specific representational details of individual segments. This architecture—built around ranked, violable constraints—is fundamental to OT. Each input is associated with a candidate set generated by GEN, and these candidates are evaluated by EVAL with respect to a constraint hierarchy, which determines the optimal output. Constraints are ranked in a strict domination hierarchy: higher-ranked constraints must be satisfied before lower-ranked ones are considered (Prince & Smolensky, 1993/2004). This framework is particularly useful in accounting for variation in output forms, such as those observed in Chilean Spanish.

While it may no longer qualify as "recent" in linguistic years, OT is still one of the more modern frameworks relative to earlier representational models. Colina's (2009) *Spanish Phonology: A syllabic perspective*, for instance, provides another phonological perspective of the language with an emphasis on syllable structure. OT is unlike the other generative models in that it presupposes that "phonological outputs result from the ranking of constraints" (O'Grady, 2013, p. 96). OT uses tables referred to as tableaux that present a possible outputs (or phonetic realizations) of a word and presents the best candidate using a series of constraints. These constraints are evaluated over a set of possible output forms, or candidates, which are generated by a component called GEN and assessed by EVAL against the language-specific constraint hierarchy. The outcome is determined by a process of comparison known as harmonic ordering, in which the optimal candidate best satisfies the most highly ranked constraints (Prince & Smolensky, 2002). This evaluation procedure is typically represented in a tableau, which lays out the candidate set, the relevant constraints, and the violations that determine the winning form.

The following tableau is an example taken from O'Grady (2013, p. 96) for the English word *ape*:

Table 15 – An OT analysis of ape

/eɪp/	**DEP**	**MAX**	**ONSET**	**NO-CODA**
☞eɪp			*	*
eɪpə	*!		*	
eɪ		*!	*	
peɪp	*!			*

The input, or underlying representation, for *ape* /eɪp/ in the first column has a list of possible candidates below it. Based on the ranking of the constraints, we can come to the best option with the least number of constraint violations (2013). There are two types of constraint families found in OT, faithfulness and markedness (2013). Faithfulness, as suggested by its name, requires that the output preserve the input form (2013). Markedness constraints follow general tendencies across all languages that present the selection of an output that are "more physically effortful or difficult pronunciations" (2013, p. 96). The constraints above help us arrive to [eɪp] as the best candidate (2013, p. 96):

> DEP: Assign one violation mark (*) for every output element that isn't found in the lexical representation.
>
> MAX: Assign one violation mark (*) for every input element that isn't found in the output.
>
> ONSET: Assign one violation mark (*) for every syllable that does not contain an onset.
>
> NO-CODA: Assign one violation mark (*) for every consonant that is found in the coda of a syllable.

When reviewing the tableau, we see that the outputs are eliminated when they come across a constraint; this is indicated by the exclamation symbol. This ranking mechanism—known as EVAL in OT—selects the candidate that best satisfies the most highly ranked constraints, even if it violates some lower-ranked ones (Prince & Smolensky, 1993/2004). The candidate that remains is indicated by the symbol ☞. The Spanish vowel inventory is still described within a generative framework, but OT is of particular interest for this dissertation when analyzing the effects vowels have on surrounding consonants. This constraint-based approach has proven especially valuable in analyzing Spanish dialects, which offer rich cases of phonological variation. As Bradley (2014) notes, "crucial data from Spanish varieties have also contributed to the development of models and subtheories within OT" (p. 73). These include work on spirantization, rhotic variation, and stress—each shaped by dialect-specific constraint rankings. More specifically, González's (2011) offers an OT analysis of velar fronting in Chilean Spanish.

González is able to describe prevocalic advancement phenomena in Chilean Spanish via OT. According to her research, "the stages of velar fronting and palatalization are considered to be triggered by the assimilation of features [-back] and [+front] respectively, formalized through agreement constraints for each feature" (p. 291). In other words, the vowels /i e/ are specified for both [-back] and [+front] in order to account for the palatalization of /x/ in one step versus a two-stage process as depicted in Table 16 (2011, p. 283).

Table 16 – Possible processes from velar to palatal

First stage: Velar fronting	[-back]	k → k̟	g → g̟	x → x̟
Second stage: Palatalization	[+front]	k̟ → c	g̟ → ɟ	x̟ → ç
Palatalization in one step	[-back], [+front]	k → c	g → ɟ	x → ç

This chart illustrates the velar fronting and palatalization phonological processes for Chilean Spanish, based on González's (2014) analysis. The analysis suggests a two-stage derivation in which the velar segment is shifted first by means of assimilating the feature [-back] followed by a separate process of palatalization via [+front] (p. 291). However, González also demonstrates that in some instances, it is possible to use both features simultaneously to produce a process of one-step palatalization (p. 283). Such surface variation indicates the importance of interaction of constraint and feature specification within OT in which rankings in constraints favor different targets in phonology. The motivation for this fronting pattern stems from the proximity of front vowels, particularly /i/, which exerts a coarticulatory influence on preceding velar consonants. This type of context-sensitive behavior underscores the role of vowel-induced contrastive pressure within the phonological system.

Taken together, this analysis supports the implication that both [-back] and [+front] are functional features in the dialect, and that their phonological behavior is conditioned by their contrastive status. The following chapter builds on this framework with CH theory to explore how these and other dialect patterns can be explained systematically across Spanish varieties.

Other constraint-based approaches have also been applied to Spanish phonology alongside classic Optimality Theory. One of these is Stochastic OT (Boersma & Hayes, 2001), which allows the ranking of constraints to vary slightly due to random noise. This produces variation in the output forms by assigning different likelihoods to possible candidates, rather than selecting a single, fixed winner. Stochastic OT has been used to account for variable patterns in Spanish, such as /s/-deletion in syllable-final position (Evanini, 2007). Another approach is Dispersion Theory (Flemming, 1995, 2004), which explains the organization of vowel systems and contrasts by balancing perceptual distinctiveness and articulatory effort. Both frameworks build on the ideas of OT and provide additional tools for modeling variation and typological patterns observed in Spanish dialects.

3.4 The Central Role of Contrast in Phonology

Having established how earlier phonological models accounted for Spanish vowels and sonorants, this section examines the broader theoretical significance of contrast in phonological systems. At the heart of the CH framework lies the assumption that not all phonetic properties are equal; only those features that serve to differentiate phonemes are phonologically active. This foundational idea is captured by the Contrastivist Hypothesis, which holds that contrastive features are the only ones available to phonological processes. Building on this, principles like the Sisterhood Merger Hypothesis help account for how contrasts may weaken or disappear over time, offering insights into phonological change and dialectal variation. Dresher (2009) suggests that previously phonological theories have focused on defining the positive and negative values of phonemes. This duality, as he describes, has emphasized the substantive aspects of phonological entities while inadvertently downplaying the importance of contrast (p. 7).

The lack of contrast within generative phonology–especially in the SPE–poses some issues that contrastively driven theories attempt to tackle. For example, according to Dresher

(2009), SPE is unable to explain why certain phonological segments are more common crosslinguistically than others. This problem also extends to how phonological inventories are structured and how rules function within the system (2009). For example, in the following pairs illustrated in Table 17, we see “a pair of rules to which a purely formal evaluation measure would assign incorrect relative costs” (p. 105). The following table has been modified from to reflect IPA values, as illustrated in Dresher (2009, p. 105):

Table 17 - Examples of rule pairs illustrating limitations

a.	i. i	→	u		ii. i	→	ɨ	
b.	i. t	→	s		ii. t	→	θ	
c.	i. k	→	tʃ	/ ____ [-cons] [-back]	ii. t	→	k	/ ____ [-cons] [+back]

In each case, the phonological changes depicted under rule (ii) appear to be more economically favorable since only one feature is required to be adjusted between each set. For example, if we define /i/ as [-back, -round], adjusting the first feature to [+back] would result in the segment [ɨ] (Dresher 2009/2010). Likewise, /t/ [-continuant, -strident) to [θ] [-continuant, +strident] would only require an adjustment with the second feature whereas /t/ to [s] [+continuant, +strident] would require a more costly adjustment (2009/2010). However, with that being said, the (1a) and (1b) describe phonological rules that are more commonly found in the world’s languages, presumably due to the fact that [u] and [s] are more segments than [ɨ] and [θ] (2009/2010). The third pair follows the same logic: although both rules could be equally viable from a formal standpoint, only the first (k → tʃ) is widely attested—a fact that cannot be adequately explained within SPE as originally formulated (Dresher, 2009/2010).

Dresher acknowledges that "contrast by itself does not account for why [u] and [s] are more common" (p. 105). However, it does allow for language-specific explanations for what we observe in the table. For example, only languages that have a three-way contrast between /i, ɨ, u/ would be able to account for the simplicity depicted in (2a), which would be a completely permissible rule (2009/10). In this way, contrastively grounded models provide more nuanced accounts of phonological structure and rule applicability than SPE, which even with its markedness conventions, fails to explain why certain rules occur more frequently than others (p. 106). To move beyond the shortcomings of earlier generative models, this dissertation adopts a contrast-based approach to phonological representation.

Contrastivist Hypothesis, as adopted from (Hall, 2007), assumes that "only contrastive features are phonologically active" (Oxford, 2015, p. 309).-Building on this, the Sisterhood Merger Hypothesis refers to "structural merges [that] apply to 'contrastive sisters'" (Oxford, 2015, p. 315). In other words, the merger of two phonemes occurs when there is a loss of a contrast (2015). Together, these principles not only explain how contrastive features function within a language but also offer insight into how contrastive relationships can weaken/DISAPPEAR over time through structural reanalysis or sound change.

Under the contrastivist hypothesis, the researcher has to be explicit about the features that will be contrastive in the inventory of a language (Oxford, 2015). According to Oxford, "a feature is taken to be contrastive for a given phoneme if another phoneme exists that differs only in the value of that feature" (p. 309). This 'minimal pairs' method, as argued by Dresher (2009), is flawed and requires the researcher to determine which features are important to develop a hierarchy.

Building from these limitations and assumptions, CH allows for a more all-encompassing approach to the phonological description of a language as distinctive features are ranked based on their importance within a language (2015). Furthermore, Oxford (2015) suggests that this approach allows us to make predictions about processes that can occur, i.e., “rounding triggered by /u/ should only be possible in languages where /u/ is contrastively [+round], while palatalization triggered by /i/ should only be possible in languages where /i/ is contrastively [coronal]” (p. 311). Therefore, the use of distinctive features plays a vital role in this phonological framework.

The Contrastivist Hypothesis ensures that only phonologically active features are considered when establishing contrasts, while the Sisterhood Merger Hypothesis provides a framework for analyzing historical and dialectal mergers. These tools are essential for building contrastive inventories that not only reflect synchronic phonological organization but also accommodate patterns of variation and change. An important feature of CH is underspecification; only those features that are deemed necessary to contrast one segment from another is needed: “in a theory where contrastive feature specifications are assigned hierarchically by the SDA, it is natural to suppose that contrastive specifications are specified and redundant specifications are unspecified” (Dresher, 2009, p. 55). This principle not only streamlines phonological representations but also allows for flexibility and adaptability in accounting for phonetic and phonological variation. For instance, dialectal differences may emerge from the reinterpretation or reweighting of contrastive features within specific linguistic contexts, leading to phonological variation across regions or speakers. This is crucial for the processes that we will examine in this paper as it provides a more thorough account of the underlying rules and features that trigger phonetic variation--something that cannot always be captured by generative theories of phonology.

To illustrate how these principles are applied in practice, we turn later in this chapter to Lee's (2012) analysis of the /w/–/v/ contrast in Paiwan as an example of a contrastive hierarchy in action.

3.5 Introduction to Contrastive Hierarchy

According to Dresher (2009), contemporary phonological analysis often leans toward phonetic explanations for describing phonological phenomena. However, the Contrastive Hierarchy (CH) approach emphasizes the importance of language- and dialect-specific feature hierarchies in shaping the organization of phonemes and their place within the phonological system. This perspective underscores that phonological contrast, rather than purely phonetic distinctions, is a key organizing principle (Dresher, 2009). Within this framework, there is a deliberate shift away from the phonetic contrasts emphasized in traditional phonemic theory, with a renewed focus on how phonological patterns align within a system. The goal of the theory is to establish "phonological contrast as a central principle of phonological theory" (2009, p. 8), moving beyond a strictly phonetic interpretation of contrast.

Given that a modified version of this theory will be applied in the analysis of my data, it is essential to first review Dresher's approach to hierarchy. This dissertation is grounded in the MCS approach to phonology, which employs the CH to allocate phonological features throughout a phonemic inventory (Dresher, Piggott & Rice, 1994; Dresher, 2009). This framework is further enriched by the inclusion of well-defined levels of representation within the sound system, as described by Purnell and Raimy (2015). Raimy (2021) emphasizes that "these MCS-type representations are phonological ones and not phonetic ones" (p. 71) and that there is always at least one item that is fully underspecified in any contrastive inventory/hierarchy. This perspective reinforces the notion that phonological systems derive structure from contrastive relationships, not from phonetic substance. By integrating these theoretical insights, this study aims to demonstrate how contrastive hierarchies not only structure phonological systems but also play a dynamic role in shaping patterns of sound change across languages and dialects. This model's emphasis on abstract phonological contrasts and context-sensitive completion aligns well with the kinds of surface variation observed in Spanish dialects—variation which cannot be captured by phonetic form alone but emerges from underlying contrastive hierarchies.

This section is organized as follows: §3.5.1 introduces the theoretical underpinnings of contrastive features, including their form, function, and role in phonological representations. §3.5.2 details how these features are assigned using the Successive Division Algorithm (SDA), contrasting this approach with earlier models such as the Pairwise Algorithm. Together, these sections provide the foundation for understanding how contrastive hierarchies are constructed and interpreted within a phonological system.

3.5.1 Distinctive Features: Form and Function

Distinctive features, as described by Purnell and Raimy (2015), "[…] are phonetically grounded building blocks of segments providing a description of a gesture that have contrast-maintaining ability" (p. 523). In other words, these entities are considered fundamental elements of phonological representations that primarily serve to differentiate sounds from one another.

Phonemes are made up of distinctive features that cannot be parsed into smaller units. Additionally, these sets of features are considered finite in nature, apply to all sounds, and are binary or oppositional (Purnell & Raimy, 2015). Phonemes can be characterized by binary features, which denote their content as either positive [+feature] or negative [-feature]. They could also be characterized as unary or privative features, which encodes contrast as the presence (or lack thereof) of feature content[7]. In a privative system, a segment either carries a feature or it does not; its absence is not marked, but simply unrepresented. This contrast in how features are represented—either as binary oppositions or as the presence/absence of substance—has important implications for phonological analysis.

