The intricate connection between diphthongs and stress in Spanish

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Abstract

This article investigates the interaction of gliding and default stress in Spanish and provides a unified constraint-based analysis of the two phenomena. It is argued that a better understanding of the representations/constraints responsible for the default patterns of gliding and stress in Spanish is achieved when syllabic and metrical structure are treated as interdependent. The originality of the proposal lies in the idea that, contrary to most common patterns of extrametricality at the edges of words, word final consonants and word final offglides are claimed to be the only moraic codas in the language. Within the present analysis, default patterns of gliding and stress are accomplished via the interaction of well-established markedness constraints, whereas exceptions to default (i.e. marked stress and the so-called exceptional hiatus) are all explained by the same mechanism, i.e. lexical prosodic specifications to which output must be faithful.

1. Introduction

It has traditionally been acknowledged that syllable structure and stress interact in Spanish (Cabré & Prieto 2006, Harris 1983, Roca 1991, 1997, 2006; Rosenthall 1994, among many others). This interaction is particularly interesting regarding the realization of two adjacent vowels. In European Spanish, a sequence of two vowels can be tautosyllabic or heterosyllabic depending on the sonority and stress of the vowels (Hualde 2005, Navarro Tomás 1918/1977). The data in (1-3) exemplify this fact. When two adjacent vowels are non-high or one of them is high and stressed, they are typically parsed in two different syllables (see 1-2). In contrast, if one of the vowels is unstressed and high, as in (3), the vowels generally surface as tautosyllabic, with gliding of the high vowel. This latter context gives rise to the two types of diphthongs in the language: *rising diphthongs*, which contain an onglide (3a), and *falling diphthongs*, with offglides (3b):[1]

(1) Heterosyllabic parsing (hiatus): Two non-high vowels

a. /teatro/	[te.'a.tɾo]	'theather'
b. /koreo/	[ko.'re.o]	'mail'

(2) Heterosyllabic parsing (hiatus): High and stressed vowel + another vowel

a. /poliθia/	[po.li. 'θi.a]	'police'
b. /baido/	[ba.'i.ðo]	'dizziness'
c. /baul/	[ba.'ul]	'trunk'

[1] When forms are given in their phonetic transcription, they appear in brackets and (') stands before stressed syllables. When forms are given in their orthographic form, the stressed syllable is marked with an acute accent. Syllable boundaries are indicated with periods.

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(3) Tautosyllabic parsing (hiatus): High and unstressed vowel + another vowel[2]

a. Rising diphthongs:	/ɾadio/	['ra. ðjo]	'radio'[3]
	/duelo/	['dwe.lo]	'duel'
b. Falling diphthongs:	/kausa/	['kaw.sa]	'cause'
	/beinte/	['bejn.te]	'twenty'

Additional evidence of the interaction between stress and syllable structure is seen in the existence of words with vacillating stress (RAE and ASALE 2011). The words in (4) can be realized with penultimate or antepenultimate stress. Individual speakers, however, usually choose only one option. What is important here is that the selection of either stress pattern always entails the selection of a specific syllabification strategy:

(4) Words with vacillating stress and vacillating syllabification

Penultimate stress	Antepenultimate stress	Gloss
pe.'r[jo].do	pe.'r[i.o].do	'period'
gla. 'd[jo].lo	gla. 'd[i.o].lo	'gladiolus'
a.mo.'n[ja].co	a.mo.'n[i.a].co	'ammonia'

The present paper contributes to current debate on the status of derived glides in Spanish and their relation to default stress assignment. The goals of the paper are twofold. First, this study is concerned with the prosodic representations of postconsonantal onglides (e.g. *p[j]edád* 'pity', *ág[w]a* 'water'), offglides (e.g. *va[j]nílla* 'vanilla', *rá[w]do* 'fast') and peak vowels in Spanish. I argue that the exploration of the phonological behaviour of the diphthongs with respect to the default pattern of stress can shed light on the nature of their prosodic representation. Thus, this study also investigates the prosodic representation of unmarked stress in non-derived words. Secondly, the paper aims to explore the way in which those specific structures are generated within an Optimality Theory framework (OT, Prince & Smolensky 1993/2004), providing a cohesive analysis of default stress and gliding. In particular, I investigate which constraints are responsible for the tautosyllabic parsing of high vocoids, the heterosyllabic parsing of other sequences of vowels and the location of unmarked stress in the language.

The remainder of the article is organized as follows. Section 2 describes the general facts regarding the syllabification of high vowels and the unmarked pattern of stress in Spanish non-derived nominal forms. This section shows that gliding and default stress are semi-productive patterns in the language (i.e. there is evidence of their productivity, but this productivity is sometimes blocked). Section 3 explores the possible prosodic representations for words with default stress, as well as the specific representation for Spanish diphthongs. Based on the interaction between stress and glides, I argue that the representation of postconsonantal onglides in Spanish is slightly different from that of offglides. Then I present an optimality-theoretic analysis of both stress assignment and the syllabification of adjacent vowels. Section 4 briefly compares the present proposal to some of the previous analyses, highlighting their major differences. Finally, the main conclusions are outlined in section 5.

[2] Tautosyllabic high vowel clusters (e.g./iu, ui/) are left out from the present study. The general tendency in such cases is to realize them as rising diphthongs, although falling resolutions have been also reported (Navarro Tomás 1918/1977, Alarcos Llorach 1965/1991). For recent discussion on tautosyllabic high vowel clusters the reader is referred to Cabré & Ohannesian (2011) and Martínez-Paricio & Torres-Tamarit (2010).

[3] Following Harris (1983) and Roca (2005a), I assume a word initial trill derives from an underlying flap /ɾ/, but cf. Bonet and Mascaró (1997) for a different interpretation of the facts.

2. Description of the facts: gliding and stress

2.1 Gliding

Given that the distribution of high vowels and glides is generally predictable in Spanish (see 2-3), it has traditionally been assumed that high vowels [i, u] and high glides [j,w] have the same underlying segmental makeup and differ only in their syllabic position (Colina 1995, 2006; Dunlap 1991, Harris & Kaisse 1999, Hualde 2005, Morgan 1984, Roca 1991, 1997). The predictability of the vowel/glide distribution is captured by the lexical gliding rule in (5). The term *vocoid* is used here to refer to both glides and vowels.

(5) Lexical Gliding Rule (adapted from Hualde 2005: 80)
Vocoid [+high] == > [-syllabic] / if unstressed and adjacent to another V
== > [+syllabic] / elsewhere

A vowel surfaces when the vocoid is parsed in a syllabic position (i.e. the peak of a syllable); otherwise, a glide emerges. This entails that glides will never appear as the only segment linked to a nucleus position. It has been long reported in the literature that the rule in (5) is not exceptionless (Cabré & Prieto 2006, Colina 1999, Hualde 1999, Navarro Tomás 1918/1977). Furthermore, the exceptions to the gliding rule are not the same in every dialect and idiolect. The data in (6a-d) illustrate some exceptions to the gliding rule in certain Spanish dialects (these examples are from Hualde 1991 and Hualde & Prieto 2002 and they are all present in this paper author's own variety of Northern-Central Peninsular Spanish):

(6)

Unexpected underapplication			Application of gliding		
a. /diaɾio/	[di. 'a.ɾjo]	'diary'	e. /presidiaɾio/	[pre.si. 'ðja. ɾjo]	'prisoner'
b. /kliente/	[kli. 'en.te]	'client'	f. /diente/	['djen.te]	'tooth'
c. /dueto/	[du. 'e.to]	'duet'	g. /duelo/	['dwe.lo]	'sorrow'
d. /piano/	[pi. 'a.no]	'piano'	h. /ulpiano/	[ul. 'pja.no]	'name'

The rule in (5) predicts gliding for the words listed in (6a-d). In fact, gliding generally applies in very similar situations (6e-h). The contrast between the two groups of words (6a-d *vs*. 6e-h) has been confirmed by native speakers' phonological intuitions (Cabré & Prieto 2006, Navarro Tomás 1918/1977) and experimental research. Specifically, it has been shown that besides durational differences —words with unexpected heterosyllabic parsing are longer than those with gliding—, the two groups of words exhibit differences in their formant frequencies (Aguilar 1999, Hualde & Prieto 2002).

The cases in which the gliding rule does not apply are very limited in number compared to the number of items undergoing gliding and, thus, they have been considered exceptional. Additionally, most of the exceptional hiatus are not randomly distributed in the lexicon, but they have a morphological justification or tend to surface in a prosodic prominent position, namely the initial syllable of a word (for details, see Cabré & Prieto 2006, Chitoran & Hualde 2007, Colina 1995, 1999; Hualde 1999, 2005; Hualde & Prieto 2002, Navarro Tomás 1918/1977). On the basis of these facts, I will assume that gliding is a productive pattern in Spanish, which can be blocked under exceptional circumstances.

The productivity of the gliding rule is also observed in the adaptation of loanwords and foreign names. When borrowings and foreign names with a sequence of vowels are adapted into Spanish, they tend to follow the general pattern of the language, i.e. non-high vowels are heterosyllabic (e.g. *Romeo* [ro.'me.o]), whereas unstressed high-vowels are parsed in the same syllable as their preceding/following vowel (e.g. *skype* [es.kajp], *muesli* ['mwes.li], *Billy Elliot* ['e.ljot]). Although few loanwords are subject to variation and can present exceptional hiatus (e.g. for the designer name *Dior*, both ['djoɾ] and [di.'oɾ] are attested), the most common pattern in borrowings, as in native vocabulary, is to undergo gliding.

It is not among the goals of this paper to provide a detailed description/analysis of the dialectal variation in exceptional hiatus in Spanish vocabulary, but just to offer a general strategy to deal with those exceptions.[4] When exceptions to the gliding rule are considered in this paper, they come from Northern-Central Peninsular Spanish, which is the dialect of the author.[5] Thus, even if the term Spanish is used throughout this paper, the reader should keep in mind that when dealing with the parsing of abutting vowels, the exceptional examples all come from this dialect.

2.2 Stress in nominal forms

This section outlines the general properties of default stress in Spanish nominal forms. Verbal forms and nominal forms exhibit different behaviour with respect to stress, i.e. while verb stress is morphologically determined, stress in nominal forms is not (for an analysis of verbal stress, the reader is referred to Oltra-Massuet & Arregi 2005)[6]. In nouns and adjectives, the location of stress is freer than in verbs, but it is still restricted to one of the last three syllables (Harris 1983). The three-syllable window restriction affects the position of primary stress, which is the main concern of this study, and the only one assigned at the lexical level (Roca 1986, 2006:245). Although, at first sight, the choice between the last three syllables seems quite arbitrary —e.g. in trisyllabic words with similar syllable structure, every possible stress pattern is attested: antepenultimate (e.g. *cámara* 'camera'), penultimate (e.g. *mañána* 'tomorrow') and ultimate stress (e.g. *faralá* 'frill')— quantitative studies have indicated that not all options are equally frequent.[7] As shown in (7), when a word ends in a vowel, penultimate stress is by far the most attested. If it ends in a consonant, final stress is the most frequent pattern:

(7) Frequent patterns of stress in Spanish:
a. Penultimate stress: words ending in a vowel: *cása* 'house', *ménta* 'mint', *maléta* 'suitcase' *conténto* 'happy', *pistóla* 'gun', *redóndo* 'round '...
b. Ultimate stress: words ending in a consonant: *melón* 'melon' *mercéd* 'favor, mercy', *ajuár* 'trousseau', *cinturón* 'belt', *cristál* 'glass', *arróz* 'rice'...

