The Spanish lexicon stores stems with theme vowels, not roots with inflectional class features.

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Abstract

The choice of theme vowels in Spanish nouns and adjectives can be predicted neither from the phonological shape of roots nor from syntactic features like gender. However, this state of affairs does not require the postulation of inflectional class features. The alternative is for the Spanish lexicon to store stems with their theme vowels, instead of roots annotated with declension diacritics; default generalizations over the lexical entries of stems can be expressed by means of lexical redundancy rules. The hypothesis of stem storage is compatible with the failure of Spanish theme vowels to surface in certain environments: this is demonstrably caused by an entirely general and regular phonological process deleting unaccented stem-final vowels before suffixes beginning with another vowel. Stem storage receives further support from psycholinguistic data from recognition latencies. Additional new evidence comes from cyclic locality conditions on allomorph selection, as shown by an analysis of the well-known stressdriven alternation displayed by items like [kont-á-r] 'count.INF' ~ [kwént-a] 'count.3SG'. In derivatives like $[N] v kont-a \delta or-\emptyset$ 'counter', assuming that diphthongal allomorphy is a property of the root incorrectly predicts that the choice of allomorph will be determined in the first cycle: i.e. *[kwentaðór]. The locality problem vanishes if /kont-a/ and /kwent-a/ are both listed in the lexicon as stem allomorphs. These data show that Stratal Optimality Theory allied to a stem-driven theory of morphology performs better than alternative approaches to allomorphic locality. Root-driven Distributed Morphology is too local: the domains for allomorph selection that it generates are too narrow. Conversely, noncyclic versions of Optimality Theory fail to predict allomorphic locality (even if they can describe its effects) because they endow allomorph selection with unrestricted access to the global environment.

Keywords

Root, stem, lexeme, theme vowel, inflectional class feature, morphome, diacritic, stem storage, lexical redundancy rule, phonologically driven allomorphy, locality, cycle, Stratal Optimality Theory, Distributed Morphology, diphthongization, Spanish.

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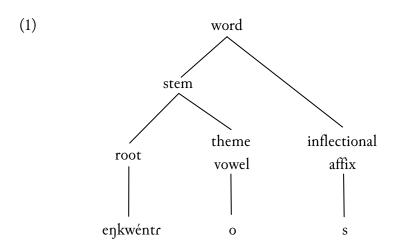
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1. Introduction: roots, stems, and words¹

Apollini Musisque

Traditional studies of Indoeuropean morphology often distinguish three levels of constituency within inflected words: the ROOT, the STEM, and the WORD (labelled as *raíz*, *tema*, and *palabra* in Spanish, or *racine*, *thème*, and *mot* in French). Many ordinary words in present-day Spanish, such as the noun form [eŋkwéntr-o-s] 'meeting.PL', display this tripartite structure transparently:



In (1), the smallest morphologically segmentable unit with lexical content is the root [eŋkwéntr-]. By itself, this root has no determinable syntactic category: combined with the THEME VOWEL [-o], it yields the noun [eŋkwéntr-o] 'meeting'; but, combined with the theme

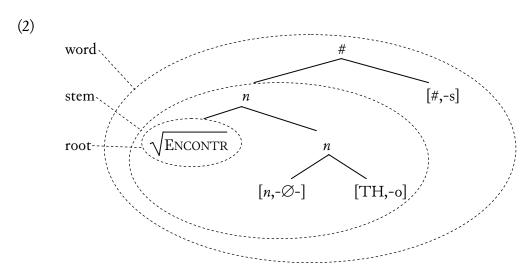
This article follows Bermúdez-Otero (2006, 2007) as the conclusion of a triptych dealing with the surprisingly rich questions arising from the grammar of Spanish nominal and adjectival theme vowels. It illustrates the application of, and I believe provides empirical support for, the grammatical architecture outlined in Bermúdez-Otero (2012a). This architecture has the following three main features: (i) a refined dual-route approach to the

relationship between the grammar and the lexicon, (ii) a programme of four hypotheses concerning modularity and locality in morphology-phonology interactions, and (iii) a stratal-cyclic organization of the phonology.

Earlier versions of the research reported here were presented at the Workshop on Theoretical Morphology 2 (Leipzig, 17 June 2006), at the Workshop on Theoretical Morphology 4 (Großbothen, 20 June 2008), at the Workshop 'Perspectives on the Morphome' (Coimbra, 30 October 2010), and at the CASTL Colloquium (Tromsø, 26 May 2011). I am very grateful to the organizers of these meetings for their hospitality and to the audiences for their stimulating comments (particularly Jonathan Bobalijk, Antonio Fábregas, Gereon Müller, Donca Steriade, and Dieter Wunderlich). I have also greatly benefited from related discussions with John Beavers, Yuni Kim, Andrew Koontz-Garboden, Violeta Martínez-Paricio, Andrew Nevins, Marc van Oostendorp, Tobias Scheer, Jochen Trommer, and Leo Wetzels. Finally, I am deeply indebted to two anonymous reviewers and, above all, to Adam Albright, whose extensive comments on an earlier draft where generous beyond the call of duty. All remaining faults are mine alone.

vowel [-a], it gives the verb [eŋkwéntr-a] 'find/meet'. We know that the noun derives from the root, and not from the verb, because the meaning of the noun does not contain that of the verb: [eŋkwéntr-o] can refer to an event of meeting, but not to an event of finding (see §2.2 below). Of course, the root, being acategorial, cannot be inflected. In contrast, the stem [eŋkwéntr-o], which results from combining the root with the theme vowel [-o], does belong to a syntactic category, namely N, and can therefore take inflections: it has inherent masculine gender, and can inflect for singular (with null marking) and plural (with the suffix /-s/). Finally, the plural form [eŋkwéntr-o-s] is a WORD: it bears the complete set of inflectional features required by its syntactic category (gender and number), and behaves as a syntactically autonomous item.

Most contemporary theories of morphology incorporate this three-way distinction in one way or another. In Distributed Morphology (DM), for example, the noun [eŋkwéntr-o-s] is assumed to have the following structure (Marantz 1997, Oltra-Massuet 1999):



The traditional terms *root*, *stem*, and *word* conflate the morphosyntactic units to which they refer with their respective morphophonological realizations, but contemporary linguistic usage enables one to distinguish the two concepts if necessary:

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Traditional term	root	stem	word
Morphosyntactic unit	√node	lexeme	syntactic word
Mouthoblesselsselsses	root	stem	
Morphophonological exponent	(narrow sense)	(narrow sense)	morphological word

The English term *theme vowel* is unfortunately opaque, whereas the expressions *vocal temática* and *voyelle thématique* are transparently compositional in their respective languages. A more helpful rendering in English would be *stem vowel*: recall that Spanish *tema* and French *thème* both mean 'stem' (Bermúdez-Otero 2007: footnote 6).

In this paper I shall often use the traditional terms ambiguously, overtly distinguishing between √nodes and roots, and between lexemes and stems, only where convenient.³

The article addresses problems for the theory of grammar arising from the relationship between roots and stems. In Spanish, for example, it is possible to make a number of generalizations about the way in which roots or suffixes combine with theme vowels so as to form stems or stem-deriving suffixes. Thus, nominal and adjectival stems and stem-deriving suffixes typically belong to one of three inflectional classes, distinguished by their respective theme vowels: [-o], [-a], or [-e]. The *a*-class is the default for feminine stems, and the *o*-class is the general default. Yet, alongside these generalizations, there is massive lexical idiosyncrasy: the theme vowel that a particular stem will in fact select can be predicted neither from the phonological shape of its root nor from its syntactic features (see §2.1). Faced with this situation, one can adopt either of two general approaches:

- A ROOT-DRIVEN approach will take the root as the starting point of grammatical derivations, resorting to diacritics such as inflectional class features where necessary to deal with idiosyncrasies in root-to-stem derivation. This is the line taken by most proponents of DM, who assume that lexical storage is restricted to exponents of √nodes and of single functional heads (e.g. Halle and Marantz 1993, Embick 2010).
- A STEM-DRIVEN approach, in contrast, will assume that the permanent lexicon contains entries for stems and stem-deriving suffixes, complete, in the case of Spanish, with theme vowels. Generalizations over these lexical entries, if cognitively real, will be expressed by means of lexical redundancy rules in the sense of Jackendoff (1975).

My goal in this paper is to use empirical evidence from present-day Spanish to show that a stem-driven approach to morphology is superior to a root-driven one.

The argument will move in two steps. Section 2 examines the grammar of theme vowels in Spanish nouns and adjectives. I ask whether roots are paired up with the appropriate theme vowels by means of class diacritics, as assumed in **root-driven** approaches, or through storage in the lexical entries of stems, as assumed in **stem-driven** accounts. The question turns out to depend crucially on the underlying distribution of theme vowels. On the surface, the theme vowels of nouns and adjectives are absent before stem-attached derivational suffixes: e.g. $[m\acute{a}n-o]$ 'hand-TH_o[F]' ~ $[man-\acute{a}\theta-a]$ 'hand-AUG-TH_a[F]. A tradition of research associated with James Harris, among others, infers from this that the stem of MANO takes an overt theme

For the distinction between √nodes and roots in the narrow sense, see e.g. Harley and Noyer (2000: §2.1), Acquaviva (2009: 12-3), and Harley (forthcoming). For the term *lexeme*, see e.g. Matthews (1991: 26).

Since the publication of Aronoff (1994), some scholars speak of *stems* in a way that implies that they are arbitrary ('morphomic') variant realizations of lexemes (e.g. Spencer 2012: 98). In this article the term *stem* will never be used in this sense. We shall encounter several situations in which a Spanish lexeme is realized by more that one stem, but in all such cases the distribution of the alternating stems will turn out to be syntactically or phonologically motivated.

vowel only in a restricted set of morphosyntactic environments (i.e. when left-adjacent to the number head). This analysis encourages the use of inflectional class features, which can be stored in the lexical entries of roots, and disfavours the stem storage solution. However, a different research tradition (e.g. Bermúdez-Otero 2006, 2007) suggests that the disappearance of the [-o] of [mán-o] in the derivative [man-á θ -a] is caused by a regular phonological process of stem-final vowel deletion: i.e. [[man-o] a θ -a] \rightarrow [ma.ná. θ a]. In this analysis, Spanish stems never enter the derivation without their theme vowels, and so it is perfectly feasible to store full stems in the lexicon.

Section 2.4.1 provides empirical arguments in favour of the phonological rule of stem-final vowel deletion: the rule allows us to provide a unified account of the distribution of verbal, nominal, and adjectival theme vowels, both underlyingly and on the surface; and it is necessary to avoid paradoxes in the phonological derivation of words like [swep-á θ -o] 'sleep/dream-AUG-TH_o[M]', whose root ends in a palatal and whose stem participates in the stress-driven diphthongal alternation between [o] and [wé]. On the basis of this evidence, section 2.4.2 goes on to develop a theory of stem storage, discussing the format of lexical entries for stems and the role of stem-level lexical redundancy rules. I show that psycholinguistic data from recognition latencies supports the hypothesis of stem storage. Another outcome is that, *pace* Aronoff (1994: 67-72), Spanish provides no support for the existence of inflectional class features.

The second half of the argument unfolds in section 3. It shows that, when combined with a **stem-driven** theory of morphology, Stratal Optimality Theory (henceforth Stratal OT: Bermúdez-Otero 1999, Kiparsky 2000) performs better than **root-driven** DM (Embick 2010) at the task of explaining locality constraints on phonologically driven allomorph selection. The evidence comes from a classic puzzle in Spanish morphophonology (Harris 1989b: 345, Cole 1995: 95). The stress-conditioned diphthongal alternation between [e, o] and [jé, wé] must be stem-level, since it misapplies in the presence of word-level suffixes like superlative [-ísim-o]: e.g. [bjéxo] 'old' ~ [bjexísimo] 'old.SUPL', not *[bexísimo]. Yet, unexpectedly, a stem-level deverbal derivative like $[N_i]_V$ kontá $[int]_i$ $[int]_i$ fiels to display the effects of first-cycle stress assignment to its base, the stem of the verb CONTAR: cf. [kwénta] 'count.3SG'. This is mysterious because $[N_i]_V$ am.pli.á.] $[int]_i$ 'extendable' does display cyclic transmission of the hiatus caused by first-cycle stress assignment to the stem of AMPLIAR: cf. [am.plí.a] 'extend.3SG', and [lím.pja] 'cleanse.3SG' ~ [lim.pjá. $[int]_i$] 'cleanable'.

The article uses the following notational conventions. I reserve ordinary square brackets for phonetic transcriptions and use hollow brackets to notate morphological constituents and cyclic domains. I use IPA symbols throughout, with the following exceptions: (i) I omit dentality diacritics; (ii) I use $[\beta, \delta, \gamma]$ in place of more accurate $[\beta, \delta, \psi]$; and (iii) I mark primary stress with the acute rather than with [']. In glosses, I use the standard Leipzig abbreviations supplemented with AUG for 'augmentative', DIM for 'diminutive', and SUPL for 'superlative'. Elsewhere, UR stands for 'underlying representation', SR for 'surface representation', SL for 'stem level', WL for 'word level', Af for 'affix', and TH for 'theme'. The symbol \varnothing occurs frequently to mark a null theme vowel found in singular forms of nouns and adjectives of the e-class, alternating with /-e-/ in the plural.

The solution lies in recognizing that the diphthongal alternation involves phonologically driven allomorph selection by output optimization in the stem-level phonology (Bermúdez-Otero 2006: 285): whilst the distribution of the alternating vowels tracks a derived phonological property (stress), participation in the alternation and the quality of the monophthongal alternant are both lexically idiosyncratic. Therefore, if one assumes full stem storage in accordance with the principles of a stem-driven approach to Spanish morphology, then the alternation between [kwénta] and [kontáßle] must involve competition between two stems of the verb CONTAR: namely, /y koNt-a/ and /y kweNt-a/. This correctly predicts that stem selection will not take place in the first cycle of the derivation, which sees each stem individually. Rather, the two stems compete in the second cycle, triggered by a lexeme-based operation: in the case of $[N] [V] konta] \beta le$, by the addition of the adjectivizer -BLE to the verb lexeme CONTAR. The analysis further entails that, in the course of language change, two lexemes derived from the same root can diverge in their allomorphic behaviour. This is precisely what has happened historically to the lexemes derived from the root $\sqrt{\text{CONT}}$ in Spanish: as we have seen, the verb CONTAR still has two stems, /v koNt-a/ and /v kweNt-a/, which display the expected stress-conditioned distribution both in inflection and in deverbal derivation; but the noun CUENTO no longer has a monophthongal stem, as is shown by denominal derivatives like [kwent-íst-a] and [kwent-ér-o] 'story teller'. This result supports a strikingly accurate account of the diachronic rise of misapplication in the diphthongal alternation: misapplication arises first in combinations of a nominal or adjectival base with a highly productive suffix.

Alternative approaches to the Spanish diphthongal alternation are discussed in section 4. Mainstream noncyclic OT has no difficulty in describing the facts, but cannot explain them because it allows allomorph selection to have unrestricted access to the global environment: it is therefore unable to predict locality effects, but must simply stipulate them through *ad hoc* constraint ranking. In contrast, root-driven DM is found to be too local: if the allomorphs of lexical bases are maximally of root size, then allomorph selection will necessarily take place in the first cycle of the derivation; but the Spanish diphthongal alternation falsifies this prediction. The only way out for root-driven DM is to redescribe the diphthongal alternation as a regular word-level phonological process, as was done by Halle et al. (1991: §2.2); but this requires excessively powerful phonological devices that crucially subvert the very concept of cyclic domain. Stratal OT allied with a stem-driven theory of morphology makes better predictions about local domains for allomorph selection without compromising the empirical content of phonological theory.

The paper concludes in section 5 with some methodological reflections concerning the use of WILDCARDS in the theory of grammar: i.e. devices that save the phenomena without making further empirical predictions. I suggest that inflectional class features, as currently used in many schools of morphology, and arbitrary phonology, as used in DM, are both wildcards that seriously undermine the empirical content of linguistic theory.

2. The morphology and phonology of theme vowels in Spanish nouns and adjectives

2.1. The unpredictability of theme vowel choice: the coupling question

Most Spanish nouns and adjectives belong to one of three core classes, distinguished by their respective theme vowels (Bermúdez-Otero 2006: 278-79, 307; 2007: 257). The characteristic theme vowel of each class is always overtly present immediately before the suffix /-s/ in plural forms:

$$(4) \quad \textit{Class} \qquad \textit{Theme} \qquad \textit{Singular} \qquad \textit{Plural} \qquad \textit{Gloss} \qquad \textit{Gender}$$

$$\text{a. } o\text{-stem} \qquad /\text{-o-}/\qquad \left\{ \begin{array}{l} [\text{li-o}] & [\text{li-o-s}] & \text{'muddle'} & \text{M} \\ [\text{mán-o}] & [\text{mán-o-s}] & \text{'hand'} & \text{F} \end{array} \right.$$

$$\text{b. } a\text{-stem} \qquad /\text{-a-}/\qquad \left\{ \begin{array}{l} [\text{di-a}] & [\text{di-a-s}] & \text{'day'} & \text{M} \\ [\text{kán-a}] & [\text{kán-a-s}] & \text{'grey hair'} & \text{F} \end{array} \right.$$

$$\text{c. } e\text{-stem} \qquad \left\{ \begin{array}{l} \text{ordinary} \\ e\text{-stem} \end{array} \right. /\text{-}\{e,\varnothing\}\text{-}/\qquad \left\{ \begin{array}{l} [\text{lápi}\theta\text{-}\varnothing] & [\text{lápi}\theta\text{-e-s}] & \text{'pencil'} & \text{M} \\ [\text{páŏr-e}] & [\text{páŏr-e-s}] & \text{'father'} & \text{M} \\ [\text{máŏr-e}] & [\text{máŏr-e-s}] & \text{'mother'} & \text{F} \end{array} \right.$$

$$\text{e-only} \qquad \text{stem} \qquad \left\{ \begin{array}{l} [\text{kr\'u}\theta\text{-e}] & [\text{kr\'u}\theta\text{-e-s}] & \text{'crossing'} & \text{M} \\ [\text{\'eli}\theta\text{-e}] & [\text{\'eli}\theta\text{-e-s}] & \text{'propeller'} & \text{F} \end{array} \right.$$

The distribution of the theme vowel in the singular forms of *e*-stems motivates the division of this core class into two subclasses: ORDINARY *E*-STEMS and *E*-ONLY STEMS. In ordinary *e*-stems, which constitute the default subclass (Harris 1999: 61-62, though cf. Morin 1999 and Bonet 2006: 325), the theme has two allomorphs: $/-\varnothing/$ and /-e-/. In the singular, the choice between these two allomorphs is left to the phonology: the null theme appears after segments that are phonotactically licit in domain-final position in the core native vocabulary, i.e. after a vowel, a postvocalic glide, or a single consonant belonging to the set /r, l, n, s, θ , d/s; otherwise, /-e/s is chosen (Harris 1999: 59-61; Bermúdez-Otero 2006: 287, 2007: 250). Note, however, that, although phonotactics decides the choice of theme allomorph in the singular forms of ordinary *e*-stems, it does not control the location of the vowel. In consequence, theme vowels in ordinary *e*-stem singulars do not behave like [e]s epenthesized in the phonology.

In the optimality-theoretic analysis provided by Bermúdez-Otero (2006: 288), the preference for $/-\varnothing/$ over /-e/ after single /r, l, n, s, $\theta/$ or /d/ is driven by the constraint FINALC, which requires prosodic words to end in a consonant (McCarthy 1993: 176). FINALC is of course dominated by the markedness constraints penalizing other consonants and consonant clusters in domain-final position, as well as by the faithfulness constraints banning vowel deletion. Thus, the effects of FINALC emerge only when the input to the phonology contains an allomorph disjunction, although the constraint may conceivably also be implicated in determining the location of vowel epenthesis in examples like Bonet's (2006: 318) Al Sadr /al sadr/ \rightarrow [al sáðer] (proper name), discussed below.

Bonet (2006: 318) proves this point with a penetrating observation. The position of the theme in e-stem [páðr-e], underlyingly /padr-{e, \varnothing }/, is determined by the morphology: accordingly, the vowel follows the root. Compare this with [al sáðer], the adapted Spanish pronunciation of the Arabic proper name Al Sadr, underlyingly /al sadr/: here the placement of epenthetic [e] is governed by the phonology, which inserts the vowel inside the root. In fact, Spanish never uses word-final [e]-epenthesis to repair ill-formed syllables (Morin 1999: 216, Bonet 2006: 317-8).

In the plural of ordinary e-stems, morphological subcategorization preempts phonological selection: e-stem plurals always select the /-e-/ allomorph, and this time phonotactics plays absolutely no role. This point is demonstrated by the behaviour of items like /indú- $\{e,\emptyset\}$ -/ 'Hindu': sg. [indú- \emptyset] ~ pl. [indú-e-s]. The singular form [indú- \emptyset] exhibits the null allomorph of the theme because stressed vowels are phonotactically licit in domain-final position. In contrast, the plural form [indú-e-s] takes the theme vowel /-e-/ despite the fact that *[indú- \emptyset -s] would have been perfectly well-formed phonologically: cf. [awtoβús] 'bus', [xesús] 'Jesus', [oβús] 'cannon shell', etc. (Bermúdez-Otero 2006: 289, 2007: 251). Indeed, the plural [indú-s] **is** produced by speakers who treat the noun as athematic, rather than as an ordinary e-stem: see (7) below.

In turn, e-only stems differ from ordinary e-stems in that the former take /-e/ in the singular even when /- \varnothing / would have been phonotactically licit (Harris 1999: 61-62; Bermúdez-Otero 2006: note 9). In the e-only class, therefore, the theme has a single allomorph /-e-/.

Some nouns and adjectives belong in the relatively peripheral class of ATHEMATIC stems, which lack a theme vowel altogether: examples are given in (5,a).

(5) a.	athematic	stems	1	b. ordinary e-stems			
	sg.	pl.			sg.	pl.	
	[kúrsi]	[kúrsi-s]	'pretentious'				
	[tɾíβu]	[tríβu-s]	'tribe'				
	[kafé]	[kafé-s]	'coffee/café'				
	[menú]	[menú-s]	'menu'		$[ind\acute{u}\text{-}\varnothing]$	[indú-e-s]	'Hindu'
	[xerséj]	[xerséj-s]	'pullover'		[rej]	[réj-e-s]	'king'
	[bríndis]	[bríndis]	'toast'		[lápis-∅]	[lápis-e-s]	'pencil' ⁷
	[fan]	[fan-s]	'fan, supporter'		$[pan-\varnothing]$	[pán-e-s]	'bread'
	[klip]	[klip-s]	'paper clip'				

Admittedly, the default stress pattern for Spanish nouns ending in /u/ is paroxytonic, as shown by acronyms like ONU [ónu] 'UN'; but this preference against final [ú] is not strong enough to force the selection of the /-e/ allomorph in the singular form /indú- $\{e,\emptyset\}/\rightarrow$ [in.dú]. In an optimality-theoretic analysis, the markedness constraint against primary stress on final vowels will need to be ranked below the constraint penalizing the hiatus between the last two syllables of the losing candidate *[in.dú.e].

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The pronunciation of *lápiz* 'pencil' with a root-final /s/ (cf. (4,c) above) is normal in θ -less dialects: see (9) below.

As the gaps in (5,b) suggest, the distinction between ordinary *e*-stems and athematic stems is not entirely arbitrary. Rather, when presented with a noun or adjective lacking a theme vowel in the singular, native speakers have access to a variety of criteria to judge whether the item is more likely to take the /-e-/ theme in the plural (thereby behaving like an ordinary *e*-stem) or to be athematic. The general principle could be stated as follows: if for some reason an item lies outside the core vocabulary, then it cannot belong to a core inflectional class, and so must be athematic rather than *e*-stem. As a particular case of this principle, the chances that a stem will be athematic increase if the phonological shape of the singular form is atypical for the core vocabulary (cf. *indeclinabilia* in highly inflected languages like Russian).

For example, the singular noun [klip] is phonotactically deviant because it ends in a consonant other than single [*r*, 1, n, s, θ, δ]. As we have seen, ordinary *e*-stems whose roots end in [p] select the /-e/ allomorph of the theme: e.g. [gríp-e] 'influenza'. It follows that [klip] must be an athematic noun, and so its plural is [klip-s], not *[klíp-e-s], even though this renders it even more phonotactically aberrant (Bermúdez-Otero 2006: 287, 2007: 250-51). Similarly, the noun [béneton] 'Benetton' violates the constraint forbidding antepenultimate stress in stems with a closed final syllable: hence the athematic plural [béneton-s] (Bermúdez-Otero 2006: 306; 2007: 258-59, 261-62). Nonetheless, exceptions exist. For example, there is a small number of long-established loanwords ending in consonants other than single [*r*, 1, n, s, θ, δ], like [kluβ] 'club' and [álβum] 'album', which exhibit relatively old-fashioned *e*-stem plurals (*club-e-s, álbum-e-s*) alongside the now expected athematic forms (*club-s, álbum-s*). Similarly, the metrically exceptional noun [réximen] 'diet, régime' has an idiosyncratic, lexically listed *e*-stem plural form with stress shift, [rexímen-e-s], although the expected athematic plural [réximen-s] is attested outside the prescriptive norm (Bermúdez-Otero 2007: 261).

If we set hypocoristics aside, words ending in unstressed [i] or [u] are rather uncommon in Spanish. Thus, the generalization that stems with unusual phonological shapes are athematic correctly predicts that nouns and adjectives ending in unstressed [i] or [u] will not have plural forms ending in [-e-s], even though the latter would be phonotactically viable, as shown by the *e*-stem plurals in (6,b).