For instance, in a binary system, the high front rounded vowel /y/ would be marked [+round], while its unrounded counterpart /i/ would be [-round]. In a privative system, /y/ would be marked [round], whereas /i/ would not be specified for rounding at all, indicated by the null set ∅. This distinction is significant because it determines how much information the phonological grammar has access to: both values are accessible in a binary model, whereas only specified features are phonologically active in a privative model (Iverson & Salmons, 1995).

This difference in feature specification has consequences for phonological behavior. In English, fortis obstruents (such as /p/ or /t/) are specified for [spread glottis], which accounts for their aspirated realizations in certain contexts. In contrast, lenis obstruents (such as /b/ or /d/) lack laryngeal feature specifications entirely. This asymmetry explains why aspiration spreads from voiceless obstruents but not from voiced ones (Iverson & Salmons, 1995). The broader implication is that natural classes in phonology often reflect the presence or absence of a single active feature, rather than a binary opposition between two values.

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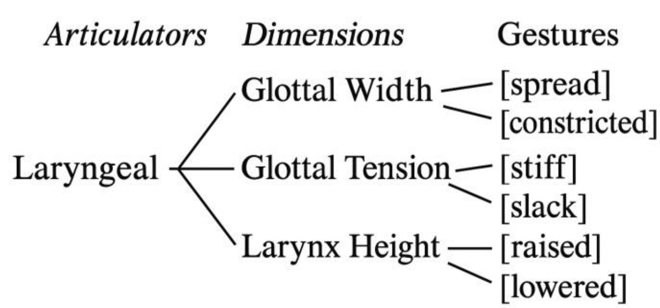
[7] See also Purnell & Raimy, 2015, for how these assumptions are implemented within a multi-level, dimension-based framework of phonological representation

Building on these ideas, Avery and Idsardi (2001) propose that distinctive features are best understood as dimensions—abstract articulatory pathways that are defined by mutually exclusive gestures. Each dimension can be completed with only one gesture at a time, due to physiological constraints (Avery & Idsardi, 2001; see also Keating, 1996). Figure 8 illustrates the laryngeal articulator organized into three such dimensions—Glottal Width, Glottal Tension, and Larynx Height—each of which can be completed with one of two opposing gestures (2001). For example, the Glottal Width dimension may be completed with either [spread] (producing aspiration) or [constricted] (producing glottalization), but never both (2001). Similarly, Glottal Tension can be completed with [stiff] or [slack], and Larynx Height with [raised] or [lowered] (2001). Importantly, dimensions are not inherently binary; rather, they are privative, as only one articulatory gesture can be realized at a time within a given dimension (2001).

Figure 8 - Laryngeal organization module



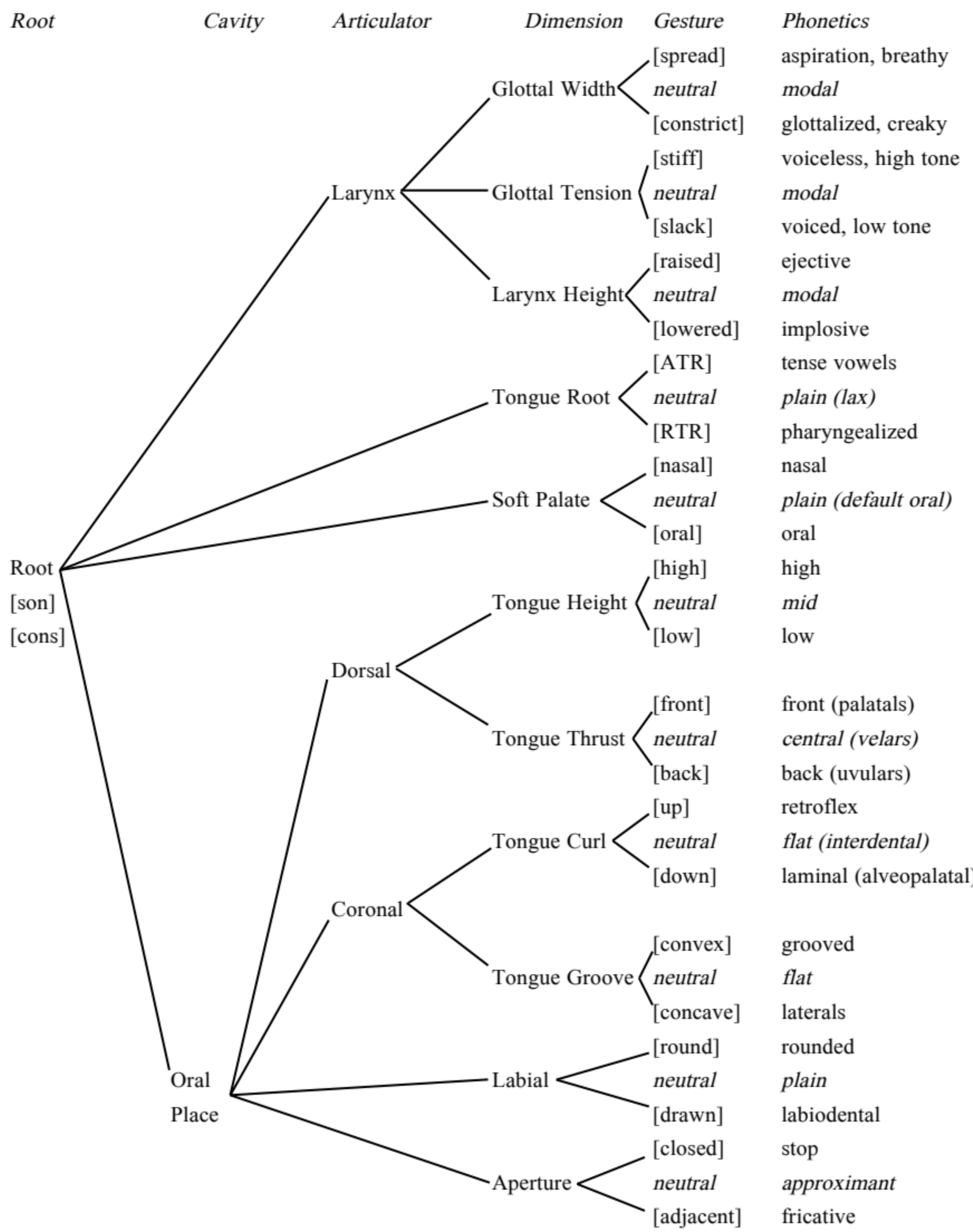
In this framework, phonological representations are inherently underspecified. Segments are marked only for the dimensions necessary to distinguish them in the phonological inventory.

The actual phonetic realization—what gesture a segment will surface with—is determined later through a process Avery and Idsardi (2001) refer to as completion. For example, fortis stops in English are specified only for Glottal Width. This dimension is completed with [spread] when the stop occurs in onset position (e.g., [pʰɪn]), and optionally with [constricted] in coda position (e.g., [nɪpʔ]) (Purnell & Raimy, 2015). This context-sensitive realization of dimensionally specified features follows the enhancement and representational mapping proposed by Purnell and Raimy (2015).

This dimensional approach also extends to vowels. Instead of describing vowels using traditional binary features like [high], [low], [front], [back], and [round], the present study follows Purnell and Raimy (2015) in identifying four articulatory dimensions for vowel specification: Tongue Height, Tongue Thrust, Tongue Root, and Labial. These dimensions map onto phonetic qualities via completion with gestures such as [high], [front], [RTR] (retracted tongue root), and [round], depending on phonological context (Purnell & Raimy, 2015, pp. 526–527). Dimensions represent phonological information that "are converted to gestures through a completion rule" (Raimy, 2021, p. 72). Gestures are therefore phonetic representations. This model assumes a modular architecture in which contrastive, underspecified phonological specifications are completed by the phonetics interface to produce surface articulation. These dimensional labels refer to oral and (supra)laryngeal points of contrast within the vocal tract, rather than articulatory gestures or motoric outcomes. For example, a vowel specified with Tongue Height and completed with [high] is a high vowel; a vowel with Tongue Thrust completed with [front] is a front vowel.

The same organizational logic applies to consonantal place features. In Raimy's (2016) articulator-based model, dimensions such as Labial, Coronal, and Dorsal are grouped under a superordinate Oral Place category. Figure 9 illustrates this organization, showing how consonantal place is structured into hierarchically related dimensions that function as abstract contrastive specifications, rather than direct phonetic instructions.

Figure 9 - Distinctive Features



This organization of features by dimension is consistent with Raimy's (2021) proposal for an articulator-based model of phonological contrast. In this approach, dimensions like Labial, Coronal, and Dorsal are not treated as simple place features but as subordinate elements grouped under a superordinate category called Oral Place: "Oral Place as a category includes the lips and tongue as articulators with the tongue being split into two parts. This gives us the categories of Labial, Coronal, and Dorsal. Oral Place is the superordinate category for all three" (2021, pp. 71–72). These dimensions are not themselves phonetic instructions; rather, they are abstract contrastive specifications that must be completed by a phonological-to-phonetic mapping process. As Raimy further notes, "[t]he phonological information provided by the phonology to the phonetic module must be converted into gestures by the phonetics. This is the essential claim of the Modified Contrastive Specification framework" (2021, p. 74). Earlier in the same chapter, Raimy emphasizes that "phonological representations for spoken language act as a link between articulatory and acoustic representations" (p.71), underscoring the role of phonological structure as a modular interface. This supports the current study's use of dimension-based contrastive representations, where features are both underspecified and contextually interpreted.

In languages with more complex vowel systems, such as Norwegian, these dimensions also help distinguish multiple vowel heights (Natvig, 2018). High vowels are specified with Tongue Height (completed with [high]), while low vowels are specified via Tongue Root, completed with [RTR], which lowers the tongue body (Purnell & Raimy, 2015, pp. 533–534). Rounding is achieved through the Labial dimension, completed with the [round] gesture.

By relying on dimension-based features and allowing for underspecification, this model aligns with the Contrastivist Hypothesis—the idea that only contrastive features participate in phonological processes. Features that are present phonetically but are not needed to distinguish phonemes are left out of the phonological representation. As a result, this system provides a formally elegant, typologically predictive, and empirically motivated account of how features are distributed, specified, and interpreted across different languages.

3.5.2 Building Contrastive Hierarchies: MCS & SDA

When it comes to the phonemic analysis of segments, the process shares similarities with generative grammar in that phonemic contrast is determined through phonological features. However, the methods used to arrive at these contrasts differ significantly between the two theories. Traditional generative grammar often employs the Pairwise Algorithm, an explicit method for extracting contrastive features.

As Dresher (2009) explains, the algorithm, originally proposed by Archangeli (1988), involves fully specifying all segments, isolating pairs of segments, and designating as 'contrastive' those features that distinguish each pair. Once all pairs have been examined, any unmarked feature specifications are deleted. The method has been illustrated below and is adapted from Archangeli (1998, as depicted in Dresher, 2009, p. 14).

a. Fully specify all segments.
b. Isolate all pairs of segments.
c. Determine which segment pairs differ by a single feature specification.
d. Designate such feature specifications as ‘contrastive’ on the members of that pair.
e. Once all pairs have been examined and appropriate feature specifics have been marked ‘contrastive’, delete all unmarked feature specifications on each segment.

While this method reliably identifies minimal pairs, it is not without limitations. Dresher (2009) reports the issues that arise when using minimal pairs to determine segments that contrast: "[A] feature is taken to be contrastive for a given phoneme if another phoneme exists that differs only in the value of that feature. [Dresher] has argued at length that this intuitive method is in fact logically flawed and that, in many cases, it requires the analyst to tacitly decide that certain features are more important than others" (p. 309). For example, when considering the phones (or segments) /p b m/, /p/ and /b/ have a contrast in voicing whereas /m/ when paired with /p/ not only has a contrast in voicing but in nasality as well (Oxford, 2015). This is illustrated below.

Table 18 - Full specifications for French bilabial stops

	p	b	m
[voiced]	–	+	+
[nasal]	–	–	+

To provide a clearer understanding of how hierarchies operate in this model, we must examine the SDA, which forms the foundation for contrastive phonological systems. According to Dresher (2009), to prevent problems that could arise in the pairwise approach, features divide inventories into smaller inventories. This process ensures a systematic and hierarchical approach to understanding phonemic distinctions, thereby avoiding arbitrary or ad hoc classifications. In SDA, there are no feature specifications mentioned and features are only added if they serve to mark some type of phonemic distinction. This principle emphasizes economy and efficiency, ensuring that only meaningful contrasts are highlighted, which is crucial for accurately modeling linguistic systems. The SDA consists of the following rules (Dresher, 2009).

a. Begin with *no* feature specifications: assume all sounds are allophones of a single undifferentiated phoneme.
b. If the set is found to consist of more than one contrasting member, select a feature and divide the set into as many subsets as the feature allows for.
c. Repeat step (b) in each subset: keep dividing up the inventory into sets, applying successive features in turn, until every set has only one member.

The algorithm above is a very general formulation for defining contrast and redundancy for members of an inventory. It designates feature values as being contrastive or redundant in terms of an ordering of features, which I will call a contrastive hierarchy. In this approach, contrast is a matter of relative scope or ordering of contrastive features. For clarification purposes, a modified version has been presented by Purnell et al. (2019, p. 4448):

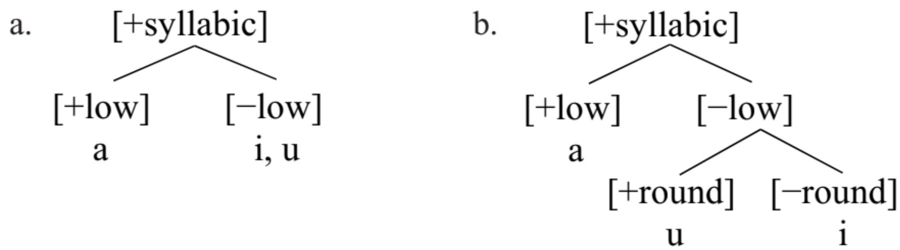
Successive division algorithm (clarified)

a. Begin with NO feature specification: assume all sounds are allophones of a single undifferentiated phoneme.
b. If the phone set is found to consist of more than one contrasting member, select a distinctive feature to characterize the contrast and divide the set into as many subsets as the features allow.
c. Repeat step 1b in each subset: keep dividing the inventory into sets, applying successive features in turn, until every set has only one member.

