Distributed Morphology and historical linguistics

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1 Introduction

1.1 Background

Distributed Morphology (DM) has only begun to be systematically applied to problems of historical morphology and diachronic reanalysis in the past 10–15 years, but has already given rise to some promising research avenues. This chapter provides a survey of the literature and the type of research on historical linguistics that has been conducted within DM so far, as well as alternative and competing analyses, gaps in the existing research, and desiderata for future work. We will investigate diachronic changes in the morphophonology and morphosyntax from the point of view of what is expected given a DM architecture assuming that:

1. Morphemes are organized into syntactic structures
2. Morphophonological changes are governed by locality principles sensitive to these structures
3. There is a set of morphological operations preceding Phonological Spell Out (here called Morphological Spell Out)
4. Phonological Spell out includes Vocabulary Insertion, Morphophonological Processes (= Readjustment Rules), and phonological processes.

Crucially, in DM "word formation" is an epiphenomenon of the interaction between the output of a given syntactic derivation and the mechanisms that linearize this output and give it phonological form ("Spell Out"). Morphosyntactic derivation is distributed between the lexicon, the syntax, and the phonological component. Based on these assumptions we discuss how DM accounts for phenomena commonly discussed in the literature on historical morphology and morphological change (e.g., analogy, leveling, syncretism), how it differs from other approaches, and what kind of predictions follow from it.

1.2 Why use DM in historical linguistics

DM has built on historical data right from the start, and Latin in particular has played an important role in developing and elucidating some of its toolkit such as Fission and Fusion (e.g., Halle 1990; Calabrese 1995b, 1998; Halle and Vaux 1998; Embick 2000). But historical linguistics is more than just a data mine for the theory: DM provides a constrained framework for the *synchronic* analysis of the morphology of dead languages from which testable predictions about possible and impossible/unlikely "morphological" changes follow: "The choice of DM is motivated by the ease with which some of the best insights of functionalist work in this area can be translated into a more formal, precise idiom that makes clear predictions about what kinds of structural changes are possible." (Diertani 2011: 2). As Diertani (2011) and Ringe and Eska (2013) also point out, DM is parsimonious, in that morphological change can be reduced to syntactic and phonological "misacquisition" during the Child Language Acquisition

(CLA) process. That is, no designated module or theory of "morphological change" (e.g., of grammaticalization or analogy) is necessary (see also Reiss 2003, 2006). Many of the most problematic and most widely-discussed issues in historical morphology (analogy, paradigmatic leveling and other "paradigm effects", reanalysis) can thus be straightforwardly reduced to the interaction of syntax, phonology and the lexicon during CLA. In the following, we provide a survey of how exactly these changes can be modeled in DM and what the implications are.

1.3 Overview: Types of morphological changes

In DM, complex word forms are generated in the syntax from terminal nodes which are linearized postsyntactically and morphophonologically realized through a process of Vocabulary Insertion. Vocabulary Insertion matches exponents (vocabulary items, VIs, stored in the lexicon) to terminal nodes in accordance with the Subset Principle and contextual locality conditions. An example is given in (1) for the VIs of the abstract terminal node T[+past] in English, expressed by past tense morphology on finite verbs (based on Embick 2015: 169).

(1) Vocabulary Items for T[+past] in English

a. T[+PAST] ↔ -*t*/ {$\sqrt{\text{BEND}}$, $\sqrt{\text{LEAVE}}$,...}
b. T[+PAST] ↔ -Ø/ {$\sqrt{\text{HIT}}$, $\sqrt{\text{QUIT}}$,...}
c. T[+PAST] ↔ -*ed*

DM-style vocabulary items consist of three parts: The terminal node and its feature content, the phonological shape of the exponent, and the contextual conditions on the insertion of a particular exponent shape (allomorph; absent in Elsewhere exponents); in this case, a set of particular roots (we will use root diacritics henceforth instead of listing the roots as in (1); cf. Section 4).