The high frequency of the pattern given in (7) has lead many scholars to interpret it as the default pattern of stress (Lipski 1997, Roca 1997, Rosenthall 1994). Moreover, as Roca (2006:242) highlights there is additional evidence, besides frequency, pointing to the unmarkedness of the pattern. First, the unmarked pattern of stress productively surfaces in many Spanish acronyms (FECO**VÁL**, UNI**CÉF**, **CSÍC**, U**NÉD** *vs*. A**DÉ**NA, EN**DÉ**SA, **CÓ**PE).[8] Additionally, psycholinguistic research has provided evidence for the psychological reality of the pattern. Several production and perception experiments with nonce words have shown that speakers apply this pattern in very high percentages (e.g. Alvord 2003, Eddington 2000,

[4] For a recent investigation on the topic see Cabré & Prieto (2006). These authors report a high degree of idiolectal variation in Peninsular Spanish varieties. They note, however, that their data show two biases: there is a conservative group of speakers who tend to preserve exceptional hiatus in initial position and in items morphologically related to words containing hiatus, while there is a second group of speakers, more innovative, in which the gliding rule has been generalized, showing only very few exceptions.

[5] This dialect is the closest to standard European Spanish.

[6] Despite the different behaviour of the two categories, this study and others (e.g. Harris 1995 and Ohannesian 2004) have attempted to provide a single algorithm for the placement of stress in verbs and non-verbs.

[7] For instance, Bárkány (2002) reports an 88% of penultimate stress in trisyllabic words ending in a vowel; Núñez-Cedeño & Morales-Front (1999:221) did a search on an electronic listing corpus of 91000 words from all syntactic categories, and showed that there is a very high percentage (97,8%) of final stress when the last syllable is closed. Other studies reporting similar results are Aske (1990) and RAE and ASALE (2011).

[8] The acronym test has also been used to determine whether other Romance languages have or do not have a default stress pattern, see Wetzels (2006) for Portuguese or Krämer (2009) for Italian.

Face 2000, Waltermire 2004). Finally, the early acquisition of the pattern, at least in disyllabic words, can be taken as another piece of evidence of its unmarkedness (Pons & Bosch 2010). For all these reasons, I will consider that penultimate stress is the preferred option in the language unless there is a final consonant that, generally, attracts stress.[9]

The default pattern of stress outlined in (7) is a general tendency, but is not an exceptionless generalization. That is, Spanish words sometimes exhibit antepenultimate stress in words ending in a vowel or a consonant (cf. 8a), ultimate stress in words ending in a vowel (cf. 8b) and penultimate stress in words ending in a consonant (cf. 8c). These cases are a minority when compared to the number of words with default stress and I will consider them instances of non-default stress. Importantly, the three-syllable window is also respected by the words with non-default stress.

(8) Non-default stress
a. Antepenultimate stress: *sá.ba.na* 'sheet'; *Mán.ches.ter*
b. Ultimate stress in words ending in -V: *ca.fé* 'coffee', *Pa.na.má*
c. Penultimate stress in words ending in -C: *ár.bol* 'tree', *crá.ter* 'crater'

Additionally, it must be highlighted that stress can be contrastive in Spanish, e.g. [sa. 'βa.na] 'savannah' with default stress *vs*. ['sa.βa.na] 'sheet', with non-default stress.

Finally, it should be pointed out that in contrast to the rich dialectal variation in the realization of adjacent vowels, the location of stress in Spanish is uniform across dialects, i.e. all speakers exhibit the same patterns of stress, with the only exception of a few words that display two alternatives (see above (4) or RAE and ASALE 2011 for a complete list of these words).

3. A unified analysis of gliding and stress in Spanish

This section deals with the representations and constraints responsible for the tautosyllabic or heterosyllabic parsing of two adjacent vowels in Spanish. Because metrical and syllabic information interact in the construction of the prosodic form of words, I first explore the structure of words with unmarked stress and, then, examine the behaviour of glides with respect to stress (section 3.2). On the basis of this particular behaviour, I provide different prosodic representations for Spanish onglides and offglides (section 3.3). Finally, I present an OT analysis which accounts for the emergence of the relevant prosodic representations (section 3.4). Before expanding on the prosodic structure of words with unmarked stress, however, a crucial distinction between two sources of weight must be introduced.

3.1. Distinctive weight vs. Coerced weight

Following, among many others, Hyman (1985), Kager (1989), Hayes (1989) and Morén (1999, 2000), I assume there are two different sources of weight: *distinctive* and *coerced* (Morén's terminology). Distinctive weight results from an underlying moraic specification that is reflected in a surface contrast (e.g. geminate *vs*. non-geminate intervocalic consonants, or phonemic long *vs*. short vowels, Morén 2000: 371). For instance, in Standard Literary Hungarian, an underlyingly non-moraic intervocalic consonant surfaces as non-moraic (e.g. /vicɛ/ > [vicɛ] 'janitor'), while an underlying moraic intervocalic consonant surfaces as moraic (e.g. /vic$^{\mu}$ɛ/ [vic.cɛ] 'his joke') (Hayes 1989, Morén 1999:22). Since Northern-Central

[9] An argument that has sometimes been raised against the productivity/existence of a default pattern of stress is the fact that loanwords do not always conform to the pattern described in (7) (e.g. *Mánchester* is realized with antepenultimate stress rather than final stress). However, loanwords do not always show default patterns in other grammatical respects. (see Bermúdez-Otero 2006, 2007 and forthcoming for examples and discussion). Furthermore, the imposition of antepenultimate stress upon loanwords like Mánchester can be taken as a marker of exoticism and un-Spanishness, rather than as argument against a default stress pattern in Spanish, as Bermúdez-Otero (2006: 261) points out.

Peninsular Spanish does not present phonemic geminates or long vowels, I assume it does not exhibit distinctive weight.

Coerced weight, in contrast, has nothing to do with underlying specifications. It results from a restriction on minimal or maximal surface moraicity in some phonological contexts. For instance, some languages have a restriction on the number of morae that a prosodic word must minimally contain (e.g. prosodic words in Hawaian must be bimoraic, Morén 1999:33). Another example of coerced weight is the phonological restriction by which coda consonants must surface as moraic (i.e. Weight by Position, Hayes 1989). In these languages, coda consonants do not contain an underlying mora, but they can project one when their surface representation is built.

Based on the default assignment of stress and the unmarked foot in Spanish, the next section puts forward a hypothesis regarding the prosodic representation of words with default stress in Spanish. In line with the work of Broselow et al. (1997), Hayes (1995), Kager (1989), Morén (1999, 2000) and Rice (1996), I assume that closed syllables in Spanish may vary in weight depending on the context. That is, consonant weight for a particular segment in a given syllabic position does not have to be static, but it can vary depending on the relative position of the syllable within the word. More specifically, I propose that word final codas are the only segments that can exhibit coerced weight in Spanish.

3.2. Prosodic structure of words with unmarked stress

In order to provide the prosodic structure of Spanish words, one first has to determine what the unmarked foot of the language is and, second, if there is any evidence for quantity-sensitivity in the language. With respect to the unmarked foot in Spanish, I follow much of the traditional literature and assume that Spanish feet are consistently trochaic[10]. As Roca (2006:246) points out, this assumption is based on evidence from truncation —both ordinary (e.g. *bicicléta* 'bicycle'> *bíci*) and hypochoristic (*Tóni* from *António*, *Édu* from *Eduárdo*)— and from secondary stress at the postlexical level. Although this evidence supports the preference for left-headed feet in Spanish, it does not suffice to determine the constituents of the foot. In fact, while some studies have proposed that Spanish trochees are bisyllabic (see Ohannesian 2004 and references therein), other studies have assumed moraic trochees (Garret 1996, Lipski 1997 and Martínez-Paricio & Torres-Tamarit 2010). Furthermore, different types of additional data do not help in identifying the specific constituents of the foot, i.e. some cases of hypocoristics can only be analysed as moraic, *Fér* from *Fernándo*; *Chú*s from *Jesús* or *María Jesús*), while others seem to be purely syllabic (e.g. *Márce* from *Marcéla, Ródo* or *Ródol* from *Rodólfo but not* **Rodól*).

Crucially, minimality requirements on prosodic words and the default pattern of stress in Spanish seem to provide further support for the moraic trochee position. First, prosodic words are minimally bimoraic (e.g. *sol, mar, ley, hoy*), with only a few exceptions in the nominal domain (e.g. the name of letters, the name of musical notes and the word *té* '*tea*', Elordieta 2010). Second, building on the default pattern of stress (i.e. penultimate stress when the word ends in a vowel and final stress when it ends in a consonant), I hypothesize that word final consonants usually project morae in Spanish. By making this assumption, it can be proposed that words with a default assignment of stress all exhibit the same prosodic structure. Namely, they build a moraic trochee aligned to the right edge of the prosodic word. This is illustrated in (9).

[10] For an exception, see Oltra-Massuet & Arregi 2005, who propose right-headed feet.

(9) Disyllabic word[11]

		Metrical Structure	Transcription	Gloss
Penultimate Stress	a. CV.CV	[('ka$^{\mu h}$.sa$^{\mu}$)$_{Ft}$]$_{PrWd}$	['ka.sa]	'house'
	b. CVC.CV	[('me$^{\mu h}$n.ta$^{\mu}$)$_{Ft}$]$_{PrWd}$	['men.ta]	'mint'
Final Stress	c. CV.CVC	[ba. ('lo$^{\mu h}$ ɾ$^{\mu}$)$_{Ft}$]$_{PrWd}$	[ba. 'loɾ]	'value'
	d. CVC.CVC	[man. ('te$^{\mu h}$ l$^{\mu}$)$_{Ft}$]$_{PrWd}$	[man. 'tel]	'table cloth'

What is crucial to the present proposal is that only word final consonants are moraic. Even though cross-linguistically this hypothesis may be odd (i.e. generally we find the opposite pattern: word-final consonants being extrametrical, e.g. Norwegian, dialects of Arabic, Greek, etc.), the pattern of default stress, together with the word-minimality restrictions in Spanish, seem to support this idea. Furthermore, there are other languages that have been analysed in a similar way, providing additional support to the final coerced weight hypothesis (see Bennett's 2012 recent analysis of Huariapano and references therein for other languages with coerced weight in final position).