In A), the process begins with the idea that all sounds are part of a single, undivided group—no features are assumed at the start. This reflects the simplest possible version of the system, where nothing is yet specified. In B), the selection of features is not arbitrary; it is guided by the need to account for observable phonemic distinctions within a language. This ensures that the resulting hierarchies are empirically grounded. In C), the process continues gradually, dividing the sounds further at each step until every phoneme is distinguished. This approach mirrors how phonological systems may develop diachronically and synchronically. In this way, the SDA provides the foundation for constructing contrastive hierarchies—ordered representations of the features needed to distinguish a language's phonemic inventory. These hierarchies represent the step-by-step application of the SDA, creating a structured framework that reflects the underlying contrastive features of a phonemic inventory. Within the hierarchy, certain principles can be invoked to describe changes that occur, e.g., Contrastivist Hypothesis, Sisterhood Merger Hypothesis, Contrast Shift Hypothesis, and Segmental Reanalysis (Oxford, 2015). For this study, the first two will be of importance for the development of the hierarchies in Spanish.

The principles of the Successive Division Algorithm provide a structured basis for determining which features are truly contrastive in a phonemic inventory. To illustrate how this approach works in practice, Oxford (2015) presents a simple, yet revealing, application of the SDA to a minimal vowel system containing just three segments: /i a u/. This example highlights how hierarchies can be constructed by successively applying contrastive features to divide the inventory step by step, ultimately reflecting language-particular phonological activity. The hierarchy first divides the [+low] vowel /a/ from the [-low] vowels /i/ and /u/. Then, the feature [round] distinguishes /u/ from /i/, a feature irrelevant for /a/, as it was already separated by the [low] feature. This has been illustrated in Figure 10, which has been adapted from Oxford (2015, p. 310).

Figure 10 - Contrastive hierarchy for a three-vowel system /i a u/



(10a) first divides the [+low] segment /a/ from the [-low] segments /i/ and /u/. In order to then divide the remaining segments, we can use the feature [round], which is illustrated in (10b). This feature is not relevant for /a/ as we were able to successfully divide it with only the feature [low]. The distinction between /i/ and /u/ can then be made using the feature [coronal], a contrastive property that predicts processes such as palatalization in languages where this hierarchy applies (Oxford, 2015). According to the Contrastivist Hypothesis, this distinction is significant because it predicts possible phonological processes (Oxford, 2015). This observation underscores the fact that contrastive hierarchies "appear to be at least partly language-particular and are thus a fundamental source of crosslinguistic variation" (2015, p. 310). For instance, the vowel inventory represented in (10b) would theoretically be possible only in a language where rounding is contrastively specified for the vowel /u/ (2015). Similarly, a hierarchy in which /i/ is contrastively [coronal] would be expected in a language where palatalization is triggered by this vowel. By integrating the Contrastivist Hypothesis with hierarchical contrastive specification, we obtain a model of phonological activity and typology that is both explicitly constrained and predictive (2015).

While the fundamental principle of the MCS framework and the SDA is to define distinctive features and construct hierarchies based solely on contrastive necessity, the resulting phonological systems frequently exhibit a high degree of symmetry. This apparent symmetry is not a mere accident. Instead, it often reflects underlying linguistic forces that shape phoneme inventories. Oxford (2015) highlights that forces such as symmetry influence contrast shifts, leading to changes that tend to increase the overall balance of a system. For instance, a system where all possible combinations of feature values are realized by distinct phonemes is considered to have "full symmetry" or "maximal feature economy". Purnell and Raimy (2015) discuss how a lack of symmetry in a contrastive hierarchy can complicate predictions about phonological change, such as mergers. They point out that Dresher's (2015) Old English hierarchy, where the structures beneath the [±round] contrast are not symmetrical, raises questions about how phonemes would merge upon the loss of [±round]. This implies that symmetry, while not a rigid constraint at every branching point, is often a desirable property for the predictive power and clarity of the hierarchy, especially concerning processes like mergers.

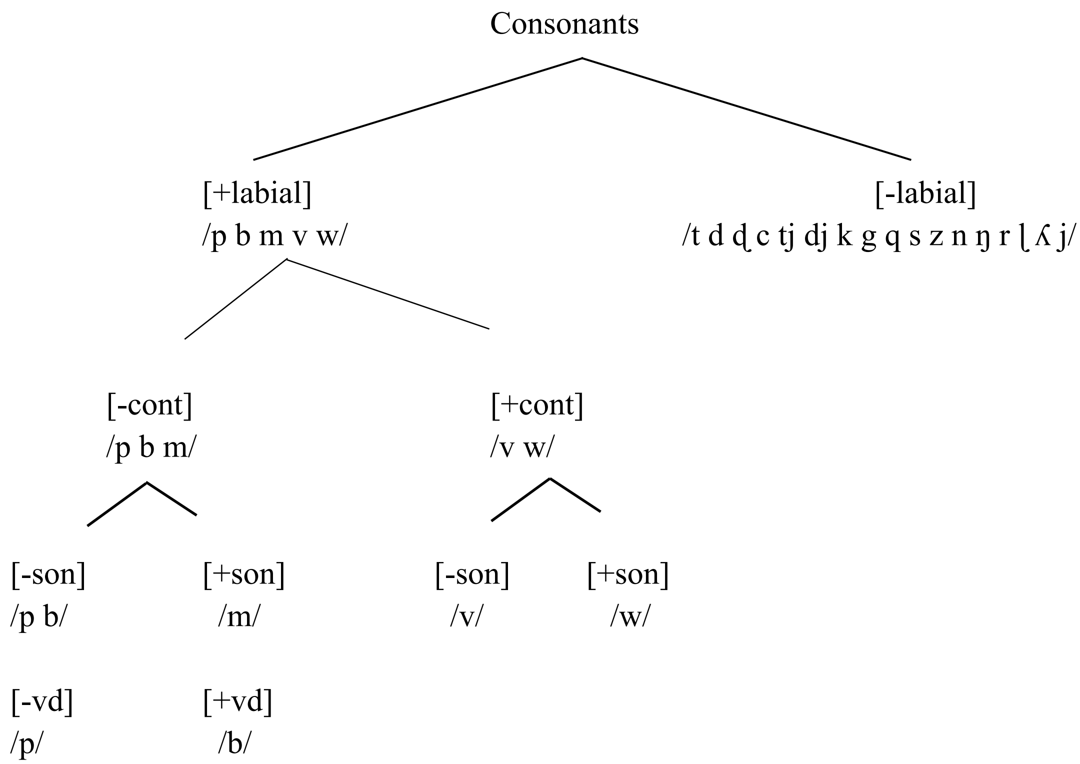
3.5.3 Motivating Example: Contrastive Hierarchy in Paiwan

The following study—Lee (2012)'s analysis of the segment /w/ in Paiwan—is an example of a model that will resemble one that I will employ for our analyses. In this language, there is an alternation between the segments /v/ and /w/, which Lee describes as "phonemic and dialectal, which occurs in most Paiwan dialects" (p. 21). As illustrated in Figure #, in order to account for this phonological activity, it is important to create a hierarchy in which /v/ and /w/ are in a structurally parallel contrastive relationship. In order to do so, Lee has PARSED the consonant segments at the top of the hierarchy based on the feature [±labial], reflecting the importance of place features in labial dissimilation. For the purposes of this study, the [-labial] segments were not divided even further. However, Lee makes an important notation that much like /v/ under the first set, the segments [ɖ] and [q] in the plosive set also lack voicing counterparts and therefore are similarly prone to phonological alternations (p. 21).

Lee used the place feature of LABIAL to divide the consonants “given the labial strengthening process from /w/ to /v/ and labial dissimilation” (p. 21). She then divided by the feature [continuant] since /v/ is a fricative that does not have a voiced counterpart, which she suggests is the supporting evidence to have it higher up in the hierarchy. This is reflected in Figure 11 as it depicts both segments occupying parallel positions.

Each segment in the first set are fully specified by the feature ordering of [labial] > [continuant] ([cont]) > [sonorant] ([son]) > voiced [(vd]) (p. 22). This means that /v/ and /w/ are contrastively distinguished by the [continuant] feature under the [labial] node. The ordering places [labial] at the top of the hierarchy, which reflects its contrastive priority—a choice motivated by processes such as labial strengthening and dissimilation involving /w/ and /v/. Lee explains that [continuant] comes next because /v/, as a fricative, lacks a voiced obstruent counterpart in Paiwan, whereas /w/, a glide, does not occupy the same fricative space. This contrast is sufficient to distinguish the segments without requiring full specification for all possible features. [Sonorant] and [voiced] are added below to capture other segmental behavior, but the crucial division between /v/ and /w/ occurs at the level of [continuant].

Figure 11 – CH /w/ ~ /v/ alternation in Paiwan



This hierarchical arrangement illustrates how the segments /v/ and /w/, though phonetically distinct, are distinguished in the phonological system not simply by surface form but by contrastive structure. Importantly, the ordering of features reflects the actual phonological processes active in the language—specifically, the fact that /w/ undergoes strengthening to [v] in certain environments, and that this strengthening targets a contrastive dimension ([continuant]) that is present in one segment but not the other. Thus, Lee's figure demonstrates how contrastive hierarchies can model allophonic and dialectal variation by carefully selecting and ordering features that are active in the system. This serves as a direct methodological model for how we will analyze similar alternations in Spanish dialects—such as palatalization of velar segments or lenition of rhotics—as outcomes of contrastive feature structures, not just surface differences.

As Dresher and Zhang (2005) argue, segments that are phonetically distinct may pattern together phonologically if they occupy similar structural positions in the hierarchy. In the same way, this study examines whether dialect-specific variants in Spanish—such as uvularized or palatalized realizations—can be understood not merely as phonetic variation, but as a result of differences in contrastive specification. Feature selection will be guided by phonological behavior—such as where assimilation, dissimilation, or neutralization occurs—rather than phonetic form alone. By using existing phonological descriptions and analyses of dialectal variation, this study will model contrastive hierarchies that explain the underlying organization of Spanish phonologies.

3.5.4 Adding Superordinate Marking

While Lee's (2012) application of the MCS/SDA framework to Paiwan demonstrates how contrastive hierarchies can be used to capture phonologically active features, her analysis does not explicitly address how to represent the unmarked sister in a split. For my purposes—particularly for explaining how vowel context influences the realization of dorsal consonants in Chilean Spanish (see §4.3.1)—this distinction is essential. To address this, I adopt the version of MCS/SDA developed by Purnell, Raimy, and Salmons (2019) [8], which retains the core principles of the hierarchy while introducing superordinate marking as a way of representing the unmarked side of a contrast without resorting to negative feature values.

While the SDA provides a systematic way of assigning contrastive features in an underspecified, privative system, it does not by itself specify how to represent the unmarked side

[8] For ease of reference, I will abbreviate Purnell, Raimy & Salmons (2019) as PRS in what follows.

of a contrast. In a strictly privative framework, the absence of a feature is not equivalent to a negative value (e.g., [–front]) but instead represents a lack of specification altogether. The question, then, is how to capture the phonological content of those segments that remain unspecified for a given dimension after a division. The motivation for this representational strategy comes directly from the feature geometry of Avery & Idsardi (2001), where each dimension is dependent on a higher-level articulator node. Tongue Root is subordinate to [sonorant], Tongue Height and Tongue Thrust are subordinate to Dorsal, and Labial is subordinate to Oral Place. This hierarchical structure means that when a dimension is invoked to divide the inventory, both sides of the split remain connected to their superordinate node. The marked category is specified with a feature (e.g., TT [front]), and the unmarked category is not left empty but is identified by its structural position under the dominating node (e.g., $\text{Dorsal}^{\text{TT}}$). In this way, the system avoids having bare categories and instead ensures that both sides of a contrast are phonologically represented.

In the version of MCS/SDA adopted here—following PRS—these unspecified categories are explicitly marked by the superordinate node that dominates the contrastive dimension in question. This is referred to as superordinate marking. For example, if Tongue Thrust is used to split front vowels (completed with [front]) from non-front vowels, the latter are not simply marked Ø; instead, they receive the superordinate label $\text{Dorsal}^{\text{TT}}$ (Dorsal–Tongue Thrust). This notation signals that these segments are still organized under the same articulator and dimension as their marked counterparts, even though they lack a specific gesture at the phonological level. An additional advantage of this approach is its explicit notation conventions. As Natvig (2020) explains, drawing on PRS, the unspecified member of a privative contrast is not left empty but instead linked to its dominating node, with the marked feature indicated in superscript on that node (e.g., [sonorant]^{SP} for non-nasal sonorants as opposed to nasal (Soft Palate)). This superordinate null marking ensures that both sides of the contrast are structurally represented in the hierarchy. As Raimy (2021) explains, "privative representations in phonology act as a specification or mark in opposition to something else. The classic interpretation of this something else can be understood as zero […]" (p. 68). In other words, a strictly privative system risks missing important patterns, since the 'unmarked' category is treated as nothing more than an absence. As Raimy (2021) goes on to note, "ternary phonological activity requires a representation that is different from the basic privative item and the absence of it" (p. 68), which is precisely what motivates the PRS convention of superordinate marking.

Superordinate marking serves several purposes. First, it preserves the structural relationships among segments in the hierarchy, allowing for generalizations that target the entire superordinate category. This is especially important in cases like Chilean Spanish, where dorsal consonants change their pronunciation depending on neighboring vowels; in these cases, the change is explained not by a single feature (like [front]) but by the broader class of dorsals as a whole, which acts as the structural basis for the interaction. Second, this approach integrates neatly with the Avery & Idsardi (2001) feature geometry adopted here, in which dimensions and gestures are organized under articulator nodes, and with the multi-level representation model of Purnell & Raimy (2015), where abstract phonological structures are later "completed" with phonetic gestures. PRS describe the value of this representational strategy as follows:

> Superordinate marking retains the structural organization of the feature hierarchy even for segments that are not specified for the lower-level dimension. This allows the phonological grammar to recognize and manipulate natural classes defined at higher nodes in the hierarchy, enabling processes to apply to underspecified segments without requiring the insertion of redundant features. (p. 7)

In other words, superordinate marking ensures that both sides of a contrast remain phonologically represented: the marked category with its feature, and the unmarked category through its shared superordinate node, all within the same hierarchical structure.