The criteria for admission into the e-class appear to have been considerably laxer around the middle of the 18^{th} century and to have become stricter afterwards: see the discussion of [kafé-e-s] and [bol-s] below. For present-day speakers, club must have an athematic stem, i.e. /klub/; if it were an ordinary e-stem, i.e. /klub-{e, \emptyset }-/, it would surface as *[klú β -e]. In line with the dual-route approach to morphology adopted in this paper, therefore, I assume that the e-stem plural club-e-s is a stored irregular, probably listed analytically (Bermúdez-Otero 2012a: §3). The athematic plural club-s emerges if the speaker lacks the lexical entry for club-e-s or if in a particular instance of use lexical retrieval fails to block the affixation of /-s/ to the athematic stem.

[sérj-e]

[ténw-e]

[píŋqw-e]

/bríndis-s/→[bríndis].9

	sg.	pl.		
	[kúrsi]	[kúrsi-s]	*[kúrsj-e-s]	'pretentious'
	[táksi]	[táksi-s]	*[táksj-e-s]	'taxi'
	[tríßu]	[tríβu-s]	*[tríβw-e-s]	'tribe'
	[útu]	[útu-s]	*[útw-e-s]	'Hutu'
b.	e-stems			
	sg.		pl.	
	[espéθj-e]		[espéθj-e-s]	'species'

[sérj-e-s]

[ténw-e-s]

[píŋqw-e-s]

'series'

'tenuous'

'fat' (as in a fat profit)

The same is true of items ending in unstressed [us] or [is]. In this case, the effects of phonological shape are probably reinforced by a strong association with the learned vocabulary of Greek and Latin origin. In cases like [bírus] 'virus.SG/PL' and [bríndis] 'toast.SG/PL', the failure of thematic /-e-/ to intervene between stem-final /s/ and the number marker creates an underlying cluster of two identical consonants, which is resolved by degemination: i.e.

The behaviour of nouns and adjectives ending in stressed vowels, which have a marked metrical pattern (see note 6), is particularly interesting. In this group there appears to be a long-term historical trend for ordinary *e*-stems to be reassigned to the athematic class. The change advances by lexical diffusion, and its spread exhibits effects both of internal factors (particularly vowel quality) and of sociolinguistic variables. Today, for example, no variety of Spanish retains ordinary *e*-stems ending in /é/: e.g. sg. [kafé] ~ pl. [kafé-s], not *[kafé-e-s]; but [kafé-e-s] is attested from the mid 18th to the mid 19th centuries (Bermúdez-Otero 2006: note 19, Bonet 2006: note 6). Nouns and adjectives ending in /á/ or /ó/ are now also predominantly athematic, e.g. sg. [sofá] 'sofa' ~ pl. [sofá-s], but a few exceptions remain: e.g. sg. [faralá-Ø]

In line with Harris (1985b, 1992, etc), most linguists in the generative tradition have treated unstressed final [is] and [us] as exotic thematic elements that disappear before derivational suffixes (see §2.2 and §2.3 below). This analysis fails to account for important contrasts that emerge under evaluative suffixation: e.g.

(i)	[bíɾ us] [káɾl- o -s]	SG/PL SG/PL	[bir us -ót-e] [karl-ót-e], *[karl os -ót-e]	AUG.SG.	'virus' 'Charles'
(ii)	[brínd is] [krís i-s]	SG/PL	[brind is -ít-o] [kris-eθít-a], *[kris is -ít-a]	DIM.SG DIM.SG	'toast'

The behaviour of the evaluative suffixes reveals that the final [Vs] in [bírus] and [bríndis] is just a substring of an athematic stem, whereas the final [-s] of [kárl-o-s] and [krísi-s] is a pseudoplural suffix. See Bermúdez-Otero (2007) for extensive discussion.

'frill' ~ pl. [faralá-e-s]. In contrast, standard varieties currently maintain a highly robust opposition between e-stems and athematic stems among items ending in /i/ or /ú/, as shown by the following token counts for the plurals of bindú and menú in CREA:

This sharp disparity is incompatible with an analysis based on phonological free variation (cf. Colina 2006: 57-59). In low-prestige varieties, however, forms like [indú-s] occur more frequently.

Overall, then, there is a tendency for nouns with relatively uncommon phonological shapes to be assigned to the athematic class, but purely phonological criteria suffice to distinguish athematic stems from ordinary *e*-stems only in a tiny minority of cases: those of roots ending in [é] or in unstressed [i] or [u].

Conversely, a loanword ending in a consonant may be assigned to the ordinary e-class if its segmental and prosodic properties are fully native-like; but, crucially, it may also continue to be treated as athematic as long as native speakers remain aware of it as foreign and therefore excluded from the native core classes. A clear example of this phenomenon is found in the noun bol [bol($-\varnothing$)] 'bowl', a borrowing from English whose earliest occurrence in CORDE dates back to the year 1832. Bol is impeccably well-formed both segmentally and prosodically: cf. native e-stem nouns like sg. [sol- \varnothing] 'sun' \sim pl. [sól-e-s], sg. [kol- \varnothing] 'cauliflower' \sim pl. [kól-e-s], etc. Although the plural of bol is rather sparsely attested in controlled corpora, the available data confirm that the stem was first treated as athematic, began to be admitted into the e-class later, and retains a great deal of interspeaker variation: 10

(8)			tokens in CREA	first attestation in CORDE
	athematic plural	[bol-s]	14× (in 6 texts)	1891-1894
	e-stem plural	[ból-e-s]	6× (in 6 texts)	1940

-

Surprisingly, eleven tokens of <bols> in CREA turn out to be unambiguously singular: e.g. *utilizando un bols plástico* 'using a plastic bowl'. All eleven tokens come from two Argentinian texts, one of which contains ten instances of <un bols>, excluding the possibility of typographical error. Given the presence of the cluster /ls/ in final position, this new variant of the noun is expected to be athematic, and so its plural should be homophonous with the singular, i.e. /bols-s/→[bols] (see the discussion of [bríndis] above); and, indeed, *<bolse> is not attested in CREA, whereas <bols> does occur in plural environments in Argentinian texts. My suspicion is that the novel singular form [bols] arose through reanalysis: some speakers exposed to the athematic plural of [bol], i.e. [bol-s], mistakenly assumed it to be derived by degemination, like the plural of [bríndis].

This pattern of evolution is confirmed by the evidence of the noun [fan], whose behaviour is insightfully highlighted by Bonet (2006). With a first CORDE attestation dating from 1964-1967, [fan] is a considerably more recent loan than *bol*; but, like the latter, it is fully native-like phonologically: cf. *e*-stem nouns like sg. [pan- \varnothing] ~ pl. [pán-e-s], sg. [plan- \varnothing] 'plan' ~ pl. [plán-e-s], etc. To date, [fan] remains exclusively athematic: pl. [fan-s], not *[fan-e-s].

For some root shapes, the contrast between ordinary e-stems and athematic stems persists without transfers in either direction. Notably, loanwords ending in [ej] currently join the athematic class, both when they retain an alien stress contour, as in [jókej-s] 'jockeys', and when they are metrically nativized, as in [xerséj-s]; but native e-stem items like [bwéj-e-s] 'oxen' and [réj-e-s] show no sign of joining the athematic class in any variety of Spanish (Bermúdez-Otero 2006: 289). Strikingly, there are also cases where the predictive value of phonological criteria has actually decreased historically as a result of independent developments. For example, the merger of $/\theta/$ with /s/ across wide swathes of the Spanish-speaking world created a new morphological opposition between ordinary e-stem nouns like $l\acute{a}piz$ (also sg. $c\acute{a}liz$ 'chalice' ~ pl. $c\acute{a}lic$ -e-s) and athematic nouns like brindis:

(9) sg. pl.

a.
$$/\theta$$
/-ful dialects $/l$ ápi θ - $\{e,\emptyset\}$ / \rightarrow [lápi θ] $/l$ ápi θ - $\{e,\emptyset\}$ -s/ \rightarrow [lápi θ es] $/$ bríndis/ \rightarrow [bríndis] $/$ bríndis-s/ \rightarrow [bríndis]

b. $/\theta$ /-less dialects $/l$ ápis- $\{e,\emptyset\}$ / \rightarrow [lápis] $/l$ ápis- $\{e,\emptyset\}$ -s/ \rightarrow [lápises] $/$ bríndis/ \rightarrow [bríndis]

The scope of this morphological opposition among nouns ending in unstressed [is] may in fact be growing, with some speakers reassigning *iris* 'iris' from the athematic class (pl. [íris]) to the *e*-stem class (pl. [íris-e-s]), perhaps under the influence of English *irises*: see Bermúdez-Otero (2006: note 26).

The upshot of our discussion so far is that theme vowel choice in Spanish nouns and adjectives is largely independent of the phonological shape of roots. For example, roots ending in [án] and monosyllabic roots ending in [ol] are found in every class and subclass:

(10)	a.	sg.	pl.	
	o-stems	[mán-o]	[mán-o-s]	'hand'
	a-stems	[kán-a]	[kán-a-s]	'gray hair'
	ordinary e-stems	$[pan-\varnothing]$	[pán-e-s]	'bread'
	<i>e</i> -only stems	[inán-e]	[inán-e-s]	'inane'
	athematic stems	[fan]	[fan-s]	'fan'

b. sg. pl.
$$o$$
-stems $[b\acute{o}l-o]$ $[b\acute{o}l-o-s]$ 'bowling pin' a -stems $[b\acute{o}l-a]$ $[b\acute{o}l-a-s]$ 'ball' $[b\acute{o}l-a-s]$ 'ball' $[b\acute{o}l-e-s]$ 'mole' $[b\acute{o}l-\varnothing]$ $[b\acute{o}l-e-s]$ 'bowl' for some speakers: see (8) e -only stems $[m\acute{o}l-e]$ $[m\acute{o}l-e-s]$ 'bowl' for some speakers: see (8) $[b\acute{o}l-e-s]$ 'bowl' for some speakers: see (8)

As we have seen, the unpredictability of theme vowel choice extends to the presence or absence of thematic /-e-/ in plural forms whose corresponding singular lacks an overt theme vowel. In this case, most root shapes fail to neutralize the opposition between *e*-stems and athematic stems: see (11) for a reminder of representative examples discussed above.

(11)
$$[klip-s]$$
 vs $[kliúβ-e-s]$ $[fan-s]$ vs $[pán-e-s]$ $[béneton-s]$ vs $[rexímen-e-s]$ $[xerséj-s]$ vs $[réj-e-s]$ $[sofá-s]$ vs $[faralá-e-s]$ $[bríndis]$ vs $[lápis-e-s]$ $[menú-s]$ vs $[indú-e-s]$

This evidence refutes the traditional claim that the [e] of e-stem plurals is epenthesized in the phonology (see e.g. Colina 2006 and references therein). Indeed, assuming that the behaviour of /-e-/ in plural forms serves to improve phonotactics makes strikingly incorrect predictions. Take, for example, two loanwords of roughly the same age: $/\text{bol}(-\varnothing)/$, discussed above, and /défi0it/ 'deficit'. In CORDE, $/\text{bol}(-\varnothing)/$ makes its first appearance in 1832; /défi0it/, in 1822. As we saw in (8), impeccably well-formed $/\text{bol}(-\varnothing)/$ has started to behave as an e-stem noun in some idiolects, and so plural [bol-s] now faces competition from [bol-e-s]. In contrast, /défi0it/, which is deviant both segmentally and metrically, remains exclusively athematic: as we would expect, its only plural form is [défi0it-s]. Yet, by phonotactic criteria such as sonority sequencing, [défi0it-s] is much worse than [bol-s], and so the former should be in more urgent need of repair than the latter; in fact, coda [ls] is found in [sols.tí.0jo] 'solstice'. Thus, the phonological make-up of singular forms turns out to be relevant only as a probabilistic diagnostic of lexical affiliation to the core native vocabulary. See Bonet (2006) for further criticism of [e]-epenthesis in Spanish plurals.

Just as the class membership of Spanish nouns and adjectives cannot be predicted from the phonological shape of the root, so it cannot be predicted from the gender of the stem (Harris 1991). There is good reason to treat /-a/ as the default theme vowel in the feminine, and /-o/ as the default elsewhere:¹¹

Rule (12) takes scope over gendered (i.e. nominal) categories only: nouns, adjectives, pronouns, and determiners. Unlike Harris and Bonet, I do not believe that adverbs have theme vowels: see the discussion of (44) below. In addition, thematic /-o/ cannot be the default for the masculine gender only, *pace* Bonet (2006: 325): the

(12)
$$\begin{cases} TH \rightarrow /-a/ / [Feminine] _ \\ TH \rightarrow /-o/ \end{cases}$$

However, the rule in (12) merely expresses the default pattern and sustains many exceptions. First, Spanish has a handful of feminine nouns that belong to the o-class: a nearly exhaustive list is given in (13,a), in descending order of token frequency according to CREA. The class of feminine o-stems is not closed, however: it can be expanded through the addition of truncations, like [mót-o] 'motorcycle', ¹² and of feminine mates of masculine human nouns, like [el testíy-o] 'the [male] witness' \sim [la testíy-o] 'the [female] witness'. Secondly, Spanish has a very sizable set of masculine nouns that belong to the a-class: examples are given in (13,b).

(13)	a.	feminine 0-ste	ems	b.	masculine a-st	ems
		[mán-o]	'hand'		[dí-a]	'day'
		[liβíð-o]	ʻlibido'		[proβlém-a]	'problem'
		[ná-o]	'ship, vessel'		[sistém-a]	'system'
		[dinám-o]	'dynamo'		[planét-a]	ʻplanet'
		[biráy-o]	'virago'		[máp-a]	'map'

The situation, therefore, is one where each underived noun stem is unpredictably and idiosyncratically associated with one of the thematic elements shown in (4) or is athematic. The same is true of suffixes that build derived noun stems. For example, the derivational suffixes $/-or-\{e,\varnothing\}/$ and /-ur-a/ both generate deadjectival *nomina qualitatum*. Arbitrarily, these derived nouns are masculine e-stems in the case of the former, and feminine a-stems in the case of the latter: e.g. [fresk- $or-\varnothing$] (M) ~ [fresk- $or-\varnothing$] (F) 'freshness', cf. [frésk-o] 'fresh'. The stem-class that a derivational suffix imposes on derived noun stems cannot be predicted from the

many adjectives that belong to the o-class in the masculine and to the a-class in the feminine (see (14) below) appear in their o-stem forms in neuter constructions such as [l-o β wén-o] 'the-TH $_o$ [N] good-TH $_o$ [N]', i.e. 'the good, goodness, good stuff'. Also relevant here is the behaviour of the distal demonstrative:

Observe that the masculine singular form is a suppletive *e*-stem, whereas the neuter form is a regular *o*-stem (for the suppletive character of the /ʎ/-/l/ alternation, see Pensado Ruiz 1997, Harris 1999, Eddington 2004: §3.4, and Bermúdez-Otero 2006: 287, though cf. Lloret and Mascaró 2006).

Harris (1991: 37) states that the final [o] of this item does not behave like a theme vowel. The grounds for this assertion are unclear to me. Under augmentative suffixation, for example, [mót-o] behaves just like [mán-o]: e.g. [mot-á θ -a], not *[moto-á θ -a]; see (16,a) below.

phonological shape of the unit that results from stripping the theme vowel from the suffix: in our example, from /-or-/ and /-ur-/, respectively. Hereafter, I shall refer to such units as SUFFIX-STUMPS: in this terminology, a suffix-stump is to a stem-deriving suffix what a root is to an underived stem.

Adjectives behave in the same way, with an added twist caused by gender agreement. Setting rare athematic cases aside, ¹³ each underived adjective stem is unpredictably and idiosyncratically associated with one thematic element for masculine forms, and another (possibly the same) for feminine forms (14,a). Derivational suffixes creating adjective stems behave in the same way (14,b).

(14)	M.SG	M.PL	F.SG	F.PL	
a.	[bwén-o]	[bwén-o-s]	[bwén-a]	[bwén-a-s]	'good'
	[bély-a]	[bély-a-s]	[bély-a]	[bély-a-s]	'Belgian'
	[alemán- \emptyset]	[alemán-e-s]	[alemán-a]	[alemán-a-s]	'German'
	[komún- \emptyset]	[komún-e-s]	[komún- \emptyset]	[komún-e-s]	'common'
	[inmún-e]	[inmún-e-s]	[inmún-e]	[inmún-e-s]	'immune'
b.	[-ós-o]	[-ós-o-s]	[-ós-a]	[-ós-a-s]	'-ous'
	[-íst-a]	[-íst-a-s]	[-íst-a]	[-íst-a-s]	'-ist'
	[-és-∅]	[-és-e-s]	[-és-a]	[-és-a-s]	'-ese'
	[-ál-∅]	[-ál-e-s]	[-ál-∅]	[-ál-e-s]	'-al'
	[-éns-e]	[-éns-e-s]	[-éns-e]	[-éns-e-s]	'-ese, -ensic'

As noted by Harris (1991: 35, 46), there are significant restrictions on possible theme vowel alternations in adjectival gender inflection; many logically possible pairings of masculine and feminine forms are not attested. Notably, adjectives with masculine stems of the *o*-class or the *a*-class can only have feminine stems of the *a*-class; and no adjective can be *o*-stem in the feminine, even it is *o*-stem in the masculine (see further note 13). Some of these restrictions fail to generalize to the feminine mates of masculine human nouns: cf. [el testíy-o] - [la testíy-o]. I return to this interesting problem in section 2.4.2 below. At this point, however, I wish to highlight just two facts. First, one cannot rely on the phonological shape of the root or the suffix-stump to predict which of the licit pairings of thematic elements a particular adjective or adjectival suffix will select. Secondly, although many pairings are unattested, both genders have more than one choice: masculine adjectives may belong to any class (including the athematic set); feminine adjectives may belong to any class other than the *o*-stems.

Finally, diminutives and augmentative suffixes come in two themes too:

Athematic adjectives do exist. We saw two examples in (6,a) above: [kúrsi] and [útu]. Interestingly, their feminine forms are syncretic with the masculine: M/F.SG [kúrsi], M/F.PL [kúrsi-s]; M/F.SG [útu], M/F.PL [útu-s]. I believe this to be true of all athematic adjectives.

(15)	M.SG	M.PL	F.SG	F.PL	
	[-ít-o]	[-ít-o-s]	[-ít-a]	[-ít-a-s]	DIM
	[-áθ-o]	[-áθ-o-s]	[-áθ-a]	[-áθ-a-s]	AUG
	[-ón-∅]	[-ón-e-s]	[-ón-a]	[-ón-a-s]	AUG
	[-ót-e]	[-ót-e-s]	[-ót-a]	[-ót-a-s]	AUG

This is because, in their purely evaluative uses, diminutives and augmentatives inherit the gender of the base, but then make their own choice of stem vowels in the masculine and feminine (Lázaro Mora 1999: 4656):

Augmentative suffixes like $[-i\theta-o]$ have other derivational uses, such as creating *nomina* actionum. When used in this way, they behave like ordinary noun-forming derivational suffixes, determining not just the stem-class of the derived form, but also its gender:

(17)	a.	base	b.	evaluative	c.	augmentative
				augmentative		nomen actionis
		[sartén-∅]		[sarten-áθ-a]		[sarten-áθ-o]
		frying_pan- $TH_e[F]$		frying_pan-AUG-TH $_a$ [F]		frying_pan-AUG-TH _o [M]
		'frying pan'		'big frying pan'		'blow struck with a frying pan'

There are instances of the purely evaluative use of diminutive /-it-/ in which the output appears to inherit not just the gender of the base, but also its inflectional class: e.g. (18,b). However, these constructions involve infixation. The existence of infixal diminutives in Spanish is proved by instances like (19,b), where /-it-/ occurs inside a root and the string on its right does not constitute a separate morph. In contrast, suffixal diminutives, e.g. (18,c) and (19,c), obey the affix-driven selectional patterns laid out in (15).

	a.	base	b.	infixal diminutive	c.	suffixal diminutive
(18)		[mán-o]		[man<ít>-o]		[man-ít-a]
		$hand ext{-}TH_o[\mathtt{F}]$		$hand < DIM > -TH_o[F]$		hand-DIM-TH $_a[F]$

(19)	[a θ úkar- \varnothing]	[aθuk<ít>ar-∅]	[aθukar-ít-o]		
	$sugar-TH_e[M]$	$sugar < DIM > -TH_e[M]$	sugar-DIM-TH $_o$ [M]		

For further evidence and discussion, see Bermúdez-Otero (2006: 302-5, 2007: 246-49) and references therein.

In sum, final /-o/, /-a/, and /-e/ in Spanish noun and adjective stems are theme vowels. The behaviour of thematic /-e-/ is demonstrably different from that of epenthetic [e], and, although its distribution exhibits some phonological effects, it is mostly independent of root shape. Similarly, the three theme vowels are involved in the exponence of gender, but they are not gender markers: none is consistenly affiliated with the masculine or the feminine, and so the choice of theme vowel cannot be predicted on the basis of syntactic features. This raises our main question: what morphological or lexical mechanism pairs up roots and suffix-stumps with the appropriate theme vowels so as to form noun and adjective stems? is it a class feature borne by the root or the suffix-stump? or are roots and suffix-stumps simply stored together with the respective theme vowels in lexical entries for each underived stem and each stem-deriving suffix? Henceforth I will refer to this as THE COUPLING QUESTION.

2.2. Disappearing theme vowels in stem-based derivation

Fortunately, the answer to the coupling question does not come down to mere theoretical preference; the facts of Spanish impose empirical constraints on one's choice of solution. Be it class features or lexical storage, the mechanism that pairs up roots and suffix-stumps with theme vowels within noun and adjective stems must meet two requirements. First, it must ensure that theme vowels surface in the right places. Secondly, it must do so in a way that accommodates the other morphophonological facts of Spanish: in particular, the presence or absence of theme vowels at more abstract levels of representation than the surface must be consistent with the proper formulation of morphological and phonological generalizations holding at those levels.

In this section we will see that meeting the first requirement is a far from trivial task. The main challenge lies in accounting for the observation that nominal and adjectival theme vowels never surface inside derivational suffixes attached to stems; they only surface at the right edge of singular words or just inside the number marker /-s/ in plural words. ¹⁴ Moreover, surfacing theme vowels are always selected by the immediately preceding overt morph, except in cases of diminutive infixation like (18,b). Consider, for example, the augmentative derivation in (16,a), repeated again below (Bermúdez-Otero 2006: 280ff):

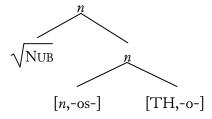
This statement ignores the behaviour of theme vowels in compounds, but surveying the whole menagerie of Spanish compound types would take us too far afield (see Val Álvaro 1999).

(20) a. base b. augmentative
$$[m\acute{a}n-o] \qquad [man-\acute{a}\theta-a] \qquad *[man-o-\acute{a}\theta-a]$$
 hand-TH $_o[F]$ hand-AUG-TH $_a[F]$ hand-TH $_o[F]$ -AUG-TH $_a[F]$

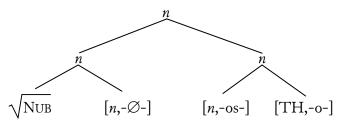
Here, because the augmentative suffix is used purely evaluatively, the derived stem inherits the gender of the base: in this case, feminine (see (17) above). However, it is the suffix, not the base, that selects the theme vowel of this feminine derived stem: [-a-], not [-o-]. Crucially, the theme vowel of the base itself disappears before the suffix.

When it comes to testing accounts of this phenomenon, it will be essential to distinguish between two types of derivation: ROOT-BASED (or √NODE-BASED) and STEM-BASED (or LEXEME-BASED); see (3) above. In the former, a derivational affix attaches to a root (i.e. to the exponent of a vnode); in the latter, to a stem (i.e. to the exponent of a lexeme). The superficial absence of a nominal or adjectival theme vowel before a derivational suffix requires explanation only if the derivative is in fact stem-based; roots do not have theme vowels in any case. A derivative can easily be recognized as root-based when its base is obviously bound and acategorial, as in $[A \ vert empire]$ ik-o] 'empirical' and $[A \ vert empire]$ ism-o] 'empiricism'. Diagnosis can be much more difficult, however, when the string that precedes the derivational suffix on the surface can be parsed both as a root and as a stem without its theme vowel. Take for example the derived adjective [nu β -ós-o] 'cloudy.M': is it derived from (a) the root \sqrt{NUB} or (b) the stem of the e-class noun NUBE? Only if the answer is (b) need one go on to ask why there is no [-e-] before [-ós-o] on the surface. In the formalism of DM, the question is whether the *n* head realized by the suffix-stump /-os-/ merges with $\sqrt{\ }$, as in (21), or rather attaches outside an inner n head, as in (22). Only in the latter case do we ask whether the representation passed from the morphology to the phonology is in fact (22,a), (22,b), or (22,c).

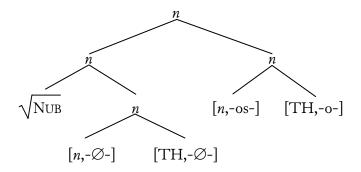
(21) Root-based derivation: [n,-os-] merges with $\sqrt{.}$



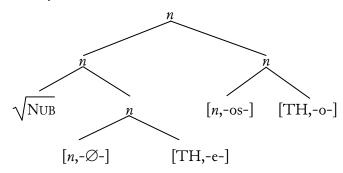
- (22) Stem-based derivation: [n,-os-] attaches outside an inner null n head.
 - a. A TH position is adjoined to the outer n head only:



b. TH positions are adjoined to both n heads, but the inner TH position has a null realization:



c. TH positions are adjoined to both n heads, and both TH positions are realized by theme vowels:



Unfortunately, there is no criterion guaranteed to reliably distinguish between root-based and stem-based derivation in all relevant cases. However, we can go a long way by applying a number of widely accepted rules of thumb variously relying on morphosyntactic, phonological, and semantic diagnostics.