The assumption that only final consonants have coerced weight allows for a unified representation of all the unmarked patterns of stress, i.e. they all have a moraic trochee aligned with the right edge of the prosodic word. This becomes clear when one compares the contrast between penultimate stress in *cása* 'house' (9a) and final stress in *valór* 'value' (9c). If final consonants did not project morae and the unmarked foot in Spanish were a syllabic trochee, the stress in *valor* would remain in the penultimate syllable, as in hypothetical *['ba$^{\mu h}$.lo$^{\mu}$r]. A syllabic trochee analysis does not have a direct explanation for the general pattern of final stress in words that end in a consonant.[12] Moreover, psycholinguistic and acquisition research support the hypothesis that speakers mainly pay attention to the configuration of the final syllable when they have to assign stress (§ 2.2). Thus, this analysis (i.e. only final CVC are heavy) is assumed here. Although there is a general tendency that word-final consonants attract stress, some exceptions are attested; for instance: *Lúnes* 'Monday', *árbol* 'tree', *clímax* 'climax'.

The data in (9) illustrate the prosodic structure only for disyllabic words with default stress. However, since feet are bimoraic and right-aligned, the same type of structure is assumed for trisyllabic and longer words (e.g. [ma.('le$^{\mu h}$.ta$^{\mu}$)] 'suitcase', [θin.tu('ɾo$^{\mu h}$n$^{\mu}$)] 'belt', [as.θen('so$^{\mu h}$ɾ$^{\mu}$)] 'elevator', [con.('te$^{\mu h}$n.to$^{\mu}$)] 'happy').

It should be noted that the word final coerced weight hypothesis goes against previous research where penultimate syllables with a diphthong (CVG, CGV) or a coda consonant (CVC) were treated as bimoraic, since I assume they are monomoraic. Scholars like Harris (1983) and Rosenthall (1994) proposed that CVC, CGV and CVG were bimoraic building on the fact that antepenultimate stress was thought to be absent in structures like *'σ.CGV.σ, *'σ.CVG.σ, *'σ.CVC.σ. In short, it was claimed that the reason for banning antepenultimate stress in such words is that penultimate syllables are heavy and attract stress. Contrary to these analyses, I follow Alvord (2004), Bárkány (2002), Ohannesian (2004), Pensado (1985) and Roca (1997) and do not interpret the banning of antepenultimate stress before a heavy penultimate as clear evidence of their bimoraicity. These latter studies have shown that, even if the above-mentioned structures are scarce, they are not completely absent from Spanish vocabulary, as illustrated in (10):

[11] The following abbreviations will be used throughout the paper: C: consonant, G: glide, V: vowel, σ: syllable, μ: mora. *μ*h: head mora, i.e. head of a foot. Syllable boundaries are indicated with periods, foot boundaries with brackets and the edges of the prosodic word are marked with a square bracket []$_{PrWd}$.

[12] Moreover, although it could alternatively be proposed that the prosodic structure of words with non final closed syllables such as *menta* 'mint' is [(ˈme$^{\mu h}$n$^{\mu}$)$_{Ft}$ ta$^{\mu}$]$_{PrWd}$ with a moraic trochee whose right edge does not coincide with the right edge of the prosodic word, the assumption that only final consonants have coerced weight allows for a unified representation of all the unmarked patterns of stress.

(10) a. ['fɾo.mis.ta] 'place name of Castilla'
b. [a.'li.kwo.ta] 'aliquot'
c. ['se.kwa.no] 'related to Sena'

It is true that the words in (10) are not very common and that antepenultimate stress in forms of the type 'σ.CGV.σ, 'σ.CVG.σ and 'σ.CVC.σ is not generally found in Spanish vocabulary. However, instead of assuming that penultimate CVC, CGV and CVG are heavy and that is the reason for banning such structures, there is an alternative interpretation of the facts. Since antepenultimate stress was forbidden in Latin in words with heavy penultimates, the near-absence of 'σ.CGV.σ, 'σ.CVG.σ, 'σ.CVC.σ in Spanish vocabulary can be seen as an historical accident (Pensado 1985). That is, antepenultimate stress in words containing a CVC, CVG or CGV in the penultimate syllable is rare but not ungrammatical. On the other hand, it should be kept in mind that, in Spanish, antepenultimate stress is infrequent anyway. So the scarcity of the above-mentioned structures ('σ.CGV.σ, 'σ.CVG.σ, 'σ.CVC.σ) could be interpreted as a consequence of the general markedness of antepenultimate stress. Note that the vast majority of words with a CVC, CGV or CVG in the penultimate syllable end in a vowel and, therefore, default stress is assigned to the penultimate syllable (e.g. *i.'d[jo].ma* 'language', *a.'pl[aw].so* 'applause', *va.'l[je]n.te* 'brave'). In conclusion, in the absence of concrete phonological evidence for the bimoraicity of penultimate syllables with diphthongs or coda consonants, this paper will assume that the word-final codas are the only ones that project a mora.

3.3. Prosodic Representations of postconsonantal onglides and offglides

Postconsonantal onglides and offglides have been fairly unanimously represented as part of the syllable rhyme on the basis of phonotactic restrictions in the language (see Harris 1983, Hualde 1991, 1999, Núñez-Cedeño & Morales-Front 1999, although Cabré & Ohannesian 2011 treat some onglides as part of the onset). Apart from the traditional phonotactic arguments reported in the literature,[13] this paper provides an additional argument for the rhyme analysis of Spanish postconsonantal onglides. This argument builds on research on sonority co-occurrence restrictions and syllable constituency tests (Steriade 1988, Davis & Hammond 1995). In particular, I propose that the fact that Spanish onglides do not show any co-occurence sonority restrictions with the preceding consonant in the onset, as illustrated in (11), can be taken as further support for a rhyme analysis of the onglides:

(11) a. *Onglides after an obstruent*

['tje].rra	'land'	Te.['twan]	'Tetouan'
['pja].ra	'herd'	['pweɾ].ta	'door'
a.'go.[bjo]	'anxiety'	['bwe].no	'good'
pa.['sjon]	'passion'	['swa].ve	'soft'
['fjes].ta	'party'	['fwe].go	'fire'

[13] The traditional arguments in favour of the rhyme analysis of onglides are based on the phonotactics of Spanish. Complex onsets contain maximally two segments, an obstruent plus a liquid (*pl, pr, fl, fr*...). Since glides can occur after complex onsets, it has been assumed that they must be part of the rhyme (e.g. [in. 'dus. trja] 'industry', [su.'peɾ.flwo] 'superfluous', ['klwe.ka] 'broody' (Harris 1983). Furthermore, Spanish rhymes contain maximally three segments. Crucially, glides cannot occur in rhymes that already contain three segments: while the first syllable of words like *mwes.tra* 'sample', and *mons.trwo* 'monster' are valid syllables, there are no structures with an additional segment in the rhyme, e.g. **mwens.tra* or **awns.tral*. If onglides were syllabified in the onset, there would not be a clear explanation for the banning of these words (Harris 1983, Núñez-Cedeño & Morales-Front 1999).

b. *Onglides after a sonorant*

fo.['nja]tra	'speech therapist'	con.'ti.[nwo]	'continuous'
['mje].do	'fear'	['mwe].la	'back tooth'
con.'ci.[ljo]	'council'	e.va.[lwa].'cion	'evaluation'
ca['rjo].ca	'from Rio di Janeiro'	['rwe].da	'wheel'

If [j,w] were forbidden after some consonants, then it could be argued that they are part of the onset. In fact, this is what happens in American English postconsonantal labiovelar onglides. In CwV sequences, the consonant can never be a sonorant, i.e. *mwV, *nwV, *rwV, *lwV. Davis & Hammond (1995) take this as an evidence for the [w] being in an onset position, in contrast to the palatal glide [j] which does not show any co-occurrence sonority restriction with the preceding consonant.[14]

Although postconsonantal onglides and offglides are both in a rhyme position, when one looks at their phonological behaviour, it becomes clear that they display an asymmetry in their prosodic structure. This is particularly evident considering their interaction with the default stress pattern, as illustrated in table (12).

(12) Interaction of stress and gliding in Spanish

(i) Penultimate stress: words ending in a vowel

Rising diphthongs	a. C**G**V.CV	'm[je].do	'fear'
	b. CV.C**G**V	'me.d[jo]	'middle, half'
	c. CCVC.C**G**V.CV	fram.'b[we].sa	'raspberry'
	d. C**G**V.CV.CV	g[wa].'da.ña	'scythe'
	e. CVC.CV.C**G**V	far.'ma.c[ja]	'pharmacy'
Falling diphthongs	f. CV**G**.CV	'g[aj].ta	'pipe'
	g. CV**G**.CV.CV	v[aj].'ni.lla	'vanilla'
	h. CV**G**C.CV.CV	v[ejn].'te.na	'set of twenty'

(ii) Ultimate stress: words ending in a offglide

Falling diphthongs	i. CV.CV**G**	ca.'r[aj]	'good heavens!'
	j. CVC.CV**G**	jer.'s[ej]	'pullover'
	k. CV.CV.CV**G**	sa.mu.'r[aj]	'samurai'

Rising diphthongs do not attract stress when they appear word-finally, i.e. stress stays on the penultimate syllable; e.g. *mé.d[jo]* 'middle', *far.má.c[ja]* 'pharmacy'. Falling diphthongs, on the other hand, generally attract stress in final position: e.g. *ca.* '*r[aj]* 'good heavens!', *jer.* '*s[ej]* 'pullover', *sa.mu.* '*r[aj]* 'samurai'.[15] In positions other than word-final, offglides do not cause any modification to the location of stress. That is, when there is an offglide in a penultimate or antepenultimate syllable, stress remains in the penultimate position if the word ends in a vowel, e.g. *v[aj].'ni.lla* 'vanilla', *v[ejn].'te.na* 'set of twenty', or in the final syllable if the word ends in a consonant, e.g. *l[aw].rél* 'bay tree'; *f[aj].sán* 'pheasant'; *b[oj].cót* 'boycott'. Consequently, the only offglides that seem to have a clear impact on stress assignment are the word-final ones; i.e. offglides in word-final position exhibit a similar behaviour to word-final consonants that attract stress. Additionally, whereas monosyllabic nouns of the type CV and CGV are generally banned within

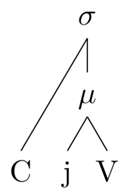
[14] The rhyme assumption is applied in this paper only to postconsonantal onglides. Nothing is said about word initial glides, which contrary to postconsonantal glides, seem to be syllabified in the onset (for further details see § 4.2).

[15] There are a few final glides that fail to attract stress (e.g. *hóck[ej]* 'hockey' *vóll[ej]* 'volleyball'). As with word final consonants that, contrary to the general tendency do not project a mora, they are treated as exceptional.

nouns (cf. § 3.2), monosyllables with a final glide are allowed: e.g. ['lej] 'law', ['oj] 'today', ['rej] 'king'. This fact can also be interpreted as an evidence of the weight of word final glides.