The hierarchies presented in Chapter 4 will follow this PRS convention. In those diagrams, labels such as $\text{Dorsal}^{\text{TT}}$ or $\text{Dorsal}^{\text{TH}}$ indicate the unmarked sister in a split, marked by its superordinate category rather than by a null or negative specification. This explicit marking will be crucial in accounting for vowel-conditioned consonant processes, such as the dorsal outcomes in Chilean Spanish (§4.3.1), where the interaction is best understood at the level of shared superordinate structure. §3.5.3 presents Lee's (2012) application of the framework to Paiwan, which serves as a motivating example for the analyses undertaken here. Finally, §3.5.4 introduces the version of the framework developed by Purnell, Raimy, and Salmons (2019), which incorporates superordinate marking as a representational strategy. Together, these sections provide the foundation for understanding how contrastive hierarchies are constructed and interpreted within a phonological system.

3.6 Research Questions

Building on the theoretical framework outlined above and the motivating example provided by Lee (2012), this dissertation addresses the following research questions. These questions are grounded in the principles of the MCS framework and the SDA and are informed by previous analyses of Spanish phonology and dialectal variation:

1. How can the CH model account for the observed variation in the surface realization of Spanish vowels and sonorants across dialects?

2. To what extent do differences in the ordering and specification of contrastive features explain phonological processes such as velar fronting, uvularization, fricativization, and glide strengthening in Spanish dialects?
3. Can the CH approach provide a systematic, language-internal explanation for dialectal variation in Spanish, beyond what is predicted by linear or purely articulatory models?

These questions guide the analysis that follows, which applies the CH model to Spanish vowel and sonorant inventories to demonstrate that dialect-specific patterns can be understood as outcomes of differences in contrastive specification.

3.7 Research Methodology

Having established the theoretical foundation for contrastive hierarchies and their relevance to Spanish phonology, this section outlines the methodological approach employed in the current study. This study adopts the Modified Contrastive Specification (MCS) framework, implemented through the Successive Division Algorithm (SDA), as the primary model for analyzing Spanish phonological variation. The types of linguistic phenomena described in §3 will be described through the Contrastive Hierarchy (CH). The traditional description of Spanish vowels assumes full binary feature specification. However, applying the CH to vowel systems across dialects allows us to account for surface variation through differences in feature ordering, e.g., the palatalization of velar segments in Chilean Spanish. These phonetic variations motivate the application of this approach to Spanish, as they point to underlying contrasts that vary across dialects; simply stating that in one dialect we find palatalization or uvularization, for example, does not provide a full account of the phonology of the language or dialect in question. A key question that arises is what underlying motivation leads certain phonemes to surface as one allophone in one dialect but as another in a different dialect of the same language.

While this study is not concerned with the historical development of Spanish dialects, it adopts a synchronic perspective focused on describing current phonological variation. The present study adopts a comparative and qualitative approach, drawing exclusively from existing descriptive and theoretical analyses of Spanish dialect phonology. Previously documented phonological processes—such as allophonic alternation, assimilation, and neutralization—will serve as the empirical basis for generating contrastive hierarchies.

To examine the phonological processes observed in Spanish dialects, this study will adopt a comparative, contrast-based analytical framework. Following the methodology employed by Lee (2012), each dialect's segmental inventory will first be grouped according to major articulatory dimensions (e.g., Labial, Dorsal, Laryngeal) and parsed using the SDA. This dimensional feature model adheres to the suggestion by Avery and Idsardi (2001), elaborated by Purnell and Raimy (2015) and applied by Natvig (2018), whereby phonological contrasts are structured according to articulator-specific pathways instead of binary feature matrices. Phonemes will be specified only for features that are necessary to distinguish them within a given dialect, as per the principles of MCS (Dresher, 2009). Phonological processes—such as palatalization of velars in Chilean Spanish, uvularization of /x/ in Castilian Spanish, and the ongoing fricativization of glides in Argentine Spanish—will be analyzed as the result of differences in contrastive structure. This approach assumes that segments behave phonologically not only due to their surface phonetic properties, but due to their contrastive status within the phonological system.

Having established the theoretical framework and methodological approach, in the following chapter I will apply the MCS model to Spanish phonology analysis. Chapter 4 offers contrastive hierarchies for Spanish vowel and sonorant systems in different dialects. Through computation of these inventories based on the SDA and consulting phonological processes such as palatalization, uvularization, and glide strengthening, I aim to demonstrate that dialectal variation can be explained systemically based on contrastive specification. The chapter provides a synchronic analysis in detail that shows how abstract phonological structure translates into surface phonetic variation, thereby underlining the utility of the MCS model to typological and dialect studies. This methodology directly addresses the research questions outlined above, applying the MCS framework and SDA to systematically analyze contrastive hierarchies in Spanish vowel and sonorant systems across dialects.

Chapter 4: CH and Dialectal Variation in Spanish

4.1 Overview and Goals

This chapter builds directly on the descriptive and theoretical foundations established in Chapters 2 and 3 by applying the MCS framework and the SDA to patterns of phonological and phonetic variation in Spanish. Its primary goal is to show that well-documented processes—such as velar fronting, uvularization, fricativization, and liquid vocalization—reflect differences in the contrastive feature hierarchies of each dialect rather than purely phonetic or rule-based variation/accounts (Dresher, 2009).

While some traditional accounts of Spanish phonology have often employed fully specified, binary feature systems and emphasized articulatory or phonetic motivations for processes, this chapter adopts a contrastive perspective. Following the Contrastivist Hypothesis (Dresher, 2009; Hall, 2007), it assumes that only features that play an active role in triggering alternations or interacting with other segments are specified in the hierarchy. This perspective also assumes that phonological representations are underspecified; segments are minimally defined by contrastive features, and phonetic realization fills in unmarked properties (Iverson & Salmons, 1995; Avery & Idsardi, 2001). Such an approach explains why phonetically similar sounds may behave differently across dialects, depending on how they are specified in the hierarchy.

The following sections analyze patterns of dialectal variation in Spanish that have been described in prior linguistic research. Each is examined through the lens of CH theory to show how contrastive features predict the observed phonological behavior. Processes such as the /l/~/r/ merger in Dominican Spanish and the uvular realization of /x/ in Peninsular Spanish, for example, are analyzed as systematic outcomes of dialect-specific feature rankings, demonstrating the explanatory adequacy of the MCS model and the SDA in accounting for cross-dialectal variation.

4.2 Canonical Contrastive Hierarchies in Spanish

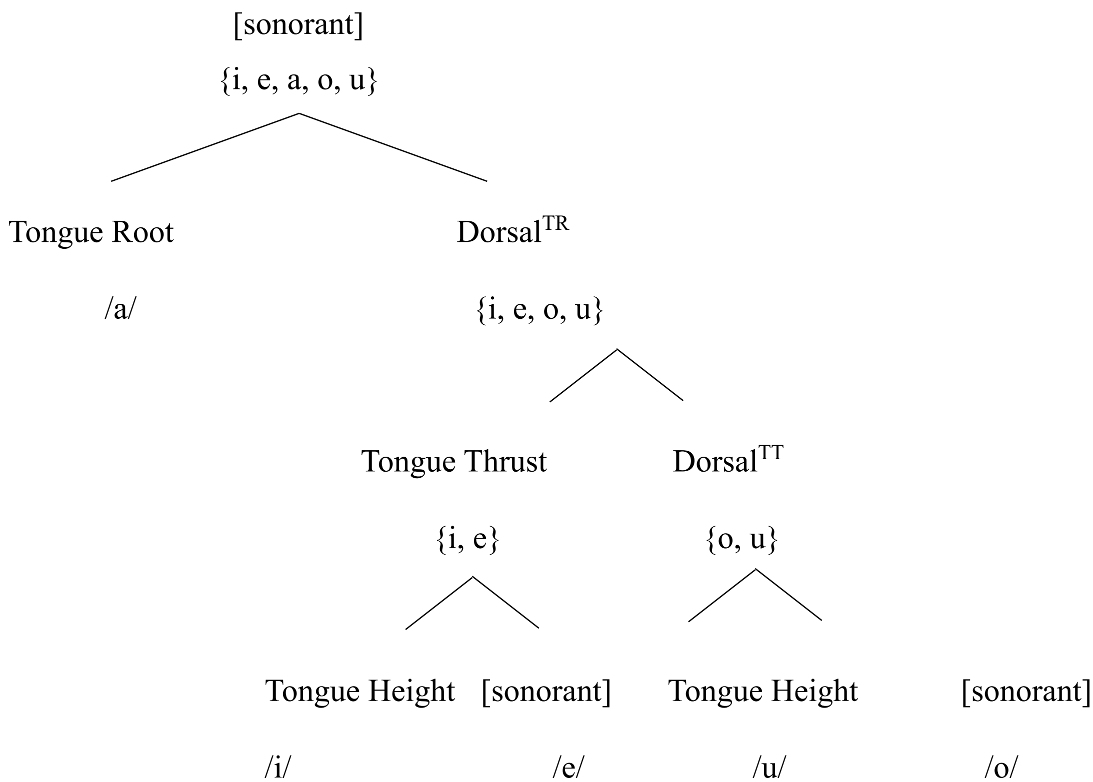
4.2.1 Spanish Vowels

Before turning to dialect-specific variation, I believe that it is necessary to first establish a baseline contrastive hierarchy for the Spanish vowel system using the MCS framework and the SDA. This hierarchy will provide a reference point for the structures proposed in later sections, ensuring that only the features required to distinguish phonemes are specified and that the analysis focuses on underlying contrasts rather than full phonetic detail.

Building on the articulatory dimensions established in Chapter 3, the hierarchy begins by isolating the low vowel /a/. Following Purnell and Raimy (2015) and Avery and Idsardi (2001) and PRS, the dimension Tongue Root (completed with the gesture [RTR]) serves as the primary division, specifying /a/ as the only low vowel and distinguishing it from the remaining non-low vowels, which are marked by their shared superordinate category [sonorant] (PRS). Next, among the remaining vowels {i, e, o, u}, the hierarchy introduces Tongue Thrust (completed with the gesture [front]). This dimension separates the front vowels {i, e} from the back vowels {o, u}. Finally, Tongue Height (completed with the gesture [high]) distinguishes the high vowels /i/ and /u/ from the mid vowels /e/ and /o/, respectively. This aligns with Dyck (1996), who describes the mid vowels /e/ and /o/ as phonologically underspecified for height. This layered approach reflects the minimum set of features necessary to capture the phonological behavior of Spanish vowels. The resulting canonical hierarchy for Spanish vowels is illustrated in Figure 12. Dialect-specific hierarchies may reorder these features, promote others, or eliminate some altogether, leading to the phonological variation examined in this chapter. This MCS-driven representation directly addresses how abstract phonological structure translates into surface phonetic variation, underlining its utility/usefulness for typological and dialect studies.

Figure 12 - Canonical contrastive hierarchy for Spanish vowels

Tongue Root [RTR] > Tongue Thrust [front] > Tongue Height [high]



4.2.2 Spanish Sonorants (Liquids)

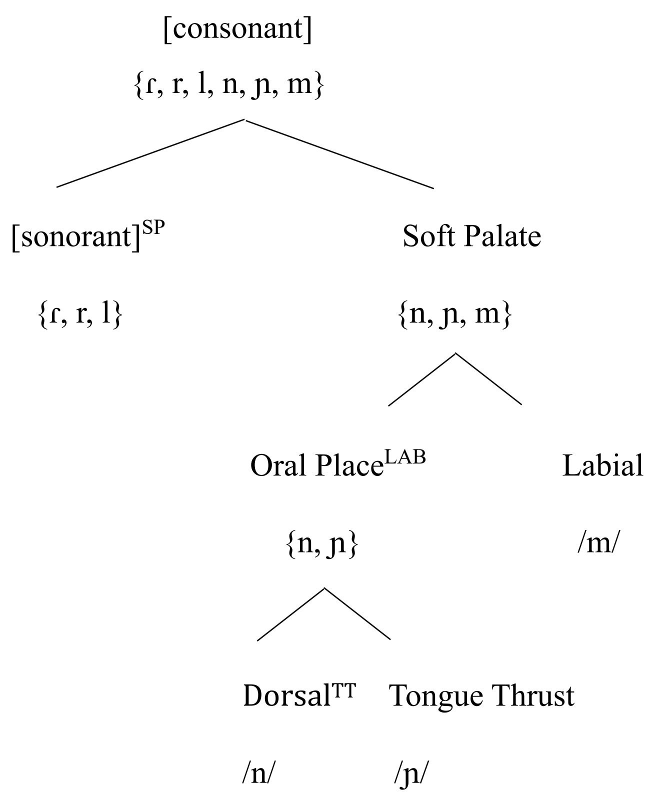
Sonorants form a major class of consonants characterized by their inherent voicing and by the absence of turbulent airflow at the primary constriction (Ladefoged & Maddieson, 1996). These properties distinguish them clearly from obstruents (1996). As with all phonemes, the phonological representation of these segments is based on a minimal set of features, and these are specified only when they are contrastive and actively participate in phonological processes or interact with other segments in systematic ways.

At the highest level of the consonant hierarchy, Spanish segments are first divided by the feature [sonorant], which groups together segments produced with a relatively open vocal tract that allows for spontaneous voicing. This division separates sonorants from obstruents. Within the broad [sonorant] class, the next division is based on the Soft Palate dimension, which determines whether the velum is lowered to produce nasal airflow or raised to produce oral airflow. This step separates nasals from liquids.