In (16) and (17) above, for example, we saw that, in their purely evaluative uses, suffixes like diminutive [-ít-o] and augmentative [-á θ -o] inherit the gender of the base. But having gender entails being a member of one of the gendered lexical categories (see note 11). It therefore follows that pure evaluative derivation must always be stem-based, not root-based. Thus, in (20) we can be absolutely certain that the augmentative form [man-á θ -a] derives from the stem of the *o*-class feminine noun MANO, and not from the root $\sqrt{\text{MAN}}$. In contrast, further evidence will be needed in cases like that of [sarten-á θ -o] in (17,c), where a *nomen actionis* is derived by means of an augmentative suffix that imposes its own gender on the derivative: see the discussion of (23), (36), and (37) below.

Stratified phonological frameworks like Lexical Phonology and Stratal OT provide a useful phonological diagnostic. In such frameworks, a [base-affix] expression is said to be STEM-LEVEL if it constitutes a domain for the stem-level phonology (roughly equivalent to the cyclic stratum of Booij and Rubach 1987 and of Halle and Vergnaud 1987), and it is said to be WORD-LEVEL if it constitutes a domain for the word-level phonology (roughly equivalent to the postcyclic stratum of Booij and Rubach 1987 or the noncyclic stratum of Halle and Vergnaud 1987). Whether the expression is stem-level or word-level depends on properties of

both the base and the affix: a stem-based expression may itself be stem-level or word-level depending, among other things, on the idiosyncratic stratal affiliation of the affix; but, crucially, root-based expressions can only be stem-level (e.g. Bermúdez-Otero 2006: 283). In Spanish, one of the phonological phenomena that distinguish between stem-level and word-level forms is the stress-driven alternation between the diphthongs [jé, wé] in tonic syllables and the mid vowels [e, o] in nontonic syllables: if a derivative exhibits overapplication of diphthongization, i.e. if it displays an alternating diphthong in an nontonic syllable, then it is word-level (Halle et al. 1991: 146, Bermúdez-Otero 2006: 286, and see §3 and §4 below for extensive discussion). By this criterion, the noun [kwent-ist-a] 'story-teller', based on the noun [kwent-o] 'tale', is a word-level derivative: compare the monophthong in the nontonic syllable of the infinitive [kont-á-r] 'tell'. The fact that [kwent-íst-a] belongs to the word level confirms that it does indeed derive from the stem of the o-class noun CUENTO, rather than from the root $\sqrt{\text{CONT}}$: as we have seen, a word-level form cannot be root-based. Reassuringly, applying this phonological test to evaluative derivatives yields exactly the same results as the genderinheritance criterion: purely evaluative derivatives, which inherit the gender of the base, also display overapplication of diphthongization and so must be word-level (23,b). In contrast, augmentative nomina actionum, whose gender is determined by the suffix, are stem-level and so display monophthongal alternants: see (23,c), as well as the discussion of (36) and (37) below.

(23)	a.	base	b.	evaluative	c.	augmentative
				augmentative		nomen actionis
		[pwért-a]		[pwert-áθ-a]		[p o rt-áθ-o]
		$\operatorname{door-TH}_a[\mathtt{F}]$		door-AUG-TH $_a[F]$		door-AUG-TH $_o$ [M]
		'door'		'big door'		'door slam'

Finally, stem-based derivation can be distinguished from root-based derivation by means of semantic criteria. These have wide applicability, but their evidence must be interpreted with great care. In general, if the meaning of a derivative is perfectly compositional, then its base is more likely to be a lexeme than a \node. The grounds for this statement come across particularly clearly in the case of derived nominals. For example, in a discussion of claims by Chomsky and Halle (1968: 39, 112, 116), Bermúdez-Otero (2012a: 35-6) concedes that the English noun *condensation* might conceivably be parsed as \node-based when used as a referential nominal in the sense of Borer (2003: §4), ¹⁵ as in (24,a), but asserts that it must be parsed as lexeme-based when used as an argument-structure nominal, as in (24,b): the idea is that, when the noun *condensation* takes the same arguments as the verb *condense*, this indicates that the verb is contained within the noun.

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¹⁵ Borer (2003) draws on Grimshaw (1990). See further Alexiadou (2010: 500-1).

- (24) a. I used a cloth to wipe the condensation from the windscreen.
 - b. Andrew's skilful condensation of the argument into a few sentences helped me to see the point.

Some DM work advances a much stronger claim: namely, that all stem-based derivation must be strictly compositional (e.g. Marvin 2002: 39, Arad 2003: 740, Embick and Marantz 2008: 11, Embick 2010: 14):

The combination of Root-attached x and the Root might yield a special interpretation. When attached in the outer domain, the x heads yield predictable interpretations.

(Embick and Marantz 2008: 11, repeated in Embick 2010: 14)

But this is false (e.g. Alexiadou 2009, Anagnostopoulou and Samioti forthcoming, Borer 2009, Harley forthcoming). Among a long list of counterevidence from English, for example, Harley (forthcoming) adduces the noun edit-or-ial in the sense 'article setting out the editor's views or policies'. There can be no doubt that, in this reading, edit-or-ial derives from the noun stem edit-or. On the morphophonological side, edit-or-ial properly includes the morphs making up edit-or. On the semantic side, the reading 'article setting out the editor's views or policies' also includes the meaning 'editor': for example, an opinion article by an outside writer expressing views disclaimed by the editors cannot be referred to as an editorial. Thus, if edit-or-ial in its specialized use contains the phonology and the semantics of edit-or, it would be perverse to describe it as root-based, for the base edit-or is indisputably a noun stem. Harley's example highlights the fact that, contrary to Embick and Marantz's claims, certain types of semantic idiosyncrasy are perfectly compatible with stem-based derivation: notably, we do not have good reason to assume root-based derivation if the meaning of the base is fully contained within that of the derivative, and the latter merely adds an unpredictable semantic restriction; we shall see instances of this phenomenon in §2.4.1.2 below. For the time being, observe that the compositionality criterion converges with our stratal phonological test in identifying [kwent-ist-a] as stem-based: the base [kwént-o] has two readings, which may be roughly paraphrased in English as 'short story' and 'fib'; these are transparently reflected in the two readings of the derived form, viz. 'short-story writer' and 'fibber' (cf. Santiago Lacuesta and Bustos Gisbert 1999: 4572).¹⁶

Before moving on, we should note that stem-based derivation needs to be distinguished not only from root-based derivation, but also from WORD-BASED DERIVATION. In the latter,

It is also relevant to note that the suffix [-íst-a] is highly productive (Santiago Lacuesta and Bustos Gisbert 1999: 4573). Semantic compositionality and productivity are obviously correlated. Forms generated anew by productive stem-based or word-based processes normally have compositional meanings. In contrast, inherited forms (i.e. those acquired and stored upon exposure to tokens produced by older speakers) may have developed semantic idiosyncrasies in the course of their history; this includes most items that are synchronically root-based. I return to this issue in section 3.5.

the base is a word, defined as a fully inflected, syntactically free lexical item. Word-based derivation is rare in Spanish, but partitives derived from cardinals provide a clear instance. In (25,a), the partitive suffix $[-4\beta-0]$ attaches to the base $[dos-\theta jént-o-s]$ 'two hundred'. Within the latter, the noun $[\theta jént-o-s]$ is overtly marked with the plural suffix [-s] by agreement with [dos] 'two' (Rainer 1996: 85, Fábregas 2005: note 99). Thus, since its base is inflected for number, $[dos-\theta jent-o-s-4\beta-o]$ counts as a word-based derivative. Strikingly, this explains why the theme vowel of the base is retained before the partitive suffix in $[on\thetae4\betao]$ (25,b): the generalization is that nominal and adjectival theme vowels disappear before derivational suffixes in stem-based derivation, but not in word-based derivation (Pensado Ruiz 1999: 4461-2; Bermúdez-Otero 2006: 296, 2007: 239).

2.3. Inflectional class features in root-driven morphology

The criteria reviewed in section 2.2 confirm that [kwent-íst-a] derives from the stem of a noun of the o-class: [kwént-o]. Why, then, does the theme vowel of the latter fail to appear in the surface phonological representation of the derivative? According to James Harris, the answer to this question is to be sought in the morphology of Spanish, not in its phonology: Harris believes that the presence or absence of nominal and adjectival theme vowels on the surface faithfully reflects their distribution in the output of the morphology. In Harris's view, therefore, the phonological derivation of [kwent-íst-a] has the following start and end points: 17

If this is so, then we must ask why the morphology of Spanish equips noun and adjective stems with theme vowels in certain morphological environments, but not in others. Harris's answer is to postulate a special TH position for nominal and adjectival theme vowels, roughly occurring outside all derivational suffixes and inside number marking (Harris 1983, 1985b, 1991, 1992, 1996). Thus, within the taxonomy of analyses outlined in (22), Harris's morphological solution falls under type (22,a).

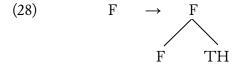
¹⁷ See section 4.3 below for the value of Harris's /O/.

Harris's proposal raises obvious questions. What is the ontology of this TH position? Morin (1999: 214), for example, worries about a perceived lack of typological parallels. Harris says relatively little about these issues, but in Harris (1992: 67) he appears to suggest that TH closes the stem off to further derivation and opens it up for inflection (see also Harris 1985b: 39). This idea might be seen as sufficiently rationalizing the distribution of nominal and adjectival theme vowels in Spanish, were it not for two facts. First, nonverbal theme vowels do occur inside some derivational suffixes, like partitive $[-\acute{a}\beta$ -o]: see (25,b). Secondly, and more importantly, the theme vowels of verbs are routinely found inside derivational affixes, as Harris (1985b: 39) himself acknowledges (see §2.4.1.1 below for more extensive discussion):

(27)
$$[N \ v \ kont-a] \ \delta \acute{o}r-\varnothing]$$
 'counter' cf. $[kont-\acute{a}-r]$ 'count/tell.INF' $[N \ v \ ko\theta-e] \ \delta \acute{o}r-\varnothing]$ 'boiler' cf. $[ko\theta-\acute{e}-r]$ 'boil.INF' $[N \ v \ sent-\emph{i}] \ \delta \acute{o}r-\varnothing]$ 'that feels or can feel' cf. $[sent-\emph{i}-r]$ 'feel.INF'

Thus, Harris's analysis demands two morphosyntactic ontologies: one for the theme vowels of nouns and adjectives, and another for the theme vowels of verbs; but this demand is never satisfied.

However, Oltra-Massuet and Arregi (2005) show that it is possible to provide a more satisfactory ontology for Spanish nominal and adjectival theme vowels while retaining Harris's assumption that surface phonological representations reflect faithfully the theme vowel distribution generated in the morphology. Following Oltra-Massuet's DM treatment of theme vowels, Oltra-Massuet and Arregi (2005: 46) propose that, in Spanish, a TH position is morphologically adjoined to all functional heads (see Oltra-Massuet 1999: 12, 26, 60, 79):

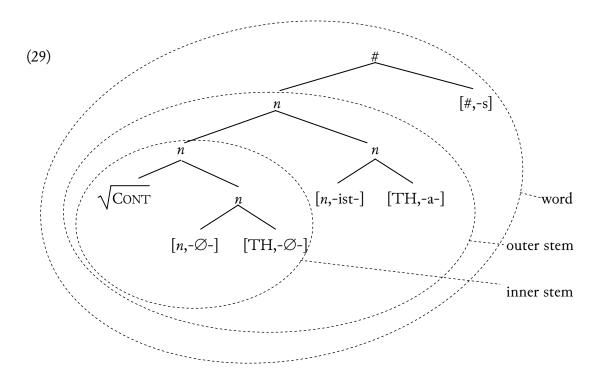


Adjectival theme vowels also appear inside the adverbial suffix [-ménte]. This presents a number of peculiarities: it freely allows suspended affixation in coordinate structures; it selects feminine bases; and it projects a separate prosodic word, as shown by the clashing stresses in (iv) below.

(iv)
$$[_{\omega} \text{ eŏukáŏ-a}]$$
 i $[_{\omega} \text{ kortès-}\varnothing][_{\omega} \text{ -ménte}]$ polite-TH $_{a}[F]$ and courteous-TH $_{e}[F]$ -ly

Unlike partitive $[-\acute{a}\beta-o]$, it is not immediately clear if adverbial $[-m\acute{e}nte]$ should be regarded as attaching to stems or to words; it does not occur outside plural [-s]. If adverbs in $[-m\acute{e}nte]$ turned out to be stem-based, Harris's account would suffer, whereas the phonological rule of stem-final vowel deletion proposed in this paper (see §2.4.1 below) would automatically account for the retention of the theme vowel of the base: $[-m\acute{e}nte]$ would still be unlike other stem-attaching suffixes in that it begins with a consonant. Harris (1985b: 39, 1992: endnote 6) notes the facts of $[-m\acute{e}nte]$, but not those of $[-\acute{a}\beta-o]$.

In this view, the derived plural noun [kwent-ist-a-s] has the morphosyntactic structure shown in (29) below. The inner stem does contain a thematic element. The fact that the exponent of this thematic element is $/-\emptyset-/$, rather than /-o-/ as in [kwent-o], is not a matter of morphosyntactic constituency, but of allomorphic realization: when adjoined to an n or a head, a TH position is realized overtly by means of a theme vowel only if left-adjacent to the number head #. In (29) this contextual requirement is met only by the thematic element of the outer stem. ¹⁹



In taxonomy (22), therefore, Oltra-Massuet and Arregi's analysis belongs to type (22,b).

Oltra-Massuet and Arregi's allomorphic solution removes the problem of providing different ontologies for nominal and verbal theme vowels: theme vowels occupy the same type of structural position, introduced by the same morphological adjunction operation, in verbs, nouns, and adjectives (Oltra-Massuet 1999: 80). Indeed, if we replace Oltra-Massuet and Arregi's F with x, where $x = \{v, n, a\}$, then the distribution of thematic positions generated by rule (28) becomes exactly identical with the distribution advocated in Bermúdez-Otero (2006:

Oltra-Massuet and Arregi (2005) address this subject *en passant* in a footnote, and so do not undertake to provide a technical formalization. They simply make the following observation: "The theme position of n or a is not realized overtly if this head is not the highest one in the structure" (footnote 8). Cyclic locality forbids a direct translation of this statement into the formalism of DM: if n and a are cyclic heads (Embick 2010: 13), vocabulary insertion will not be able to look outside the current cyclic domain to check if there are higher n or a heads in the structure. The formulation I provide in the main text is compatible with Embick' (2010) version of DM, where # is assumed to be a noncyclic head in the edge $^+$ of the highest n or a.

291, 2007: 236-7) and in §2.4.1 below: each and every stem, in the sense of STEM defined in section 1, ends with a thematic element.²⁰

However, while the contrast between parses of types (22,a) and (22,b) matters a great deal to our understanding of what theme vowels **are**, it is largely irrelevant to the coupling question raised at the end of section 2.1. Harris's analysis, which centres on the distribution of the TH position, and Oltra-Massuet and Arregi's, which appeals to its allomorphic realization, have the same phonological outcome. The stem of the *o*-class noun CUENTO ends up having two different underlying phonological representations, occurring in different morphosyntactic environments: (30,a) inside derivational suffixes, and (30,b) when left-adjacent to number.

This state of affairs makes lexical storage unfeasible as a solution to the coupling question. Suppose that both (30,a) and (30,b) were stored in the lexicon as alternative exponents of the noun stem, with their distribution controlled by morphological subcategorization statements. That scenario would fail to account for the generalization that every noun stem—with absolutely no exceptions at all—would have a listed exponent without an overt theme vowel. Suppose instead that the lexical entry of the stem provided only representation (30,b). In that case, a morphological operation, crucially applying ahead of phonological computation, would be required to suppress the theme vowel /-o-/ before the derivational suffix /ist-a/ in the underlying representation of *cuentista*. This morphological process would need to apply to all nominal and adjectival theme vowels in all instances of stem-based derivation. But such extensive use of morphological deletion is implausible: subtractive exponence is very rare, and in the least doubtful cases deletion is clearly performed in the phonology, targeting a phonologically defined string (see e.g. Alber and Arndt-Lappe 2012, Bye and Svenonius 2012: §12.5). Thus, if the absence of nominal and adjectival theme vowels before stem-based derivational suffixes is indeed a morphological rather than a phonological fact, then one is forced to pursue an alternative solution to the coupling question: positing inflectional class features. In this approach, a diacritic such as [Class:0] will ensure that, when the stem of the noun CUENTO stands in a morphosyntactic configuration that requires it to bear an overt theme vowel, it will select /-o-/.

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Following Oltra-Massuet (1999), Oltra-Massuet and Arregi's (2005: 46) goal in positing F rather than $x = \{v, n, a\}$ in (28) is to assign theme vowels not only to stems, but also to tense markers like first-conjugation past imperfective indicative /-ba-/, reanalysed as $[T_T b][T_T a]$. I remain unconvinced by this claim, but the arguments are not relevant in the present context.

This move is pregnant with implications for the issue of lexical storage. Solving the coupling question by storing actual theme vowels in lexical entries logically entails storing the stems and suffixes to which those theme vowels belong. In contrast, class features have the power to control theme vowel choice through their mere presence in the local environment; it does not matter which particular node bears the class feature, as long as it is sufficiently close to the thematic element. In consequence, the morphosyntactic affiliation of class diacritics is not a logical given: it is possible to regard them as features of stems and stem-deriving suffixes, but it is equally possible to treat them as features of roots and suffix-stumps. DM exploits the latter option because, as a root-driven framework, it is committed to minimal storage and to minimal redundancy: storage is limited to roots and to exponents of functional heads; the listing of complex grammatical expressions is rejected. In DM, therefore, inflectional class features inhere in acategorial roots and in particular exponents of the category-giving heads v, n, a (Embick and Halle 2005: 46, Embick 2010: 75-77). In the structure in (29), for example, class features will appear on two terminal nodes: the root $\sqrt{\text{CONT}}$ will bear the feature [Class:0]; the outer n head, spelt out by the suffix-stump /-ist-/, will bear the feature [Class:a]. Given the vocabulary items in (31), where (31,c) is the elsewhere option, vocabulary insertion produces the desired underlying phonological representations.²¹

But merely asserting the existence of inflectional class features has profound consequences as well, regardless of which nodes are chosen to bear them. It is no coincidence that Aronoff (1994: §3.2.1) deployed Harris's (1991, 1992) account of Spanish nominal and adjectival theme vowels as an argument for the existence of an autonomous level of

(v)
$$n \leftrightarrow -\emptyset_{[\text{Class}:o]}$$
- / X ___ X = { $\sqrt{\text{CONT}}$, $\sqrt{\text{MAN}}$, ... }

(vi)
$$v \leftrightarrow -\emptyset_{[\text{Class}:a]}$$
 $Y = \{\sqrt{\text{Cont}}, \sqrt{\text{Am}}, \dots\}$

Both solutions look unattractive to me. The first appears conspiratorial, since the root knows in advance what category-giving heads it is going to combine with. The second blurs the distinction between storage and computation by embedding lists within rules.

DM will need to say something about the fact that the root $\sqrt{\text{CONT}}$ selects the theme vowel /-o-/ in the stem of the *o*-class noun CUENTO 'tale', structurally $[n, \sqrt{\text{CONT}} \ [n, [n, -\varnothing -] \ [\text{TH,-o-}]]]$, but it takes the theme vowel /-a-/ in the stem of the first-conjugation verb CONTAR 'tell', structurally $[v, \sqrt{\text{CONT}} \ [v, [v, -\varnothing -] \ [\text{TH,-a-}]]]$. I imagine that one possibility would be simply to posit two root diacritics: [nClass:o] and [vClass:a]. Another option, given the liberal use of lists in the framework (e.g. Embick and Halle 2005: 39, 41, 47-49; Embick 2010: 31, 43, 46, etc), might be to locate the diacritics in the vocabulary items of null exponents of category-giving heads, thus:

morphological representation in the grammar: the 'morphomic' level. Harris's account entails not only that Spanish nouns and adjectives are arbitrarily divided into inflectional classes, as we saw in section 2.1, but also that class membership is marked by a purely morphological primitive of representation, the class feature, which plays absolutely no role in either the syntax or the phonology. In other words, Harris's account implies the existence not just of morphomic **patterns**, but also of morphomic **objects**. This point stands out in bold relief when one considers the exponence of gender in Spanish. In (12) above I proposed a simple set of default rules mapping gender features onto theme vowels: here, gender features are syntactic objects, involved in the computation of agreement, and theme vowels are phonological objects, made up of distinctive features such as [+back], [+round], and so forth. If Harris and Aronoff are right, however, the realization of gender in Spanish involves a less direct mapping from syntax to phonology: purely morphological class diacritics mediate between gender features and theme vowels. Compare (12) with Aronoff's formalization of his own analysis in (32).

(32) a. Masculine
$$\rightarrow$$
 class 1
Feminine \rightarrow class 2 (Aronoff 1994: 69)
b. $\langle [N, \text{class 1}], (X \rightarrow Xo) \rangle$
 $\langle [N, \text{class 2}], (X \rightarrow Xa) \rangle$
 $\langle [N, \text{class 3}], (X \rightarrow X) \rangle$ (Aronoff 1994: 68)

In this context, Harris's putative result was felt to be particularly impressive precisely because it purported to establish the need for all this apparatus in what was, after all, a relatively impoverished inflectional system, with just four cells in adjective paradigms, two cells in noun paradigms, three theme vowels, and one plural marker (Halle 1994: note 6).²²

In sum, Harris's contention that surface phonological representations reflect faithfully the underlying distribution of Spanish nominal and adjectival theme vowels precludes a lexical storage answer to the coupling question, instead favouring the use of inflectional class features. This solution is compatible with a minimal-storage minimal-redundancy root-driven approach

Not surprisingly, inflectional class features continue to incite much controversy and unease (Bermúdez-Otero 2008). Some scholars propose more or less radical ways of dispensing with them altogether: e.g. Blevins (2006), Wunderlich (1996, 2004). Other writers regard them as indispensable and suggest that one can extract more value from them by decomposing them into smaller elements that can be used to capture patterns of syncretism across inflectional classes: e.g. Oltra-Massuet (1999), Müller (2004), Alexiadou and Müller (2008), Trommer (2008). Virtually everyone agrees that inflectional class features are syntactically inert (cf. Bernstein 1993, but see Alexiadou and Müller 2008: §5.3), yet the task of explaining this inertness (Halle 1994: note 12) has pulled different analysts in different directions: cf. Acquaviva (2009) with Alexiadou and Müller (2008). Similarly, the relationship between inflectional class features and phonology is disputed: e.g. Aronoff (1992, 1994: ch. 4) uses the example of Arapesh to claim that inflectional class features may be assigned by rules referring to the phonological properties of stems (see also Lloret 2009), but Bermúdez-Otero (2008: §13-§15) questions his analysis of the Arapesh data.

to morphology like that of DM, in which there are no units of lexical storage larger than acategorial roots and exponents of functional heads. In addition, positing inflectional class features entails the existence not merely of arbitrary morphological patterns, but also of purely morphological primitives of representation.

2.4. Lexical storage in stem-driven morphology

2.4.1. The phonology of stem-final vowel deletion

There is thus a good deal at stake on the claim that Spanish phonology does not bear responsibility for the failure of nominal and adjectival theme vowels to surface inside stembased derivational suffixation. This view has hitherto informed most research in the generative paradigm: see e.g. Bonet (2006: 326ff) and Roca (1990: 135, 1991: 604, 2005: 358), alongside the works by Harris and by Oltra-Massuet and Arregi discussed in section 2.3. There is, however, an alternative tradition that analyses the facts as reflecting the operation of a regular phonological process of stem-final vowel deletion. This idea turns up repeatedly in works on Spanish that set store by descriptive comprehensiveness (Pena 1999: 4337; Pensado Ruiz 1999: 4461; Rainer 1993: 95, 96), and it frequently underpins technical accounts of other languages, both in the Romance family and beyond: see e.g. Scalise (1983: 74-78, 287ff; 1994: 105, 151ff) and Montermini (2003) for Italian; Wetzels (1993: 335 and endnote 9) for Brazilian Portuguese; and Jakobson (1948), Halle (1994: 43, 52), and Halle and Nevins (2009: 356-8) for Russian. With remarkably few exceptions, like Aranovich and Orgun (2006) and Bermúdez-Otero (2006, 2007), generative approaches to Spanish have either ignored this hypothesis altogether or cursorily dismissed it (e.g. Harris 1991: footnote 9, Roca 1990: 135). In this section, however, I shall argue that it is in fact correct.

Thus, I shall defend the thesis that, in the input to the phonology, every Spanish verb, noun, and adjective stem bears a thematic morph, the only exceptions being nouns and adjectives of the athematic class. This holds true for stems of all three categories in all morphological environments: not only in the absence of following suffixes and before inflectional markers, but also when the stem provides the base for derivational suffixation. With the sole exception of ordinary *e*-stem nouns and adjectives (whose thematic element has two allomorphs, one of them null), the thematic morph has phonological content—a theme vowel—in all morphological environments. In consequence, the phonological derivation of [kwent-ist-a] does not proceed as in (26), but has the following start and end points:

(33) a. UR
$$\left[\left\{\begin{array}{ll} koNt-o \\ kweNt-o \end{array}\right\}\right]$$
 ist-a $\left[\begin{array}{ll} b. \end{array}\right]$ B. SR $\left[\begin{array}{ll} kwentista \end{array}\right]$

Here, the underlying /-o-/ of the inner stem is removed by a regular phonological process that deletes a stem-final vowel when immediately followed by another vowel in a suffix. This phonological process is subject to a number of conditions: it is not allowed to iterate, and it is blocked when the stem-final vowel bears stress in the input (Bermúdez-Otero 2006: 293, 2007: 237). These conditions, however, generalize to stems of all three lexical categories.