All three components can change over time: functional heads/terminal nodes can lose or gain features through syntactic change (for example, when categories such as aorist and perfect merge into a single perfective or preterit category), phonological exponence can change through sound change (loss of exponents, creation of new exponents) or resegmentation, and the context for insertion can also change, in that conditions on insertion can be lost or acquired diachronically, descriptively "lexical change".[1] For example, failure to store the root QUIT as specified for rule (1b) will result in the generation of the past tense form *quitted*, on the surface generating the impression that something about the lexical item QUIT has changed. From a DM perspective, however, what has changed is the *context* of a VI rule, namely the diacritic of a particular root (see Section 4.2), without any need to refer to analogy or leveling. This type of "regularization" in favor of the Elsewhere form is also the most common CLA error that children make[2] and is of course well-represented in the historical record.

These changes basically affect the stored vocabulary items. However, these are not the only possible changes. Language-specific postsyntactic rules such as item-specific morphonological rules or morphological readjustments rules such as Impoverishment (the deletion of features from terminal nodes in specific contexts; Bonet 1991, 1995; Noyer 1992), Fusion (the combination of two sister nodes into a single terminal node of exponence for VI; or "portmanteau" formation; Halle and Marantz 1993), Pruning, and various forms of non-concatenative morphology or "process morphology" such as ablaut and reduplication can develop over time.

While we cannot discuss the diachrony of all of these for reasons of space, the following sections aim to give a comprehensive survey of as many as possible. This survey is heavily Indo-European-centric for three interrelated reasons: 1) The nature of the attestation, which goes back

[1] See Grestenberger and Fellner (2024) for a more detailed discussion of these changes and the typology of morphosyntactic cognacy that follows from them.

[2] Though CLA studies suggest that children overgeneralize a lot less than is commonly assumed and are in fact remarkably efficient acquirers even of irregular verbs, e.g., Marcus et al. 1992, Xu and Pinker 1995.

thousands of years for many of the language families under discussion, 2) the focus of previous work in DM, especially regarding historical and diachronic research, and 3) the background and training of the authors of this chapter. Nevertheless, we hope that it will provide impetus for future work on the historical morphology of other language families as well.

This chapter is organized as follows: In Section 2 we discuss changes affecting the morphosyntax of complex word forms, including Fusion and Pruning (Section 2.1), resegmentation (Section 2.2), the rise of ornamental morphology (Section 2.3), and the role of locality and adjacency in morphosyntactic change (Section 2.4). We also provide a longer case study on the development of periphrastic constructions and reanalysis in analytic verb forms (Section 2.5) and discuss the role of directionality in reanalysis (Section 2.6). Section 2.7 treats case syncretism.

Section 3 focuses on the diachrony of the morphophonological side of VIs, in particular the development of irregular morphology (Section 3.2), "crazy rules" (Section 3.2.2), and cliticization and affixation in diachrony (Section 3.3).

Section 4 discusses what we here term "morpholexical change", for want of a better term: basically a set of changes that affect roots or tend to be lexical root-specific, many of which are usually summarized under the term "analogical change" (Section 4.2), but also changes that affect the shape of the root for other reasons (Section 4.3). Section 5 concludes with a summary and brief discussion of future research avenues.

2 Morphosyntax

2.1 Fusion, pruning and zero morphemes

DM's ultimate goal is to define the grammatical conditions that constrain morphological exponence under the assumption that morphemes are structure-dependent, syntactic entities. This results in two theoretical criteria. Firstly, given an independently motivated morphosyntactic structure, changes in word exponence can only involve changes in the exponents of the terminal nodes of this structure. Furthermore, the structure constrains the analytical choices that can be made insofar as the nature of each morphological piece in the surface string must be assessed in terms of the independently motivated morphosyntactic structure of the word. We illustrate this with a case study from the Vedic Sanskrit and reconstructed Proto-Indo-European (PIE) verbal system and the changes that affected it.