The proposed hierarchy for Spanish nasals can be derived using the SDA. The process begins by distinguishing the major classes of sonorants. Starting with the full set {ɾ, r, l, n, ɲ, m}, the primary division applies a feature related to oral versus nasal airflow. This distinction is fundamentally captured by the Soft Palate dimension, with the [nasal] gesture explicitly characterizing segments {n, ɲ, m}. Next, within the nasal phonemes, the hierarchy differentiates place of articulation by marking /m/ with the Labial dimension. The remaining non-labial nasals {n, ɲ} are not redundantly specified, but instead receive the superordinate marking Oral Place^{LAB}, signaling that they fall under the same oral place node as /m/ while lacking a labial specification themselves. Finally, the last contrast between /n/ and /ɲ/ is resolved by introducing the Tongue Thrust dimension. Here, /ɲ/ is marked with Tongue Thrust (completed with the gesture [front]), which captures its palatal articulation as a contrastive element. The alveolar nasal /n/, by comparison, is left unmarked for this dimension and is represented as Dorsal^{TT}, the superordinate category for segments not specified with [front]. In this way, Tongue Thrust functions as the contrastive dimension distinguishing /ɲ/ from /n/, while avoiding the need to redundantly assign coronal specifications across the inventory. The resulting canonical hierarchy for Spanish nasals is illustrated below:

Figure 13 - Canonical contrastive hierarchy for Spanish nasals

[sonorant]^{SP} > Tongue Groove [concave] > Aperture [adjacent]

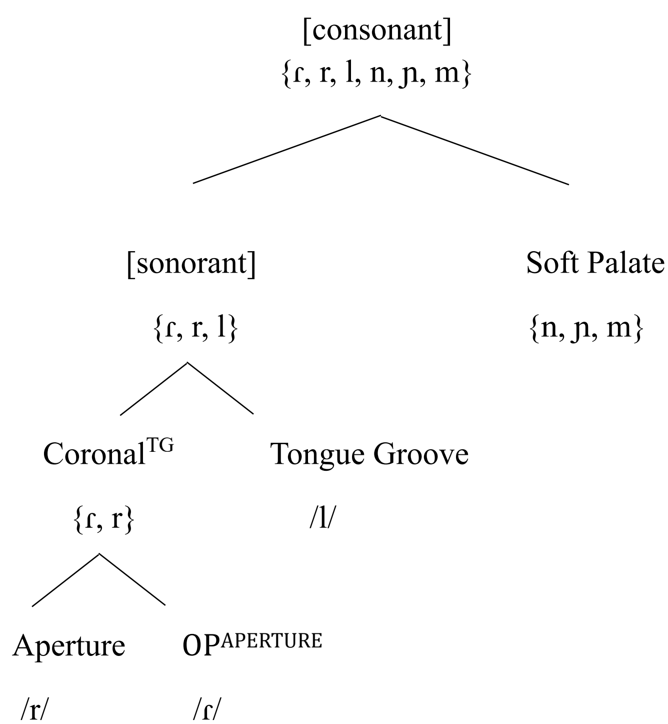


This organization reflects the fact that /m/ and /ɲ/ carry contrastive place specifications (labial and palatal, respectively), while /n/ remains underspecified. Because /n/ lacks a contrastive place specification, it is susceptible to assimilation, adopting its place features from adjacent consonants at the surface. Although Tongue Thrust is typically introduced as a dimension of vowel advancement, I follow Raimy's suggestion that it can be extended to consonantal contexts—specifically to the palatal nasal /ɲ/—where the [front] gesture functions as a contrastive property (personal communication, August 14, 2025). In this way, the palatal segment is marked with Tongue Thrust [front], efficiently capturing its palatal articulation, while /n/ remains the underspecified nasal segment, represented only by its superordinate node.

This leaves us with the liquids {ɾ, r, l}, which we can parse using the SDA. The process begins by classifying the liquids as [sonorant]. Next, within the sonorants, the Soft Palate articulator differentiates oral from nasal sounds. The crucial distinction between the lateral /l/ and the rhotics /ɾ/ and /r/ is then made using the Coronal (Tongue Groove) dimension: /l/ is specified as [concave] (reflecting its lateral airflow), while the rhotics remain phonologically unmarked, accounting for their phonetic variability. Finally, to capture the phonemic contrast between the tap /ɾ/ and the trill /r/ -- evident in minimal pairs like *pero* vs. *perro* -- the tap /ɾ/ is designated as the unmarked member of the rhotic class, while the trill /r/ is assigned a marked [adjacent] feature under the Aperture dimension, encoding its distinct manner of articulation. This sequential division ensures that only active, contrastive features are included in the phonological representation. Both /ɾ/ and /r/ can be analyzed as sonorants completed with Aperture gestures, [closed] for the tap and [adjacent] for the trill (Raimy, 2016). In the present framework, however, only the trill /r/ is contrastively specified under Aperture, while /ɾ/ remains phonologically unmarked. This treatment is supported by Natvig's (2020) proposal that rhotics represent the underspecified member of the liquid class. Although the MCS framework does not require fully specified feature matrices—since the hierarchy includes only contrastive features—I follow Raimy (2016) in including a fully specified chart of Spanish consonantal phones as a reference (see Appendix 1). This chart is not used for the contrastive analyses developed here, but it provides a complete featural specification of the segments for readers who wish to consult the full phonetic detail of the inventory.

Figure 14 - Canonical contrastive hierarchy for Spanish liquids

[sonorant]^{SP} > Tongue Groove [concave] > Aperture [adjacent]



4.3 Vowel-Conditioned Dorsal Variation

Building on the canonical hierarchy outlined above, this section shifts focus to dialectal differences that arise when vowel specifications interact with consonantal structure. In particular, I examine two processes in which the realization of dorsal obstruents is conditioned by the surrounding vowel environment. In both Chilean and Peninsular Spanish, vowels play a crucial role in triggering systematic variation in the place of articulation of dorsal segments, reflecting differences in each dialect's contrastive hierarchy. In Chilean Spanish, front vowels /i, e/ promote palatalized outcomes such as [ç], while in Peninsular Spanish, back vowels /o, u/ correlate with uvular [χ] realizations of /x/. These patterns are analyzed here as the result of dialect-specific rankings of contrastive place features within the dorsal space, offering an alternative to purely phonetic or gradient accounts by emphasizing the role of phonological structure.

4.3.1 Velar Fronting in Chilean Spanish

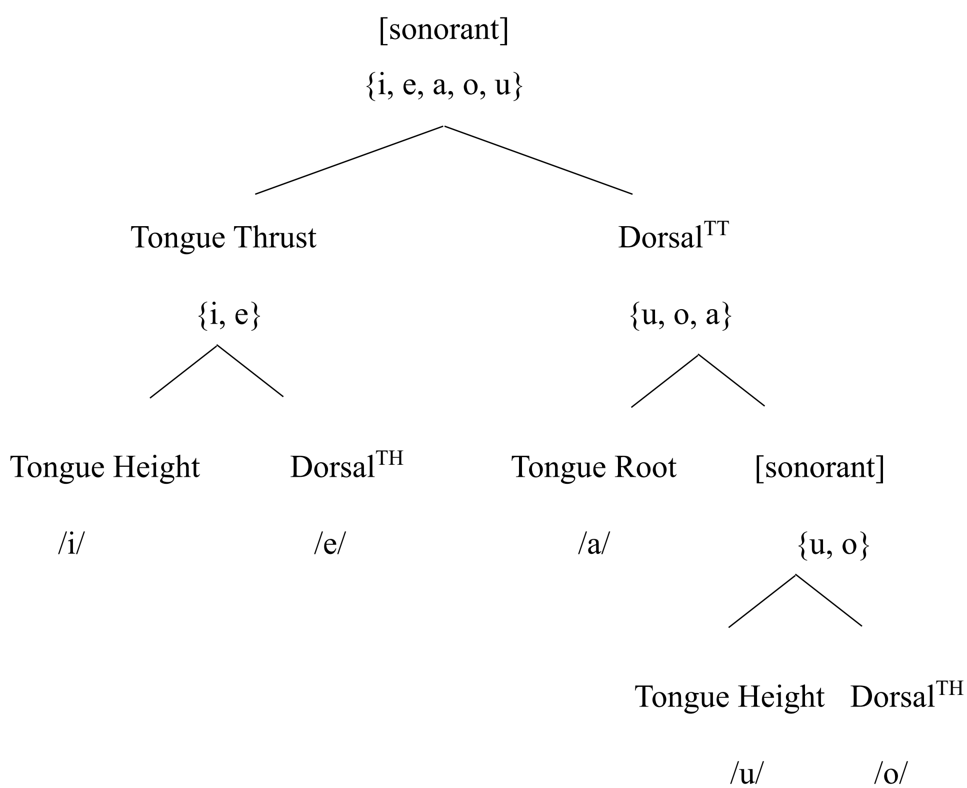
As discussed in Chapter 2, Chilean Spanish is known for producing palatalized variants of velar obstruents /k/, /ɡ/, and /x/ before the front vowels /i/ and /e/. While these surface realizations—[c], [ɟ], and [ç], respectively—have often been attributed to phonetic assimilation, González (2014) argues that the patterns are better explained as phonologized changes, reflecting contrastive feature specifications. While she frames these changes using binary features within an OT framework, I reinterpret the same pattern through the lens of CH theory and MCS. Rather than assuming binary oppositions like [±back], this analysis adopts a dimensional model of privative features, where contrast is encoded only when necessary to distinguish phonemes.

In Chilean Spanish, I propose that the dimension Tongue Thrust is introduced early in the hierarchy to distinguish the front vowels /i/ and /e/ from back vowels /o/ and /u/. This high-ranking position renders the feature phonologically active across the system and accounts for the palatalization of the dorsal consonants /k/, /ɡ/, and /x/ before front vowels. The presence of TT in these vowels triggers advancement of adjacent dorsals, producing [c], [ɟ], and [ç]. The vowel inventory of Chilean Spanish is {i, e, a, o, u}. The first division introduces Tongue Thrust, which separates the front vowels {i, e} from the non-front set {u, o, a}. Within the front subset, Tongue Height distinguishes the high vowel /i/ from the mid vowel /e/. In the non-front subset, Tongue

Root [RTR] isolates the low vowel /a/ from the rounded vowels /u, o/. Finally, Tongue Height distinguishes /u/ from /o/. We can formalize this structure using the SDA:

Figure 15 – Hierarchy for Chilean vowels

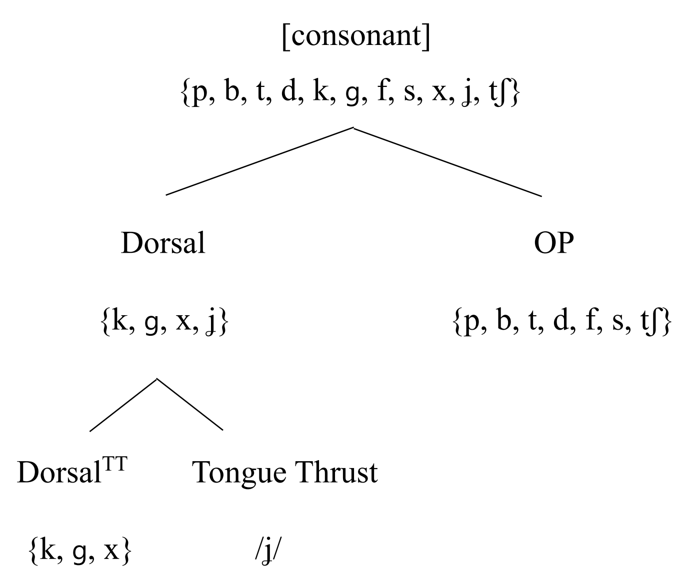
Tongue Thrust [front] > Tongue Root [RTR] > Tongue Height [high]



At first glance, this hierarchy differs from the canonical contrastive hierarchy for Spanish vowels proposed in §4.2. In the canonical system, Tongue Root [RTR] introduces the initial division, isolating /a/ from the non-low vowels, followed by Tongue Thrust [front] and then Tongue Height [high]. By contrast, in Chilean Spanish, Tongue Thrust is promoted to the highest level, preceding Tongue Root. This difference is not arbitrary but reflects a dialect-specific restructuring of the CH. In particular, the promotion of TT to the highest tier signals that in Chilean Spanish the [front] dimension is phonologically more active than [RTR]. This restructuring allows /i/ and /e/ to carry the contrastive TT [front] specification necessary to trigger palatalization of dorsals. In other words, the highest contrast in this dialect is advancement, which drives the consonantal alternations. Thus, while the canonical hierarchy provides a baseline for Spanish, the Chilean hierarchy demonstrates how the promotion of a single feature in the ordering can give rise to systematic dialect-specific alternations.

This raises the question of why palatalization in Chilean Spanish targets only velar segments, rather than extending to alveolars, as is common in other languages. In this system, /k/, /g/, and /x/ appear to be specified solely for Dorsal and lack internal place gestures:

Figure 16 – Hierarchy for Chilean obstruents



Because these velars lack additional place specifications, they are structurally open to adopting features from adjacent segments that are contrastively marked. In the CH, /k/, /g/, and /x/ are specified only for Dorsal, which leaves them available to receive further place gestures (e.g., TT [front]) from neighboring sounds. In Chilean Spanish, this means that the TT [front] specification on /i/ and /e/ can extend leftward to a preceding dorsal consonant, yielding palatalized realizations such as [c], [ɟ], and [ç] before front vowels. Crucially, this process is not expected to occur in dialects where the same vowels are underspecified or where velar consonants are phonologically completed with a backing gesture, such as [back] in Peninsular Spanish (see §4.3.2).

This contrastive restructuring explains why velar segments front in precisely these environments: In dialects where /i/ and /e/ are not contrastively specified for TT, dorsal consonants do not advance, and no palatalization occurs. This pattern mirrors Lee's (2012) findings in Paiwan. In that system, the fronting of /w/ to [v] occurs before front vowels and palatals due to their contrastive specification for [front] (functionally equivalent to TT in the present paper), and because /w/ is underspecified for place. Similarly, in Chilean Spanish, velar consonants must be underspecified for TT, allowing the high-ranked [front] feature of adjacent vowels to influence their articulation. In both systems, front vowels influence neighboring segments not through phonetic coarticulation, but because TT is an active phonological feature in the CH.

In summary, the Chilean case provides clear evidence for the role of dialect-specific contrastive hierarchies in shaping phonological outcomes. By promoting TT to the top of the vowel hierarchy, Chilean Spanish enables a systematic pattern of velar palatalization that is not observed in other dialects. This restructuring aligns with the predictions of the MCS model and demonstrates how contrastive reordering, not phonetic coarticulation alone, produces these outcomes.

4.3.2 Uvularization in Peninsular Spanish

Peninsular Spanish, particularly in northern and central varieties, frequently realizes /x/ as the uvular fricative [χ], especially before back vowels such as /o/ and /u/. Hualde (2005) observes that the dorsal constriction of /x/ is more retracted before central or back vowels (/a o u/) than before front vowels (/i e/) in Latin American Spanish (p. 155). This articulatory pattern, generalizing in Castilian Spanish, raises the question of whether it reflects phonetic assimilation or a more structured phonological process.