The argument leading to these conclusions moves through four steps (Bermúdez-Otero 2006: §2.1). We first examine derivatives built by attaching a consonant-initial suffix to a verb stem; these forms show that verbal theme vowels do occur inside derivational suffixes (§2.4.1.1). We then compare these deverbal derivatives with items consisting of a verb stem followed by a vowel-initial suffix; this comparison reveals the operation of a regular phonological process of stem-final vowel deletion, subject to the conditions mentioned above (§2.4.1.2). In the third step of the argument, we verify that, without further stipulation, this account of verb stems generalizes to nouns and adjectives, correctly and exhaustively predicting the distribution of nominal and adjectival theme vowels on the surface (§2.4.1.3). To conclude the argument, it remains only to show that unifying the analysis of verbal, nominal, and adjectival theme vowels through a phonological process of stem-final vowel deletion is not merely possible, but actually necessary: this is done by demonstrating that, unless the theme vowel of a noun like [swép-o] 'sleep/dream-THo[M]' is underlyingly present inside the evaluative suffix in derivatives like [swép-aθ-o] 'sleep/dream-AUG-TH_o[M]', the analysis of the diphthongal alternation and of the phonotactics of palatals is caught in a stratal-cyclic paradox (§2.4.1.4).

2.4.1.1. Deverbal derivation with consonant-initial suffixes

Spanish has a highly productive suffix $[-\delta \acute{o}r-\varnothing]$ (feminine $[-\delta \acute{o}r-a]$) that derives *nomina* agentium from verb stems (see e.g. Santiago Lacuesta and Bustos Gisbert 1999: 4541-46). As we saw in (27), reproduced below as (34), the inner verb stems display their theme vowels inside $[-\delta \acute{o}r-\varnothing]$, each according to its conjugation.

```
(34) [N \text{ [V kont-a] } \delta \acute{o}r-\varnothing] 'counter' cf. [kont-\acute{a}-r] 'count/tell.INF' [N \text{ [V ko}\theta-e] } \delta \acute{o}r-\varnothing] 'boiler' cf. [ko\theta-\acute{e}-r] 'boil.INF' [N \text{ [V sent-i] } \delta \acute{o}r-\varnothing] 'that feels or can feel' cf. [sent-\acute{i}-r] 'feel.INF'
```

The Latin ancestors of these agentive nominalizations were constructed by adding the suffix *-or*, *-ōris* to the verb stem found in perfective participle forms. However, the Spanish forms cannot be synchronically analysed as departicipial because they do not show the effects of participial allomorphy: e.g. $[a\theta-\acute{e}-\acute{e}]$ 'do/make.INF', $[a\theta-\acute{e}-\acute{o}\acute{o}r-\varnothing]$ 'doer/maker', $[\acute{e}t]$ -o] 'do/make.PFV.PTCP' (see Bermúdez-Otero 2006: 292 for more examples). *Pace* Burzio (1998), this is the state of affairs that seems currently to prevail throughout Romance (Tucker 2000; Steriade 2002, forthcoming; Bachrach and Nevins 2008: 15-17). Conversely, forms like

[ayres-ór- \varnothing] 'aggressor' are synchronically irregular and based on bound allomorphs: cf. [ayreð-í-ð-o] 'attack.PFV.PTCP'.

The adjectival suffix $[-\beta l-e]$, also highly productive, displays exactly the same behaviour as $[-\delta \acute{o} \iota - \varnothing]$, with a minor twist: the theme vowel of second-conjugation verb stems undergoes gradation to $[-\acute{i}-]$ (Rainer 1993: 95, 1999: 4609-10). However, this phenomenon is amply attested elsewhere: e.g. $[be\beta - \acute{e} - \iota]$ 'drink.INF' ~ $[be\beta - \acute{e} - \iota]$ 'drink.PFV.PTCP'.²³

(35)
$$[A \ [V \ pley-\acute{a}] \ \beta l-e]$$
 'foldable' cf. $[pley-\acute{a}-r]$ 'fold.INF' $[A \ [V \ be\beta-\acute{i}] \ \beta l-e]$ 'drinkable' cf. $[be\beta-\acute{e}-r]$ 'drink.INF' $[A \ [V \ sufr-\acute{i}] \ \beta l-e]$ 'sufferable' cf. $[sufr-\acute{i}-r]$ 'suffer.INF'

The evidence of (34) and (35) shows that verbal theme vowels are overtly present inside derivational suffixes attached to verb stems.

2.4.1.2. Deverbal derivation with vowel-initial suffixes: conditions on stem-final vowel deletion

Let us now turn to deverbal derivatives with vowel-initial suffixes. Take the ordinary e-stem augmentative suffix $[-\acute{o}n-\varnothing]$, which becomes a-class $[-\acute{o}n-a]$ in the feminine (15). Alongside its purely evaluative uses, this suffix has a productive category-changing use in which it forms deverbal *nomina agentium* (Rainer 1999: 4606) and, somewhat less frequently, deverbal *nomina actionum*. Examples are given in (36); see (17) and (23) above for a similar phenomenon involving augmentative $[-\acute{a}\theta-o]$.

- (36) a. [akus-ón-Ø] cf. [akus-á-r] 'accuse.INF'

 nomen agentis: '(one) who makes accusations too often'

 of schoolchildren, 'grasser'
 - b. [reβent-ón-Ø] cf. [reβent-á-ɾ] 'burst.INF'

 nomen agentis: 'that bursts or is about to burst'

 of carnations, 'bursting with red petals'
 nomen actionis: 'event of bursting'

 of tyres or pipes, 'blow-out'
 - c. [reβolk-ón-Ø] cf. [reβolk-á-r=se] 'wallow-TH-INF=REFL' nomen actionis: 'event of wallowing' 'impromptu bout of vigorous sexual intercourse' [-]

In the underlying representations provided in this article I set aside the intricate patterns of gradation characterizing the theme vowels of second- and third-conjugation verbs: see e.g. Harris (1997: 547) for a brief synopsis, Roca (2010) for a more extensive analysis of gradation in verbal inflection, and Bermúdez-Otero (2012a: 9-14) for theoretical discussion of gradation in deverbal derivation.

- d. [tray-ón-∅] cf. [tray-á-r] 'ingest/swallow/eat_voraciously.INF' nomen agentis: '(one) who eats in excess'
- e. [respond-ón-Ø] cf. [respond-é-r] 'answer.INF' nomen agentis: '(one) who answers back impudently'
- f. [pið-ón-Ø] cf. [peð-í-r] 'ask.INF', [pið-j-ó] 'ask-TH-PST.PFV.3SG' nomen agentis: '(one) who asks for things importunately'

How do we know that these forms are based on verb stems? The possibility that they might be denominal, like (17) and (23), is ruled out by semantic and allomorphic mismatches with the relevant nouns (Lázaro Mora 1999: 4673, Bermúdez-Otero 2006: 293). For example, [tray-ón- \varnothing] cannot derive from the *o*-stem noun [tray-o] 'draft of a liquid', because it fails to inherit the latter's idiosyncratic denotational restriction, which excludes the ingestion of solids. Similarly, [respond-ón- \varnothing] cannot derive from the *a*-stem noun [respwést-a] 'answer' because it does not display the latter's allomorphy.

But could the derivatives in (36) be root-based? On this point, the evidence is more subtle, but nonetheless leads to a negative answer. The gender-inheritance criterion formulated in §2.2 is obviously inapplicable, since these forms are not denominal. In any case, the criterion works only in one direction: gender transparency entails that the base is a stem of a gendered category, but the absence of gender transparency does not entail that the base is a root. The same is true of the stratal phonological criterion. As strikingly demonstrated by the minimal pair in (37), the category-changing use of $[-\acute{o}n-\varnothing]$ with verbal bases creates stem-level derivatives where the diphthongal alternation applies normally (37,a), whereas the purely evaluative gender-transparent use of $[-\acute{o}n-\varnothing]$ with nominal bases generates word-level forms where diphthongization overapplies; in (23) above we saw a similar pattern with $[-\acute{a}\theta-o]$.

umpire at the 1981 Wimbledon tournament was an *encontrón* (37,a); the 2008 final between Nadal and Federer was an *encuentrón* (37,b). I provide detailed derivations in (82) and (83) below.

As we saw in (1), the noun ENCUENTRO is root-based, not deverbal: the verb ENCONTRAR can mean both 'meet' and 'find', but ENCUENTRO can only refer to an event of meeting. Mainly through its use in sports reporting, as in the phrase *encuentro deportivo*, the noun has acquired the specialized reading 'sports meeting'. The semantic contrast between the two derivatives in (37) is thus extremely crisp: McEnroe's altercation with the

Again, the stratal criterion works asymmetrically: it confirms that word-level [enkwentr-ón- \emptyset] is stem-based, but it does **not** entail that stem-level [enkontr-on- \emptyset] is root-based. We are thus forced to fall back on the semantic criterion. Fortunately, this clearly shows that the forms in (36) are stem-based, because in each case the meaning of the verb is fully contained within the meaning of the derived nominal. When the latter is used as a nomen agentis, it transparently denotes the set of entities that play the same role as the subject participant in a sentence headed by the verb (36,a,b,d,e,f). In the nomen actionis reading, the derivative transparently denotes a set of events (36,b,c). Some forms admit both readings (36,b). The augmentative suffix crucially contributes an expressive index (Potts 2007, Fortin 2011), which typically triggers pejorative evaluations, as shown by the underlined portions of the glosses in (36). It is true that, in some cases, the expressive meaning of the augmentative suffix has caused the derived nominal to be used in such a way as to develop specialized readings over time: in (36), these are highlighted with a flag. Even in such cases, however, the specialized reading of the derived nominal subsumes the meaning regularly derived by composition of the verbal base with the affix; the interpretation is special only by virtue of the addition of a further semantic element that narrows the denotation of the derivative: e.g. 'one who accuses too often' \rightarrow 'a schoolchild who accuses too often' (36,a), 'bursting' -> 'bursting with red petals' (36,b). In addition, the derived nominal can still take the same arguments as the verb, as well as temporal modification: cf. (24) above.

- (38) a. Anoche Noemí se revolcó con Dani. 'Last night N. wallowed in sexual intercourse with D.'
 - b. El revolcón de Noemí con Dani anoche dará mucho que hablar.'N.'s wallowing in sexual intercourse with D. last night will be talked about a lot.'

I therefore conclude that the forms in (36) and (37,a) are indeed derived from verb stems.

If we now compare the deverbal derivatives in (34) and (35) with those in (36) and (37,a), we find that the theme vowel of the verbal base is retained before the derivational suffix in the former, whereas it is lost in the latter. But the only relevant difference between the two sets of derivatives lies in the phonological shape of the suffix, which begins with a consonant in in (34) and (35), but with a vowel in (36) and (37,a). The simplest account of the difference will therefore be one where a phonological process deletes the theme vowel of the base stem before a suffix beginning with a vowel. Examining further instances of deverbal derivation and verbal inflection will enable us to ascertain the precise properties of this phonological process.

First, the vowel deletion process must be sensitive to morphological information. For example, the tautomorphemic sequence /eo/ surfaces faithfully as a hiatus in (39,a), and so the presence of a morphological boundary must be essential to the application of vowel deletion in (39,b):

```
(39) a. 'lion' b. 'who answers back impudently' (36,e) UR  [leon-\{e,\emptyset\}]  [[respoNd-e]] on-\{e,\emptyset\}] first cycle (SL) le.ón res.pón.de second cycle (SL) — res.pon.dón SR [le.ón] [res.pon.dón], not *[res.pon.de.ón]
```

Indeed, we have already seen that the process only applies when its conditions are met across a stem-suffix boundary; when the base of suffixation is a word, deletion is blocked: see (25,b). These observations will make it necessary to verify that the deletion process can be correctly implemented within a restrictive theory of the morphology-phonology interface, specially one that preserves an adequate degree of modularity and locality, like the Four-Hypothesis Program of Bermúdez-Otero (2012a: 44ff). In tableau (51) below I provide an optimality-theoretic implementation that abides by the Indirect Reference Hypothesis as formulated in Bermúdez-Otero (2012a: 77): this forbids reference to nonphonological information by all phonological constraints other than those on morphosyntax-prosody alignment. The Bracket Erasure Theorem (Bermúdez-Otero 2012a: 82) imposes a related restriction: since the output of the first cycle of the phonological derivation in (39,b) retains no record of the fact that the final [e] is an exponent of TH, the deletion process must be formalized as targeting all stem-final vowels in general, rather than theme vowels specifically. As I demonstrate in (43) below, this turns out to make exactly the right predictions.

Secondly, stem-final vowel deletion does not iterate: it does not target stem-medial vowels that come into contact with suffix-initial vowels through a previous application of deletion.

```
(40) a. [A[V] mare-a] on-\{e,\emptyset\}]

\rightarrow [ma.re.\'on], *[ma.r\'on] 'dizzying, importuning'<sup>25</sup>

cf. [mare-\'a-r] 'make_dizzy/importune.INF'

b. [A[V] pele-a] on-\{e,\emptyset\}]

\rightarrow [pe.le.\'on], *[pe.l\'on] 'quarrelsome'

cf. [pele-\'a-r] 'quarrel.INF'
```

Thirdly, stem-final vowel deletion does not apply to vowels that bear stress in the input to the relevant phonological cycle. To establish this point I shall need to review a few basic

The stem-level deverbal *nomen agentis* in (40,a) is homophonous with the word-level augmentative form of the *o*-stem noun [maré-o] 'dizzy spell': cf. (37) above, where the contrast between stem-level and word-level derivation manifests itself overtly through its effects on the diphthongal alternation.

facts about Spanish stress.²⁶ As is well-known, stress is phonemically contrastive in Spanish: 'renowned' ~ [θe.lé.βre] 'celebrate.1/3SG.PRES.SBJV' e.g. [θé.le.βre] 'celebrate.1SG.PST.PFV'. Nonetheless, the position of the tonic syllable in verbs is predictably determined by a complex combination of morphological and phonological factors (see e.g. Harris 1987, 1989a; Oltra-Massuet and Arregi 2005: §2). Elsewhere, the phonology defines very clear default patterns, in which the structure of the stem-final syllable plays a key role: the default contour is thus paroxytonic for stems ending in vowels (see e.g. note 6), and oxytonic for stems ending in consonants (see the figures and references in Bermúdez-Otero 2007: 258-9). The most robust and parsimonious approach to this type of system, eschewing arbitrary diacritics and preserving modularity, is simply to let subordinate markedness constraints in the phonology express the default patterns, whilst high-ranking faithfulness constraints preserve lexical and morphological exceptions encoded by means of prespecified metrical structure in underlying representations. 27 In this approach, morphologically driven stress in verbs will simply reflect the underlying metrical specifications of verbal markers, including the allomorphs of verbal theme vowels (see note 23 for evidence of theme vowel allomorphy in verbs).

Let us now consider the metrical contrast between the present and past imperfective indicative (henceforth, 'the present' and 'the imperfect') of the first-conjugation verb AMAR 'love':

(41)		a.	PRS.IND		b.	PST.IPFV.IND	
	1sg		ám-o	á.mo		am-á-βa	a.má.βa
	2sg		ám-a-s	á.ma <s></s>		am-á-βa-s	a.má.βa <s></s>
	3sg		ám-a	á.ma		am-á-βa	a.má.βa
	1PL		am-á-mos	a.má.mo <s></s>		am-á-βa-mos	a.má.βa.mo <s></s>
	2PL		am-á-js	a.máj <s></s>		am-á-βa-js	a.má.βaj <s></s>
	3PL		ám-a-n	á.ma <n></n>		am-á-βa-n	a.má.βa <n></n>

Here, *stress* refers only to primary stress. Spanish secondary stress is irrelevant to our current concerns because it is assigned at the phrase level (Roca 1986).

I cannot in the space available tackle the multiple technical questions raised by this approach to Spanish stress. For example, Adam Albright asks why, in the derivation of augmentative [manáθa] from [[man-o]aθ-a], faithfulness to the stress assigned to the stem [máno] in the first cycle fails to induce proparoxytonic stress in the second cycle: i.e. *[mánaθa]. The question is intriguing for two reasons. First, proparoxytonic stress is of course possible in noun stems ending in vowels. Secondly, although the augmentative suffix could in principle be prespecified with an underlying foot-head, there are no independent reasons to do so: it follows the default pattern of penultimate stress for stems ending in vowels. Albright's question has several possible answers. One line of attack is to suggest that metrical faithfulness is positionally restricted to the right edges of cyclic domains, where the precise characterization of 'right edge' will depend on one's theory of word syntax. Another line of attack, which may be combined with the first, is to underlyingly specify exceptional absence (as opposed to presence) of stress (e.g. Cabré and Ohannesian 2009): faithfulness to stresslessness will be vacuously satisfied in the second cycle of the derivation of [manáθa] because the unstressed vowel of the stem disappears by stem-final vowel deletion.

In the present, stress alternates between the theme vowel and the last vowel of the root. This alternation can in principle be analysed in either of two ways: phonologically or morphologically. In the first scenario, the alternation emerges from default stress assignment in the phonology. This requires the assumption that a word-final consonant belonging to an inflectional marker does not project a mora, and so is irrelevant to stress, exactly like the /-s/ suffix in plural nouns and adjectives (Bermúdez-Otero 2007: footnote 20). The angled brackets in (41) mark these weightless consonants. If so, stress in the present will correctly fall on the final syllable when the metrically relevant domain ends in a glide (i.e. in the 2PL), and on the penultimate syllable when the metrically relevant domain ends in a vowel (i.e. in the other forms). In the second scenario, the stress alternation of the present tense has been partly or wholly morphologized, and is driven by appropriate metrical specifications in the underlying representations of the theme vowel and the person-and-number markers. If these specifications take precedence over underlying accents possibly borne by the root (see note 27), the morphological analysis will correctly predict the systematic absence of metrically exceptional verb forms like *[súplik-a] 3SG.PRS.IND; cf. the existing Spanish verb [suplik-a] 'supplicate.3SG.PRS.IND', its Latin ancestor [súp:lik-a-t], and the metrically marked Spanish noun [súplik-a] 'supplication' (Harris 1969: 120ff).

In the imperfect, in contrast, this analytical choice does not arise. Stress falls consistently on the theme vowel, even when this results in marked contours: a proparoxytone in the 1PL, and a paroxytone in the 2PL despite the presence of a falling diphthong in the ultima. (Recall that, in noun and adjective stems belonging to the core vocabulary, final syllables headed by falling diphthongs attract stress: see again the discussion of nouns ending in [ej] in §2.1.) We may therefore infer that the imperfect of first-conjugation verbs selects an underlyingly accented theme vowel allomorph: /-á-/. In the phonology, the underlying foothead borne by the theme vowel blocks default stress assignment. ²⁸

We are now ready to look at the crucial evidence of the imperfect in third-conjugation PARTIR 'part':

(42) 1SG part-í-a par.tí.a
2SG part-í-a-s par.tí.a<s>
3SG part-í-a par.tí.a

_

In this approach, the diachronic rise of the so-called 'columnar' stress pattern of the Spanish imperfect (cf. Latin 2SG [a.má:.ba:s], 1PL [a.ma:.bá:.mus], 2PL [a.ma:.bá:.tis]) is a simple instance of morphologization by input restructuring: the majority stress pattern displayed by 1/3SG [am-á- β a], 2SG [am-á- β a-<s>], and 3PL [am-á- β a-<n>], formerly derived in the phonology, is reanalysed as already specified in the output of the morphology. This general tendency for properties derived in one module of the grammar to be reinterpreted as already specified in the output of a higher module drives several aspects of the life cycle of phonological processes (Bermúdez-Otero and Trousdale 2012: §2, specially §2.2).

```
1PL part-í-a-mos par.tí.a.mo<s>
2PL part-í-a-js par.tí.aj<s>
3PL part-í-a-n par.tí.a<n>
```

The 1PL and 2PL forms exhibit the same tell-tale marked contours as in (41,b): antepenultimate stress, and failure to stress a falling diphthong in the ultima. It follows that, like AMAR, third-conjugation PARTIR selects an underlyingly accented exponent for the TH position in imperfect forms. In the second and third conjugations, however, the tense and mood marker of the imperfect begins with a vowel, rather than a consonant: it is /-a-/, rather than /-ba-/. Nonetheless, the underlyingly accented theme vowel fails to delete before this suffixal vowel. We may therefore conclude that stem-final vowel deletion does not apply to vowels bearing stress in the input representation. (For similar facts in Brazilian Portuguese, see Wetzels 1993: endnote 9).

In sum, the evidence of verbal inflection and deverbal derivation demonstrates the existence of a regular phonological process that deletes a stem-final vowel when followed by another vowel across a stem-suffix boundary. The process does not discriminate between theme vowels and other stem-final vowels, applies noniteratively, and is blocked if its target bears stress in the input to the current cycle.

2.4.1.3. Stem-final vowel deletion in denominal and deadjectival derivation: OT analysis

I now proceed to show that the phonological process of stem-final vowel deletion described above suffices to explain the disappearance of theme vowels inside derivational suffixes attached to noun and adjective stems (see §2.2).

First, the Bracket Erasure Theorem predicts that stem-final vowel deletion will not distinguish between theme vowels and unstressed root-final vowels in athematic stems. This prediction can be tested against data from athematic nouns and adjectives ending in unstressed [i] or [u] (see (6) above). Recent instances of productive derivation from such bases confirm that the prediction is correct:

(43)		base		derivative	
	a.	[gwíski]	'whisky'	[gwisk-erí-a]	'whisky bar'
	b.	[táksi]	'taxi'	[taks-ér-o]	'taxi driver'
				[taks-e-á-r]	'drive_a_taxi.INF'; of aircraft, 'taxi.INF' ²⁹

_

Tax-er-o is a vernacular form that has arisen in certain varieties, particularly in Latin America, alongside standard tax-ist-a. On 17 August 2012 Google returned approximately 3,850 tokens of <taxero> and 68,600 tokens of <taxero> in Spanish-language webpages. Related to the verb tax-e-a-r is the noun tax-e-o [tak.sé.o] 'taxi_driving/taxiing'.

Deadverbial derivation provides further evidence that stem-final vowel deletion is blind to the morphological affiliation of its target:

Data like these compel Harris to grant thematic status to the final vowels of adverbs, despite the fact that they do not otherwise behave like separate morphs: they do not participate in the exponence of inflection or zero-derivation, ³⁰ unlike the theme vowels of verbs, nouns, and adjectives. Once the existence of stem-final vowel deletion is acknowledged, however, Harris's assumption becomes unnecessary (see e.g. Harris 1983: §5.1.1 endnote 1, 1985b: endnote 2, 1991: §2.1, 1992: 65; Bonet 2006: 324-5, 327).

Secondly, stem-final vowel deletion does not apply to vowels that bear stress in the input. Accordingly, there should be no deletion in forms derived from athematic nouns or adjectives ending in stressed vowels, since these have a marked metrical contour. Again, this is consistent with the facts:

(45)		base		diminutive
	a.	[papá]	'Dad'	[papa-ít-o] ³¹
	b.	[kafé]	'coffee'	[kafe-ít-o] ³²

Thirdly, stem-final vowel deletion applies noniteratively to nominal and adjectival bases, just as it does to verbal ones. This is shown by the evidence of derivation from nouns and adjective stems ending in a theme vowel preceded by another unstressed vowel:

(46)	base			derivative		
	a.	[éro-e]	'hero'	[ero-ísm-o]	'heroism'	
	b.	[korpóre-o]	'corporeal'	[korpore-jŏáŏ-∅]	'corporeality'	

For example, a highly productive pattern of zero-derivation converts first-conjugation verb stems into noun stems by adding a null suffix bearing the theme vowel of the *e*-only class: e.g. $[N] [V \text{ tok-a}] \varnothing - e] \to [\text{tók-e}]$ 'touch' (see Bonet 2006: 319).

The diminutive [pap-ít-o] exists, but it derives from the hypocoristic [páp-i] 'Daddy'.

The variant [kafe-θít-o], which is irrelevant to our purposes, is much more frequent. Nonetheless, on 17 August 2012 Google found approximately 20,000 tokens of <cafeito>/<cafeito>.

c. [kráne-o] 'cranium' [krane-á θ -o] 'cranium.AUG' / 'headbutt'³³ d. [líne-a] 'line' [line-á θ -o] 'linear'

I conclude that, if nominal and adjectival theme vowels never surface inside stem-based derivational suffixation, it is for the simple reason that, in Spanish, all derivational suffixes attaching to noun or adjective stems begin with vowels, and so trigger regular stem-final vowel deletion in the phonology (Pena 1999: 4337; though see note 18 for a possible exception). The literature mentions an exceedingly small number of putative counterexamples to this account, but they are all suspect in one way or another. For example, Harris (1983: 92, 147; 1996: 104) adduces a handful of patrimonial words like [bon-dá δ - \varnothing] 'goodness' and [erman-dá δ - \varnothing] 'fraternity', where the theme vowels of the putative bases [bwén-o] 'good' and [ermán-o] 'brother' fail to surface even though the derivational suffix begins with a consonant. However, these forms are lexically listed historical relics of a now unproductive pattern; they do not involve synchronic derivation (see Bermúdez-Otero 2006: 295-6 for details). In addition, these forms have readings which are consistent with √node-based, rather than lexeme-based, derivation (§2.2): [bon-dá δ - \varnothing] can be used to mean 'act of courtesy', and, even more clearly, it is possible to assert without contradiction that two members of an [erman-dáð-Ø] are not [ermán-o-s] to each other. Similar considerations apply to items like [manu-ál] 'manual/nonautomatized/handbook', related to [mán-o] 'hand' (pace Pensado Ruiz 1999: 4461). Also doubtful is the evidential value of extremely rare instances of derivation like [le] '3SG.DAT' → [leísmo] 'nonstandard use of le instead of la' and [máo] 'Mao' → [maoísta] 'Maoist' (Rainer 1993: 96, Santiago Lacuesta and Bustos Gisbert 1999: 4571, Lloret and Mascaró 2006: 82). The base of [leísmo] is a wordform in metalinguistic use; that of [maoísta], a foreign proper name; in neither case is it immediately obvious that the affix attaches to an ordinary stem. 34 Stemfinal vowel deletion thus fully merits its description by Rainer (1993: 96) as 'eine allgemeine morphonologische Regel des Spanischen' [emphasis mine].