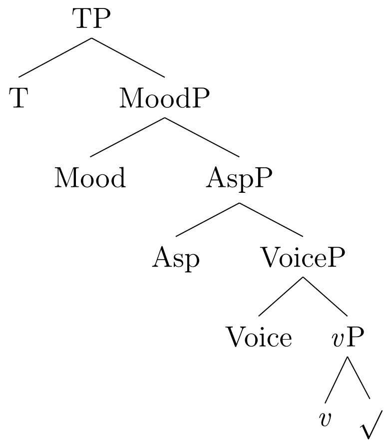
Vedic Sanskrit verbs are traditionally described as being organized into 'systems' based on three basic "stems", the so-called present (imperfective), the perfect, and the aorist (perfective), which are distinguished in terms of aspectual (Asp) features. These stems further interact with modality (Mood; indicative, subjunctive, optative, imperative) and tense (T; ±PAST), as sketched out in Table (2). The expression of voice and agreement features is discussed below.

Along the lines of Wurmbrand (Wurmbrand 2015; see also Cinque 1999), we adopt the verbal functional structure in (3), which expresses the basic core temporal, aspectual, and modal structure of the "verbal spine".

(2) The Vedic Sanskrit verbal system, $\sqrt{}$*kar* 'do', 3sg.act. forms

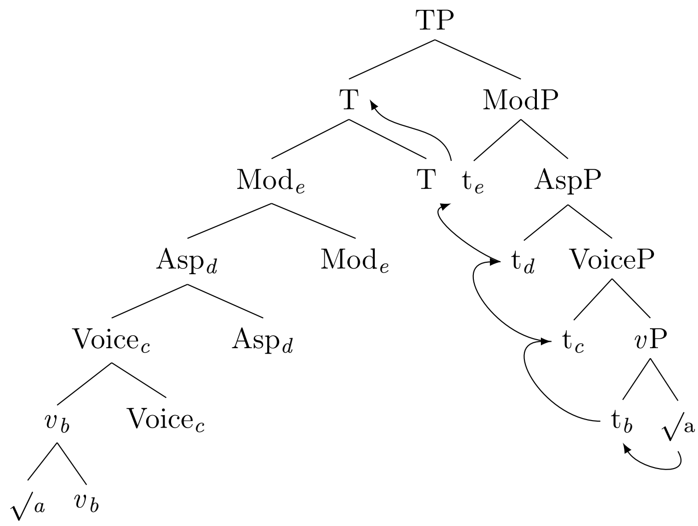
		Pres.		Perf.		Aor.	
Asp	[PFV]	–		+		+	
	[STAT]			+		–	Mood
T	[PST]	–	+	–	+	+	
		Pres.	Ipf.	Perf.	Pluperf.		
	Ind.	***kr̥-ṇó-ti***	***á-kr̥-ṇo-t***	***ca-kā́r-a***	***á-ca-kar-/t/***	***á-kar-/t/***	[–IRR]
					[***ácakar***]	[***ákar***]	
	Subj.	***kr̥-ṇáv-a-t***		***cā-kár-a-t****		***kár-a-t***	[+IRR, –DES]
	Opt.	***kr̥-ṇu-yā́-t***		***ca-kr-[i]-yā́-t****		***kr-[i]-yā́-t***	[+IRR, +DES]

(3)



The universal hierarchical structure in (3) is then mapped onto surface morphological units (i.e., X^0-complexes; Embick and Noyer 2001) via cyclic, iterated roll-up movement of the root through *v*, Asp, Mood, and T, creating the structure in (4).[3]

(4) Head movement and synthetic verb formation

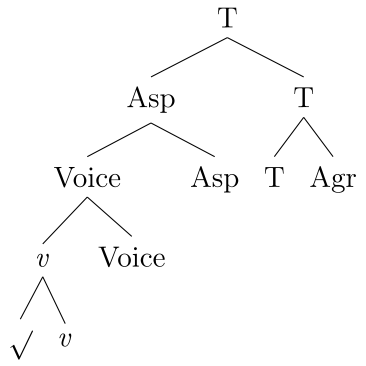


Following Halle and Marantz (1993) and Bobaljik (2008), the node AGR is inserted as an ornamental morpheme in the morphology by a rule that adjoins AGR to the highest X_0 in the

[3]The positioning of the exponent of the head as a suffix/prefix is due to information associated with the exponent and not a morphosyntactic property (see below).

complex verbal head. Application of this rule in the case of a complex head structure that is the output of (4) generates (5).