Rather than treating [χ] as a distinct or contrastively specified segment, the analysis views /x/ as specified only for the Dorsal (DOR) articulator, with the uvular outcome derived through gesture spreading. As Raimy notes, the plain velar fricative corresponds to a plain DOR specification, and the uvular realization [χ] emerges via spreading of the [back] gesture from adjacent back vowels (E. Raimy, personal communication, June 10, 2016). Within the dimensional model of phonological representation (Avery & Idsardi 2001; Purnell & Raimy 2015), this [back] feature is considered a phonetic feature, rather than a contrastive feature of the consonant itself

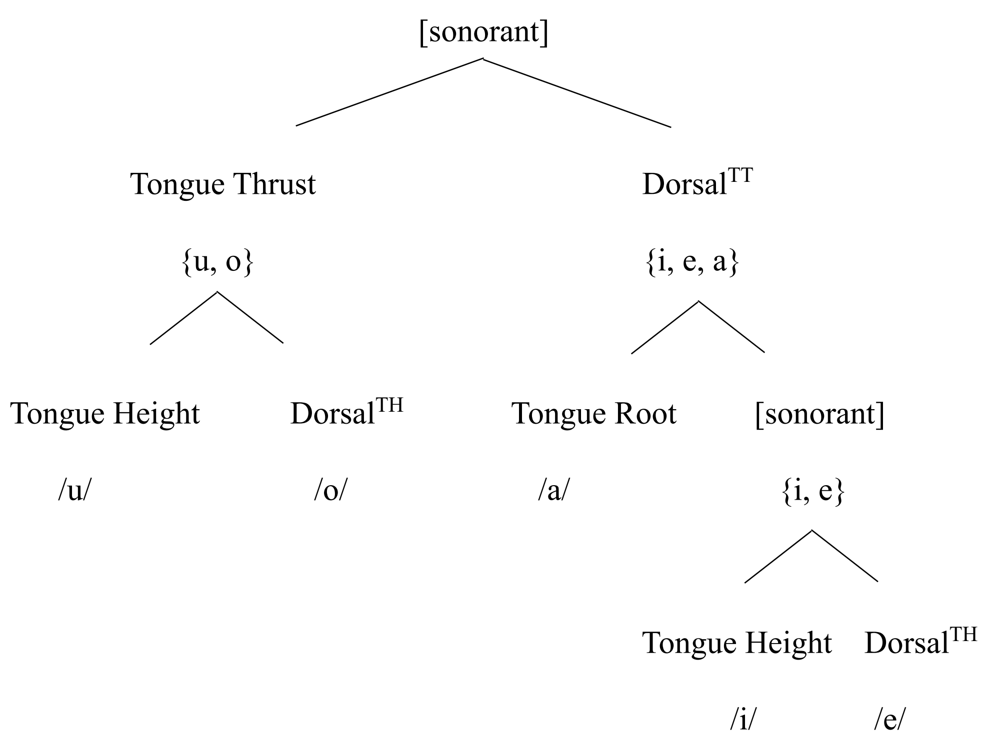
This analysis captures the generalization that [χ] surfaces primarily before back vowels in Castilian Spanish, and it aligns with the hierarchy derived via the SDA. Because /o/ and /u/ are contrastively specified for [back], this gesture can spread to the adjacent Dorsal fricative /x/, producing the uvular realization [χ] in these contexts. Crucially, this outcome does not require /x/

to be contrastively specified for place; instead, [χ] emerges through interaction between an underspecified consonant and contrastively specified vowels.

Capturing this using the SDA, the first division introduces the Tongue Thrust dimension, which is completed with the gesture [back]. This initial high-ranking position for [back] is crucial as it directly relates to the uvularization of /x/ before these vowels, reflecting the observed phonological activity. This division separates the back vowels {o, u} from the rest of the vowels. Within the back subset, Tongue Height distinguishes the high vowel /u/ from the mid vowel /o/. In the non-back subset, Tongue Root, completed with the [RTR] gesture, isolates the low vowel /a/ from{i, e}. Finally, Tongue Height distinguishes high /i/ from mid /e/.

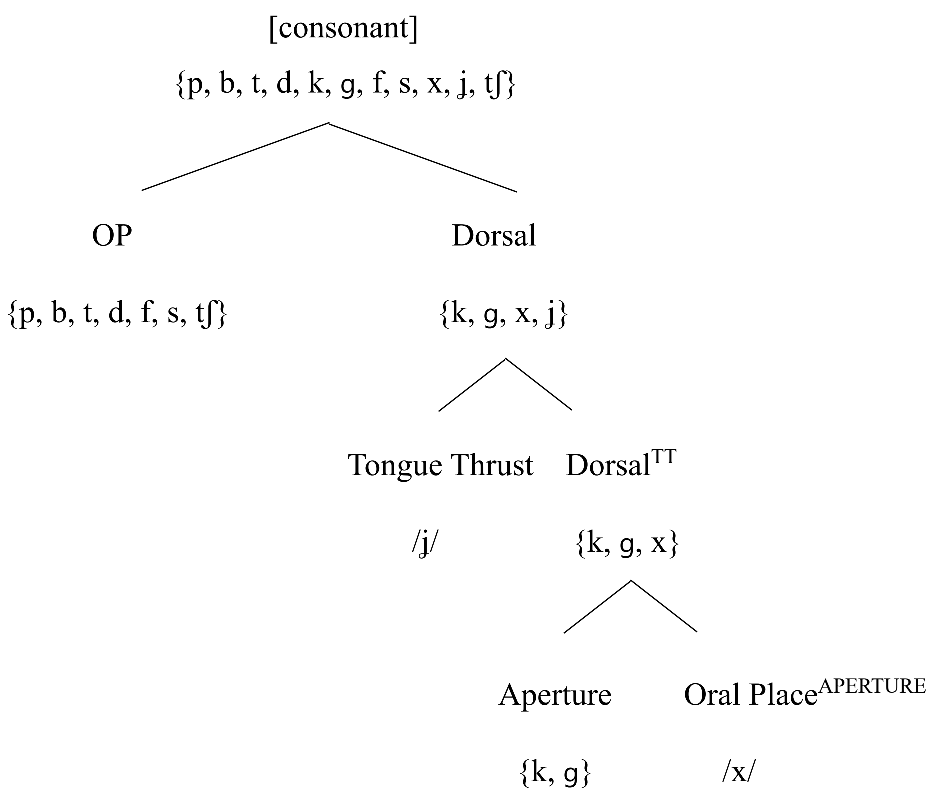
Figure 17 – Hierarchy for Peninsular vowels

Tongue Thrust [back] > Tongue Root [RTR] > Tongue Height [high]



This hierarchy predicts that only /o/ and /u/ carry the relevant [back] specification needed to trigger dorsal spreading. The velar fricative /x/ experiences this backness because it is phonologically underspecified for internal place features, being specified only for the Dorsal (DOR) articulator, as illustrated in Figure 18:

. **Figure 18 – Hierarchy for Peninsular obstruents**



Beginning with the full obstruent inventory {p, b, t, d, k, g, f, s, x, ʝ, tʃ}, the first major division in the hierarchy establishes the Dorsal articulator, separating {k, g, x, ʝ} from other obstruents. Within this Dorsal set, the palatal fricative /ʝ/ is uniquely distinguished by the Tongue Thrust ([front]) dimension. This leaves {k, g, x} as the remaining dorsal obstruents. To separate the velar stops /k/ and /ɡ/ from /x/ without specifying /x/ for manner, the Aperture dimension is utilized. Stops /k/ and /ɡ/ are contrastively specified with the [closed] gesture under Aperture, clearly marking them as stops within the Dorsal class. Consequently, the voiceless velar fricative /x/ remains phonologically underspecified for internal place gestures and manner of articulation beyond its Dorsal (DOR) specification. This minimal specification for /x/ at the phonological level renders it uniquely susceptible to coarticulatory completion or enhancement from adjacent segments. In particular, when /x/ occurs next to the back vowels /o/ and /u/, the contrastively specified [back] gesture from these vowels can spread to the underspecified fricative, enhancing its articulation and shifting its place of articulation posteriorly to a uvular [χ] realization.

Crucially, in Peninsular Spanish, this uvularization is specifically observed with /x/ and not with other velar segments like /k/ or /ɡ/. This contrasts with dialects such as Chilean Spanish, where the promotion of the Tongue Thrust [front] dimension in the vowel hierarchy causes a more generalized palatalization, affecting all velar obstruents—/k/, /ɡ/, and /x/—through feature spreading from front vowels. Therefore, in the Peninsular system, the consistent uvular outcome [χ] arises predictably for /x/ from this specific vowel-triggered dorsal enhancement, without requiring /x/ to be a distinct phoneme or possessing a contrastive uvular feature.

Traditional accounts describe /x/ as a voiceless dorsal fricative whose articulation ranges from velar [x] to uvular [χ], and in some dialects, to glottal [h]. The present analysis, however, anchors this phonetic range in contrastive hierarchies and dimension-based representations within the MCS framework. This framework illustrates how surface forms can diverge systematically without requiring structural reanalysis: in Castilian Spanish, the consistent realization of [χ] in syllable-initial position and before back vowels emerges through predictable interaction with the vowel system and the principles of phonetic implementation. As such, the uvular output [χ] does not require a contrastive [uvular] feature, nor does it reflect a restructured place hierarchy within the consonant inventory; instead, it is the natural result of contextual feature sharing and default enhancement mechanisms. While some sources (e.g., Schwegler et al., 2010) report [χ] even after front vowels like /i/ and /e/, these cases are interpreted as phonetic enhancement to reinforce the perceptual salience of /x/, rather than a result of feature spreading.

Ultimately, this uvularization in Peninsular Spanish strikingly parallels the palatalization of /x/ in Chilean Spanish, where both surface realizations diverge from the velar norm due to feature interaction with adjacent vowels. However, within the CH framework, the underlying mechanisms differ: Chilean Spanish advancement results from the promotion of the Tongue Thrust dimension in the vowel hierarchy, while Peninsular Spanish backing results from vowel-triggered enhancement of the Dorsal articulator.

4.4 Glides and Sonorants in the Contrastive Hierarchy

Building on the canonical vowel and consonant hierarchies established in §4.2, this section examines dialectal differences in the realization of glides and sonorants. Three case studies are considered: (i) the strident realization of the palatal consonant /ʝ/ in Argentine Spanish ("glide strengthening"), (ii) the vocalization of coda-position liquids in Dominican Spanish, and (iii) the /l/~/ɾ/ merger in the same dialect. Although these processes differ in articulatory outcome, they each involve segments that can pattern as either vowel-like or consonant-like depending on the features active in a given hierarchy. Each is analyzed within the MCS framework, focusing on how dialect-specific contrastive hierarchies account for their phonological behavior and structural outcomes.

4.4.1 Reframing Glide Strengthening

Argentine (and Uruguayan) Spanish is well known for *yeísmo rehilado*, the realization of the palatal consonant as a strident fricative or affricate ([ʒ], [ʃ], [dʒ]) rather than the [ʝ] common in other dialects (Hualde, 2005). This phenomenon is most salient in words spelled with orthographic ⟨y⟩ or ⟨ll⟩ (*yerba* 'mate leaves' [ˈʒeɾ.βa], *lluvia* 'rain' [ˈʃu.βja]), and contrasts with the glide [j] that appears as the nonsyllabic allophone of /i/ (*hierba* 'grass' [ˈjeɾ.βa]) (Hualde, 2005).

In earlier stages of this project, I planned to adopt Harris & Kaisse's (1999) treatment of Rioplatense "glide strengthening" as a test case for how the hierarchy could capture the interaction between vowel-derived glides and prosodic structure. Their account, however, assumes that all instances of [j] — including those from orthographic <y> and <ll> — originate from the high vowel /i/, with consonantality and stridency derived through a series of ordered rules and lexically marked syllabicity distinctions (1999). While such a system could, in principle, be implemented within the SDA, it would require encoding syllabicity and source distinctions for /i/ that function derivationally in Harris & Kaisse's model but are not contrastively necessary in the synchronic inventory, thereby adding representational complexity that the hierarchy does not otherwise require. This consideration led me to adopt a more economical analysis in line with the principles of MCS.

Hualde (2005) notes that Rioplatense Spanish has a palatal consonant contrasting with [j], which surfaces as a predictable allophone of /i/ in both diphthongs and certain hiatus contexts. For the purposes of the present analysis, this palatal consonant is represented as /ʝ/. The hierarchy can then represent these two segments in different domains — /ʝ/ in the consonant hierarchy, /i/ in the vowel hierarchy — without requiring derivational detours or syllabicity diacritics. In this analysis, [j] from /i/ — whether derived from a diphthong (e.g., *hierba*) or from a high vowel in hiatus contexts (e.g., *paranoia*) — surfaces predictably as a glide[9]. By contrast, the underlying palatal consonant /ʝ/ in Rioplatense Spanish is contrastively specified as an obstruent and undergoes fortition to [ʒ], [ʃ], or [dʒ]. This distinction resolves the Harris & Kaisse dilemma: strengthening applies only to an underlying consonant phoneme, not to a glide derived from a vowel. This fits directly with the SDA's procedure of dividing the inventory according to contrastive features and assigning only those that are needed to differentiate phonemes (Dresher, 2009).

Following Hualde (2005), I treat these two sounds as distinct underlying segments: /i/, a high front vowel whose glide [j] allophone is predictable in pre- and post-vocalic position; and /ʝ/, a palatal consonant inherently specified as an obstruent in Argentine Spanish and typically realized as [ʒ], [ʃ], or [dʒ], with variation in precise articulation. This reframes what is often called "glide strengthening" in Rioplatense Spanish. Rather than viewing the strident consonant as the result of a fortition process affecting a vowel-derived glide, the analysis here recognizes /ʝ/ as a separate consonant phoneme. The [j] from /i/ remains a glide because it is not contrastively specified for consonantal features (Levi, 2011).