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Nadie duda de que si Zinedine Zidane hubiera convertido en gol el soberbio cabezazo que le contuvo Buffon en sensacional atajada, el segundo "craneazo" no se habría producido.

(El País, Montevideo, 20 July 2006)

Observe that, just as in (17) and (23) above, [krane-áθ-o] has both a purely evaluative reading and a reading as a *nomen actionis*. As an instance of the latter, consider the following quotation:

^{&#}x27;Nobody doubts that, if Zinedine Zidane had scored with the splendid headshot which Buffon stopped in a spectacular save, the second "headbutt" would not have taken place.'

The evidence of [krane- $i\theta$ -o] is thus particularly valuable as an example of a pattern that is fully productive synchronically.

Another argument frequently deployed against stem-final vowel deletion builds on the incorrect assumption that the final [Vs] string in nouns like [bírus] and [bríndis] is a thematic element (e.g. Roca 1990: 135). For counterevidence, see note 9 above and Bermúdez-Otero (2007).

Having demonstrated the regularity and generality of stem-final vowel deletion, I shall now redeem the promise prompted by (39) above: to provide an optimality-theoretic formalization that complies with the Indirect Reference Hypothesis as formulated in Bermúdez-Otero (2012a: 77). This requires that reference to nonphonological information in the phonology should be limited to constraints on morphosyntax-prosody alignment. Bermúdez-Otero (2006: 295) showed how the task could be accomplished by means of a gradient alignment constraint that penalized candidates in proportion to the distance, measured in segments, between an initial vowel in a stem-attached suffix and the nearest preceding onset. However, gradient alignment constraints have come under suspicion in the OT literature as being the cause of typological pathologies, and so there has been a trend to replace them with categorical counterparts (e.g. Eisner 1997, McCarthy 2003, Buckley 2009, Hyde 2012). The argument is by no means closed: one need look no further than Spanish to find instances of recalcitrant patterns (Hyde 2008, Hyde and McCord 2012). Be that as it may, the essence of Bermúdez-Otero's (2006: 295) implementation can be preserved in a framework where all alignment constraints are evaluated categorically.

Let us assume that the iterative application of stem-final vowel deletion is prevented by the selfconjoined faithfulness constraint in (47), which is assessed over the smallest possible local domain: a sequence of two adjacent segments (Łubowicz 2002: 248, 260). McCarthy (2003: 81) explicitly states that conjoined constraints do not violate the ban on gradient evaluation.

(47) MAX-V&AdjSegMAX-V

Assign one violation mark if both members of a sequence of two adjacent input vocoids lack output correspondents.

Let us further assume that vowels bearing stress in the input are protected by the following positional faithfulness constraint:

(48) Max- \acute{V}

Assign one violation mark for every foot-heading segment in the input that lacks an output correspondent.

The simplest cases of stem-final vowel deletion, in which the target is immediately preceded by a consonant, can now be handled by means of a categorical version of the alignment constraint posited by Bermúdez-Otero (2006: 295):

(49) ALIGN:_{stem} $[suffix V \rightarrow_{onset}]$

For every vocoid V in the output, such that V has an input correspondent that is initial in a stem-attached suffix, assign one violation mark if the left edge of V does not coincide with the right edge of an onset.

This is demonstrated by the derivation of [tak.sé.ro] (43,b) and [ka.fe.í.to] (45,b) in tableau (51) below. Observe that candidate (b), which turns the stem-final vowel into a glide, fails to satisfy constraint (49) because, in Spanish, a prevocalic glide preceded by a tautosyllabic consonant is syllabified in the nucleus, not in the onset (e.g. Harris 1983: 9-14, Hualde 1991: 479-81).

More difficult cases where the stem-final vowel is preceded by another vowel will in turn be handled by a distance-sensitive, but nonetheless categorically evaluated, version of (49), with the left edge of a syllable as the 'separator category' (Hyde 2012: 791ff):

(50) ALIGN: $^*_{onset}$]...[$_{\sigma}$... $_{stem}$ [$_{suffix}$ V

For every vocoid V in the output, such that V has an input correspondent that is initial in a stem-attached suffix, assign one violation mark if the left edge of a syllable intervenes between the left edge of V and the right edge of a preceding onset.

This constraint, being more specific than (49), is expected to rank higher. The effect of (50) is illustrated with the derivation of [kra.ne.á. θ o] (46,c) in tableau (51): although candidates (g) and (h) both tie on distance-insensitive alignment, and low-ranked MAX-V prefers (g), the distance-sensitive constraint in (50) decides in favour of (h).

(51)							
		IDENT-[high]	$MAX-V\&_{AdjSeg}MAX-V$	Max-Ý	ALIGN:* onset][ostem[suffixV	$ALIGN:_{stem}[suffixV \rightarrow_{onset}]$	MAX-V
	(a) tak.s _{onset}]i.é.ro					*!	
ták.si _{stem}] [suffixer-o	(b) tak.s _{onset}]jé.ro					*!	
	(c) tak.s _{onset}]é.ro			! ! !			*
ka.fé _{stem}] [suffixit-o	(d) ka.f _{onset}]e.i.to					*	
Ka.icstem [suffixIt-0	(e) ka.f _{onset}]í.to			*!			*
	(f) kra.ne.w _{onset}] ά .θο	*!					
krá.ne.o _{stem}] [suffix a θ-o	(g) kra.n _{onset}]e.o. á .θo				*!	*	
Ki a. IIC. Ostem [suffix a O - O	(h) kra.n _{onset}]e. á .θο 🖘					*	*
	(i) kra.n _{onset}]ά.θο		*!	 			**

There is, in sum, no empirical or theoretical obstacle to asserting that it is the phonological process of stem-final vowel deletion that causes nominal and adjectival theme vowels to disappear before stem-attached derivational suffixes. Compared with Harris's account (§2.3), this explanation has the virtue of allowing a unified ontology for theme vowels in all lexical categories, just as in Oltra-Massuet and Arregi's analysis. Compared with the latter, however, our proposal has the added advantage of dispensing with the stipulation that TH has a null exponent precisely when adjoined to n or a but not left-adjacent to # (see (31,a,b) above); stem-final vowel deletion is completely blind to lexical category. Concomitantly, once the underlying distribution of theme vowels is correctly ascertained, their nature becomes considerably less elusive: except for nouns and adjectives of the athematic class, every stem is underlyingly closed by a theme vowel, and so theme vowels may be seen as 'stem formatives' (Bermúdez-Otero 2006: footnote 2, (25); 2007: 236ff) or, to put it differently, as markers of lexemehood.

2.4.1.4. Phonotactic effects of nominal and adjectival theme vowels before deletion

Generalizing the application of stem-final vowel deletion from verbs to nouns and adjectives is elegant, but in stratal-cyclic frameworks it is more: it is necessary. Bermúdez-Otero (2006: 290-1) shows this by means of phonological arguments based on evaluative forms like [swep- $\acute{a}\theta$ -o] 'sleep/dream-AUG-TH $_o$ [M]', derived from [swép-o] 'sleep/dream-TH $_o$ [M]'.

The argument rests on two premises. The first premise states that, in their purely evaluative uses, suffixes like augmentative $[-\dot{a}\theta$ -o] are affiliated to the word level, since they trigger overapplication of diphthongization:

We have already encountered this idea above: recall the discussion of (23) and (37). Section 3 provides further details and extensive discussion.

The second premise relates to the phonotactic constraint that prevents the palatal consonants $[n, \Lambda]$ from occurring in codas, permitting only their alveolar counterparts [n, 1]. Crucially, this constraint must be active already at the stem level. The evidence for this assertion lies in the systematic absence of ordinary e-stem nouns or adjectives with singular forms in $[...n-\varnothing, ...l-\varnothing]$ alternating with plurals in [...n-e-s, $...\Lambda$ -e-s] and with diminutives in

[...p-ít-o, ...\lambda-ít-o] (Bermúdez-Otero 2006: 288-9). If the ban on palatal codas were inactive at the stem level and only came into force later at the word level, then the grammar would generate impossible paradigms like (53,a) alongside the attested options in (53,b) and (53,c).

To see this, consider the behaviour of the hypothetical ordinary e-stem noun /dena Λ -{e, \emptyset }/ in (54), where palatal codas are counterfactually permitted at the stem level.

Under the incorrect assumption that palatal codas are allowed domain-finally at the stem level, the singular form selects the null allomorph of the theme vowel in the first cycle: recall the discussion of ordinary e-stems following (4) above. The ban on palatal codas must however come into effect no later than the word level, since Spanish does not permit [n] or [l] in word-final position—not even when resyllabified before a word beginning with a vowel. Accordingly, the final [l] of the singular will necessarily turn into [l] in the second cycle. In the diminutive form, in contrast, the stem-final palatal generated in the first cycle will be rescued in the second cycle by resyllabification into the onset before the evaluative suffix. The result is unattested (53,a). If, in contrast, palatal codas are banned already at the stem level, the outcome is well-formed, like (53,c).

We are now ready to prove that that the underlying representation of [swep-á θ -o] cannot be [WL [SL sOp] a θ -o], as assumed by Harris, or [WL [SL sOp- \oslash] a θ -o], as suggested by Oltra-Massuet and Arregi; it must be [WL [SL {sop-o, swep-o}] a θ -o], with the theme vowel of the inner stem underlyingly present inside the augmentative suffix and undergoing regular

stem-final vowel deletion in the phonology. ³⁵ Given the facts of depalatalization and diphthongization in Spanish, underlying [WL [SL sOp]] a θ -o] generates ungrammatical *[swená θ o] instead of correct [swepá θ o]:

There is no way of rescuing the underlying representation in (56,a). Attaching /-a θ -o/ at the stem level, rather than the word level, would produce *[sopá θ o]: cf. [sopéra] in (52,a). And, as shown in (54), turning off the phonotactic ban on coda palatals at the stem level would license ungrammatical alternations like (53,a).

Thus, the correct underlying representation of [kwent-ist-a] turns out to be (33,a), not (26,a). More generally, the right account of the underlying distribution of nominal and adjectival theme vowels in Spanish falls under type (22,c), rather than under types (22,a) or (22,b). Even if the latter approaches manage to ensure that theme vowels surface in the right places, they fail to capture significant generalizations holding across verbs, nouns, and adjectives. More decisively, they fail to meet a crucial desideratum: they are incompatible with the proper formulation of phonological generalizations, such as the phonotactics of palatals and the diphthongal alternation, which hold at more abstract levels of representation than the surface (§2.2, first paragraph).

2.4.2. Storing stems

We have established that no Spanish simple stem and no Spanish derivational suffix—whether verbal, nominal, or adjectival—ever enters the phonology without the theme vowel it idiosyncratically selects (§2.4.1, second paragraph). This finding altogether changes the complexion of the coupling question (§2.1, final paragraph). In a storage solution to this question, each simple stem and each stem-deriving suffix has a lexical entry in which the appropriate theme vowel is listed alongside the root or suffix stump. As we saw in the discussion of (30), this approach would be unfeasible if it were true that every noun and adjective stem had two underlying phonological representations: one with the theme vowel, and one without. But we now know that, despite its prevalence in the generative literature, this

The cyclic domain structure of SUEÑAZO will in fact turn out to be slightly richer than shown in (56,b): see section 3.4 below, specially (83,b).

assumption is false. We are therefore free to pursue a storage solution to the coupling question, dispensing with inflectional class features (cf. §2.3).

I therefore propose that simple noun lexemes like MANO have lexical entries like the following:

(57)
$$\begin{cases} 632 \\ \text{SEM} & \lambda x (\mathbf{mano}(x))_{\gamma} \\ \hline & N^{-1}_{[F] \gamma} \\ \text{SYN} & \sqrt{\alpha} & \text{TH } \beta \\ \text{PHON} & [SL & \mathbf{man}_{\alpha} - o_{\beta}]_{\gamma} \end{cases}$$

The entry is identified by an index, here represented by the arbitrarily chosen number 632 (Harley forthcoming, following work by Pfau and Acquaviva); I shall discuss one use of this index in section 3.4 below. The entry itself consists of a series of attributes: semantic (SEM), syntactic (SYN), phonological (PHON), etc. Here we need only be concerned with SYN and PHON; henceforth I shall omit SEM attributes. The information relevant to each grammatical module is stored, in the appropriate representational vocabulary, under a separate attribute (for the precise approach to modularity assumed here, the Four-Hypothesis Program, see Bermúdez-Otero 2012a: 44ff, specially §2.4.1). Crucially, an attribute may consist of a complex representation with internal constituent structure, and relationships of correspondence between constituents of different attributes are expressed by coindexation: in this sense, (57) works exactly like an interface rule in the sense of Jackendoff (2002: 131). The SYN attribute of MANO, for example, consists of a treelet whose top node is specified for syntactic category (noun) and for gender (feminine); in addition, it is annotated with a negative X-bar level, indicating that it is a lexeme rather than a word (Ackema 1995). 36 In turn, the top node dominates two terminals: a root ($\sqrt{}$) and a thematic position (TH). The PHON attribute consists of two concatenated and linearly ordered pieces: /man-/ and /-o/. Postsubscripted Greek letters indicate the relationships of exponence holding between the constituents of SYN and PHON: /man-/ exposes $\sqrt{\ }$, /-o/ exposes TH, and the whole /man-o/ exposes N^{-1} . In addition, the PHON attribute states (redundantly) that /man-o/ is a domain for the stem-level phonology (SL).³⁷

I assume a grammatical framework containing separate modules for word and phrase syntax, along the lines of Selkirk (1982) or Ackema and Neeleman (2004, 2007): see Bermúdez-Otero (2012a: note 38). The representation of word constituents by means of negative X-bar levels is expositorily convenient, but not essential to my argument. Indeed, the N node in the SYN attribute of (57) bears an incomplete set of inflectional features, since it lacks number; this can be regarded as implicitly indicating that (57) is the entry for a lexeme, rather than a word.

Bermúdez-Otero (2012a: §2.3) argues that stem-level expressions are stored nonanalytically, i.e. they are listed with the segmental and prosodic properties assigned to them by the stem-level phonology. In that case, the PHON attribute in (57) will be replaced with the output of a stem-level cycle over /man-o/, i.e. $[_{\omega}$ má.no]. I have omitted

As I noted in section 2.1, Spanish adjectives have two stems, one for the masculine, the other for the feminine: see (14) and (15). I therefore propose that simple adjectives, adjectival suffixes, and evaluative suffixes have two lexical entries each. This is illustrated in (58) with the lexical entries for the adjectival suffix [-ós-o]-[-ós-a]: see (14,b).

I assume that lexical insertion is governed by some implementation of the Elsewhere Condition (Kiparsky 1973: 94). In consequence, the gender specification in the SYN attribute of (58,b) will give precedence to /-os-a/ in feminine environments; elsewhere, including in neuter environments (see note 11), /-os-o/ will be inserted to prevent a gender mismatch. It should therefore be obvious that the two lexical entries of adjectives, adjectival suffixes, and evaluative suffixes are by no means 'morphomic' in the sense of Aronoff (1994): every Spanish adjective has two stems, whose shape is only partially predictable (see below for discussion of this point); but their distribution is transparently motivated by syntax.

Note, in addition, that the PHON attributes in (58) specify, nonredundantly this time, that the adjective stems derived by suffixation of /-os-o/-/-os-a/ define domains for the stem-level phonology. As in (57), the location of this information follows considerations of modularity: since it refers to phonological behaviour, it must be stored in the PHON attribute.

Answering the coupling question in this way, by means of lexical storage, presupposes a stem-driven (or lexeme-driven) approach to morphology: it forces one to reject the idea that the lexicon only lists roots and exponents of functional heads (cf. §2.3); rather, each simple stem and each stem-deriving suffix must be given its own lexical entry. Note, however, that

this idea from the main text in order to facilitate comparison with other theoretical approaches to Spanish morphophonology. See further notes 50, 51, and 54 below.

storing stems is fully compatible with formulating generalizations over them. Thus, a key feature of stem-driven frameworks is the postulation of lexical redundancy rules, which capture generalizations holding over the lexical entries of stored stems, and which kick into generative mode only when an item is not already stored (Jackendoff 1975); Bermúdez-Otero (2012a: §2.3) provides extensive discussion of lexical redundancy rules in phonology, and shows how to implement them in the framework of Stratal OT. In fact, stem storage does not even preclude the existence of lexical entries for acategorial roots, nor is it inconsistent with the formulation of stem-level processes for deriving new stems from those roots. Such entries and processes may very well exist: whether they actually do will depend on whether learners have enough evidence to acquire them, and that may in turn depend both on the nature of the grammatical system and on contingent factors such as the size of the individual's vocabulary. The Semitic languages, for example, appear at first blush to provide more robust evidence for acategorial roots and for processes of root-based derivation than Spanish, where root-based derivation is largely unproductive—although the jury remains very much out even for Semitic: e.g. Bat-El (1994, 2003) pursues an explicitly stem-driven approach to the morphology of Modern Hebrew (see also Ussishkin 2005 and Laks 2009). In Spanish itself, the size of a speaker's vocabulary, and possibly even her level of formal education, may determine the extent to which she is able to derive new lexemes like the verb EMPIRIZAR 'empiricize', infinitive [empir-iθ-á-r], from acategorial roots such as $\sqrt{\text{EMPIR}}$ (see Bermúdez-Otero 2012a: 76-77). In any case, if some semiproductive processes of root-based derivation do exist, their status will be that of lexical redundancy rules.

These considerations prompt a further question: if processes of root-based derivation are at best lexical redundancy rules, how can there be exceptionless generalizations over simple stems and stem-deriving suffixes? Harris's (1991: 35, 46) observations about the exponence of adjectival gender concord in Spanish are a case in point: Harris noted, for example, that feminine adjectives never belong to the *o*-class (see the discussion of (14) above). A root-driven theory might be supposed to have the advantage in accounting for such generalizations: the theory asserts that, as complex objects, all feminine adjectives are grammatically derived rather than simply stored, and so the systematic absence of *o*-stem feminine adjectives would simply reflect the fact that the grammatical rules of Spanish do not generate them. A stem-driven

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The verb EMPIRIZAR does not appear in dictionaries and it is probably absent from the mental lexicon of most Spanish speakers, but it is nonetheless attested: e.g.

^{[...}E]l empirismo está bien cuando uno se propone empirizar, cuando parte de la decisión de uno de ponerse a prueba.

http://firstswimminglesson.blogspot.co.uk/2012/07/te-rompes-la-pierna-por-tres-sitios.html (accessed on 26 August 2012)

^{&#}x27;Empiricism is all well and good when one intends to empiricize, when it arises from one's decision to test oneself.'

theory, in contrast, might be supposed to force us to treat the ban on *o*-stem feminine adjectives as an accidental lexical gap. Yet both suppositions are false.

As we saw in section 2.3, root-driven theories are compelled to use diacritics such as inflectional class features to perform some of the functions of lexical storage in stem-driven frameworks. In consequence, the overall generative capacity of a root-driven grammar depends as much on its inventory of diacritics as on its architecture. Tellingly, Harris's explanation for the absence of *o*-stem feminine adjectives in Spanish relies crucially on an arbitrary stipulation about the inventory of class diacritics:

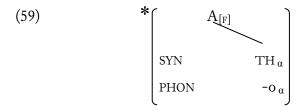
Spanish systematically lacks adjectives ambiguous with respect to gender that have word marker -o. This fact is explained by the proposal that -o is the unmarked case, literally. If there were a lexical diacritic]o parallel to $]\emptyset$ and]a, then adjective stems could bear this diacritic as a lexical peculiarity. [...] The nonexistence of such a diacritic thus has the desired consequences (Harris 1991: 48; emphasis mine).

This account mobilizes no deep principle: it is tantamout to saying, 'The diacritic that would cause this phenomenon to occur could exist but happens not to'. Even more seriously, Harris's arbitrary stipulation about the inventory of diacritics conflicts with the data insofar as it deprives him of a theoretically consistent explanation for the existence of *o*-stem feminine nouns (13,a):

Lexical entries must be provided with a phonological representation for the word marker -o attached to feminine stems: the lexical entry of mano is essentially $[[man]_{\text{stem}} + o]_N$ (Harris 1991: 50; emphasis mine).

Thus, in a single sentence, Harris abdicates the claims of root-driven theory and concedes the fundamental principle of stem-driven frameworks.

As far as the latter are concerned, the existence of exceptionless generalizations over simple stems and stem-deriving suffixes only shows that the stem-level grammar must contain both 'structure-building' processes (subject to blocking by prespecified structure) and 'structure-changing' processes (capable of overwriting lexically specified structure): the former express default patterns; the latter, exceptionless generalizations. This fact is also explicitly acknowledged in root-based theory: see e.g. Halle (1994: 39) for DM. The technical implementation of the distinction between structure-building and structure-changing processes will depend on one's theory of mappings (rule-based, constraint-based, etc). In a Stratal OT account of stem-level phonology, for example, structure-building processes are modelled by means of markedness constraints subordinated to faithfulness; structure-changing processes, by undominated markedness constraints (Bermúdez-Otero 2012a: 19, 32). The same distinction must be implemented in the stem-level morphology. For Spanish adjectives, we need to ensure that an interface rule like (59) operates in structure-changing fashion, feeding something like the default rule in (12):



We have seen that storing stems is fully compatible with formulating a set of stem-level lexical redundancy rules that capture all cognitively real generalizations over them. In this sense, root-driven theories cannot claim an advantage in terms of descriptive adequacy. What distinguishes stem-driven approaches, however, is the postulation of lexical entries for all simple stems, and this hypothesis turns out to enjoy considerable psycholinguistic support. Consider again the case of adjectival inflection. Spanish adjectives inflect for two categories: gender and number. As we saw in (14), the two categories differ dramatically in their means of exponence: number is simply realized by suffixation of /-s/ in the plural, whereas gender is realized by means of theme vowel choice. According to the storage solution to the coupling question, this means that adjectival gender is realized by choosing among stems with separate lexical entries: see (58) above. The analysis therefore entails that adjectives have different lexical entries for the two genders, but not for the two numbers. This, in turn, makes three precise predictions about the effects of token frequency on response latencies in lexical recognition tasks (see e.g. Baayen et al. 2002: 62-63):

- Since the masculine stem /bwen-o/ and the feminine stem /bwen-a/ have separate lexical entries, they should trigger different response latencies, correlated with their respective surface frequencies.
- By the same token, since there is no shared lexical entry for the lexeme BUENO, its cumulative frequency (i.e. the sum of the surface frequencies of the stems /bwen-o/ and /bwen-a/) should have no effect on reaction times.³⁹
- In contrast, the masculine singular word [bwén-o] and the masculine plural word [bwén-o-s] are both derived from the same lexical entry: that of the stem /bwen-o/. Accordingly, reaction times to [bwén-o] and [bwén-o-s] should display an effect of the cumulative frequency of their stem.

All three predictions prove correct:

• Domínguez, Cuetos, and Seguí (1999: 488-90) used a visual lexical decision task to compare masculine-dominant adjective lexemes like CIEGO 'blind' (whose masculine form is more frequent than the feminine) with feminine-dominant adjective lexemes like VIUDO 'widowed' (whose feminine form is more frequent than the masculine). As predicted,

Of course, to say that there is no shared lexical entry for the lexeme BUENO is not to say that the lexeme does not exist; it is to say that it exists as the collection of its interlinked stems. See Boyé (2000) and Boyé and Cabredo Hofherr (2006) for one of many takes on this idea.

reaction times to <ciego> were shorter than to <ciega>, whereas reaction times to <viudo> were longer than to <viuda>.

- Domínguez, Cuetos, and Seguí (1999: 490-1) also found that masculine forms with similar surface frequencies, like <culto> 'cultivated.M' and <bello> 'beautiful.M', triggered similar response latencies, with no effect of the surface frequency of the corresponding feminine forms: low in the case of <culta>, high in the case of <bella>. Thus, the different cumulative frequencies of the lexemes CULTO and BELLO had no effect on reaction times to their masculine forms, exactly as predicted.
- In turn, Domínguez, Cuetos, and Seguí (2000: 394) studied pairs of noun forms like {<dama> 'lady.SG', <dedo> 'finger.SG'} and {<ratos> 'while.PL', <botas> 'boot.PL'}. Within each pair, the two forms are matched for number and for surface frequency; but the first belongs to a singular-dominant lexeme (DAMA, RATO), whereas the second belongs to a plural-dominant lexeme (DEDO, BOTA). As expected, subjects reacted more slowly to singular <dama> than to singular <dedo>, despite their identical surface frequencies, because plural <damas> has lower surface frequency than plural <dedos>, and so overall cumulative frequency is lower for the stem /dam-a/ than for the stem /ded-o/. Similarly, plural <ratos> was recognized faster than plural <botas>, despite having the same surface frequency, because singular <rato> is more frequent than singular <bota>, and so the stem /rat-o/ has higher cumulative frequency than the stem /bot-a/.

I conclude that there is no internal evidence against, and there is good external evidence for, the hypothesis that the Spanish lexicon contains entries for each simple stem and stem-deriving suffix. The coupling question (§2.1, final paragraph) can therefore be solved simply by storing the appropriate theme vowels alongside roots and suffix stumps; when the theme vowel fails to surface, the explanation is supplied by an independently motivated phonological process of stem-final vowel deletion (§2.4.1). *Pace* Aronoff (1994: 67-72), therefore, Spanish nouns and adjectives do not provide reliable evidence for the existence of purely morphological primitives of representation in the shape of inflectional class features (cf. §2.3).