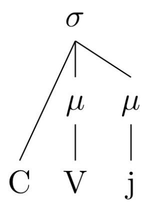
Adopting a model of phonological representations in which phonological structures are learned on the basis of language specific contrasts and phonological activity (Dresher et al. 1994, Dresher 2009; Morén 2003, Rice 2005, 2007; Youssef 2010) and building on the notion of coerced weight (Morén 1999), I propose that the different behaviour of onglides and offglides with respect to stress is due to a difference in their phonological representations. In Spanish, as in many other languages, onsets do not contribute to weight[16]. Thus, segments in the onset in Spanish are directly linked to the syllable node, skipping the moraic tier. In the previous section I showed that postconsonantal onglides are in a rhyme position and, furthermore, that they do not contribute to weight. Thus, I propose that they must share a mora with the following vowel as illustrated in (13):

(13) Onglides: co-moraic with the following vowel



Offglides, in contrast, can contribute to weight by projecting their own mora when they appear word-finally, and their structure is thereby crucially different from the one of rising diphthongs: rising diphthongs area always light (i.e. they are monomoraic), falling diphthongs are heavy (i.e. bimoraic) in final position:[17]

(14) Final offglide representation: projection of its own mora



As already argued, when falling diphthongs appear in positions other than the final syllable of a word, there is no clear positive phonological evidence for their prosodic representation. They could either be monomoraic or bimoraic. However, along the lines of the prosodic structure provided above for words with penultimate closed syllables (e.g.CVC.'CVC, 'CVC.CV), I will assume that the only offglides that project their own mora are word final offglides. This allows for a unified analysis of default stress. As indicated above, some scholars have interpreted the absence of antepenultimate stress in words with a falling diphthong in the penultimate syllable (e.g. **te.'ra.p[ew].ta* 'thereapist', **di.nó.s[aw].rio, di.no.'s[aw].rio* 'dinosaur') as evidence of the bimoraicity of the latter. Here, in contrast, this absence is seen as a general consequence of antepenultimate stress being a marked pattern of the language, compared to the more general penultimate stress in words ending in a vowel, e.g. *te.ra.'p[ew].ta* 'thereapist', *di.no.'s[aw].rio* 'dinosaur'). It is, thus, assumed that the absence of antepenultimate stress in words like **di.nó.s[aw].rio* 'dinosaur' is a result of default penultimate stress assignment in words ending in a vowel. Similarly, words with falling diphthongs in antepenultimate position (e.g. *v[aj].ní.lla* 'vanilla')

[16] See Topintzi (2006, 2008) for instances of languages with moraic onsets.

[17] Bakovic (2006), in his analysis of hiatus resolutions in Chicano Spanish, assumes the same representation for onglides and offglides as the ones presented here.

also have penultimate stress when ending in a vowel. If falling diphthongs behaved as heavy in every position, stress could be expected to move from the penultimate syllable to the antepenultimate. However, this is not what we generally find.

3.4. OT analysis

I follow Prince & Smolensky (1993/2004) and assume a classical model of OT where the derivation is global and parallel (i.e. in a single step and using a single hierarchy of constraints). In this model, GEN is unrestricted and is free to build different types of prosodic structures. It is, thus, the role of the constraint hierarchy to determine which of those structures surface as optimal in Spanish (i.e. 13 and 14), and which are ruled out. The globalism and parallelism of the OT model adopted here entails that stress and syllable structure are constructed side by side.

Before going into the details of the hierarchy of constraints that accounts for the syllabification of high vowels in Spanish, the constraints responsible for the generation of the default pattern of stress are explored. Since gliding and stress in Spanish are semi-productive patterns (§2), the grammar must provide a general mechanism to account for their productivity. Nevertheless, since both patterns exhibit exceptions, some lexical items must be marked in order to block the appearance of the general pattern.

3.4.1. Default pattern of stress

Unlike previous studies on Spanish stress, this one assumes that Spanish stress is partially unpredictable. The location of the unmarked stress in Spanish results from the interaction of a small set of well-established markedness constraints. With respect to the constituents and size of the feet, I previously argued that Spanish has moraic left-headed feet. Therefore, the following constraints must be high-ranked in Spanish:

(15) **FOOT-BINARITY-μ** (abbr. FT-BIN-μ): Assign one violation mark for every foot that does not contain exactly two morae.

(16) **ALIGN-HEAD-LEFT**: Assign one violation mark for every foot whose head is not initial (based on Hayes 1995).

More precisely, ALIGN-HEAD-LEFT outranks the constraint against right-headed feet:

(17) **ALIGN-HEAD-RIGHT**: Assign one violation mark for every foot whose head is not final (based on Hayes 1995).

The alignment constraint in (15) favours trochees, whereas (16) favours iambs. For ease of presentation, I will refer to them by using the terms TROCHEE and IAMB (ALIGN-HEAD-LEFT = TROCHEE, ALIGN-HEAD-RIGHT = IAMB). The ranking TROCHEE >> IAMB ensures that the default metrical structure of Spanish nominal forms favours trochees over iambs. This is illustrated in (18). The present analysis assumes that every head of a syllable projects a mora in Spanish (i.e. a constraint like σHEADμ is undominated in Spanish). Since Spanish does not have syllabic consonants, vowels are the only segments that will project a mora when they are the head of a syllable. For ease of presentation, the next tableaux do not include σHEADμ and they only consider candidates that do not violate it.

(18)

kasa	TROCHEE	IAMB
a. ☞(ka$^{\mu h}$.sa$^{\mu}$)		*
b. (ka$^{\mu}$.sa$^{\mu h}$)	*!	

In Spanish, the right-edge of the (main) foot must be aligned with the right-edge of the prosodic word (Ohannesian 2004). In order to ensure the alignment of the right edges of the two prosodic categories, a high-ranked alignment constraint needs to be posited:

(19) **ALIGN-RIGHT (ProsodicWord, Foot)** (abbr. ALIGN-RIGHT(PrWd-Ft): Assign one violation mark for every prosodic word whose right edge does not coincide with the right edge of the main foot of the word (McCarthy & Prince 1993).

Furthermore, I assume that in Spanish, as in many other languages, the boundaries of metrical structure and syllable structure always coincide (sometimes referred as 'syllable integrity', Prince 1980; Rice 1988, Kager 1993, Hayes 1995). Thus, a word like *menta* 'mint' would never surface with a structure like me(n$^{\mu}$.ta$^{\mu}$)]$_{PrWd}$, where the left edge of the foot does not coincide with the edge of a syllable. The following constraint bans this type of *non-aligned* structures:

(20) **ALIGN-EDGES-(Foot, Syllable)** (abbr. AL-ED-(FT,σ): Assign one violation mark for every edge of a foot that it is not aligned with some edge of a syllable.

Since ALIGN-EDGES(FT,σ) is undominated in Spanish, the constraint (and the hypothetical structures that violate it) will not be included in the following tableaux for ease of exposition. Furthermore, I assume that by default, every syllable dominates at least one mora. Thus, moraless syllables will not be considered in the tableaux either.

I have proposed that Spanish has coerced weight in word final codas. The constraint WEIGHT-BY-POSITION (Hayes 1989) ensures that all codas are moraic. In Spanish, this is not always the case, since only word-final codas do so. Ranking Weight-by-Position below some of the above mentioned constraints, in particular, below FT-BINμ and AL-RIGHT(PRWD,FT), moraic codas are restricted to word-final position. [18]

(21) **WEIGHT-BY-POSITION** (abbr. WBP): Assign one violation mark for every segment to the right of the peak that does not project its own mora (based on Hayes 1989, Morén1999).

To sum-up, I propose the default pattern of stress in Spanish is the result of the rankings given in (22):

(22) a. FT-BINμ, AL-RIGHT(PrWd,Ft) >> WBP
b. FT-BINμ, TROCHEE >> IAMB

The ranking arguments for (22a) are presented in (23-25). All these tableaux indicate that the optimal candidate for a word like /menta/ 'mint' is [(me$^{\mu h}$n.ta$^{\mu}$)]$_{PrWd}$, with penultimate stress and the right edge of the prosodic word aligned with the right edge of the foot. Tableau (23) shows that AL-RIGHT(PrWd, Ft) dominates WBP. Candidate (b) does not have the right-edge of its foot aligned with the right-edge of the prosodic word and, thus, violates AL-RIGHT(PrWd,Ft). Even though the coda consonant in (23a) does not project a mora, this candidate is preferred because it performs better with respect to the alignment constraint:

(23)

menta	AL-R(PRWD,FT)	WBP
a. ☞(me$^{\mu h}$n.ta$^{\mu}$)		*
b. (me$^{\mu h}$n$^{\mu}$).ta$^{\mu}$	*!	

Tableau (24) illustrates FT-BINμ >> WBP. Here again, the optimal candidate is (24a), because (24b) incurs a violation of the higher ranked constraint FT-BINμ:

(24)

menta	FT-BINμ	WBP
a. ☞(me$^{\mu h}$n.ta$^{\mu}$)		*
b. (me$^{\mu h}$n$^{\mu}$.ta$^{\mu}$)	*!	

Finally, tableau (25) shows that TROCHEE dominates IAMB:

[18] For an alternative strategy to derive final weight-by-position see Rosenthall & van der Hulst (1999) and Bennett (2012).

(25)

menta	Trochee	Iamb
a. ☞('me$^{\mu h}$n.ta$^{\mu}$)		*
b. ('me$^{\mu}$n.ta$^{\mu h}$)	*!	

Tableaux (18) and (23-25) illustrate the assignment of default stress in words ending in a vowel, i.e. penultimate stress. When words end in a consonant, however, the unmarked stress is final. Crucially, the same hierarchy of constraints that accounts for default penultimate stress can account for default final stress in consonant-final words. This is illustrated in tableaux (26-28), which respectively evaluate CV.CVC and CVC.CVC structures. The optimal parsing for a word like *melon* 'melon' is again the one with a moraic trochee, whose right edge is aligned with the right edge of the prosodic word (26a). This candidate exhibits coerced weight and, therefore, it performs better than the rest of the candidates (b-c), whose final consonants are non-moraic.

(26)

melon	FtBin-μ	Trochee	Al-R(PrWd,Ft)	WbP	Iamb
a. ☞me$^{\mu}$.('lo$^{\mu h}$n$^{\mu}$)					*
b. me$^{\mu}$.('lo$^{\mu h}$n)	*!			*	
c. (me$^{\mu}$.l'o$^{\mu h}$n)		*!		*	

Given this hierarchy, a candidate without final coerced weight (27b) will be harmonically bounded by a candidate with a final moraic consonant (27a):

(27)

melon	FtBin-μ	Trochee	Al-R(PrWd,Ft)	WbP	Iamb
a. ☞me$^{\mu}$.('lo$^{\mu h}$n$^{\mu}$)					*
b. ('me$^{\mu h}$. lo$^{\mu}$n)				*!	*

Finally, the evaluation of a CVC.CVC word is given in (28). The optimal candidate for *mantel* 'table cloth' is the one with final stress, i.e. with a moraic trochee aligned to the right-edge of the prosodic word (28a). Candidate (28b) has an iamb instead of a trochee and, thus, it is ruled out even if it also has final stress. In (28c), the foot is not aligned with the right edge of the prosodic word, so the candidate fares worse than the optimal candidate in the alignment constraint Al-R(PrWd,Ft).

(28)

mantel	FtBin-μ	Trochee	Al-R(PrWd,Ft)	WbP	Iamb
a. ☞ma$^{\mu}$n.('te$^{\mu h}$l$^{\mu}$)				*	*
b. (ma$^{\mu}$n. 'te$^{\mu h}$l)		*!		**	
c. ('ma$^{\mu h}$n$^{\mu}$).te$^{\mu}$l			*!	*	*

The previous tableaux have exemplified the evaluation of the metrical structure in disyllabic words. Since the metrical foot in Spanish is aligned with the right edge of the prosodic word, the same hierarchy proposed in (22) would account for the unmarked pattern of stress in words with more than two syllables. Having presented the constraints responsible for the default stress assignment it is now possible to account for its exceptions.