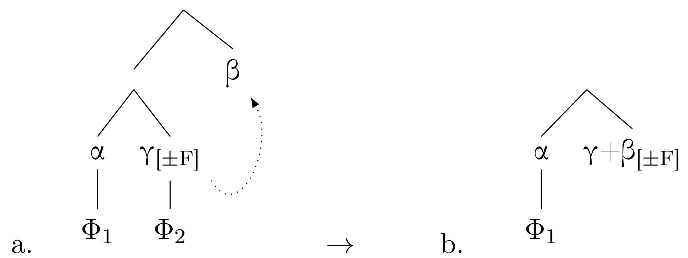
(5)



The structure in (5) then undergoes Vocabulary Insertion, i.e., the procedure of association between (bundles of) morphosyntactic features (= functional nodes) and phonological content (exponence), which is assumed to occur cyclically from the inside out (Bobaljik 2000).

Before introducing the VIs needed for Vedic Sanskrit verbal exponence, we need to discuss the crucial role that zero exponence plays in deriving surface forms. Calabrese (2023) argues that the distribution of morphological zeros does not follow from syntactic activity/inactivity but is simply a property of node exponence: Non-overt Ø exponents are inserted when independently motivated terminal nodes fail to have phonological realization, for example, due to the loss of phonological material through sound changes such as syncope, apocope, etc. (see Grestenberger and Kastner 2022 for discussion), or resegmentation and reanalysis of phonological material as belonging to a different node (see Sections 2.5 and 2.6). Crucially, however, Øs trigger null node **pruning** (i.e., delinking of nodes with non-overt exponence), followed by upward docking of the features that consequently become floating. This results in the **fusion** of the two terminal nodes triggered by this pruning operation. This is shown in (6), where Φ_1 and Φ_2 are exponents, and Φ_2 is phonologically empty.