3. Stem storage solves the problem of the missing cycle in the diphthongal alternation

Une difficulté est une lumière. Une difficulté insurmontable est un soleil. Paul Valéry

3.1. Lexical storage and locality conditions on allomorphy

So far I have accomplished only one half of my task: I have demonstrated that stem storage provides a viable approach to the grammar of Spanish theme vowels (§2.4), but I have yet to prove that this account is superior to a root-driven one (cf. §2.3). As always, conceptual considerations alone fail to settle the matter: faced with lexical redundancy rules, the

proponents of root-driven theories may well retort that dispensing with inflectional class features at such a cost constitutes a false economy. The effects of surface and cumulative frequencies on recognition latencies do lend empirical support to stem storage, but the adherents of root-driven frameworks may cite the limitations of this experimental paradigm, adducing difficulties in the interpretation of the evidence (e.g. Domínguez, Cuetos, and Seguí 2000: 397-8; Eddington 2004: 139; Clahsen and Neubauer 2010: §6.1). Indeed, just three minor modifications to Oltra-Massuet and Arregi's analysis suffice to generate the correct underlying and surface distributions of theme vowels as established in section 2.4.1:

- (i) replacing F with $x = \{v, n, a\}$ in the TH adjunction rule (28);
- (ii) dropping the stipulation that a TH position adjoined to n or a has a null realization unless left-adjacent to # (31);
- and (iii) adding a rule of stem-final vowel deletion to the phonological derivation.

Advocates of mainstream DM may wish to draw the line here, otherwise continuing to rely on inflectional class features rather than stem storage as their preferred solution to the coupling question.⁴⁰

A tolerably convincing argument for a stem-driven approach to Spanish morphology will therefore need to show that it can beat root-driven theories on their home ground. In an important recent contribution, for example, Embick (2010) asserts that mainstream DM allied to Phase Theory succeeds in accounting for locality conditions on suppletive allomorphy better than other frameworks, including Stratal OT. It will consequently be a result of some significance if it turns out that Stratal OT allied to a stem-driven theory of morphology makes more accurate predictions about the local domains for allomorph selection in Spanish than root-driven DM. Section 3 shows that this is precisely the case.

The argument capitalizes on the fact that both DM and Stratal OT rely on cyclic derivations to define the local domains in which allomorphs are chosen. This strategy establishes a close connection between the size of stored exponents and the size of domains for allomorph selection: a theory that posits allomorphs of root size predicts that the choice between them will take place in the smallest cyclic domains, triggered by √node-to-lexeme derivation; ⁴¹ a theory that posits allomorphs of stem size predicts that selection will occur in larger cyclic domains defined by lexeme-based operations. The evidence of the Spanish diphthongal alternation, which we have already encountered at several points (e.g. (52)), supports the latter position.

⁴⁰ I say 'mainstream DM' because there are versions of the theory that countenance a form of stem storage: see e.g. Siddiqi (2009).

Some proponents of DM (e.g. Marantz 1995, Embick and Halle 2005: 41) deny the existence of root allomorphy and assert that only functional items can have suppletive exponents. This claim is unfalsiable when upheld through the completely unconstrained use of readjustment rules; otherwise it is false: see e.g. Bermúdez-Otero (2012a: 80), Harley (forthcoming: §2.1), and Haugen and Siddiqi (forthcoming: §2.1). For DM's loss of empirical content through the use of unconstrained phonological devices, see further §4.3 below.

The case for this assertion will unfold as follows. Section 3.2 shows that the diphthongal alternation involves phonologically driven allomorph selection by output optimization: within stem-level domains, the distribution of the alternating vowels tracks a derived phonological property (stress), but participation in the alternation itself and the quality of the monophthongal alternant are both lexically controlled. Section 3.3 shows that, when embedded in a root-driven framework, this approach to the diphthongal alternation incurs a problem first encountered by analyses in rule-based Lexical Phonology (Harris 1989b: 345, Cole 1995: 95), and which has since lain unsolved. This can be illustrated with stem-based deverbal derivatives like $[\![N]\![V]\!]$ kont-a $[\![N]\!]$ 'counter'; cf. $[\![kw\acute{e}nt-a]\!]$ 'count/tell.3sG'. If it were the case that the stem-level phonology chooses between two allomorphs of the acategorial root $\sqrt{\text{Cont}}$, then we would expect the choice to be made in the first phonological cycle, triggered by root-to-stem derivation; but this yields ungrammatical *[kwentaðór].

(60) a. cyclic domain structure
$$\begin{bmatrix} \text{SL} & \text{SL} & \text{koNt} \\ \text{kweNt} \end{bmatrix} - a \end{bmatrix} \text{ dor} - \begin{bmatrix} \varnothing \\ \text{e} \end{bmatrix} \end{bmatrix}$$
b. first cycle
$$\text{kwén.ta}$$
c. second cycle *kwen.ta.dór

The problem cannot be solved by stipulating that stress assignment does not reapply cyclically in stem-level domains, as suggested by Harris (1995: 879), because other stem-based deverbal derivatives do show the expected cyclic transfer of properties dependent on the stress assigned in the first cycle, such as the syllabification of high vocoids in hiatus: e.g. [am.plí.a] 'extend.3SG' ~ [am.plí.á.βle] 'extendable', cf. [lím.pja] 'cleanse.3SG' ~ [lim.pjá.βle] 'cleanable'. In section 3.4, however, we will see that the problem vanishes if, as predicted by lexeme-driven frameworks, the diphthongal alternation involves a choice between stem allomorphs: in this case between two stems of the verb CONTAR, namely /koNt-a/ and /kweNt-a/. This is because stem selection takes place in the second phonological cycle, triggered by derivation from the verb:

(61) a. cyclic domain structure
$$\begin{bmatrix} SL & koNt-a \end{bmatrix} & dor - \begin{cases} \emptyset \\ e \end{bmatrix} \end{bmatrix}$$
b. first cycle
$$\begin{cases} k\acute{o}n.ta \\ kw\acute{e}n.ta \end{cases}$$
c. second cycle
$$kon.ta.d\acute{o}r$$

The accuracy of this solution will be demonstrated with a detailed analysis of the subtle contrast between deverbal [eŋkontrón] 'abrupt meeting' and denominal [eŋkwentrón] 'major sports meeting' presented in (37) above. Section 3.5 concludes the argument by deducing one

further prediction from stem-driven theory: if stored allomorphs are of stem size, rather than root size, then allomorphy itself is a property of lexemes, not $\sqrt{\text{nodes}}$, and so it should be possible for the allomorphic behaviour of lexemes descending from the same root to become decorrelated. This proves correct. For example, unlike the verb [kont-á-r] (3SG [kwént-a]), the noun [kwént-o] no longer participates in the diphthongal alternation: cf. denominal [kwent-íst-a] and [kwent-ér-o] 'story teller'.

3.2. The diphthongal alternation as phonologically driven allomorph selection

As we have already seen in (23), (37), and (52), many Spanish lexical items exhibit an alternation between the mid vowels [e, o] and the diphthongs [jé, wé]: see (62) for further examples.

(62) a.	[pley-á-r]	'fold.INF'	[k o nt-á-r]	'count/tell.INF'
	[pley-á-mos]	'fold.1PL'	[k o nt-á-mos]	'count/tell.1PL'
	[pley-a-ŏór-∅]	'(one) that folds'	[kont-a-ðór- \varnothing]	'counter'
	[pley-á-βl-e]	'foldable'	[k o nt-á-βl-e]	'countable' / 'accountant'
	[pl jé y-o]	'fold.1sg'/'fold'(N)	[k wé nt-o]	'count/tell.1sG' / 'tale'
	[pljéy-a]	'fold.3sG'	[k wé nt-a]	'count/tell.3sG' / 'sum'(N)
b.	[sent-í-r]	'feel.INF'	$[k\mathbf{o}\theta$ -é-r]	'boil.INF'
	[sent-í-mos]	'feel.1PL'	$[k\mathbf{o}\theta$ -é-mos]	'boil.1PL'
	$[sent-i-\delta \acute{o} r-\varnothing]$	'that feels or can feel'	$[k$ o θ-e-δόr- $\emptyset]$	'boiler'
	[s jé nt-e]	'feel.3sG'	$[k\mathbf{w}\acute{\mathbf{e}}\theta$ -e]	'boil.3sG'
c.	[tend-ér-o]	'shoopkeeper'	[p o rt-ér-o]	'doorman'
	[t jé nd-a]	'shop'	[pwért-a]	'door'
d.	[dent-ál-∅]	'dental'	[m o ɾt-ál-∅]	'mortal'
	[d jé nt-e]	'tooth'	[m wé rt-e]	'death'
e.	[ser-án-o]	'from the mountains'	[beneθ o l-án-o]	'Venezuelan'
	[s jé r-a]	'mountain range'	[bene θ wél-a]	'Venezuela'
f.	[θ e γ-eδάδ-Ø]	'blindness'	[n o β-eδáδ-Ø]	'novelty'
	$[\theta \mathbf{j} \mathbf{\acute{e}} \mathbf{\acute{y}} - \mathbf{o}]$	'blind'	[n wé β-o]	'new'

The alternation is phonologically conditioned insofar as the diphthongs appear in tonic syllables and the pure mid vowels occur elsewhere. As noted in section 2.2, and as further illustrated by the examples in (52), the domain of this phonological generalization excludes word-level suffixes. The additional data in (63) reveal that, alongside diminutives and augmentatives in their purely evaluative (not category-determining) use, this set of affixes

includes the superlative marker [-ísim-o] and the first-conjugation circumfix [a-...-á-r], which derives causative change-of-state verbs from nouns and adjectives. The blindness of the diphthongal alternation to the causative circumfix is extremely significant: it refutes attempts to reduce the distinction between stem-level and word-level affixes to a contrast between category-giving and adjunct status (cf. Newell 2005, Bachrach and Wagner 2006).

Within stem-level domains, however, the stress-driven pattern holds with impressive regularity. In these domains, moreover, stress itself is often phonologically derived. We have seen that many Spanish words have nondefault stress contours reflecting underlyingly prespecified metrical structure (§2.4.1.2). Indeed, one of the possible analyses of verb stress asserts that the theme vowel allomorphs and person-and-number markers found in presenttense forms are underlyingly specified with foot structure: see again the discussion of (41). Even in this case, however, information about which underlying accents (if any) survive in complex inflected forms is only available in the output of the stem-level phonology: recall that possible (e.g. underlying accents in roots systematically overriden *[v are 'supplicate.3SG.PRS.IND', but [N súplik-a] 'supplication'). Thus, instances of the diphthongal alternation within the present, such as [pljéya] 3SG ~ [pleyámos] 1PL and [kwénta] 3SG ~ [kontámos] 1PL, indicate that the pattern is sensitive to a derived phonological property.

In all other respects, however, the diphthongal alternation is lexically idiosyncratic. This idiosyncrasy manifests itself in at least four ways. First, the stressed correspondents of unstressed [e, o] need not be diphthongal: Spanish phonology allows [é, ó] in tonic syllables.

Secondly, the unstressed correspondents of stressed [jé, wé] need not be pure vowels: Spanish phonology allows [je, we] in nontonic syllables.

Thirdly, if stressed [jé] or [wé] has monophthongal correspondents in unstressed syllables, the quality of the monophthong is unpredictable. Although the predominant alternation patterns are [jé]-[e] and [wé]-[o], they are not the only ones: occasionally, [jé] alternates with [i], and [wé] with [u].

Fourthly, the frequency of unstressed [je, we] is relatively low in tautomorphemic environments, but it is still the case that morpheme-internal [je] and [we] are permitted in nontonic syllables even when they lack stressed correspondents or when stressed vowels in related lexical items are pure:⁴²

Thus, whether a lexical item participates in the diphthongal alternation and, if it does, what quality the monophthong will display are both arbitrary lexical facts.

In consequence, Bermúdez-Otero (2006: 285) described the diphthongal alternation as an instance of phonologically driven allomorph selection by output optimization (e.g. Tranel 1996, 1998; Kager 1996, 2009: 420ff; Mascaró 1996, 2007; Rubach and Booij 2001). ⁴³ In this account, the lexicon supplies two listed allomorphs for alternating items: one containing a pure vowel, the other containing a diphthong. The morphology inserts both allomorphs at the appropriate place in the underlying representation, with an instruction for the phonology to resolve the disjunction. In the phonology, low-ranking markedness constraints, otherwise inactive owing to their subordination to faithfulness, kick into action, so that there emerges a

⁴² Instances of unstressed [je] and [we] arising from morpheme concatenation can be found in great profusion: e.g. seri-o [sé.rjo] 'serious' ~ seri-edad-Ø [se.rje.δάδ] 'seriousness', vari-o [bá.rjo] 'various' ~ vari-edad-Ø [ba.rje.δάδ] 'variety', etc; ambigu-o [am.bí.γwo] 'ambiguous' ~ ambigü-edad-Ø [am.bi.γwe.δάδ] 'ambiguity', antigu-o [an.tí.γwo] 'antique' ~ antigü-edad-Ø [an.ti.γwo] 'antiquity', etc.

This should be distinguished from phonologically driven allomorph selection by input subcategorization. *Pace* Paster (2006), Bye (2007), and Embick (2010), both exist: see e.g. Lapointe (2001), Nevins (2011), and Bermúdez-Otero (2012a: 52).

preference for diphthongs in tonic syllables and for monophthongs in nontonic syllables. The avoidance of the diphthongal alternant in unstressed positions is plausibly analysed as driven by a context-free markedness constraint against complex nuclei: *COMPLEXNUC. In turn, the avoidance of the monophthongal alternant in stressed syllables can be interpreted as a sonority effect, on the likely assumption that diphthongs are more sonorous than pure vowels: crosslinguistically, low-sonority nuclei are disfavoured as designated terminal elements of feet (i.e. *PEAKFOOT/i,u \gg *PEAKFOOT/e,o \gg ...; see Kenstowicz 1997: 162). This is illustrated in tableau (68), which represents the phonological evaluation that takes place in the second cycle of the derivation of [kontadór], shown in (61).

(68)						
				IDENT	* PEAK $_{ m FOOT}$ /e,o	*COMPLEXNUC
		kón.ta - dor	kon.ta.dór 🖘		(*)	
	ſkón.ta] ,	Kon.ta - doi	kwen.ta.dór	*!	(*)	*
	{kwén.ta} -dor	kwén.ta - dor	kon.ta.dór	*!	(*)	
		Kweii.ta - dor	kwen.ta.dór		(*)	*!

This analysis is fully compatible with the observation that native speakers of Spanish make statistically informed guesses as to whether a lexical item will participate in the diphthongal alternation or not: see Eddington (2004: §6.1) for a survey of the literature, including Bybee and Pardo (1981) and Albright et al. (2001). Such probabilistic behaviour is commonly observed in deneutralization experiments (Nevins and Vaux 2008), and can plausibly be imputed to pattern association in a dual-route model of grammar (e.g. Prasada and Pinker 1993, Clahsen 1999, Pinker 1999, Ullman 2001, Pinker and Ullman 2002). The same phenomenon is observed, for example, in the equally lexically idiosyncratic 'raising' alternation, found in a subset of third-conjugation verbs whose roots display [i] unless the thematic element is realized as stressed [i], in which case the root has [e]: e.g. (36,f) above (see Harris 1969: 110-2). Linares et al. (2006) carried out a deneutralization experiment on third-conjugation nonce verbs and found that family resemblance with existing raising verbs determined the likelihood that a test item would participate in raising. Crucially, the analysis of the raising alternation as involving selection between suppletive stems also explains Linares et

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For the sake of expository clarity, in (68) I ignore the allomorphy of the theme vowel of the derivational suffix, which belongs to the ordinary e-class. I shall do this whenever convenient in the remainder of the discussion.

al.'s finding that stimuli containing the wrong root vowel elicit event-related potentials (ERPs) characteristic of lexical (as opposed to combinatorial) violations. Note, incidentally, that the type of stochastic behaviour produced by pattern association differs qualitatively from the application of knowledge encoded in lexical redundancy rules (§2.4.2): the refined dual-route framework outlined in Bermúdez-Otero (2012a: 41-43) incorporates this distinction.

The generative literature contains many attempts to analyse the diphthongal alternation as regular phonology, rather than as phonologically driven allomorph selection. All of them rely on excessively powerful devices that undermine the empirical content of phonological theory. In section 4.3 below I discuss the proposals made by Harris (1985a) and Halle et al. (1991): their account depends on the diacritic use of prosody, rampant extrinsic rule ordering, and a ruinously diluted concept of phonological cyclic domain.

3.3. Allomorph selection in root-driven morphology: the problem of the missing cycle

We have seen that the analysis of the diphthongal alternation as allomorph selection driven by output optimization in the stem-level phonology is well supported by both internal and psycholinguistic evidence. When embedded in a root-driven morphological framework, however, this analysis encounters a serious problem.

The difficulty arises over the fact that the stem-level phonology is internally cyclic. In other words, stem-level phonological processes display cyclic reapplication: they apply iteratively over a hierarchy of domains defined by recursively embedded stem-level morphosyntactic constituents. Remarkably, all stratal models of phonology agree on this one point, ⁴⁵ even if they disagree on other fundamental principles: see for example Booij and Rubach (1987) for a stratal theory that is rule-based and interactionist, Halle and Vergnaud (1987) for a rule-based noninteractionist framework, and Kiparsky (2000) for a constraint-based interactionist one. ⁴⁶ Empirical evidence for cyclic reapplication in the stem-level phonology of Spanish will be provided later in this section. Moreover, all cyclic phonological frameworks, crucially including those inspired by Phase Theory (e.g. Marvin 2002, Embick 2010), agree that roots do not

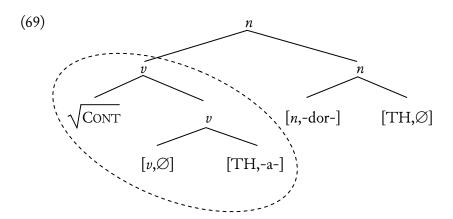
There is less discussion of why cyclic reapplication is lexically irregular for some stem-level phonological processes, and of why for others the effects of reapplication are completely invisible. Similarly, few practitioners attempt to explain why the stem level should be internally cyclic, when the word and phrase levels are not. For answers to both questions, see Bermúdez-Otero (2012a: 19-20, 31-40; 2012b). Phase-theoretic approaches to the origins of phonological cyclicity fail because the derivational cycles assumed by Minimalist syntax are grossly mismatched with the cycles motivated by phonological evidence: see Scheer (2011) for a defence of Phase Theory that engages seriously with this issue.

A cyclic architecture is said to be noninteractionist if all syntax (i.e. syntax both below and above the word node) precedes all phonology; it is interactionist if syntax and phonology are interleaved, the former preceding the latter only locally within each cycle. Kaisse and Hargus (1993: §2.2) and Scheer (2011: 127ff) review the phonological side of the debate.

define phonological cyclic domains, but operations of √node-to-lexeme derivation do trigger cycles (e.g. Kiparsky 1982b: 144-45, 1982a: 32-33; Inkelas 1989: §3.5.5; 2006: 283; etc).

It follows that the deverbal noun $[N] [V] kont-a] \delta \acute{o}r-\varnothing]$ undergoes two applications of the stem-level phonology: the first over the inner verb stem, the second over the derived noun stem. We know independently that the verb CONTAR participates in the diphthongal alternation (cf. $[kw\acute{e}nt-a] 3SG \sim [kont-\acute{a}-mos] 1PL$), and that the alternation involves allomorph selection in the stem-level phonology. All of this leads to the following question: in which of the two cycles of the stem-level phonology triggered by $[N] [V] kont-a] \delta \acute{o}r-\varnothing]$ does allomorph selection take place?

As a matter of principle, root-driven theories of morphology must answer: 'in the first cycle'. Recall that root-driven theories restrict lexical storage to exponents of acategorial roots and of functional heads (§2.3). This entails that, if the diphthongal alternation involves two allomorphs, these can only be exponents of the acategorial root $\sqrt{\text{CONT}}$: i.e. /koNt-/ and /kweNt-/. The disjunction will therefore be resolved in the first cycle, triggered by derivation of the verb lexeme CONTAR from the root $\sqrt{\text{CONT}}$. In phase-theoretic DM, this first cycle computes the phonological form of the structure circled in (69).



Yet, as shown in (60), repeated below as (70), the predictions of root-based theory are inconsistent with the facts.

(70) a. cyclic domain structure
$$\begin{bmatrix} \text{SL} & \text{SL} & \text{koNt} \\ \text{kweNt} \end{bmatrix} - a \end{bmatrix} \quad \text{dor} - \begin{bmatrix} \varnothing \\ \text{e} \end{bmatrix} \end{bmatrix}$$
b. first cycle
$$\text{kwén.ta}$$
c. second cycle *kwen.ta.dór

In the first cycle, stress falls regularly on the root: cf. (41,a). This favours the diphthongal alternant, yielding ungrammatical *[kwentaŏór]. Assuming that the diphthongal alternation involves regular derivation from an abstract vowel /O/, rather than allomorph selection, will not by itself solve the problem: as long as the putative diphthongization rule applies at the stem

level, it will still produce the same incorrect result (see §4.3 for further discussion). In addition, it is impossible to turn stress assignment off in the first cycle: see (75) below for independent evidence that metrification reapplies cyclically.

The problem faced by root-driven theories, then, is this: positing allomorphs of root size for lexical bases predicts that allomorph selection will be a first-cycle phenomenon, but in the Spanish diphthongal alternation the effects of the first cycle are mysteriously absent. Henceforth I shall refer to this as THE PROBLEM OF THE MISSING CYCLE. My claim is that the problem of the missing cycle shows root-driven theory to fail at its self-imposed task of defining correct local domains for allomorph selection. ⁴⁷

Awareness of the problem raised by (70) can be traced back a long way in the literature on Spanish phonology. Unfortunately, the debate has lain dormant since the rise of OT: this is not surprising, for the problem of the missing cycle is one of excessive locality, whereas the characteristic weakness of mainstream noncyclic OT is unbridled globality (see §4.2). In the late 1980s and early 1990s, however, sensitivity to the significance of the puzzle was acute. Harris (1989b: 345) provides a characteristically pithy summary: 'if verb and noun stems are stress domains, then Diphthongization is not cyclic'. In the terminological usage of the time, 'is not cyclic' meant 'does not reapply cyclically within the stem level'; but this conclusion directly conflicted with evidence such as (52) and (63), which indicated that the alternation could not be word-level. Cole (1995: 95) went further and used the problem of the missing cycle to impugn cyclic theory as a whole:

Although the formalism employed in this analysis gives rise to word structures with multiple, nested cyclic domains, only the stress assigned to the outermost domain can trigger Diphthongization. These data do not provide evidence for the sequential derivation of cyclic domains; in fact, all the surface forms can be derived with cyclic stress assignment in the final cyclic domain alone [sc. with stem-level stress assignment in the largest stem-level domain alone].

Cole's argument from Spanish is overstated, however, because she relies on the facts of the diphthongal alternation alone. These, as she points out, fail to provide evidence for the inner

cycle in (70); but other data from Spanish phonology confirm that stress assignment does reapply cyclically over nested stem-level domains.⁴⁸

Notably, a sequence consisting of a high vocoid followed by a more sonorous vowel, e.g. /Ia/, is obligatorily syllabified in hiatus if the high vocoid bears stress: i.e. [í.a], not *[ía]. Otherwise, the default realization for such a string is diphthongal: i.e. [ja] or [já].

(71)	a.	Stressed high 1	$vocoid \rightarrow biatus$	b.	Unstressed hig	$b \ vocoid \rightarrow diphthong$
		[am.plí.a]	'extend.3sG'		[ám.plja]	'ample.F'
		[a.βa.δí.a]	ʻabbey'		[a.βa.θjál]	'abbey-related'
		[dí.a]	'day'		[dja.yo.nál]	'diagonal'

The default pattern in (71,b) does not hold across the board. First, there are exceptional instances of hiatus with nonalternating unstressed [i] in morpheme-internal environments. Such nonalternating tautomorphemic exceptional hiatus is highly restricted in its distribution: the high vowel almost always occupies the first syllable in the word, and stress falls no further away than the second or third syllable (Hualde 1999: 191, Cabré and Prieto 2006: 211-2). Thus, the following contrasts (both reported by Hualde as being present in his idiolect) are representative:

(72)	default diphth	ong	exceptional hiatus				
	[bjá.xe]	'travel'	[mi.á.xa]	'crumb'	(Hualde and Prieto 2002: 219)		
	[dja.mán.te]	'diamond'	[di.a.ɣɾá.ma]	'diagram'	(Hualde 1999: 190)		

Even in this narrow word-initial environment, however, nonalternating tautomorphemic exceptional hiatus is unstable. The syllabification of words like (72) displays a great deal of variation within and across speakers: see Cabré and Prieto (2006: 213) for quantitative data from fifteen informants from the Iberian Peninsula.

The default syllabification pattern for unstressed high vocoids is also disrupted—but this time very systematically—in heteromorphemic environments. Consider, for example, inflected forms of first-conjugation verbs and deverbal $[-\beta l-e]$ adjectives derived from first-conjugation bases (Cabré and Ohannesian 2009). We know that expressions of these types belong to the stem level because they exhibit normal application of the diphthongal alternation: recall triads like $[plj\acute{e}\gamma-a]$ ~ $[pley-\acute{a}-mos]$ ~ $[pley-\acute{a}-\beta l-e]$ and $[kw\acute{e}nt-a]$ ~ $[kont-\acute{a}-mos]$ ~ $[kont-\acute{a}-\beta l-e]$ in (62,a). Here we are particularly interested in instances where the verb stem consists of a root ending in a high front vocoid followed by the first-conjugation theme vowel:

In addition, the analysis provided in section 3.4 suggests that Cole's diagnosis is imprecise in yet another way. In the passage just cited she suggests that the diphthongal alternation is sensitive to the stress contours assigned in the **last** cycle of the stem-level phonology. The correct generalization is that it is conditioned by stress assignment in the **second** cycle.