In keeping with the principles of the MCS framework, the vowel and consonant systems are represented in separate hierarchies, with features assigned only when needed to distinguish phonemes in each domain. In the vowel hierarchy for Spanish, /i/ is distinguished from other vowels through the dimension Tongue Height (completed with [high]) and Tongue Thrust

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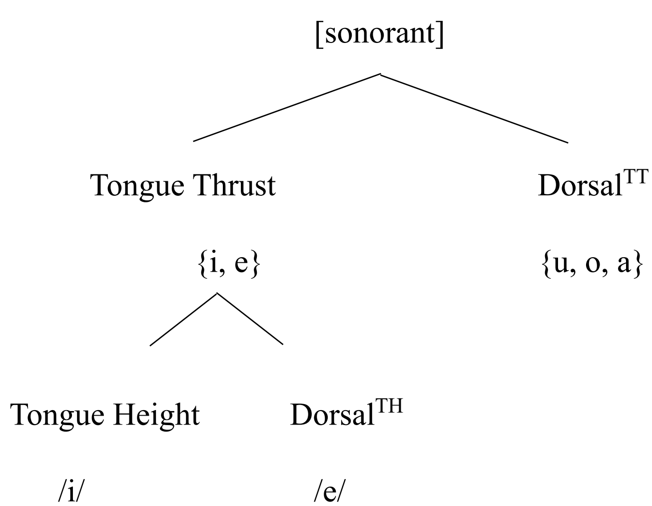
[9] Across Spanish dialects, [j] in strong onset position (e.g., *hielo*) may undergo phonetic enhancement or partial fortition, sometimes approaching a [ʝ]-like or even [dʒ]-like realization. This widespread effect is not phonologized and does not confer the contrastive specifications of an underlying palatal consonant, but it illustrates that "glide strengthening" in the broader sense is possible outside Rioplatense Spanish.

(completed with [front]). Because its glide [j] is a predictable allophone, it receives no consonantal features. In the consonant hierarchy, /ɟ/ is placed under the Dorsal articulator and distinguished from other dorsals by Tongue Thrust ([front]) and a manner specification marking it as an oral fricative or affricate. The relevant portions of the hierarchies can be represented as:

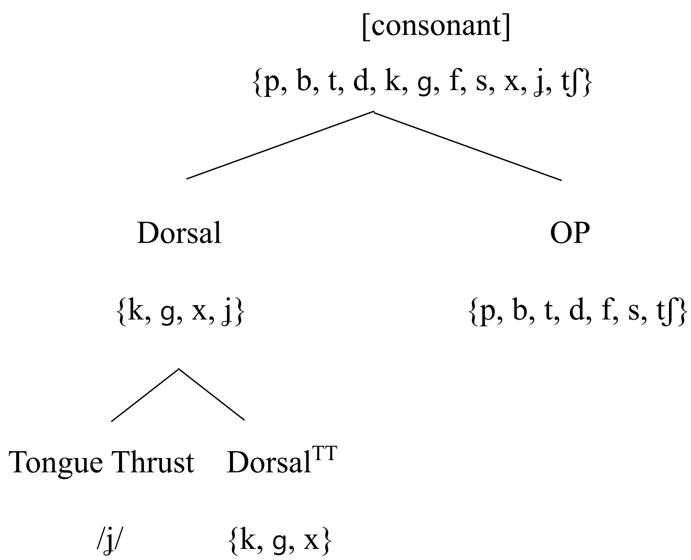
. **Figure 19 – Hierarchy for Rioplatense vowels**



Because the MCS assigns features only when they serve to differentiate phonemes, the hierarchy does not encode additional properties—such as [strident] or [aperture]—for /ɟ/. These are not necessary for phonemic contrast in the synchronic system. Instead, the characteristic realization of /ɟ/ in Rioplatense Spanish as [ʒ], [ʃ], or [dʒ] is accounted for at the level of phonetic completion or enhancement. In the framework of Avery & Idsardi (2001) and Purnell & Raimy (2015), completion rules fill in the articulatory details that are not specified at the phonological level. For most Spanish dialects, /ɟ/ is completed as a voiced palatal fricative [ɟ]. In Rioplatense

Spanish, however, the same underlying /ʝ/ is completed with an enhancement that increases turbulence and retraction, yielding the more strident [ʒ] (and its sociophonetic variants).

. **Figure 20 – Hierarchy for Rioplatense obstruents**



Because the MCS assigns features only when they serve to differentiate phonemes, the hierarchy does not encode additional properties—such as [strident] or [aperture]—for /ʝ/. These are not necessary for phonemic contrast in the synchronic system. Instead, the characteristic realization of /ʝ/ in Rioplatense Spanish as [ʒ], [ʃ], or [dʒ] is accounted for at the level of phonetic completion or enhancement. In the framework of Avery & Idsardi (2001) and Purnell & Raimy (2015), completion rules fill in the articulatory details that are not specified at the phonological level. For most Spanish dialects, /ʝ/ is completed as a voiced palatal fricative [ʝ]. In Rioplatense Spanish, however, the same underlying /ʝ/ is completed with an enhancement that increases turbulence and retraction, yielding the more strident [ʒ] (and its sociophonetic variants).

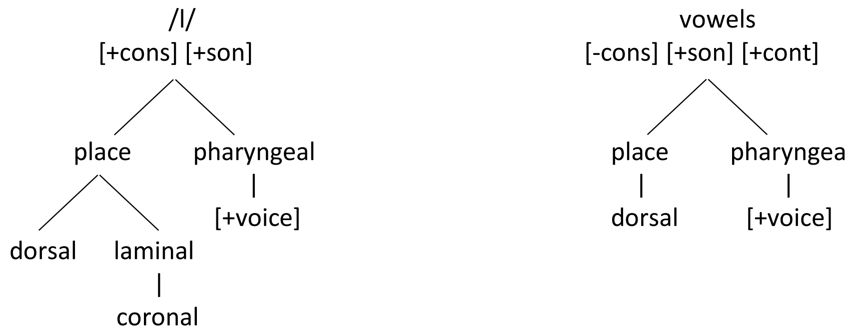
This analysis avoids the unnecessary representational burden of deriving /ʝ/ from /i/, instead grounding the account in contrastive specification. In the present framework, /ʝ/ and the glide [j] from /i/ occupy distinct positions in the hierarchy, reflecting their different contrastive roles. What distinguishes Rioplatense Spanish is the consistent, turbulent, and strident realization of /ʝ/, typically surfacing as [ʒ], [ʃ], or [dʒ] (Hualde, 2005). This pattern is best understood as a dialect-specific phonetic enhancement rather than a difference in the underlying contrastive hierarchy.

4.4.2 Liquid Vocalization in Caribbean Spanish

The vocalization of liquid consonants in Dominican Spanish—particularly in the Cibao region—has long been recognized as one of the most distinctive phonological features of the Caribbean. In this dialect, both the lateral /l/ and the tap /ɾ/ undergo vocalization in coda position, yielding outputs such as [muˈhej] for *mujer* 'woman' and [ˈajɣo] for *algo* 'something' (Lipski, 2012; Proctor, 2009). Traditional descriptions attribute these outcomes to articulatory weakening or a shift toward vowel-like realizations in syllable-final position.

Proctor (2009), using an articulatory–gestural analysis, highlights the structural similarity between liquids and high vowels once certain place features are absent. In languages with vocalization—such as Portuguese and Dominican Spanish—the featural makeup of /l/ differs only minimally from that of a high back vowel after the removal of the laminal or lateral node. This proximity in featural composition explains why liquids, once deprived of their lateral or rhotic specification, tend to pattern as vocoids in production.

Figure 21 – Proctor's feature geometry for Dominican Spanish



This relationship is illustrated in Figure 21, adapted from Proctor (2009), which compares the feature geometry of the lateral /l/ to that of a high back vowel. In Proctor's representation, both segments share the same dorsal place node completed with the [high] and [back] gestures, as well as the upper-level [+sonorant] and [+consonantal] specifications. The only structural difference is that /l/ bears an additional laminal/lateral node branching from the coronal tier. Once this lateral specification is removed, the remaining structure is essentially identical to that of the high back vowel, accounting for the observed tendency toward vocalization..

While Proctor's framework is grounded in Articulatory Phonology, the patterns he identifies can also be modeled using MCS. Within our framework, this pattern can be reinterpreted as the result of a shift in the contrastive hierarchy. Features that previously distinguished /l/ and /ɾ/—such as [lateral] and [rhotic]—are no longer contrastively specified in coda position. When these features are absent from a segment's phonological representation, the phonology treats the segment as a default sonorant, lacking sufficient cues to distinguish it from a vowel. In this system, coda-position liquids merge into an underspecified non-obstruent category, which surfaces as high vocoids.

For Dominican Spanish, I adopt a dialect-specific liquid hierarchy: at the top, OP$^{\text{Aperture}}$ [adjacent] separates the trill /r/ from {l, ɾ}; within the remaining liquids, Tongue Groove [concave] distinguishes /l/ from /ɾ/. This ordering preserves the onset contrasts but will be neutralized in coda position, as described below. In coda position, the OP$^{\text{Aperture}}$ node continues to separate the trill /r/ from the other liquids, but the TG [concave] specification is not contrastively active. As a result, {l, ɾ} merge into a single underspecified liquid class, in line with Oxford's (2015) Sisterhood Merger Hypothesis. With no active subordinate content within this merged liquid node (i.e., no TG [concave] on /l/ and no internal OP$^{\text{Aperture}}$ contrast between {l, ɾ}), the class defaults to vocoid completion, producing the Dominican vocalization patterns. In closely related contexts where the liquid node remains consonantal (i.e., does not undergo vocoid completion) but the TG contrast is inactive, /l/~/ɾ/ merger results, as discussed in §4.4.3.

Figure 22 – Hierarchy for Dominican sonorants

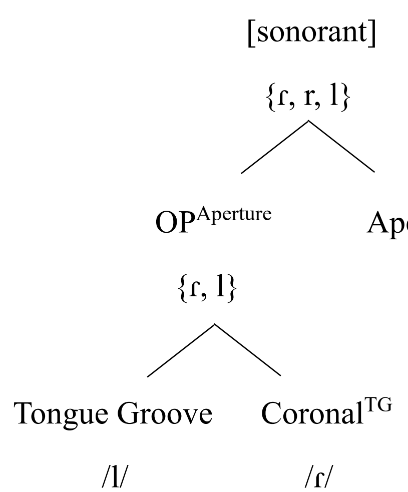
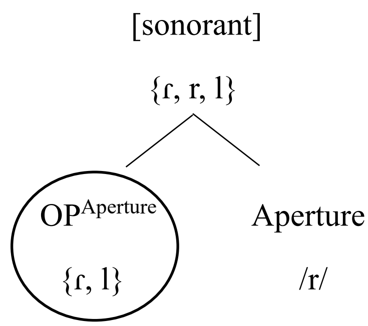


Figure 23 – Neutralization in Dominican Spanish



As shown in Figure 23, coda position in Dominican Spanish neutralizes the contrast between /l/ and /ɾ/. The trill /r/ remains distinguished by Aperture [adjacent], but the Tongue Groove specification that separates /l/ from /ɾ/ in onset position is inactive. This leaves {l, ɾ} as a single underspecified liquid class, which, lacking further contrastive content. Because these liquids are then specified only for [sonorant], with no additional active dimensions, their representation overlaps structurally with vowels, making them especially susceptible to surfacing as vocoids. This parallels Proctor's (2009) observation that once lateral or rhotic content is stripped, the remaining features of liquids closely resemble those of high vowels. The resulting surface forms thus reflect a systematic reorganization of the hierarchy in coda position, rather than arbitrary weakening. This account also explains why the process is found in Dominican Spanish but not in other varieties: its occurrence depends on the activity of these features within the phonological grammar of the dialect.

4.4.3 /l/~/ɾ/ Merger in Dominican Spanish

In addition to vocalization, another well-attested process involving liquids in Dominican Spanish is the neutralization—or merger—of /l/ and /ɾ/ in syllable-final position. In these cases, speakers produce either segment interchangeably, or a single intermediate articulation that lacks a clear lateral or rhotic identity (Hualde, 2005; Lipski, 2012). For example, *carne* may be realized as [ˈkaɾne], [ˈkalne], or with a fused lateral-rhotic realization [ˈkaɾlne].

From a CH perspective, this process arises when the features responsible for distinguishing /l/ from /ɾ/ are absent from the active hierarchy in coda position. This configuration matches the conditions described by the Sisterhood Merger Hypothesis (Oxford, 2015), which predicts that if the sole contrastive feature separating two "sister" segments in the hierarchy becomes inactive, those segments will merge or neutralize in that environment. Under the MCS model, phonological processes target only contrastively specified features. If neither /l/ nor /ɾ/ is marked with a distinguishing feature in a given context, the phonology treats them as belonging to a single class of underspecified coronal sonorants, resulting in neutralization.

The SDA that models Dominican vocalization (§ 4.4.2) applies equally here: the neutralization of /l/ and /ɾ/ in coda position results from the deletion of TG, their only contrastive feature. The difference between the two processes lies in the outcome at the stage of phonetic completion: in vocalization (§4.4.2), the merged liquid class lacks any active Oral Place content and is completed with high vocoid gestures; in merger, the liquids remain specified under the Oral Place node, but without an active Tongue Groove contrast; completion therefore supplies a generic coronal sonorant realization, yielding a consonantal output with no lateral–rhotic distinction. This account explains why merger occurs without full loss of segmental identity. Because both vocalization and merger result from the same reorganization in the contrastive hierarchy, I propose that they can co-exist in the same dialect. The final phonetic outcome—vowel-like or neutralized consonant—depends on which features remain available for completion in the given context.

This analysis also provides insight into why both vocalization and merger can co-exist in the same dialect. As discussed in §4.4.2, vocalization reflects loss of internal contrastive content below [sonorant], yielding a vowel-like output. In the present case, the [sonorant] structure remains intact, but the Tongue Groove contrast is deleted, resulting in a neutralized consonant. In both cases, the underlying driver is the same: the absence of contrastive specification, with the final phonetic outcome determined by what remains structurally active in the hierarchy.

Taken together, the patterns of glide strengthening, liquid vocalization, and /l/~/ɾ/ merger show how the phonological behavior of sonorants and glides is conditioned by the organization of contrastive features in a given dialect. In Argentine Spanish, the promotion of Tongue Thrust [front] within the consonant hierarchy leads to the fortition of /ʝ/ and the emergence of strident outcomes. In Dominican Spanish, the absence of Tongue Groove [concave] and subordinate liquid content, and, in the case of vocalization, the liquid node lacks internal Oral Place content, produces either vowel-like realizations or a neutralized consonant. While these processes differ in surface outcome, they share a common structural basis: segments situated at the boundary between vowels and consonants are particularly sensitive to changes in their contrastive specifications. When features that distinguish them are re-ranked, demoted, or absent, these segments are prone to reanalysis, resulting in systematic and often categorical changes. Within the MCS framework, such outcomes follow directly from the hierarchical distribution of features, providing a principled explanation for how dialect-specific reorganization of contrasts drives phonological variation and change.