3.4.2. Non-default stress

Words with non-default stress are presented again in (29):

(29) Non-default stress

a. Antepenultimate stress: *sá.ba.na* 'sheet'; *Mán.ches.ter*

b. Ultimate stress in words ending in -V: *ca.fé* 'coffee', *Pa.na.má*

c. Penultimate stress in words ending in -C: *ár.bol* 'tree', *crá.ter* 'crater'

The hierarchy of constraints presented above would by default assign penultimate stress to the words in (29) that end in a vowel, and final stress to those that end in a consonant. In order to generate the appropriate stress for these types of words, I propose that their phonological forms are prespecified with some additional information, i.e. the underlying form of these words does not only contain an ordered set of phonological segments, but they also have some kind of underlying prosodic specifications. In particular, I claim that the head of the main foot is specified with a head mora. A high-ranked faithfulness constraint to that specification will prevent the word from undergoing default stress assignment. This faithfulness constraint is INTEGRITY(HEAD-μ)[seg], as defined in (30):[19]

(30) **INTEGRITY(Head-μ)[seg]** (abbr. INTEG(μh)): For two corresponding segments, if S1 (in the input) is associated to a head mora, then S2 (in the output), and only S2, is associated to the same head mora in the output (based on other integrity constraints McCarthy & Prince 1995)

The integrity constraint given in (30) preserves moraic specifications in the output, but it also crucially avoids cases in which a specified head mora that is linked to one segment in the input is linked to two segments in the output. Although this is not so relevant in the case of stress assignment, the next subsection will show that it is crucial in the case of the syllabification of adjacent vowels.

To illustrate the importance of this faithfulness constraint, the evaluation of three words with non-default stress is given in the following tableaux. Tableau (31) shows how antepenultimate stress is generated by the model. Note that in Spanish the word for 'sheet' *sábana* contrasts with *Sabána* 'savanna'. The two words are identical regarding their segments, but they crucially differ in the location of stress. Whereas *Sabána* 'savannah' exhibits default penultimate stress (see tableau 32), *sábana* 'sheet' has antepenultimate stress (see tableau 31). However, the same hierarchy of constraints is able to derive the two patterns. The crucial difference is, thus, placed in the lexicon: *Sabána* 'savannah' is only specified with segmental information (tableau 32), but *sábana* 'sheet' contains, in addition, an underlying head mora that ensures its emergence as the head of the prosodic word (tableau 31):[20]

(31) *sábana* 'sheet' ['sa.βa.na]

sa$^{\mu h}$bana	INTEG(μh)	FTBIN-*μ*	TROCH	AL-R (PRWD,F)	WBP	IAMB
a. ☞('sa$^{\mu h}$.βa$^{\mu}$).na$^{\mu}$				*		*
b. sa$^{\mu}$.('βa$^{\mu h}$.na$^{\mu}$)	*!					*

(32) *sabána* 'savannah' [sa. 'βa.na]

sabana	INTEG(μh)	FTBIN-*μ*	TROCH	AL-R (PRWD,F)	WBP	IAMB
a. ☞sa$^{\mu}$.('βa$^{\mu h}$.na$^{\mu}$)						*
b. ('sa$^{\mu h}$. βa$^{\mu}$).na$^{\mu}$				*!		*

The following tableaux show the evaluation of the other two types of exceptions: words ending in a vowel with final stress, like *café* 'coffee' (tableau 33) and words ending in a consonant with penultimate stress, like *ágil* 'agile' (tableau 34). Note that this latter group constitutes an exception to the coerced weight hypothesis, since its final consonant does not project a mora and, thus, the final syllable fails to attract stress.

[19] A more general constraint like RESPECT (*Respect idiosyncratic lexical specifications*) proposed in Bonet et al. (2007: 9018) would do the same job and, thus, could also be used. However, we opt here for the specific Integrity constraint to highlight the specific information that needs to be stored.

[20] To ensure that INTEGRITY(Head-μ)[seg] does not generate long vowels in rich inputs, we assume a high-ranked undominated constraint against long vowels.

(33)

kafe$^{\mu h}$	INTEG(μh)	FTBIN-μ	TROCH	AL-R (PRWD,F)	WBP	IAMB
a. ☞ (ka$^{\mu}$. 'fe$^{\mu h}$)			*			
b. ('ka$^{\mu h}$.fe$^{\mu}$)	*!					*

(34)

a$^{\mu h}$xil	INTEG(μh)	FTBIN-μ	TROCH	AL-R (PRWD,F)	WBP	IAMB
a. ☞ ('a$^{\mu h}$.xi$^{\mu}$l)					*	*
b. (a$^{\mu h}$. 'xi$^{\mu}$l$^{\mu}$)		*!				*
c. a$^{\mu}$.('xi$^{\mu h}$l$^{\mu}$)	*!					*

If INTEGRITY(Head-μ)[seg] were completely undominated, it could generate undesirable outcomes in inputs where the head mora is specified in other than one of the three final syllables. Consequently, in order to ensure that stress does not fall to the left of the antepenultimate syllable, a constraint from the family of LAPSE —which prohibits consecutive unstressed syllables (Green & Kenstowicz 1995)— must dominate the faithfulness constraint. This constraint is *EXTENDEDLAPSERIGHT from Gordon (2002:503) ("A maximum of two unstressed syllables separates the rightmost stress from the right edge of a stress domain"). The action of the LAPSE constraint is illustrated in (35). In this tableau the word *cucaracha* 'cockroach' is evaluated. Note that even if the first vowel were specified with an underlying head mora, it will never surface as the head of the prosodic word:

(35)

ku$^{\mu h}$kaɾatʃa	*EXT LAPSER	INTEG (μh)	FTBINμ	TROC	AL-R (PRWD,F)	WBP
a.☞ku$^{\mu}$.ka$^{\mu}$.('ɾa$^{\mu h}$ tʃa$^{\mu}$)		*				
b. ('ku$^{\mu h}$ka$^{\mu}$).ɾa$^{\mu}$.tʃa$^{\mu}$	*!				*	

Given the hierarchy in (35), an alternative candidate with exhaustive footing, e.g. (kú$^{\mu h}$.ka$^{\mu}$).(ɾà$^{\mu h}$ tʃa$^{\mu}$) would perform better than the winning candidate (35a). However, since at the lexical level there is no clear evidence for secondary stress, the general assumption is that Spanish lexical words contain only one main foot (Roca 1997, 2006). Exhaustive parsing could be ruled out via an alignment constraint ensuring that every foot is aligned with the right edge of the prosodic word.

Finally, note that the same hierarchy generates antepenultimate stress in words with a closed penultimate and a closed final, a pattern frequent in some loanwords and few native Spanish words (see section 3):

(36)

ma$^{\mu h}$ntʃesteɾ	*EXT LAPSER	INTEG (μh)	FT BIN-μ	TROCH	AL-R (PRWD,F)	WBP
a. ☞ ('ma$^{\mu h}$n.tʃe$^{\mu}$s).te$^{\mu}$ɾ					*	***
b. ('ma$^{\mu h}$n$^{\mu}$).tʃe$^{\mu}$s.te$^{\mu}$ɾ	*!				*	**
c. ma$^{\mu}$n.tʃe$^{\mu}$s.('te$^{\mu h}$ ɾ$^{\mu}$)		*!				**

Having reviewed the constraints responsible for the assignment of unmarked and marked stress, we can now turn to the syllabification of sequences of vowels in Spanish.

3.4.3. Syllabification of adjacent vowels

In the absence of a high unstressed vocoid, vocalic sequences are generally realized with a hiatus, incurring a violation of the constraint against onsetless syllables[21] (i.e. Onset). Although in Spanish Onset is high ranked, it must be dominated by a constraint against diphthongs, formulated in (37):

---

[21] This is the general pattern at normal speech rate. In fast speech, however, a few lexical items show tautosyllabic parsing of non-high vowels. In this paper I concentrate on the syllabifications at a normal speech rate.

(37) *[XX]μ: Two root nodes within the same mora domain are prohibited.[22]

The ranking argument for *[XX]μ » ONSET is given in (38), with the evaluation of /teatɾo/ 'theatre'. Candidate [te.ˈa.tɾo], with three syllables and penultimate stress, is the optimal parsing. The candidate with a diphthong, (38b), is ruled out because it violates the higher ranked constraint [XX]μ (the {} in (38b) indicate that the head mora is linked to both *e* and *a*). The constraints ensuring default stress are left out from the following tableaux, but note that the optimal candidate has a left headed moraic foot aligned with the right edge of the prosodic word, respecting the hierarchy proposed in the previous section:

(38)

teatɾo	* [XX]μ	ONSET
a. ☞ te^{μ}.('a^{μh}.tɾo^{μ})		*
b. ('t{e̯a}^{μh}.tɾo^{μ})	*!	

An alternative parsing that does not violate*[XX]μ neither ONSET is a candidate in which the /e/ of *teatro* is parsed in the onset of the first syllable, e.g. [('te{a}^{μh}.tɾo^{μ})]. However, such a constraint is ruled out because it violates two constraints that are undominated in Spanish: (i) *COMPLEXONSET[CV], which bans complex onsets with a high sonority intrasyllabic distance between its members[23] and (ii) *ONSET/MIDVOWEL, which is part of the fixed sonority onset hierarchy, given in (39):

(39) *ONSET/a » *ONSET /e,o »*ONSET/i,u..... » *ONSET/C (based on the margin scale of Prince & Smolensky 1993/2004).[24]

Since low and mid vowels are never linked to an onset position, the specific ranking *COMPLEXONSET[CV], *ONSET /e,o» *[XX]μ » ONSET generates the correct heterosyllabic parsing in Spanish[25]. What about the tautosyllabic parsing (and gliding) of unstressed high vowels adjacent to other vowels? The proposed hierarchy would also parse these clusters as hiatus. Thus, more constraints need to be added to the hierarchy.

Whenever there is a postconsonantal unstressed high vocoid adjacent to another vowel, the former does not surface as the head of a syllable. Rather, the high vocoid is realized as a glide and it is tautosyllabically parsed with the following vowel in the rhyme. In such cases, the head of the syllable is always the non-high segment. This is so because high vowels are the least sonorant vowels and syllable heads (or peaks) are always the segments with the highest degree of sonority in the syllable. Therefore, building on the universal sonority hierarchy against low sonority syllable peaks/heads (40), I claim that the constraint *HEADσ/HighV is high ranked in Spanish. This is obvious since the optimal cross-linguistic syllable is the one that has: (i) a high sonority peak, and (ii) a considerate rise in sonority between the onset and the syllable peak.

(40) Syllable head/peak hierarchy (after Prince & Smolensky 1993:141)
*HEADσ/Consonants »....» *HEADσ/HighV » *HEADσ/MidV

[22] For languages in which this type of structure has been claimed to be active, see Broselow et al. 1997, Maddieson 1993, Sprouse 1996, Bye 2005. The formalization of *[XX]μ is based on a similar constraint banning two tones within the same mora domain (Yip 2002, Morén & Zsiga 2006).