(6) Zero node pruning & fusion



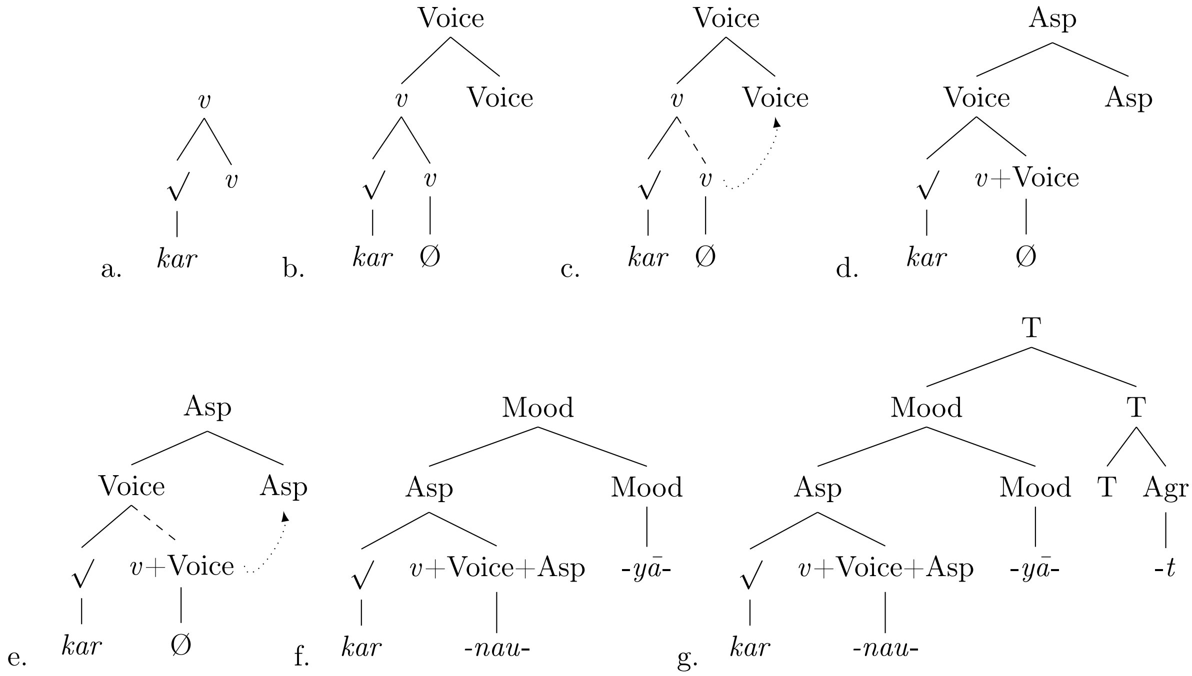
Let's see how this works in the case of Vedic Sanskrit verbal forms. The complex X^0 generated by head raising followed by AGR insertion for this form was given in (5). Phonological Spell Out operates cyclically node-by-node from the bottom up. In addition to overt exponents, Øs are inserted when independently motivated terminal nodes fail to have phonological realization. These Øs are then pruned; feature floating and docking will generate a cyclic derivation where some verbal functional nodes are fused due to pruning in cyclic steps. Considering the Vedic Sanskrit forms in Table (2), one observes that only v/Asp and Mood have overt exponence as in (7); the other nodes are then assigned zero exponence, (8). By cyclic pruning, v and Voice are delinked and fused with the higher local Asp node. Further, T is pruned and fused with Agr.

(7) a. -*nau*- ↔ $\text{Asp}_{[-\text{PFV}]}$ / $\sqrt{}^{\text{V, VIII}}$_
b. -*a*- ↔ $\text{Mood}_{[+\text{IRR},-\text{DESID}]}$
c. -*yā*- ↔ $\text{Mood}_{[+\text{IRR},+\text{DESID}]}$

(8) a. Ø ↔ *v*
b. Ø ↔ Voice
c. Ø ↔ T

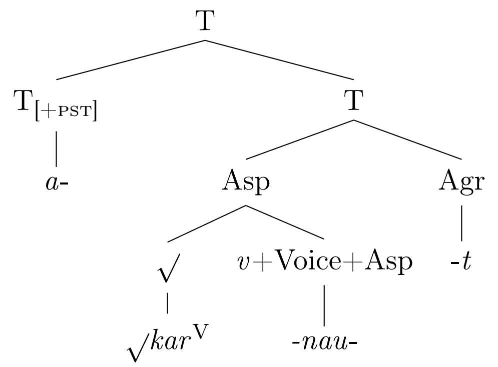
The cyclic derivation for the 3sg. optative active form *kr̥ṇuyā́t* is illustrated in (9). Delinking and fusion are indicated by dashed and dotted lines, respectively. The resulting structure after insertion of an overt exponent in AGR is given in (9g). For expository simplification, we forgo a discussion of the rules that trigger ablaut alternations (zero grade) and accentuation here (see Calabrese and Grestenberger 2023).

(9) Cyclic derivation of *kr̥-ṇu-yā́-t* make-IPFV-OPT-3SG.ACT 'may he/she make'



If Mood also has zero exponence, for example, in indicative forms where only Asp has overt realization, the resulting structure is derived as in (10).

(10) Structure of 3sg. imperfect *ákr̥ṇot* /a-kar-nau-t/ 'did, made'[4]



There are also cases in which the *v*/Voice/Asp complex is non-overt. Therefore, all functional nodes are fused as in the sample form in (11), a class II (root) present.