(73)	a.	[lím.pja]	'clean.3SG'	b.	[lim.pjá.mos] [lim.pjá.βle]	'clean.1PL' 'cleanable'
(74)	a.	[am.plí.a]	'extend.3SG'	b.	[am.pli.á.mos] [am.pli.á.βle]	'extend.1PL' 'extendable'

If stress falls to the left of the root-final high vocoid, the latter is obligatorily tautosyllabified with the theme vowel (73,a). In turn, when the addition of an inflectional marker or a derivational suffix shifts stress onto the theme vowel, the diphthong predictably remains (73,b). If the verb stem bears stress on the root-final high vocoid, there is obligatory hiatus with the theme vowel (74,a). In such cases, however, the hiatus also remains when inflection or derivational suffixation causes stress to migrate to the right (74,b): this results in a systematic violation of the default syllabification pattern shown in (71,b).

Harris (1969: 122-4) plausibly suggests that the contrast between the 3SG forms [lím.pja] and [am.plí.a] reflects an underlying contrast between the vowel /i/ and the glide /j/. On this assumption, both forms display regular stress on the penultimate vowel of the stem, with /j/ crucially not counting as a vowel:

However, Harris (1995: §4.1) goes further, claiming that the phonemic opposition between /i/ and /j/ also directly triggers the pretonic syllabification contrast in forms like the 1PL:

Yet, as highlighted by the double question mark in (76), this claim is untenable because it directly conflicts with the evidence of high vowels that lack stressed correspondents. In the absence of a tonic alternant, an unstressed high vowel can withstand gliding before a more sonorous tautomorphemic vowel only in the first syllable of the word, and even then only variably: see the discussion of (72). The root-final vowel in underlying /aNpli-a-mos/ does not meet this word-initiality requirement. In a one-cycle derivation like (76), therefore, the outcome should be ungrammatical *[am.pljá.mos]. Thus, the fact that [am.pljá.mos] and [am.pljá.gle] display invariable hiatus between two noninitial syllables can only be explained as

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The precise representation of this contrast need not concern us here. Roca (1997) makes an interesting case for a prosodic representation, involving a prespecified nucleus projection for /i/, rather than a melodic one, involving distinctive features.

an effect of first-cycle stress in the stem [am.plí.a]; specifying the root-final high vocoid as a vowel underlyingly is not enough. The true course of the derivation is therefore as follows:⁵⁰

(77)
$$UR$$

$$\begin{bmatrix} SL & SL & IiNpj-a & mos \end{bmatrix} \qquad \begin{bmatrix} SL & SL & aNpli-a & mos \end{bmatrix}$$

$$first \ cycle \qquad \qquad lim.pja \qquad \qquad am.pli.a$$

$$second \ cycle \qquad \qquad lim.pjá.mos \qquad \qquad am.pli.á.mos$$

Accordingly, CONTABLE too must undergo two cyclic rounds of stress assignment at the stem level. Yet, in a root-driven framework, a two-cycle derivation generates ungrammatical *[kwen.tá.βle]: cf. (70). In this sense, both Cole (1995: 95) and Harris (1995: 879) misrepresent the problem of the missing cycle. It is simply untrue that Spanish fails to display traces of the cyclic reapplication of stem-level stress assignment: the systematic hiatus between [i] and [á] in [am.pli.á.βle] is precisely such a trace. The conundrum lies, rather, in the fact that the expected effects of first-cycle stress are absent in the case of the diphthongal alternation. To do it full justice, therefore, the problem of the missing cycle should be stated as follows:

(78) Why is the stress-conditioned hiatus of [amplía] cyclically transmitted to deverbal [amplíaβle], whereas the stress-conditioned diphthong of [kwénta] is not cyclically transmitted to deverbal [kontáβle]?

This formulation gets us closer to the heart of the matter: the true culprit is not the theory of the cycle; it is root-driven morphology.

According to Bermúdez-Otero (2012a: §2.3), the output of the first cycle, i.e. [am.plí.a], where the unstressed theme vowel has become phonologically fused to the root, is returned to the lexicon and stored nonanalytically in the entry for the lexeme AMPLIAR (see notes 37 and 54). In this framework, therefore, the imperfect is derived from a base whose internal structure has become opaque. This renders the overwriting effect in (vii) perfectly natural. Another salient case of theme vowel overwriting in the conjugation of Spanish verbs can be found in the present subjunctive: see Harris (1969: 71-72) and Bermúdez-Otero (2008: §24-§26).

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The stress-driven hiatus of the bare stem [am.plí.a] is also cyclically transmitted to imperfect forms, e.g. [am.pli.á. β a.mos] 1PL.PST.IPFV.IND, despite the fact that the latter contain an underlyingly accented theme vowel: see the discussion of (41,b) above. This datum suggests that the derivation of the imperfect proceeds as in (vii) below: in the second cycle, the accented theme vowel of the imperfect overwrites the stressless theme of the plain stem through the regular application of phonological stem-final vowel deletion.

3.4. The solution: selecting stems, not root allomorphs

As we saw in section 2.4.2, both root-driven and stem-driven theories of morphology provide mechanisms to capture cognitively real generalizations over stems. The key difference lies in the size of the stored exponents of lexical bases: in root-driven theory, they are maximally of root size; in stem-driven theory, they are of stem size. These two assumptions make different predictions about local domains for allomorph selection. Root-driven theory predicts that, for lexical bases, allomorph selection is a first-cycle phenomenon associated with root-to-lexeme derivation (§3.3). The situation is altogether different in stem-driven theory: each stored stem goes through the first cycle of the derivation on its own; ⁵¹ if there is competition between stems, it is resolved in the second cycle, triggered by a lexeme-based operation. In the case of the Spanish diphthongal alternation, the predictions of root-driven theory fail, incurring the problem of the missing cycle (78). In contrast, stem-driven theory yields the right result, as shown by the derivation of [kontaŏóɾ] in (61), repeated below as (79).

Comparing (70) with (79) shows where the issue lies: locality is good (cf. §4.2), but, as in the story of Goldilocks, it has to be just right; the local domains for allomorph selection generated by root-driven theory are too narrow.

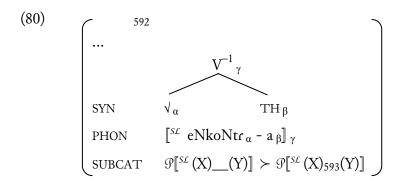
To complete a stem-driven analysis, it only remains to ensure that the diphthongal alternation cannot see word-level suffixes: see (52) and (63). This is a language-particular fact. In Romanian, for example, even diminutives have access to bound stem allomorphs of nouns. Thus, for prosodic reasons, the diminutive of Romanian [val] 'wave.SG' selects the augmented stem allomorph also found in the plural form [[val-ur] i]: this yields [[val-ur] él] 'wave.DIM.SG' (Steriade 2008: 343). Since the restriction of the Spanish diphthongal alternation to stem-level domains is a language-particular fact, ⁵² it calls for a language-particular account, rather than one based on architectural principle.

The most natural place in which to seek such an account is the instruction in the lexical entry of a stem that causes it to engage in phonologically driven competition with another stem. I propose that the instruction should be recorded in a morphological attribute

If the proposals made in Bermúdez-Otero (2012a: §2.3) are correct, the results of this cycle are returned to the lexicon and stored nonanalytically in the stem's lexical entry: see notes 37, 50, and 54.

I discuss its likely diachrony origins in section 3.5 below.

(cf. §2.4.2), which I shall label SUBCAT. Thus, a verb that participates in the diphthongal alternation, such as ENCONTRAR 'find', will have two stems, and their lexical entries will look as follows:



As in (57), the PHON attribute of the entry for /eNkoNtr-a/ in (80) redundantly states the fact that the stem defines a domain for the stem-level phonology; the same is true for /eNkweNtr-a/ in (81). The SUBCAT attribute of /eNkoNtr-a/ also states, now nonredundantly, that this stem subcategorizes for a phonological cyclic domain [(X)_(Y)], possibly containing other material, such that applying the stem-level phonological function \mathcal{P}^{sx} to this domain produces a more harmonic output than doing the same with the stem /eNkweNtr-a/. The latter is referred to by means of its index: here, the arbitrarily chosen number 593. The SUBCAT attribute of /eNkweNtr-a/ is just the reciprocal of that of /eNkoNtr-a/. Incidentally, the contents of these SUBCAT attributes should make it abundantly clear that we are in no way dealing with 'morphomic stems' in the sense of Aronoff (1994: ch. 2): the existence of the stems /eNkoNtr-a/ and /eNkweNtr-a/ is an idiosyncratic property of the lexeme ENCONTRAR, but their distribution is phonologically motivated.

To demonstrate that these lexical entries do produce the correct outcomes, I shall put them to the acid test of deriving the subtle contrast between two augmentative nouns: deverbal [eŋkontr-ón- \varnothing] 'abrupt meeting' (37,a) and denominal [eŋkwentr-ón- \varnothing] 'major sports meeting' (37,b).

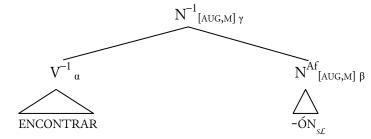
The derivation of [eŋkontr-ón- \varnothing] is displayed in (82). The process starts in the word syntax (Bermúdez-Otero 2012a: 46-48, 51-53; and see note 36 above). As shown in (82,a), this combines the verb lexeme ENCONTRAR 'meet' (node α) with the expressive nominalizer -ÓN $_{SL}$ (node β). Unlike augmentative morphemes in purely evaluative use (e.g. - δN_{WC} in (83,a) below), the nominalizer carries its own gender specification (masculine), which percolates up to the derived nominal ENCONTRÓN (node γ): see (17) and (23). In addition, the nominalizer contributes an expressive index to the semantics of the derived nominal: this yields the denotation 'event of meeting' with the negative connotation of abruptness. There follows morphological exponence: the Greek letter subscripts in (82,a,b) represent the relationships of exponence established at this point in the derivation. The morphology searches the lexicon for exponents of the V⁻¹ node, and finds the two stems in entries (80) and (81). Each stem defines a domain for the stem-level phonology, as is normal for all underived stems. Crucially, however, their SUBCAT attributes also require that both stems should be inserted as a disjunction at the relevant point in the underlying representation, and that the competition should be resolved within a stem-level domain. In this case, the next stem-level domain is defined by the top N^{-1} node, as the exponent of the nominalizer is phonologically affiliated to the stem level. The resulting underlying phonological representation is shown in (82,b). Now, in compliance with the domain structure specified in (82,b), the two stems of ENCONTRAR go separately through initial stem-level cycles, which generate the stem-level representations [en.kón.tra] and [en.kwén.tra]. 54 In the next cycle, these two representations are concatenated with the underlying representation of the nominalizer, and submitted as a disjunctive input to the stemlevel phonology: { $[e\eta.k\acute{o}n.tra]-on-\{e,\varnothing\}$ }. The winning output candidate is [en.kon.trón], which ties with losing *[en.kwen.trón] on *PEAKFOOT/e,o, but performs better on lower-ranked *COMPLEXNUC: see tableau (68) above.

For expository purposes, diagrams (82), (83), and (85) are laid out in noninteractionist fashion (see note 46); but this is not material to the argument.

In line with the arguments for stem-level nonanalytic listing in Bermúdez-Otero (2012a: §2.3), I assume that these derived stem-level representations are returned to the permanent lexicon, replacing the analytic PHON attributes in lexical entries (80) and (81): see notes 37, 50, and 51 above. Indeed, the most likely scenario is one where the nonanalytic listing of the stems of ENCONTRAR has already happened in previous instances of use of the verb by the speaker, so that the exponence of the V node in (82,a) leads directly to the insertion of the nonanalytic disjunction {[en.kón.tra],[en.kwén.tra]}, with the outcome of the first cycle already specified.

(82) Derivation of [enkontr-on-\infty] 'abrupt meeting': see (37,a) above; cf. (83) below

a. word syntax



b. underlying phonological representation

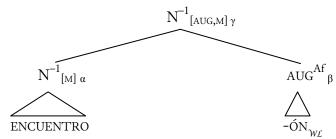
c. phonological derivation

Let us now turn to the derivation of [enkwentr-on- \emptyset], displayed in (83). The base in this case is the masculine noun lexeme ENCUENTRO in the reading 'sports meeting' (note 24). In (83,a), word syntax combines ENCUENTRO (node α) with the expressive morpheme - $\acute{O}N_{WC}$ (node β). The latter, being purely evaluative, is unspecified for syntactic category and for gender (see (17) and (23) again); it merely contributes an expressive index, which results in the denotation 'sports meeting' with a positive connotation of outstandingness. Exponence now follows. I do not know of any stem-level derivatives of ENCUENTRO, and so there is in fact no positive evidence in present-day Spanish that the noun still retains the allomorphic properties robustly displayed by the verb (see §3.5 for detailed discussion of this point). For the sake of exposition, however, let us suppose that enc[o]ntrar and $enc[w\acute{e}]ntro$ behave like m[o]rir 'die' and $m[w\acute{e}]$ rte 'death', where both the verb stem and the noun stem alternate: cf. the inflected verb [mwér-o] 'die-1SG', the stem-level denominal adjective [mort-ál] 'mortal', and the wordlevel diminutive noun [mwert-e θ it-a]. Under this assumption, a lexical search for exponents of ENCUENTRO will again return two o-class stems, /eNkoNtr-o/ and /eNkweNtr-o/, with SUBCAT attributes analogous to those in (80) and (81). As for every root-based stem, /eNkoNtr-o/ and /eNkweNtr-o/ will provide separate domains for the stem-level phonology. In addition, their SUBCAT attributes will require that both should be inserted at the same point in the underlying phonological representation, and that the phonology should resolve the disjunction at the stem level. This forces the morphology to designate the disjunction itself as a

stem-level domain; the stratal specification carried by the expressive suffix assigns the top N^{-1} node to the word level. The resulting phonological domain structure is shown in (83,b). In the phonology, the two stems of ENCUENTRO first go through separate stem-level cycles, yielding [eŋ.kón.tro] and [eŋ.kwén.tro]. ⁵⁵ The next stem-level cycle resolves the disjunction: *[eŋ.kón.tro] violates higher-ranked *PEAKFOOT/e,o, and so loses to [eŋ.kwén.tro]; see again tableau (68). The diphthongal stem is at last concatenated with the suffix /-on-{e, \emptyset }/ in a word-level cycle: ⁵⁶ stress moves to the right, and so the phonological factors that drove the selection of the diphthongal stem in the preceding cycle become opaque. Thus, the outcome is [eŋ.kwen.trón].

(83) Derivation of [enkwents-on- \varnothing] 'major sports meeting': see (37,b) above; cf. (82) above

a. word syntax



b. underlying phonological representation

c. phonological derivation

Again for the sake of expository clarity, I set aside Buckler and Bermúdez-Otero's (2012) argument that word-level suffixes go through a cycle of the stem-level phonology on their own before being concatenated with the base: see further Baker (2005).

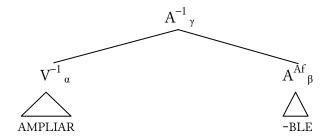
As per note 54, I assume that these outputs undergo nonanalytic listing and that, in normal circumstances, the phonological derivation of [enkwentr-on- \emptyset] begins in the second cycle of (83,c).

We now have a solution to the problem of the missing cycle in its most challenging formulation, adapted from (78) above:

(84) Why is the stress-conditioned hiatus of [amplía] cyclically transmitted to deverbal [amplíaβle], whereas the stress-conditioned diphthong of [eŋkwéntra] is not cyclically transmitted to deverbal [eŋkontrón]?

The answer becomes available only when one draws the line between allomorphy and phonology in the right place, and when one posits lexical entries of the correct size. Thus, deverbal [enkontrón] appears not to display the effects of a cycle over the stem of its base ENCONTRAR, failing to show the diphthong that surfaces in 3SG [enkwéntra], simply because the verb has not one stored stem, but two: (80) and (81). In other words, one must reckon not only with the stem that surfaces in 3SG [enkwentra], but also with the stem that surfaces in 1PL [enkontrá-mos]. Like all simple stems, each of them defines a separate domain for the stem-level phonology; the competition between the two is only settled in the next cycle of the derivation, triggered by the addition of the expressive nominalizer - $\acute{O}N_{SL}$ to the lexeme ENCONTRAR (see (82,c) again). In this competition, the stem that surfaces independently in the 3SG form just happens to lose. This account automatically predicts that deadjectival [am.pli.á.βle] will, in contrast, display the effects of the cycle triggered by the stem of its base AMPLIAR, inheriting the predictable hiatus that surfaces in 3SG [am.plí.a]. This is because the lexeme AMPLIAR has just one stored stem, not two. The hiatal syllabification of [í.a] is a predictable stem-level phonological property of this single stem. Accordingly, the derivative AMPLIABLE has no choice but to inherit it: see diagram (85).

- (85) Derivation of [am.pli.á.ßle] 'extendable': see (74,b) above; cf. (82) above
 - a. word syntax



b. underlying phonological representation

c. phonological derivation

$$\begin{array}{ccc} & & input & & output \\ first \ cycle \ (SL) & /aNpli-a/ & \rightarrow & [am.pli.a] \\ second \ cycle \ (SL) & [am.pli.a]-bl-\{e,\varnothing\} & \rightarrow & [am.pli.á.ble] \end{array}$$

3.5. The diachronic rise of misapplication: allomorphy is a property of lexemes, not $\sqrt{\text{nodes}}$

In a lexeme-driven analysis, the verb CONTAR participates in the diphthongal alternation because it has two listed stems: $/_V$ koNt-a/ and $/_V$ kweNt-a/. By the same token, the cognate noun CUENTO will display alternating behaviour only if it too has two listed stems: $/_N$ koNt-o/ and $/_N$ kweNt-o/. Yet, absent a stem-level morphological process of root-based derivation operating in structure-changing mode (§2.4.2), nothing in the analysis requires that both CONTAR and CUENTO should in fact have two stems each; even if both lexemes originate historically in the root $\sqrt{\text{CONT}}$, it is perfectly possible for CONTAR to have two stems, and for CUENTO to have only one. In this section we shall see that this is precisely the case in contemporary Spanish. Such a state of affairs illustrates a correct prediction of stem-driven theory: allomorphy is a property of lexemes, not $\sqrt{\text{nodes}}$, and so it is natural for the allomorphic properties of different lexemes descended from the same root to diverge in the course of language change. Root-driven theory fails to explain such historical developments (even if it can describe their synchronic outcomes) because it predicts that learners interpret allomorphic behaviour as a property of acategorial roots.

Consider a child who has discovered the existence of the diphthongal alternation and who, as a result, has successfully set up the stem-level phonological constraint hierarchy shown in (68). Let that child's first exposure to tokens of the verb CONTAR and of the noun CUENTO involve the wordforms [kwént-a-s] 'tell.2SG' and [kwént-o-s] 'tale.PL'. If this child now wishes to use either lexeme in production, she will need to decide whether or not the lexeme in question participates in the diphthongal alternation. In tackling this problem, she may draw some guidance from family resemblance among stored lexical entries (§3.2). That aside, however, we can ask: what further data will provide the child with the best evidence that the lexeme has two stems?

Part of the answer must be that alternations among inflectional forms of a lexeme L provide better cues to L's allomorphic properties than alternations between tokens of L and tokens of lexemes derived from L: in short, the evidence of inflectionally related forms is more effective than that of derivationally related items. This is probably because, in normal circumstances, understanding discourse requires listeners to parse the inflectional features of words: in consequence, inflectional processing is mandatory and automatic (see Post et al. 2008 for empirical evidence from English). Upon encountering [kont-á-mos] 'tell.1PL', therefore, our hypothetical child is highly likely to parse this form as a token of the verb CONTAR, thereby detecting its relationship with [kwént-a-s], and so inferring that CONTAR has two stems. In

contrast, sentence comprehension can often succeed without the decomposition of derived lexemes. For example, a Spanish learner exposed to the adjective [mel-ós-o] 'honeyed', based on the noun [mjél-Ø] 'honey', may understand and use the derivative appropriately even if she initially assigns to it a meaning like 'cloyingly sweet', without including the concept 'honey' in its denotation. Thus, the alternation between [kwént-a-s] and [kont-á-mos] cues the allomorphy of the verb CONTAR better than the alternation between [mjél-Ø] and [mel-ós-o] cues the allomorphy of the noun MIEL. Psycholinguistic investigations of Spanish confirm the hypothesis of closer relatedness in inflection than in derivation: for a recent study, see Álvarez et al. (2011).

In Spanish, however, only verbs exhibit diphthongal allomorphy within their inflectional paradigms, simply because only verbs have mobile stress; regular nouns and adjectives are stressed on the same syllable in all their inflectional forms (cf. the exceptional case of [réximen] in §2.1). Participation in the diphthongal alternation is therefore cued more robustly for verbs than it is for nouns or adjectives: for the latter, only denominal or deadjectival derivatives can provide positive evidence of diphthongal allomorphy.

This result explains why, as noted by Rainer (1993: 175-76), instances of misapplication of the diphthongal alternation have arisen first in a subset of denominal and deadjectival structures, as in (52,b) and (63,b), whereas the alternation continues to apply normally throughout verbal inflection and deverbal derivation: see (37,a) and (62,a,b). To understand this development, take for example a representative set of forms based on the noun PUERTA at an early diachronic stage before the rise of misapplication (i.e. no later than 1600):⁵⁷

(86)	a.	inflectional forms	[p wé rt-a] [p wé rt-a-s]	'door.SG' 'door.PL'
	b.	evaluative derivatives	[p o rt-eθwél-a]	'door.DIM'
	c.	other derivatives	[port-ér-o]	'doorman'
			[p o ɾt-ál-∅]	'gate/portal'

As suggested above, a learner exposed to these data may initially fail to abstract two stems for the noun PUERTA: the inflectional paradigm in (86,a) provides no cues to the existence of two stems, and the evidence from the derivatives in (86,b,c) is relatively weak. If she remains in this state, the learner becomes an innovator for whom the noun no longer participates productively in the diphthongal alternation. This innovation need not become manifest immediately; the learner may store representations like [portér-o] and [portál- \varnothing] nonanalytically, in which case no change will be apparent on the surface (see Bermúdez-Otero 2012a: 34ff). But suppose now that this speaker has occasion to use the diminutive suffix [-(e θ)í λ -a] productively to generate a

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Dates of first attestation in CORDE for diminutives of PUERTA include the following: <portezuela> 1303, <puertezuela> 1640; <portezuela> 1571, <puertecilla> 1600; <puertecita> 1635; <puertita> 1854.

purely evaluative derivative of PUERTA: since, for this speaker, the noun has a single stem, namely /pwert-a/, the outcome will be [pwert-e θ i Λ -a].

This scenario leads to yet another prediction: the first instances of misapplication should arise in forms containing the most highly productive suffixes, since it is such forms that are the most likely to be generated anew, as opposed to being simply inherited, i.e. acquired and stored upon exposure to tokens produced by older speakers. This prediction is correct: Carlson and Gerfen (2011a, 2011b) demonstrate the existence of a strong correlation between suffix productivity and the overapplication of diphthongization.

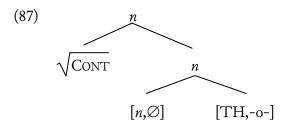
Eventually, as new instances of misapplication accumulate, the monophthongal stems of alternating nouns and adjectives become categorically unavailable to the most highly productive suffixes, like diminutive [-ít-o] and superlative [-ísim-o]. Misapplication is thus mandatory for these suffixes in present-day Spanish: it no longer depends on how well or how poorly the alternating behaviour of the base noun or adjective is cued. For example, the noun [sjér-a] 'saw' has a good range of monophthongal derivatives, including [ser-út[o] 'handsaw', [ser-erí-a] 'sawmill', and [a-ser-á-r] 'cut with a saw', of which at least the last two are perfectly compositional. Nonetheless, the monophthongal diminutive *[ser-(eθ)ít-a] is at present completely ungrammatical; only [sjer-($e\theta$)ít-a] is possible. In Stratal OT, this synchronic outcome is described by means of stratification: [-ít-o] and [-ísim-o] are now affiliated to the word level, and the SUBCAT attribute in the lexical entry of the monophthongal stem /ser-a/ specifies that this stem can be selected only when it outperforms /sjer-a/ in a stem-level domain: cf. (80). As part of the same historical process, inherited diminutives based on the monophthongal stems of alternating nouns have developed partially noncompositional specialized meanings, in accordance with Bréal's (1897: 29-42) loi de répartition and Kuryłowicz's (1947) fourth law of analogy (see also Markman and Wachtel 1988 for synonymy avoidance in acquisition). Thus, [port-eθwél-a] now means 'door of a vehicle'; cf. (86,b) and note 57.

Somewhat less productive suffixes attaching to nominal bases, like $[-\acute{e}r-o]$ and $[-\acute{i}st-a]$, remain in an intermediate stage. Inherited stem-level forms like $[tend-\acute{e}r-o]$ (62,c), attested in CORDE since early in the 13^{th} century, resist levelling. However, new formations often show word-level behaviour: e.g. $[kwent-\acute{e}r-o]$ and $[kwent-\acute{i}st-a]$ 'story teller', both with first CORDE attestations in the sixth decade of the 18^{th} century. In this case, it is significant that, although the alternating behaviour of the verb CONTAR is robustly cued in inflection and derivation, as shown in (62,a), the cognate noun CUENTO has no inherited monophthongal derivatives to indicate the existence of two noun stems. ⁵⁸

In sum, a lexeme-driven approach to morphology supports a simple but powerful account of the diachronic emergence of misapplication in the Spanish diphthongal alternation. This account explains why overapplication arises first in combinations of a nominal or adjectival base with a highly productive suffix. The explanation builds on the prediction that, for the

Meir (2006) describes the ongoing emergence of a stratal split in Modern Hebrew morphophonology, with a similar pattern of dual stratal affiliation for the affected affixes.

child, the allomorphic properties of a lexeme L are cued best by L's inflectional forms, less well by lexemes derived from L, and very poorly by parallel lexemes derived from the same root as L. ⁵⁹ Root-driven theory predicts exactly the opposite: it states that, when exposed to alternations like [kwént-a-s] ~ [kont-á-mos], the learner extracts two exponents of the acategorial root $\sqrt{\text{CONT}}$, namely / $\sqrt{\text{koNt}}$ / and / $\sqrt{\text{kweNt}}$ /. There is thus nothing to stop a child from inferring that the allomorph / $\sqrt{\text{koNt}}$ / is available to realize the noun CUENTO, assumed to have the structure shown in (87).