[23] In Spanish, complex onsets consist of an obstruent and a liquid; complex onsets with higher and lower sonority distance between their segments are ruled out.

[24] I use the ONSET scale rather than the MARGIN scale of Prince & Smolensky (1993/2004) because the margin scale treats codas and onsets as equal and this makes undesired typological predictions. The margin constraints predict a preference for low-sonority codas. However, when a language admits only a subset of consonants as codas, these are ones of relatively high, rather than low sonority (Prince 1983, Zec 1988, 1995, Clements 1990), thus, several studies have split in two the margin constraints (e.g. Baertsch 2002, Baertsch & Davis 2003, Pater 2012).

[25] The only vowels that can be linked to an onset position are the high vowels *i, u,* when they are not preceded by a consonant, e.g. /ielo/ > [jelo]. Thus, ONSET must dominate *ONSET/HIGH VOWEL (cf. § 4.2).

The fact that high vowels never constitute the head of a syllable when they are adjacent to another vowel does not imply that they cannot be linked to foot heads (i.e. head morae). Quite the contrary, I claim that the prosodic hierarchy needs to be able to distinguish between different types of heads (head of a syllable, head of a foot, etc.), and the relations these heads establish with higher and lower constituents. The present analysis crucially distinguishes between the head/peak of a syllable (i.e. the most sonorant root node in the syllable) and the head of a foot (i.e. the head mora of a metrical foot, which can be linked to one or more root nodes). Note that the relation between syllable head and foot head is not bidirectional. Every head of syllable is a potential head of a foot, but not every head of a foot is necessarily the head of a syllable. More precisely, the major distinction between the two types of heads in Spanish is the following: the head of a syllable can only be occupied by one root node (i.e. the most sonorant one), whereas the head of a foot can sometimes be realized by more than one root node. In other words, in the cases where a head mora is linked to two segments within the same syllable, the head of that syllable is only one of them (generally the most sonorant one). To make this distinction clear, look at the prosodic structure given in (41), which corresponds to the stressed rising diphthong [ˈja] in Spanish:

(41) Distinction between the head of a syllable / head of a foot

The glide [j] and the low vowel [a] share a mora; specifically, a head mora (i.e. the head of a foot). If this head mora were to surface as the head of the prosodic word, the whole syllable (and the two segments) would be stressed, since both [j] and [a] are linked to the head mora. This is in fact what happens when a syllable containing a diphthong is the head syllable of a foot, eg. ['b{ja}$^{\mu h}$.xe$^{\mu}$] 'trip'. Unfortunately, the prosodic representation given in (41) does not capture the fact that even though the two segments [j] and [a] are linked to a head mora (a head of a foot), only [a] (i.e. the most sonorant vowel) is the head of the syllable.

The prosodic hierarchy has several prosodic primitives (morae, syllables...) all of them related in a hierarchical fashion. On the one hand, we have prosodic words, which dominate one or more than one foot. These feet are generally headed, but only one of the heads surfaces as the head of the prosodic word (i.e. the one that carries main stress). Additionally, feet and foot heads can be moraic or syllabic. In either case, the mora node or the syllable node is linked to the root node, dominating different segments. The crucial point made in this article is that the root node can also be a head. The decision of which root is the head of the syllable is made by sonority. Now that this distinction is clear, we can turn to the hierarchy of constraints responsible for the generation of rising and falling diphthongs in Spanish.

When *i,u* are in inter-consonantal position, the high vowel surfaces as the head of a syllable. In contrast, when they are adjacent to other vowels, the preference is to parse the two vowels in the same syllable, although only the most sonorant (i.e. the non-high vowel) will be the head of the syllable. The difference between the two types of heads becomes clear in the evaluation of /miedo/ 'fear' in (42). This tableau illustrates the ranking argument for *HEADσ /i,u » [XX]μ. The optimal candidate for an input like /miedo/ is one in which the high vowel is parsed in the same syllable as the following vowel, sharing a mora. Thus, according to this hierarchy, candidate (42a) is the optimal. Candidate (42b) with heterosyllabic parsing of the vowels is ruled out because it has a high vocoid in the head of the first syllable, therefore, violating the high-ranked *HEADσ/i,u. Crucially, (42a) does not violate this constraint: its high vocoid is part of the head of the foot, but it does not constitute itself the head of a syllable. In Spanish, high vowels only surface as the head of a syllable when they are adjacent to consonants (e.g.

[pi.no] 'pine'). If they are adjacent to vowels, they cede the head position to the other vowel[26]. Additionally, (42b) also violates ONSET, since it contains an onsetless syllable. The optimal candidate in (42b) has a moraic trochee, whose right edge is aligned with the right edge of the prosodic word due to the high ranking of TROCHEE and AL-R(PrWd,Ft). These constraints are not included in (42) for ease of presentation.

(42)

miedo	*HEADσHighV	[XX]μ	ONSET
a. ☞ ('m{je}$^{\mu h}$.ðo$^{\mu}$)		*	
b. mi$^{\mu}$.('e$^{\mu h}$.ðo$^{\mu}$)	*!		*

Another possible candidate for an input like /miedo/ is one in which the onglide is directly linked to the onset, as in [(mje$^{\mu h}$.do$^{\mu}$)]. However, as argued above, this type of complex onsets is inexistent in Spanish because of the pressure of the high ranked constraint *COMPONSET[CV]. Whereas word-initial glides can be parsed in an onset (see footnotes14 and § 4.2), onglides preceded by a consonant are always syllabified in the rhyme.

To sum up, the specific interactions of the universal and fairly general constraints given above are responsible for the metrical and syllabic structure of Spanish words with default stress and default parsing of vowels. The previous tableaux showed the metrical structure of words containing rising diphthongs in penultimate syllables. In words with rising diphthongs on the final syllable, stress is also penultimate and the diphthong presents the same mora-sharing structure of (42). Tableau (43) illustrates the specific evaluation of a word with a word final rising diphthong /ɾadio/ 'radio'. The default stress of this disyllabic word ending in a vowel is penultimate due to the high ranking of TROCHEE and AL-R(PrWd,Ft) and the high vocoid is tautosyllabic to the following vowel because *HEADσ/HighV dominates [XX]μ:

(43)

ɾadio	TROCH	AL-R (PRWD,F)	WBP	*HDσHighV	[XX]μ	ONSET
a. ☞ ('ra$^{\mu h}$.ð{jo}$^{\mu}$)					*	
b. ra$^{\mu}$.('ði$^{\mu h}$.o$^{\mu h}$)				*!		*

However, when a word ends in a glide, stress shifts to the final position. Therefore, the hierarchy of constraints must be able to assign coerced weight to final offglides. Once the final offglide projects its own mora, the foot can be built on the final syllable, aligned to the right edge of the prosodic word. This is illustrated in the following tableau, which evaluates *caray* [kaɾai] 'goodness'.

(44)

kaɾai	TROCH	AL-R (PRWD,F)	WBP	*HDσ HighV	[XX] μ	ONS	IAMB
a.☞ ka$^{\mu}$.('ɾa$^{\mu h}$ j$^{\mu}$)							*
b. ('ka$^{\mu h}$. ɾa$^{\mu}$j)			*!				*
c. ka$^{\mu}$.('ɾa$^{\mu h}$.i$^{\mu}$)				*!		*	*
d. ('ka$^{\mu h}$. ɾ{aj}$^{\mu}$)			*!		*		*

On the one hand, candidate (44b) and (44d) are ruled out because the offglides do not project their own mora. On the other hand, although the high vowel in (44c) projects its own mora, the candidate is ruled out because is not tautosyllabically parsed with the preceding vowel (i.e. it violates *Headσ/HighVowel). Thus far, I have presented the mechanisms responsible for the default pattern of syllabification. However, gliding in Spanish is semi-productive and does not always apply. The next subsection presents a possible way to deal with the exceptional hiatus, without modifying the general account of the unmarked patterns of stress and gliding.

[26] This is true with the exception of tautosyllabic high vowel clusters, in which the second high vowel tends to be the peak of the syllable.

3.4.4. Exceptional hiatus

Along the lines of the analysis of words with exceptional stress, I propose that words with exceptional hiatus are stored with some kind of prosodic specification. This idea was presented by Levin (1985), who suggested that some vowels could have an underlying specification for a nucleus position that prevented them from gliding. Since then, this idea has been developed by several scholars, such as Cabré & Prieto (2006), Harris & Kaisse (1999) and Roca (1997) for Spanish, or Levi (2004) for other languages. Along the lines of these latter analyses, I have already proposed in section 3.4.2 that words with non-default stress are stored with some kind of prosodic structure. The same strategy is extended here to words with with exceptional hiatus. The idea is that words with non-default stress and/or non-default syllabifications are prespecified with enough underlying prosodic structure to ensure that they do not undergo the default pattern. In order to achieve this goal, the hierarchy of constraints that accounts for the general patterns must be outranked by some faithfulness constraint to underlying prosodic structure.

We already saw that words with marked stress contain an underlying specification for the head mora (§ 3.4.2). To account for exceptional syllabifications, I propose that the high vowel that does not undergo default syllabification is specified with a mora. A high-ranked faithfulness constraint, similar to the constraint proposed for respecting underlying specifications to head moras, avoids the gliding of the high vowel:

(45) **INTEGRITY(μ)[seg]** (abbr. INTEG(μ)): For two corresponding segments, if S1 (in the input) is associated to a mora, then S2 (in the output), and only S2, is associated to the same mora in the output (based on other integrity constraints McCarthy & Prince 1995)

The pressure of this constraint is illustrated with the evaluation of *piano* 'piano' in (46), which in Spanish is syllabified with a hiatus [pi.'a.no]. Note that *piano* exhibits an exceptional syllabification (i.e. it does not show gliding), but it has default penultimate stress. Candidate (46b) shows the default and preferred syllabification in the absence of any prespecified prosodic structure. However, since in the input of *piano* the high vowel is specified with its own underlying mora, it cannot be parsed in the same syllable as the following vowel.