This illustrates how the MCS framework captures not just the presence of variation across dialects, but the predictable ways in which contrastive reordering influences phonological structure across systems. The following chapter evaluates these findings in relation to the research questions outlined in Chapter 1 and considers their theoretical implications, limitations, and directions for future research.

Chapter 5: Conclusion

5.1 Summary and Discussion

This dissertation has examined how the Modified Contrastive Specification (MCS) framework and the Successive Division Algorithm (SDA) can be used to explain surface variation in Spanish vowels and sonorants across dialects. The case studies presented—velar fronting in Chilean Spanish, uvularization in Peninsular Spanish, glide fricativization in Argentine Spanish, and liquid vocalization in Dominican Spanish—highlight the relationship between contrastive feature organization and dialect-specific phonological processes.

The first research question asked how the CH model can account for the observed variation in the surface realization of Spanish vowels and sonorants. The case studies show that this model can describe these differences by tracking how contrastive features are ordered and specified across dialects. For instance, velar fronting in Chilean Spanish is linked to the promotion of the Tongue Thrust dimension (completed with [front]) dimension in the vowel hierarchy, which spreads to adjacent dorsal consonants Likewise, the vocalization of /l/ and /ɾ/ in Dominican Spanish is explained by the inactivation of the Tongue Groove [concave] specification in coda position, which leaves these segments without contrastive content under Oral Place and allows default vocoid completion.

The second research question focused on whether differences in feature ordering and specification can explain processes such as velar fronting, uvularization, fricativization, and glide strengthening. The analyses suggest that these processes often arise where CHs interact with segmental context. Uvularization in Peninsular Spanish, for example, reflects the spread of the Tongue Thrust [back] gesture from adjacent back vowels to a Dorsal-specified /x/, producing [χ] without assuming that [back] is contrastive for the consonant itself. Glide strengthening in Rioplatense Spanish, meanwhile, results from the promotion of the Oral Place (Aperture) dimension for the palatal consonant /ʝ/, which drives its fortition to strident outputs, while the high front vowel /i/ continues to pattern separately in the vowel hierarchy.

The third research question asked whether the CH approach can offer a systematic, language-internal explanation for dialectal variation beyond what linear or purely articulatory models provide. The findings suggest that it can. Instead of attributing the variation to phonetic coarticulation or to regional spread, this approach treats it as a predictable outcome of how each dialect organizes contrastive features within its phonological system.

5.2 Theoretical Implications

While this dissertation is primarily descriptive and analytical, the findings do have several theoretical implications for the study of phonology—especially concerning the role of contrastive structure, underspecification, and the interface between phonology and phonetics.

First, the analyses support the basic premise of the Contrastivist Hypothesis, which claims that only contrastive features are phonologically active. In the case studies, differences in phonological behavior across dialects often correspond to differences in the presence of contrastive features in specific contexts. For example, in Dominican Spanish, the vocalization and merger of liquids in coda position follow from the fact that [lateral] and [rhotic] are not projected by the SDA in that environment. When [consonantal] is also inactive, completion supplies high-vocoid gestures, yielding vocalization; when [consonantal] is retained, the result is a neutralized coronal consonant. This supports the view that phonological processes are shaped by contrastive structure, rather than being purely driven by phonetic or articulatory pressures.

Second, the analyses speak to the phonetics-phonology interface, especially within the MCS model's tripartite architecture. In several cases, phonological representations include only contrastive dimensions, and surface forms arise through gesture completion and enhancement at later stages. Uvularization of /x/ is one example: although the consonant is specified only for its place dimension (Dorsal), it is underspecified with respect to Tongue Root. The uvular outcome emerges when the Tongue Root gesture is completed under the influence of adjacent vowels. This illustrates how underspecified phonological structures interact with phonetically grounded processes in predictable ways, without requiring every detail to be phonologically specified.

Finally, the findings reinforce the explanatory role of underspecification in phonological theory. Rather than assigning all possible features to each segment, MCS represents only those needed to distinguish phonemes in a given system. This allows for more economical representations while still capturing meaningful variation. In Dominican Spanish, /l/ and /ɾ/ are vocalized in coda position precisely because their distinguishing features are absent from the hierarchy in that environment. This kind of absence has consequences for how the phonology interprets the segments, showing that both the presence and the absence of contrastive features can have systematic effects.

5.3 Limitations & Future Directions

This dissertation is limited in scope to a small set of dialects—Chilean, Peninsular, Argentine, and Dominican Spanish—which were selected because they exhibit clear and frequently discussed processes. While this allowed for focused case studies, other dialects may present different configurations that require further testing of the framework.

Given this limitation, several promising avenues for future research arise from this study. One would be to apply the MCS framework to a broader set of Spanish dialects to test whether the patterns observed here hold across a wider range. For example, dialects that exhibit open and close variants of the mid vowels, or that maintain additional consonantal segments such as the palatal lateral, may yield hierarchies with different feature rankings or divisions.

It may also be useful to apply MCS to other areas of Spanish phonology, such as prosody, stress assignment, syllable complexity, or intonation patterns. Doing so would test the model's applicability beyond the segmental level. Experimental work, including acoustic and articulatory studies, could also help clarify how underspecified segments are completed and enhanced at the phonetic interface, especially in dialects with known variability. This could provide independent evidence for the phonological specifications proposed here.

Finally, future work might also explore the diachronic evolution of contrastive hierarchies in Spanish, using models such as Contrastive Neutralization and Minimal Contrast Shift to account for historical sound change. (While the present study offers a synchronic analysis, some of the patterns examined likely reflect earlier developments in the language. Future work could explore how contrastive hierarchies evolve diachronically, though such an approach falls outside the scope of this dissertation.) The Contrastive Neutralization Hypothesis proposes that phonemic mergers may result in the complete loss of contrastive features for a segment, yielding a phonologically unspecified outcome (Natvig, 2018). Meanwhile, Minimal Contrast Shift suggests that phonological change tends to target the lowest-ranked (most specific) features in a hierarchy, allowing structural reorganization to occur with minimal disruption to the system (Natvig, 2018). These hypotheses have been used to explain diachronic change in other languages and could offer a useful framework for modeling historical developments in Spanish from a contrastivist perspective.

Appendix 1: Fully specified distinctive features of the consonantal phones of Spanish[10]

[p] [cons] **Oral Place** *Aperture* [closed] *Labial* **Soft Palate** [oral] **Tongue Root** **Larynx**	[b] [cons] **Oral Place** *Aperture* [closed] *Labial* **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[β] [cons] **Oral Place** *Aperture* [adj.] *Labial* **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[β̞] [cons] [son] **Oral Place** *Aperture* *Labial* **Soft Palate** [oral] **Tongue Root** **Larynx**
[t̪] [cons] **Oral Place** *Aperture* [closed] *Coronal* **Soft Palate** [oral] **Tongue Root** **Larynx**	[d̪] [cons] **Oral Place** *Aperture* [closed] *Coronal* **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ð] [cons] **Oral Place** *Aperture* [adjacent] *Coronal* **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ð̞] [cons] [son] **Oral Place** *Aperture* *Coronal* **Soft Palate** [oral] **Tongue Root** **Larynx**
[tʃ] [cons] **Oral Place** *Aperture* [closed] *Coronal* *Tongue Curl* [down] **Soft Palate** [oral] **Tongue Root** **Larynx**	[dʒ] [11] [cons] **Oral Place** *Aperture* [closed] *Coronal* *Tongue Curl* [down] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ʃ] [cons] **Oral Place** *Aperture* [adjacent] *Coronal* > *Tongue Curl* [down] **Soft Palate** [oral] **Tongue Root** **Larynx**	[ʒ] [cons] **Oral Place** *Aperture* [adjacent] *Coronal* > *Tongue Curl* [down] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]
[k] [cons] **Oral Place** *Aperture* [closed] *Dorsal* **Soft Palate** [oral] **Tongue Root** **Larynx**	[g] [cons] **Oral Place** *Aperture* [closed] *Dorsal* **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ɣ] [cons] **Oral Place** *Aperture* [adj.] *Dorsal* **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ɣ̞] [cons] [son] **Oral Place** *Aperture* [adj.] *Dorsal* **Soft Palate** [oral] **Tongue Root** **Larynx**
[f] [cons] **Oral Place** *Aperture* [adjacent] *Labial* [drawn] **Soft Palate** [oral] **Tongue Root** **Larynx**	[v] [cons] **Oral Place** *Aperture* [adjacent] *Labial* [drawn] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ɸ] [cons] **Oral Place** *Aperture* [adjacent] *Labial* **Soft Palate** [oral] **Tongue Root** **Larynx**	[θ] [cons] **Oral Place** *Aperture* [adjacent] *Coronal* **Soft Palate** [oral] **Tongue Root** **Larynx**

[10] This list of phones is not exhaustive; it represents the segments most frequently discussed in the literature on Spanish phonetics.
[11] Grayed out cells represent phones that are limited to one or few dialects of Spanish.

[s] [cons] **Oral Place** *Aperture* [adjacent] *Coronal >* *Tongue Groove* [convex] **Soft Palate** [oral] **Tongue Root** **Larynx**	[z] [cons] **Oral Place** *Aperture* [adjacent] *Coronal >* *Tongue Groove* [convex] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[s̪] [cons] **Oral Place** *Aperture* [adjacent] *Coronal >* *Tongue Groove* [convex] *Tongue Thrust* [back] **Soft Palate** [oral] **Tongue Root** **Larynx**	[z̪] [cons] **Oral Place** *Aperture* [adjacent] *Coronal >* *Tongue Groove* [convex] *Tongue Thrust* [back] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]
	[ɟ] [cons] **Oral Place** *Aperture* [closed] *Dorsal >* *Tongue Thrust* [front] *Tongue Height* [high] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Tension* [slack]	[ç] [cons] **Oral Place** *Aperture* [adjacent] *Dorsal >* *Tongue Thrust* [front] *Tongue Height* [high] **Soft Palate** [oral] **Tongue Root Larynx**	[ʝ] [cons] **Oral Place** *Aperture* [adjacent] *Dorsal >* *Tongue Thrust* [front] *Tongue Height* [high] **Soft Palate** [oral] **Tongue Root Larynx** *Glottal Tension* [slack]
[x] [cons] **Oral Place** *Aperture* [adjacent] *Dorsal* **Soft Palate** [oral] **Tongue Root**		[χ] [cons] **Oral Place** *Aperture* [adjacent] *Dorsal* *Tongue Thrust [back]* **Soft Palate** [oral] **Tongue Root** [RTR]	

[m] [cons] [son] **Oral Place** *Aperture* [closed] *Labial* **Soft Palate** [nasal] **Tongue Root** **Larynx**	[ɱ] [cons] [son] **Oral Place** *Aperture* [closed] *Labial* [drawn] **Soft Palate** [nasal] **Tongue Root** **Larynx**	[n] [cons] [son] **Oral Place** *Aperture* [closed] *Coronal >* *Tongue Groove* [convex] **Soft Palate** [nasal] **Tongue Root** **Larynx**	[n̪] [cons] [son] **Oral Place** *Aperture* [closed] *Coronal* **Soft Palate** [nasal] **Tongue Root** **Larynx**
[ɲ] [cons] [son] **Oral Place** *Aperture* [closed] *Dorsal >* *Tongue Thrust* [front] *Tongue Height* [high] **Soft Palate** [nasal] **Tongue Root** **Larynx**	[ŋ] [cons] [son] **Oral Place** *Aperture* [closed] *Dorsal* **Soft Palate** [nasal] **Tongue Root** **Larynx**	[ɾ̥] [cons] [son] **Oral Place** *Aperture* [closed] *Coronal >* *Tongue Groove* [convex] **Soft Palate** **Tongue Root** **Larynx**	[ɾ] [cons] [son] **Oral Place** *Aperture* [closed] *Coronal >* *Tongue Groove* [convex] **Soft Palate** **Tongue Root** **Larynx**

[r] [cons] [son] **Oral Place** *Aperture* [adjacent] *Coronal >* *Tongue Groove* [convex] **Soft Palate** **Tongue Root** **Larynx**	[l] [cons] [son] **Oral Place** *Aperture* *Coronal >* *Tongue Groove* [concave] *Tongue Curl* [down] **Soft Palate** [oral] **Tongue Root** **Larynx**	[l̥] [cons] [son] **Oral Place** *Aperture* *Coronal >* *Tongue Groove* [concave] *Tongue Curl* [down] **Soft Palate** [oral] **Tongue Root** **Larynx** *Glottal Width* [spread]	[l̪] [cons] [son] **Oral Place** *Aperture* *Coronal >* *Tongue Groove* [concave] **Soft Palate** [oral] **Tongue Root** **Larynx**
	[w] [cons] [son] **Oral Place** *Aperture* *Labial* [round] *Dorsal >* *Tongue Height* [high] **Soft Palate** [oral] **Tongue Root** **Larynx**		[j] [cons] [son] **Oral Place** *Aperture* *Dorsal >* *Tongue Thrust* [front] *Tongue Height* [high] **Soft Palate** [oral] **Tongue Root** **Larynx**

Appendix 2: Fully specified distinctive features of the vocalic phones of Spanish

[i] [son] **Oral Place** *Dorsal >* *Tongue Thrust* [front] *Tongue Height* [high] **Soft Palate** [oral] **Tongue Root** [ATR] **Larynx**	[a] [son] **Oral Place** *Dorsal* **Soft Palate** [oral] **Tongue Root** [RTR] **Larynx**	[e] [cons] **Oral Place** *Dorsal >* *Tongue Thrust* [front] **Soft Palate** [oral] **Tongue Root** [ATR] **Larynx**	[ɛ] [cons] **Oral Place** *Dorsal >* *Tongue Thrust* [front] **Soft Palate** [oral] **Tongue Root** **Larynx**
[ɔ] [son] **Oral Place** *Dorsal >* *Tongue Thrust* [back] *Labial* [round] **Soft Palate** [oral] **Tongue Root Larynx**	[u] [son] **Oral Place** *Dorsal >* *Tongue Height* [high] *Tongue Thrust* [back] *Labial* [round] **Soft Palate** [oral] **Tongue Root** [ATR] **Larynx**		[o] [son] **Oral Place** *Dorsal >* *Tongue Thrust* [back] *Labial* [round] **Soft Palate** [oral] **Tongue Root** [ATR] **Larynx**

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