The proponents of root-driven theory may of course add provisions to the learning algorithm in order to render the learner more conservative. For example, they could assert that, unless presented with positive evidence to the contrary, the child assumes that an exponent of a \sqrt{n} node found in the domain of a category-giving head x can realize that \sqrt{n} node only in the context of x. This provision, however, would be a stipulation after the fact; unlike the predictions of the lexeme-based account, it does not follow from first principles.

4. Implications and alternatives

4.1. Recapitulation

My argument is now complete; in this section I summarize my results (§4.1) and discuss two alternative approaches to the evidence (§4.2, §4.3).

Our foray into Spanish morphophonology has uncovered a hitherto underappreciated link between two puzzles. The coupling question, raised at the end of section 2.1, asks whether Spanish roots and suffix stumps are paired up with the appropriate theme vowels by means of

This prediction also explains the observation that diphthongal stems in patrimonial lexemes are not extended to learned items derived from the same root: e.g. [pwért-a] 'door' ~ [pórt-ik-o] 'portico', [djént-e] 'tooth' ~ [e-dént-ul-o] 'edentulous'. I am grateful to Antonio Fábregas for drawing my attention to these cases. Note, incidentally, that the facts cannot be explained phonotactically: e.g. *[pwér.ti.ko], but [mwér.ŏa.yo] 'mistletoe'.

The lexeme-driven approach to the acquisition of allomorphy also correctly predicts that the loss of one alternant in the realization of one lexeme need not trigger the loss of the same alternant in the realization of a different lexeme derived from the same root. The classic example of this phenomenon is the levelling of rhotacism in Latin: levelling within the inflectional paradigm of the noun *arbōs* ~ *arboris* 'tree', yielding *arbor* ~ *arboris*, left the related adjective *arbustus* 'wooded' unaffected. In the case of Spanish, the loss of alternating behaviour in CUENTO has of course not affected CONTAR.

inflectional class features (the diacritic solution) or through storage in the lexical entries of stems and stem-deriving suffixes (the storage solution). The problem of the missing cycle, rescued from neglect in section 3.3, challenges us to explain why the Spanish diphthongal alternation fails to show the expected effects of first-cycle stress assignment over base stems. The two puzzles turn out to be intimately connected: adopting the storage solution to the coupling question enables one to see that the diphthongal alternation involves a phonological choice between two stems, not between two root allomorphs, and so its domain is the second cycle of the derivation.

This link exemplifies a key property of cyclic architectures of grammar: the size of the exponendum determines the size of the domain for exponent choice. Accordingly, empirical data about locality constraints on allomorph selection can be used to evaluate theoretical claims about cyclicity and about exponent storage. In section 4.2 I shall argue, following Embick (2010), that noncyclic versions of OT with transderivational correspondence (Benua 1997) are not local enough: they err by predicting unattested global effects in allomorph choice. But, at the same time, the facts of Spanish reveal that Embick's version of DM, where storage is limited to roots and to exponents of functional heads, is too local: it requires allomorph selection to be carried out within cyclic domains that are too small. DM routinely responds to this problem by resorting to devices, like the unconstrained use of readjustment rules, that blurr the line between allomorphy and phonology, and destroy the empirical content of the theory (Bermúdez-Otero 2012a: 79-81). In section 4.3 I shall diagnose the same fundamental problem in Halle et al.'s (1991) answer to the problem of the missing cycle: their account of the Spanish diphthongal alternation relies on a particularly deleterious form of extrinsic rule ordering that destroys the empirical content of the concept of cyclic domain. Combining Stratal OT with a lexeme-driven theory of morphology generates empirical predictions that are closer to the mark.

To prepare the ground for theory comparison, let me first review the argument in more detail. By definition, allomorphy is concerned with the distribution of lexically stored alternants that cannot be generated by synchronically productive phonological processes. If grammatical derivations proceed cyclically, then the competition between these stored alternants must be resolved during the cycle in which insertion takes place. In consequence, locality conditions on allomorphy are intimately connected with the size of stored exponents: if two allomorphs are of root size, then the choice between them will be sensitive only to the information available within the smallest cyclic domain, triggered by \node-to-lexeme derivation; but if two allomorphs are of stem size, then the information governing their distribution will be drawn from a larger cyclic domain, arising from a lexeme-based operation.

We have found that the facts of Spanish favour the storage of stems. First, underlying phonological representations always contain complete stems, never stems stripped of their theme vowels; the failure of theme vowels to surface before certain stem-attached derivational suffixes is caused by a phonological process of stem-final vowel deletion (§2.4.1). This result permits a storage solution to the coupling question (§2.4.2), dispensing with the use of

inflectional class features (cf. §2.3). In turn, stem storage supplies the key to the problem of the missing cycle as formulated in (78). If the alternation between [kwént-a] 'count-TH_a[3SG]' and [kont-á-mos] 'count-TH_a-1PL' involves a choice between stored allomorphs (§3.2), and if the unit of storage for lexical bases is the stem, then in this case the listed alternants must be two exponents of the lexeme CONTAR, namely the stems /y koNt-a/ and /y kweNt-a/. This predicts that allomorph selection will take place in a second-cycle domain created by an operation based on the lexeme CONTAR: e.g. inflection in [[kont-á]mos], or deverbal derivation in [[kont-á]βle] 'countable'. The prediction proves correct, for the distribution of the two alternants is indeed transparent within second-cycle domains. Had the allomorphs been exponents of the root $\sqrt{\text{CONT}}$, i.e. $\sqrt{\text{koNt}}$ and $\sqrt{\text{kweNt}}$, then the choice would have been settled in the first cycle, triggered by vnode-to-lexeme derivation, and would have become opaque thereafter: i.e. the result would have been ungrammatical *[[kwent-á]mos] and *[[kwent-á]βle]. Naturally, things run differently when there is no choice between stems. The hiatus found in [amplí-a] 'extend-THa[3SG]' is a predictable consequence of first-cycle stress assignment to the stem of AMPLIAR. This hiatus is then cyclically transmitted to [[ampli- \acute{a}]mos] 'extend-TH_a-1PL' and [[ampli- \acute{a}]ble] 'extendable'. In this case, there is no allomorph selection in the second cycle, and so the effects of the first cycle are fully visible: cf. (82) and (85) above.

Each of the links in the argument is supported by independent evidence:

- First, a phonological process of stem-final vowel deletion is necessary if a storage solution to the coupling question is to be reconciled with the distribution of nominal and adjectival theme vowels on the surface. But such a process is not merely possible: it is independently needed to avoid cyclic paradoxes in the derivation of forms like [swepá θ o]: see (56).
- Secondly, stem storage itself is more than a possible answer to the coupling question: it enjoys independent psycholinguistic and diachronic support. Recall the case of the lexeme CULTO 'cultivated', which has two stems (i.e. masculine o-class /kult-o/ and feminine a-class /kult-a/) and four inflected wordforms: [kúlt-o] M.SG, [kúlt-o-s] M.PL, [kúlt-a] F.SG, and [kúlt-a-s] F.PL. The hypothesis of stem storage correctly predicts that recognition latencies do not reflect the cumulative frequency of the lexeme, or the surface frequencies of individual wordforms, but rather the token frequency of each stem (§2.4.2). In diachrony, lexemes descended from the same root often cease to display parallel patterns of allomorphy (§3.5): e.g. the nominal lexeme CUENTO, though descended from the same root as the verbal lexeme CONTAR, has a single stem rather than two, as shown by its derivatives [kwent-íst-a] and [kwent-ér-o].
- Thirdly, the argument avoids circularity by distinguishing between allomorphy and phonology on the basis of operational criteria, rather than circular reasoning (cf. §4.3, §5). The evidence shows that, in the alternation between [kwénta] and [kontámos], phonology has a say in the distribution of the two stem allomorphs, but their existence is an arbitrary

lexical fact (§3.2). Recall that Spanish phonology cannot predict if unstressed [o] will diphthongize when stressed: cf. [koβrámos] 'charge.1PL' ~ [kóβra] 3SG. Phonology is similarly unable to predict if stressed [wé] will monophthongize when destressed, even in stem-level domains: cf. [sekwéstra] 'kidnap.3SG' ~ [sekwestrámos] 1PL. If stressed [wé] happens to monophthongize when destressed, phonology will still be unable to predict the quality of the monophthong: cf. [xwéya] 'play.3SG' ~ [xuyámos] 1PL. Phonology cannot even predict if, for a given token of unstressed [we], there will be a stressed alternant anywhere at all: in cases such as [pweríl], there is none. These observations confirm that, in the case of [kwénta]~[kontámos]~[kontáβle], the verb lexeme must have two lexically listed exponents. In contrast, the hiatus in [am.plí.a] is strictly predictable from root-final stress: Spanish phonotactics bans the diphthong *[ía] absolutely.

Thus, the argument draws its strength from the fact that it links multiple observations, each of them constraining the analysis in some way. In contrast, noncyclic OT and root-driven DM both miss important connections. Noncyclic OT (§4.2) fails to establish a lawful relationship between the size of exponenda and the size of domains for exponent choice: the theory allows unrestricted globality in allomorph selection. As a result, local effects are described, but not explained. Root-driven DM (§4.3) suffers from the opposite problem: it defines domains for allomorph selection that are too narrow. The theory then disposes of counterexamples by means of overpowerful phonological devices that allow recalcitrant instances of allomorphy to be redescribed as phonology. This solution saves the phenomena, but again fails to establish an explanatory link between the contents of the Spanish lexicon, the allomorphic character of the diphthongal alternation, and the exact size of its domain.

4.2. Excessively global allomorphy in OT with transderivational correspondence

In noncyclic OT with output-output correspondence (henceforth OO-correspondence), the problem of the missing cycle does not arise: answering question (78) is trivially easy. Benua's (1997) version of the theory, for example, allows the following account.

Assume that 3SG.PRES.IND verb forms, which are coextensive with bare verb stems, constitute surface bases for deverbal derivatives: for CONTABLE, therefore, the surface base will be [kwén.ta]; for AMPLIABLE, [am.plí.a]. Similarly, assume that denominal and deadjectival items stand in OO-correspondence with the SG forms of their bases: thus, the surface base of augmentative VIEJAZO (63,b) will be [bjé.xo], which is again coextensive with a bare stem. Benua handles stratification by means of indexed OO-constraints: the correspondence between the output realizations of stem-level deverbal derivatives in [-βl-e] and their respective surface bases will accordingly be monitored by OO₁-constraints, whilst OO₂-constraints will demand identity between [bjé.xo] and the output form of word-level VIEJAZO. Given this technology, answering (78) boils down to finding a constraint ranking that matches the data. The OO₁-constraint calling for the realization of AMPLIABLE to preserve the hiatus of [am.plí.a] must

rank high: call this OO_1 -IDENT-NUC. The same will be true of the OO_2 -constraint that requires that, on the surface, VIEJAZO should preserve the diphthong of [bjé.xo]: call this OO_2 -IDENT-DIPH. In contrast, the OO_1 -constraint monitoring the correspondence between the root vowels of [kwén.ta] and [kon.tá. β le], namely OO_1 -IDENT-DIPH, must be ranked low.

(88)									
			OO ₁ -IDENT-NUC	00_2 -Ident-Diph	IO-IDENT-DIPH	ONSET	* PEAK $_{ m FOOT}$ /e,o	*COMPLEXNUC	00_1 -IDENT-DIPH
aNpli-a-bl-e _[1]	[am.pljá.βle]	*!			(*)		*		
base: [am.plí.a]	[am.pli.á.βle] 🖘				(*) *				
(koNt-a)	koNt-a-bl-e	[kon.tá.βle] 🖘							*
$ \begin{cases} koNt-a \\ kwéNt-a \end{cases} -bl-e_{[1]} $		[kwen.tá.βle]			*!			*	
base: [kwén.ta]	kweNt-a-bl-e	[kon.tá.βle]			*!				*
buse. [Kwen.ta]		[kwen.tá.βle]						*!	
(hex-o	bex-o-aθ-o	[be.xá.θo]		*!					
$\begin{cases} bex-o \\ bjex-o \end{cases} -a\theta -o_{[2]}$		[bje.xá.θo]			*!			*	
base: [bjé.xo]	bjex-o-aθ-o	[be.xá.θo]		*!	*!				
ouse. [b]c.x0]		[bje.xá.θo] 🖘						*	

This is all that the theory has to say: the analysis remains exactly the same whether the diphthongal alternation involves regular phonology or phonologically driven allomorph selection, and whether listed allomorphs are of root size or stem size.

The sheer triviality of this solution betrays the fundamental problem of the theory: it is vastly unconstrained. Manipulating the ranking of OO-constraints allows one to adjust the size of the domain of each phonological process individually: promoting OO₂-IDENT-DIPH has the effect of excluding word-level suffixes from the domain of the diphthongal alternation, whereas demoting OO₁-IDENT-DIPH has the effect of enlarging this domain to include all stem-level suffixes. By this method, one could make the domain of the diphthongal alternation as wide as one pleased: if all OO-IDENT-DIPH constraints dropped to the bottom of the hierarchy, the domain for stem selection would in effect be the entire utterance. As it happens, Spanish assigns primary stress in lexical domains, and so stem selection in the diphthongal alternation could never display effects of the phrasal environment; but this is a contingent, language-particular fact about Spanish stress. In the general case, noncyclic OT with OO-correspondence predicts that the choice of allomorphic realization for a lexeme embedded arbitrarily deeply within a word may be sensitive to derived phonological properties conditioned by material

located arbitrarily far away in the utterance. Embick (2010: ch. 6) notes, correctly, that such extreme global effects are not attested.⁶⁰

4.3. Excessively powerful phonology in root-driven DM

Recall now Harris's (1989b: 345) diagnosis of the problem of the missing cycle (§3.3): if stress assignment reapplies cyclically at the stem level, and if verb, noun, and adjective stems define cyclic domains, then the diphthongal alternation cannot be stem-level. The cyclic transmission of stress-driven hiatus from the stem [am.plí.a] to the stem-level derivative [am.pli.á. β le] confirms that the premise of this inference is true: see (77). Nonetheless, the conclusion turns out to be false: since the dipthongal alternation misapplies in the presence of affixes such as diminutive [-ít-o], augmentative [-á θ -o], superlative [-ísim-o], and causative [a-...-á-r], its domain cannot be the word; see (52) and (63). As we have seen, the solution lies in recognizing that the diphthongal alternation involves phonologically driven stem selection by output optimization in the stem-level phonology: this correctly predicts that stem distribution will be governed by second-cycle stress assignment. The implication, however, is that we must abandon the assumptions of root-driven morphology: lexical storage cannot be limited to roots and to exponents of single functional heads, as is independently confirmed by psycholinguistic and diachronic evidence (see §2.4.2, §3.2, §3.5).

Halle, Harris, and Vergnaud (1991: §2.2) prescribe a much more conservative therapy: to redescribe the diphthongal alternation as a regular word-level phonological process after all. To do so, they must set up abstract underlying representations for the alternating vowels (Harris 1985a), and they must ensure that word-level diphthongization cannot see the effects of word-level stress assignment. Attaining these goals lands phonological theory with an exorbitant bill, which includes the diacritic use of prosody, rampant extrinsic rule ordering, and a ruinously diluted concept of phonological cyclic domain. In this section I argue that Halle et al.'s devaluation of the cycle is an absolute deal-breaker: whereas the stipulations required to turn diphthongization into a regular phonological process might be justified by appeal to putative evidence for 'crazy rules' (Bach and Harms 1972; see e.g. Scheer forthcoming), Halle et al. deprive the concept of cyclic domain of empirical content for no other reason than to uphold a mistaken view of morphology and the lexicon.

To describe the diphthongal alternation by means of a word-level phonological rule, Halle et al. must first set up distinct underlying representations for the alternating vowels.⁶¹ Four abstract underliers are needed:

For further arguments against OO-correspondence, unrelated to the issue of locality, see Bermúdez-Otero (2011).

A possible alternative in OT would be to rely on lexically indexed constraints (e.g. Pater 2000, 2010). For arguments against this device, see Bermúdez-Otero (2012a: 79).

These abstract vowels are assumed to remain distinct throughout the stem-level derivation; at the word level, they undergo absolute neutralization with nonalternating /e/, /o/, /i/, /u/, /je/, and /we/. What feature, then, distinguishes them? On the basis of a discussion of stress, Harris (1969: §4.2) considered the possibility of using [±tense], but without much conviction: in practice, he resorted to an arbitrary diacritic [±D]. Harris then revisited the issue in his (1985a) article, where he sought to establish the contrast by means of independently motivated representations. The new solution relies on empty skeletal positions:

After initial syllabification at the stem level, a battery of four word-level rules effect the mapping from /eX/ to [jé] in tonic syllables:

In defence of this proposal, Harris (1985a) asserts that none of his four word-level rules looks particularly unnatural, and he points out that there is independent evidence for [e] as the default vowel of Spanish. This may all be true, but the fact remains that the four word-level rules must apply precisely in the order stated, and this ordering has no independent justification beyond the facts to be described. Several technical issues arise. First, the skeletal position that distinguishes /E/ from /e/ must remain empty throughout the stem-level derivation; this is not a trivial requirement under the classical prosodic theory of epenthesis (Itô 1989). Secondly, Harris must stipulate that, in (91), the fake long vowel created by the insertion of default [e]

after diphthongization is not repaired by coalescence: cf. /part-i-is/ 'part-TH_i-2PL' \rightarrow [par.tís]. Thirdly, it is crucial that glide adjustment should not apply before nuclearity shift; otherwise, the output would be the legal diphthong [ej], creating alternations like [pleyár]-*[pléjɣa] (cf. [pléjto] 'lawsuit'). What the analysis offers, then, is a few small and ill-fitting fragments of independent generalization, bound together by a liberal dose of stipulation. The arbitrariness of the derivation in (91) shows that the underlying representations in (90) amount to a purely diacritic use of prosody.

In Halle et al.'s (1991: §2.2) analysis, [kontaðór] displays no effect of first-cycle stress assignment to the stem of the base CONTAR simply because the diphthongization rule applies at the word level, after stress has shifted to the stem-level suffix [-ðór]:

(92)	a.	cyclic a	domain structure	$[\![^{\mathcal{WL}}[\![^{\mathit{SL}}[\![^{\mathit{SL}}kOnt-a]\!]dor]\!]\!]$
	b.	SL	1 st cycle (stress assignment) 2 nd cycle (stress assignment)	kÓn.ta kOn.ta.dór
	C.	Wr.	diphthongization	kon.ta.dór
	C.	,,2	dipituiongiadion	Rom.ta.doi

The obvious problem, however, is how to prevent diphthongization from reacting to stress shifts triggered by word-level suffixes:

(93)	a.	cyclic a	domain structure	$[V^{\mathcal{ML}}]$ $[SL]$ bEx] isim-o]		
	b.	SL	stress	bÉx		
	c.	\mathcal{WL}	stress and diphthongization	*be.xí.si.mo		

Halle et al.'s solution leverages all the power of *SPE* (Chomsky and Halle 1968): it stipulates that, within the word level, diphthongization is extrinsically ordered before stress assignment.

(94)	a.	cyclic a	domain structure	$[V^{\mathcal{L}}] = bEx isim-o$		
	b.	SL	stress	bÉx		
	c.	\mathcal{WL}	diphthongization	bjé.xi.si.mo		
			stress	bje.xí.si.mo		

The power to order segmental transformations before prosodification within a cycle was part of *SPE*'s problematic legacy to rule-based Lexical Phonology, by which the latter lost much of its empirical content (McMahon 2000): the same trick was used, for example, to uphold Strict Cyclicity and Structure Preservation in the face of overwhelming empirical disconfirmation (Bermúdez-Otero 2012b: §23-§29). In the case of (94) we witness a severe weakening of the concept of cyclic domain. To say that a sequence of phonological material

constitutes a cyclic domain is to say that there is a round of phonological computation such that the processes applying during that round can see all the phonological material contained in that sequence. In a framework incorporating nonlinear prosodic representations, however, visibility is mediated—indeed defined—by prosodic structure: whether or not two adjacent segments are able to interact in a certain way will typically depend on whether or not they stand in a certain prosodic relationship to each other. Thus, extrinsically ordering diphthongization before stress assignment at the word level enables Halle et al. to state something inherently contradictory: namely, that diphthongization applies in word-level domains but cannot see word-level affixes. The consequences for learnability are dire. Allowing this trick entails that, for every prosodically sensitive segmental process, the learner must reckon with two possibilities: either the process applies in its apparent cyclic domain, or it applies before prosodification in the next cycle. As the number of such processes in the grammar increases, the space of possibilities grows as a power of 2. Scholars working in rule-based stratal frameworks are well aware of the need to avoid this trick: Kaisse (1999), for example, explicitly forbids ordering resyllabification after segmental transformations within a noninitial cycle. In Stratal OT the extrinsic ordering trick is, of course, unavailable in principle.

In sum, Halle et al.'s (1991: §2.2) solution to the problem of the missing cycle requires phonology to put on an awesome display of generative power. This example is symptomatic of a wider trend: when phonology is forced to do the bidding of root-driven morphology, the theory of grammar suffers a haemorrhage of empirical content. The style of reasoning that leads to this situation is clearly evident in Embick's (2012) treatment of the diphthongal and raising alternations in Spanish. As we saw in section 3.3, acknowledging that the diphthongal alternation involves allomorph selection entails recognizing that the locality restrictions predicted by root-driven theory are false. This need not lead to the globalist free-for-all of mainstream OT with OO-correspondence (§4.2); Stratal OT allied to a lexeme-driven approach to morphology widens the domain of the alternation just enough to obtain the correct results: i.e. from the first cycle of the derivation to the second (§3.4). Embick's response, however, is to turn the argument around, and to infer that the dipthongal alternation cannot be allomorphic but must be caused by a phonological rule (see also Embick 2010: 203, note 24). Yet this conclusion is purely definitional, not substantive, because it is not accompanied by a contentful account of what phonological rules can or cannot do. In fact, current practice in root-driven DM suggests that phonology can literally do anything: notably, the class of phonological rules is assumed to include readjustment rules (e.g. Embick and Halle 2005: §3), which carry out arbitrary string transformations, have free access to morphosyntactic structure, and refer to lists of lexical items in their structural descriptions (Bermúdez-Otero 2012a: 79-81; and see note 41 above). In such a framework, drawing the line between allomorphy and phonology is a vacuous labelling exercise that makes no empirical predictions.

5. Conclusion

The grammar of Spanish theme vowels (§2) and the properties of the diphthongal alternation (§3) provide strong evidence against the claim that only roots and exponents of single functional heads are stored in the lexicon. Positing lexical entries for stems and stem-deriving suffixes streamlines the analysis of Spanish morphology and phonology in multiple ways: it supports a unified and principled account of the distribution of verbal, nominal, and adjectival theme vowels, both underlyingly and on the surface; and it enables one to dispense with inflectional class features in the morphology, and with prosodic diacritics and extrinsic rule ordering in the phonology. The marriage of Stratal OT with stem-driven morphology achieves all these benefits whilst still imposing stringent locality restrictions on allomorph selection (§4), and it provides explanations for psycholinguistic data (e.g. recognition latencies: see §2.4.2) and diachronic observations (e.g. the frequent failure of levelling to cross syntactic category boundaries: see §3.5).

One methodological principle of great importance emerges from the course of this argument: the theory of grammar must not contain wildcards, i.e. devices that save the phenomena without making further empirical predictions. Two wildcards have featured prominently in our discussion: inflectional class features and arbitrary phonology.

Pace Harris (1991, 1992) and Aronoff (1994: 67-72), Spanish provides no support for the existence of inflectional class features as purely morphological primitives of representation. Wunderlich (1996: §6; 2003: 29; 2004: note 4, 380ff) advances the bold claim that all inflectional class phenomena can be analysed by means of underlying phonological distinctions and overwriting mechanisms similar to those which I have shown to be at work in Spanish. That may or may not be true. What is certain is that the use of class diacritics will continue to be dangerous, and liable to conceal gross losses of generalization, for as long as the characterization of inflectional class behaviour remains purely negative: i.e. 'a language has inflectional classes if its lexemes select inflectional markers according to criteria that are neither syntactic nor phonological' (see Koontz-Garboden forthcoming for related considerations bearing on morphomes in general). In the case of Spanish, Harris's use of class diacritics concealed a failure to grasp the generality of stem-final vowel deletion (cf. Rainer 1993: 96). The situation will not improve until we have a substantive theory of class features, such that their use can be checked against principled empirical tests. These tests need not involve internal data; they could well be learning-theoretic, developmental, or psycholinguistic (cf. the argument from recognition latencies in §2.4.2)—but they **should** exist.

Arbitrary phonology is the wildcard to which root-driven theories of morphology routinely resort when faced with recalcitrant alternations. Unconstrained phonological devices such as ordering segmental transformations before prosodification within a cycle make it possible to make statements that, by their very form, we should reject as self-contradictory: e.g. 'the Spanish diphthongal alternation applies in word-level domains but cannot see word-level affixes'. To deduce the implications of a particular morphological hypothesis for phonology is

certainly legitimate, and indeed necessary, as a preliminary to linguistic argumentation; but in a mature programme of interface research any claim about one member of a pair of interfacing modules must be held to account against a substantive theory of the other (Bermúdez-Otero 2012a: 50). One cannot learn from the phenomena if a wildcard saves them for free.

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