(46) Default stress and non-default gliding in [pi.a.no]

pi$^{\mu}$ano	INTEG(μ)	TROCHEE	AL-R (PRWD,F)	WBP	*HDσ HighV	[XX]μ	ONSET	IAMB
a. ☞ pi$^{\mu}$.('a$^{\mu h}$no$^{\mu}$)					*		*	*
b. (p{ja}$^{\mu h}$.no$^{\mu}$)	*!					*		*

The same hierarchy of constraints predicts the right result in words with exceptional syllabification and exceptional stress assignment. This is the case, for instance, of words with antepenultimate stress and exceptional hiatus as *periodo* 'period' when pronounced as [pe.'ɾi.o.ðo]. Recall from §1 that /peɾiodo/ 'period' exhibits variable stress (and syllabification) depending on the speaker. Some speakers follow the default pattern of stress and syllabification and, thus, they pronounce [pe.'ɾjo.ðo], with gliding and penultimate stress. Some others locate the stress only in the high vowel (i.e. the mid vowel is left unstressed) and, thus, a word with antepenultimate stress and hiatus arises, e.g [pe.'ɾi.o.ðo]. I claim that in these latter case the underlying form contains not only segmental information but also a prosodic specification of a head mora in the high vowel, as illustrated in tableau (47):

(47)

peɾi$^{\mu h}$odo	INTEG(μ)	INTEG(μh)	TROCHEE	AL-R (PRWD,F)	WBP	*HDσHighV	[XX]μ	ONSET	IAMB
a. ☞ pe$^{\mu}$.('ɾi$^{\mu h}$.o$^{\mu}$).ðo$^{\mu}$				*		*		*	*
b. pe$^{\mu}$.('ɾ{jo}$^{\mu h}$.ðo$^{\mu}$)	*	*!					*		*
c. pe$^{\mu}$.('ɾj$^{\mu}$o$^{\mu h}$)ðo$^{\mu}$		*!	*	*					

The candidate that surfaces as optimal is the one that respects the underlying specification, i.e. (47a). Candidate (47b) is ruled out because the head mora is linked to two segments in the output, rather than only one. Finally, candidate (47c) is disfavoured because the head mora is not linked to the high vowel, as specified in the input, but to the mid vowel.

4. Previous analyses

This section briefly reviews two alternative types of approaches to gliding in Spanish. The first approach assumes all Spanish vowels contain an underlying mora and proposes that glides are vowels that have lost their morae in the process of prosodification (§ 4.1). The second one posits Spanish surface glides are not just non-syllabic versions of vowels, but also bear a subsegmental difference (i.e. there are underlying glides) (§ 4.2). After the main points of these analyses are reviewed, the major differences between the analysis of stress presented here and previous proposals are outlined in a final subsection (§ 4.3).

4.1. Gliding: mora deletion analysis

Building on Hayes (1989) several studies on Spanish gliding propose that Spanish vowels and glides should be differentiated in terms of morae. In particular, some authors have assumed that Spanish vowels are linked to a mora in both the underlying and surface form, whereas glides are interpreted as vowels that have lost their mora in the surface form (e.g. Colina 1995, 2006).

For instance, in order to account for the gliding of prevocalic high vocoids within a constraint-based framework, Colina (2006:180) proposes that onglides incur a violation of two markedness constraints, one against nucleic glides (*NUCLEUS/glide) and the other one against nucleus with more than one segment (*COMPLEX-NUCLEUS). Nucleic glides also incur a violation of faithfulness, i.e.MAX-IOμ, which militates against deletion of underlying morae (see candidate (a) in tableau (49), adapted from Colina 2006:181). In this tableau, Colina uses [j] in (49c) to represent an onset glide, thus graphically distinguishing it from a nuclear glide [i̯], as in candidate (49a). To guarantee that the glide is not parsed in the onset, *ONSET/glide must be undominated.

(48) Diphthongization of prevocalic high vocoids (Colina 2006:181)
ONSET/glide, ONSET >> *COMPLEXNUCLEUS, *NUCLEUS/glide, *MAX-IOμ

(49)

pieɾde	ONSET/glide	ONSET	*COMPNUC	*NUC/glide	MAX-IOμ
a. ☞ 'pi̯eɾ.ðe			*	*	*
b. pi.'eɾ.ðe		*!			
c. pj'eɾ.ðe	*!				*

In order to explain why only high vowels show gliding, Colina proposes that *the moracity of high vowels incurs a higher violation than mid vowels and low vowels* building on the universal sonority hierarchy in (50) (Colina 2006:183, based on Zec 1988, 1995). She claims that *HIGHVOWEL/μ must be high-ranked in Spanish:

(50) *HIGHVOWEL/μ >> *MIDVOWEL/μ >>*LOWVOWEL/μ

Note that it is *sine qua non* to the mora-deletion analysis that all vowels are underlyingly moraic. However, I have proposed that in Spanish morae are not generally present in the underlying form (with the exception of the words that exhibit exceptional hiatus), but they are the result of prosodification.

Additionally, even if the distinction between moraic vowels and non-moraic glides were correct for Spanish, Colina's analysis of gliding is problematic in another respect. Although the author assumes that vowels and glides are featurally identical, when the constraints are formulated she sometimes refers to glides (e.g. *NUCLEUS/GLIDE) and sometimes to vowels (e.g. *HIGHVOWEL/μ). If the only difference between glides and vowels in Spanish is a matter of syllabification and there are no underlying glides, the constraints should be defined in a unified way, i.e. they should refer to the features that define both vowels and glides[27]. Thus, for instance, if vowels and glides are featurally identical, the constraint *NUCLEUS/GLIDE should also be violated by candidate (b) in tableau (49), since the high features surface in a nucleus position. If, in contrast, high vowels and glides are featurally different, surface glides would not incur a violation of *HIGHVOWEL/μ. To solve this problem, the OT analysis presented in section 3 formalized these constraints in a unified way.

4.2. Underlying glides

Nevins & Chitoran (2008) have recently proposed that Spanish glides [j,w] are not just non-nuclear versions of vowels, but there is a subsegmental difference between glides and vowels. In particular, they argue that this difference is due to a feature [± vocalic]: whereas vowels are [+vocalic] glides are [−vocalic]. The evidence that they provide for this distinction in Spanish is based on: (i) glide~consonant alternations in Argentinian Spanish, (ii) cases of fortition of word initial glides e.g./uebo/ > [ˠwéβo], [ɣwéβo] ‘egg’; /ielo/ [ɟelo], [ʝelo], 'ice' (Navarro-Tomás 1918/1977), and (iii) cases of resyllabification (eg. *mi última* 'my last one' > *m[ju]ltima*).

Although I agree with the authors in that some languages may have phonemic glides, and maybe this is also the case for Argentinian Spanish, I believe assuming this for all surface glides in European Spanish is redundant. On the one hand, all the cases of strengthening can be derived by making reference to syllable structure. More specifically, it can be argued that when not preceded by a consonant, an onglide automatically shifts to an onset position, and this explains why very often they can exhibit fortition (cf. Martínez-Gil & Zampaulo 2010 for a recent analysis along these lines). On the other hand, the resyllabification facts do not speak in favour of a featural distinction between high vowels and high glides. Nevins & Chitoran argue that glides that arise through the process of resyllabication (e.g. *mi última* 'my last one' > *m[ju]ltima*) are [−vocalic] as a subsequent featural change required by its placement outside of a nucleus, due to the pressure of an inviolable constraint *[+vocalic]/MARGIN. However, this analysis is problematic. Much evidence suggests that Spanish postconsonantal glides are in a rhyme position rather than an onset position (cf. § 3.3.1). If that is the case, the MARGIN constraint cannot be claimed to be responsible for the pattern of gliding. On a more general vein, it has been shown that the margin constraints make undesired typological predictions and thus, its use is generally dispreferred (see footnote 25). These facts weaken the phonemic analysis of glides, at least when applied to Northern-Central Peninsular Spanish.

Finally, another argument that has sometimes been raised in favour of a featural distinction between glides and vowels along the lines of Nevins & Chitoran, is that word initial glides are treated as consonants for several phonological processes such as voicing of /s/ before voiced consonants. For instance, the masculine plural determiner *los* [los] is realized with a final voiceless fricative when it precedes a vowel initial word, but with a voiced [z] when the following word starts with a glide e.g. *los hilos* [lo.si.los] 'the yarns' *vs. los hielos [*[loz.jé.los*]* 'the ices'. However, this different behaviour can,

[27] Thanks to Pavel Iosad for pointing this out.

again, be easily accounted for if it is assumed that onglides, when not preceded by a consonant, are automatically shifted from a nucleus position to the onset. This would explain why in *los hilos* 'the yarns' voicing does not apply. Resyllabication at the postlexical level in *los hilos* 'the yarns' yields to [lo.si.los] whereas in *los hielos* [loz.jé.los] 'the ices', voicing applies because the following syllable already had an onset and, thus, the <s> is in the coda. That is, gliding applies in a previous stratum to postlexical resyllabification and the voicing of fricatives.

4.3. Spanish stress: A powerful grammar derives all the patterns

Spanish stress has received considerable attention within generative phonology.[28] Although the various proposals differ with respect to a number of aspects[29], the vast majority shares a common assumption. Contrary to the present study, where the difference between words with default and non-default stress is placed in the lexicon, most of previous proposals use multiple grammatical mechanisms —such as multiple rankings or indexed constraints— to derive the marked and unmarked patterns of stress. Some of these strategies are reviewed below.

One possibility within an OT framework has been to posit a different ranking of markedness constraints for every different type of stress pattern. This is the path followed, for instance, by Roca (1997) and Rosenthall (1994). Under this view, each pattern of stress has its own grammar. Words with default assignment of stress are evaluated by a general hierarchy of markedness constraints; e.g. *hierarchy A*. Words that do not conform to the unmarked pattern of stress are divided into different groups, depending on their phonotactics and location of stress. Each group is evaluated by a specific hierarchy (e.g. *hierarchy B*, *hierarchy C*...). Crucially, these hierarchies (B, C) are all variations of the default hierarchy: they employ the same constraints, but re-rank some of them with respect to each other.

Another possibility pursued within OT analyses of Spanish stress is to make use of lexical indexed constraints. Within this approach, a general hierarchy of markedness constraints accounts for the production of the unmarked stress. In order to derive the marked cases, specific indexed constraints, which only apply to a particular group of words, are incorporated into the general hierarchy. However, since words with non-default stress do not fall into a unified group, several indexed constraints come into play depending on the type of word (see, for instance, Roca 2006, who distinguishes among *unmarked, marked* and *supermarked* lexical items depending on the phonotactics of the word and the location of stress). Therefore, although there is a general non-default stress algorithm, this algorithm can be eluded when higher ranked lexical indexed constraints are activated. By positing indexed constraints to some specific items, all the existing patterns of stress can be accounted for.

These two lines of OT analyses make a crucial classification of words depending on their stress pattern. They do not only distinguish between words with default and non-default stress, but they make a further division among items with non-default stress. Under these approaches, words that do not exhibit the unmarked pattern of stress, can be *marked* or *supermarked*. Nonetheless, this division of the lexicon is not sufficiently grounded on any independent facts. As it was shown in section 2, the distinction between unmarked and marked items is based on different factors such as frequency (i.e. the unmarked pattern is the most frequent), acquisition (i.e. there is evidence of the early acquisition of the default stress) and the productivity of the unmarked stress (e.g. the emergence of the pattern in nonce word tests and acronyms). By contrast, the difference between marked and supermarked items is not equally well-grounded. To begin with, studies vary in what they consider to be *marked* and *supermarked*, based on what their stress

[28] For a detailed revision of these studies see Ohannesian (2004). For more recent accounts see Roca (2005b, 2006) and Oltra-Massuet & Arregi 2005.

[29] Such as what they consider to be the unmarked foot of the language and whether this foot is aligned with the right edge of the stem or the right edge of the prosodic word; whether they assume that Spanish is a quantity sensitive language or not; whether they treat the Spanish lexicon as a monolithic entity or, by contrast, loanwords and native vocabulary are distinguished with respect to their stress behaviour, etc.

algorithm is able to predict[30]. Additionally, apart from a slight difference in frequency (i.e. supermarked lexical items are claimed to be slightly scarcer than marked ones or, at least, restricted to a specific part of the vocabulary, e.g. Greek loans), there is no positive evidence to assume a clear division between words with non-default stress.

This paper, by contrast, has taken a different position in that it treats all the cases of non-default stress in a unified way. In particular, I have argued that while a specific hierarchy of markedness constraints provides the mechanism that generates the default assignment of stress, words showing non-default stress are all stored as lexical exceptions.

(51) Non-default stress

a. Antepenultimate stress: *sábana* 'sheet', *Mánchester*

b. Final stress in words ending in -V: *café* 'coffee', *Panamá*

c. Penultimate stress in words ending in -C: *árbol* 'tree', *cráter* 'crater'

In order to account for the production of words with non-default stress, I have proposed that the phonological form of these words contained not only segmental information (as it is the case for the phonological form of words with default stress) but also some kind of prosodic specification. In the latter case, a high-ranked faithfulness constraint to that specification prevents it from undergoing default stress assignment. Crucially, the hierarchy of constraints that accounted for the default and non-default stress was exactly the same. The difference between words with marked or unmarked stress relies on the specific information contained in the lexicon. If an input contains preparsed prosodic structure, a faithfulness constraint will prevent this type of input from undergoing default stress assignment.

A slightly similar proposal within OT, where a single hierarchy of faithfulness and markedness constraints is responsible for every kind of word stress can be found in Cabré & Ohannesian (2007, 2011) and Ohannesian (2004). Ohannesian (2004) proposes that unmarked stress falls on the rightmost syllable of the stem, due to the high ranking of an alignment constraint (ALIGNSTRESSRIGHT-STEMRIGHT). Additionally, the right edge of the main foot tends to coincide with the right edge of the prosodic word in order to satisfy another high-ranked alignment constraint (i.e. ALIGNFOOTRIGHT,PRWDRIGHT). Words without default assignment of stress are divided into two groups: *marked* and *supermarked*, depending on the number of syllables that can be found between the stressed syllable and the right edge of the stem (see table 52 below). Words with marked stress have one syllable between the stressed syllable and the right edge of the stem (see 53b), whereas words with supermarked stress have two (the right edge of the stem is here indicated with <]>):

(52) Ohanessian (2004)

		Pattern of stress		Examples	Gloss
Number of syllables between the stressed syllable and the right edge of the stem	0σ	a. Unmarked	Paroxytones	cá.s]a	'house'
			Oxytones	can.ción]	'song'
				hin.dú]	'hindu'
	1σ	b. Marked	Proparoxytones	sá.ba.n]a	'sheet'
			Paroxytones	ár.bol]	'tree'
	2σ	c. Supermarked	Proparoxytone	ré.gi.men]	'regimen'
				ó.mi.cron]	'omicron'

30 For instance, Roca (2006) and Ohannesian (2004) consider that a word like *café* [ka.ˈfe] 'coffee' with stress on the final vowel is unmarked with respect to stress based on the fact that their algorithm correctly predicts that stress falls in the final stem vowel, which in this word corresponds to the final -e. The word *café*, however, has an iamb, which is really unfrequent in Spanish and generally dispreferred by native speakers. Additionally, acquisition studies and psycholinguistic research have backed up the preference for trochees over iambs in Spanish speakers (cf. § 2 for references).

To ensure that stress does not fall on the rightmost syllable of the stem in marked and supermarked words, these lexical items contain a mark of null prominence on some of their underlying vowels. This mark, indicated with an underlined vowel, prevents the vowel from being stressed. Supermarked lexical items contain two "non-prominent" vowels (as in 53); marked lexical items contain just one. A high-ranked faithfulness constraint (FAITHFULNESSVOWELPROMINENCE) preserving vowel null prominence specifications of the input in the output consequently blocks the location of stress in these vowels. This is illustrated in tableaux (53) with the evaluation of a word with supermarked stress, *régimen* 'diet' (tableau from Cabré & Ohannesian 2007:9):

(53)

ɾegi̲me̲n	FAITHNULL PROMINENCE	AL-R(PRWD,FT)	AL-STRESSR-STEM
a. ☞ (ré.gi̲).me̲n		*	**
b. re.(gí.me̲n)	*!		*
c. re.gi̲.(mén)	*!		

However, there seems to be a conceptual problem with the constraint FAITHFULNESSVOWELPROMINENCE: what does a mark of null prominence mean? And how is it possible to make direct reference to a "nothing"? The present analysis avoids this problem by making reference to prosodic heads.

Finally, the analysis presented here crucially differs from Ohannesian's (2004) and Cabré & Ohannesian's (2007, 2011) analyses in the treatment of exceptions. To begin with, in the present proposal, the only words that contain some kind of extra-specification in the input (i.e. prosodic structure) are the marked lexical items; i.e. words with non-default stress or non-default syllabification. That is, the distinction between marked and unmarked items is made on the basis of different types of evidence (psycholinguistic, acquisition, productivity, etc.). In Ohannesian's analysis, by contrast, the division between unmarked, marked, and supermarked items is strictly dependent on the algorithm that generates the default assignment of stress. For example, Ohanessian (2004) considers that words ending in a stressed vowel are unmarked (e.g. *café, hindú*), although they are uncommon and marked from a psycholinguistic perspective. Furthermore, when Ohanessian's analysis is extended in Cabré & Ohannesian (2011) to account for the syllabification of abutting vowels, items with unmarked stress and unmarked syllabification need to be marked in the lexicon. This seems contradictory: lexical items showing unmarked syllabifications and unmarked stress are expected to show the application of default rules/constraints and, thus, marking them with some kind of additional lexical marks is counterintuitive. An illustration of this is given in (54) where the word *bóina* 'beret' with unmarked stress and unmarked syllabification (i.e. gliding and penultimate stress) needs to have a mark of null prominence on the high vowel, in order to get the right result:

(54)

boi̲n-a	FAITHNULL PROMINENCE	AL-R (PRWD,FT)	AL-STRESS R-STEM	ONSET
a. ☞ (bój̲.n-a)			*	
b. (bó.i̲).n-a		*!	*	*
c. bo.(í.n-a)	*!		*	

The present analysis circumvents this issue by positing fairly simple and general faithfulness constraints that refer to prosodic heads.

5. Conclusions

This paper has investigated the behaviour of diphthongs in Spanish and suggested that different types of diphthongs diverge in their prosodic structure. This representational difference is responsible for their different behaviour with respect to the stress pattern in the language. In particular, I have proposed that rising diphthongs are monomoraic —with the glide and the vowel sharing a mora— whereas falling diphthongs can be bimoraic, if they appear in final position. Based on the fact that words with a final falling diphthongs receive final stress (e.g. *jerséy* 'pullover', *caray* 'goodness'), I have claimed that offglides project their own morae only in word final position. Additionally, building on the notion of *coerced weight* and taking into account the general pattern of stress in the language (penultimate stress in words ending with vowels, final stress in words ending with consonants), I have argued that the structure of words containing default stress in Spanish is a bimoraic trochee aligned to the right edge of the word.

Regarding the computation of the default pattern of gliding and stress in Spanish, I have proposed that the particular way in which some syllabic and stress-related markedness constraints interact is responsible for the general pattern of gliding and default stress. In order to account for the non-default cases (i.e. words with exceptional hiatus or non-default stress), I have proposed that the hierarchy of markedness constraints is outranked by two faithfulness constraints relating to underlying prosodic structure. When lexical forms contain preparsed prosodic information, this must be maintained in the output.

To sum up, I have shown that considering both syllable and stress information in the generation of the prosodic structure of words leads to a better understanding of the representations and constraints that are responsible for the default syllabification of two adjacent vowels in Spanish.

Since the focus of the paper was to investigate the mechanisms that are active in the generation of the default patterns of stress in non-derived nominal forms and the default syllabification of vowels, there are several issues that have not been addressed and need to be explored in future research. The first of these is the location of stress in derived forms. Several suffixes tend to follow the pattern described here: if they end in a consonant, they attract stress to the final syllable (e.g. suffix -al: *industr[j+á]l* 'industrial' from *indús.tr[ja]* 'industry'); when ending in a vowel, stress falls in the penultimate syllable (e.g. suffix -*it*: *ca.s+[í.t+a]* 'house DIM.' from *cása* 'house'). Thus, it looks like stress is assigned to the prosodic word. However, there are also a couple of suffixes that seem to be extrametrical or attached to the stem at a later level of the derivation, after stress has been assigned. This is the case of the derivative suffix *-ico* (e.g. ***Cantábr[ja]*** 'Cantabry' > ***Cantábr+i.co*** 'Cantabrian') and the plural marker *-s*, which never shows coerced weight in Spanish: *cása* 'house'> pl. *cása-s* 'houses'.[31]

The second issue to be investigated is the possibility of predicting non-default patterns of syllabification, since exceptional syllabifications are not randomly distributed in the lexicon.[32] Besides exceptional hiatus, some exceptional diphthongs are arising in contemporary Spanish. Specifically, although non-high vowels are heterosyllabically parsed, some speakers of Northern-Central Peninsular Spanish show tautosyllabic parsings of these sequences. Nonetheless, in these cases the prosodic representation of the vowel clusters seems to act in a similar way as in the traditional diphthongs. In other words, these innovative diphthongs seem to exhibit the same type of coerced weight; i.e. when the cluster rises in sonority, the vowels share a mora (cf. 55b), but when the cluster falls in sonority, each vowel projects its own mora (cf. 55a).

(55)		Innovative diphthongs	Traditional heterosyllabic parsing
	a. *cacao* 'cacao'	ka$^{\mu}$. ('ka$^{\mu h}$o̯ $^{\mu}$)	ka$^{\mu}$.('ka$^{\mu h}$. o$^{\mu}$)
	b. *náusea* 'nausea'	('naw$^{\mu h}$.s{e̯a}$^{\mu}$)	'n{aw}$^{\mu}$(se$^{\mu h}$.a $^{\mu}$)

[31] See Saltarelli (2006) for a paradigmatic account of the non-moraic plural –*s* in Spanish. A purely phonological account of the non-moraicity of *s*, however should also be considered, given that *-s-* that are not part of the root do not attract stress: *íris* 'iris', *cáctus* 'cactus', *bríndis* 'toast', *lúnes* 'Monday' *vs*. franc-és 'French'. I thank an anonymous reviewer for pointing this out.

[32] For an exploration of the reasons that might cause the emergence of exceptional hiatus in Spanish see Cabré & Prieto (2006).

The default structure for a word like *cacáo* 'cacao' is [ka.ˈka.o], with a hiatus and penultimate stress. However, some speakers of Spanish realize this form with a diphthong, even though none of the adjacent vowels are high. The same applies to *náusea* 'nausea', which is more frequently produced as [ˈnaw.sea], with tautosyllabic parsing of the two final vowels, rather than the expected [ˈnaw.se.a]. More research needs to be carried out in order to be able to determine why these forms are parsed as diphthongs.

Finally, since this paper has focused on the prosodic representation of postconsonantal onglides, little has been said about onglides that are not preceded by a consonant. It is crucial to investigate the phonetics and phonology of these onglides, to complete and develop the analysis presented here.

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