[4]The past tense exponent *a*-, the "augment", is realized as a prefix rather than a suffix. We assume that this is a case of antitropal realization: when lexically marked as antitropal, the exponent of an affix is phonologically inserted in the side opposite to that expected by the morphosyntax, e.g., the affix is prefixal instead of being suffixal as regularly expected. See Bye and Svenonius (2012) for further discussion and Reed (2014) and Schreiner (2021) on the same phenomenon in Greek.

(11) a. *dviṣ-thá* hate-PRS.ACT.2PL 'you (pl.) hate'

b.

T
- √ — $\sqrt{}$*dvaiṣ*$^{\mathrm{II}}$
- *v*+Voice+Asp+Mood+T+Agr — -*tha*

Thus, given an independently motivated morphosyntactic structure such as that in (3), once the distribution of overt exponents has been established, zero exponent insertion and bottom-up cyclic pruning will generate the relevant simplified structures. In the Vedic verbal system, (*v*/Voice)Aspect, [±PST] Tense, and [+IRR] Mood have overt exponents. Putting the exponence of [+PST] Tense aside for now, this readily accounts for the structures of Vedic Sanskrit verbal forms in a simple and syntactically motivated manner.

In the following sections, we will use these structures to explore how morphological exponence of various nodes along this spine changed over time.

2.2 Morpheme resegmentation

In PIE, as in ancient IE languages such as Sanskrit and Greek, the present (imperfective) system displayed a wide variety of affixes (cf. LIV^2; Fortson 2010; Weiss 2020), which are traditionally divided into different present classes and involve root dependent realization of $\mathrm{Asp}_{[-\mathrm{PFV}]}$, cf. Table (12), which lists a selection of Vedic verb classes and their PIE and Ancient Greek (AG) correspondences.

(12) Imperfective stem-forming morphology in Vedic and Indo-European

Ved. class	root	meaning	Ved.	PIE	AG
I	*as*	'be'	-Ø-	-Ø-	-Ø-
II	*bhav*	'become'	-*a*-	*-*e/o*-	-*e/o*-
IV	*(s)paś*	'see'	-*ya*-	*-*i̯e/o*-	-*ye/o*-
V	*kar*	'make'	-*nav*-	*-*neu̯*-	-*nῠ̆*-
VII	*yauj*	'yoke'	-*n(a)*-	*-*n(e)*-	(-*n*-)

The standard analysis is that these stem-forming elements were originally Aktionsart/lexical aspect markers that were reanalyzed as aspectual markers at some late stage of PIE (e.g., Hoffmann 1970; Rix 1986; Strunk 1994; LIV^2; Fortson 2010; Meier-Brügger 2010). Diachronically, these elements would then have been reanalyzed as exponents of the formerly Ø-exponed head Asp (see Section 2.6 on the directionality of this type of reanalysis; cf. Ringe and Eska 2013: 167–77 for further examples of reinterpretation of terminal nodes). Moreover, these suffixes cannot occur together: They seem to compete for the same structural position. This also holds for the perfect and aorist system: exponents of $\mathrm{Asp}_{[+\mathrm{PFV},-\mathrm{STAT}]}$ (aorist stem) and $\mathrm{Asp}_{[+\mathrm{PFV},+\mathrm{STAT}]}$ (perfect stem) compete for the same position as (and never occur together with) exponents of $\mathrm{Asp}_{[-\mathrm{PFV}]}$ (present stem). This is illustrated in Table (13), again for Vedic. Note that there are fewer stem classes in the aorist than in the present stem: a root aorist with Ø-exponence, the *s*-aorist (with 3–4 subclasses), the thematic aorist with the theme vowel -*a*-, and the reduplicated aorist. The perfect is even more constrained, as there is only one type, the reduplicated perfect (with one exceptional unreduplicated perfect stem, *véda* 'knows').

(13) Vedic present, aorist, and perfect stem-forming morphology (stem formant = underlined)

Present	Aorist	Perfect	Meaning
ján-a-	*ján-iṣ-*	*ja-jan/ja-jñ-*	'beget, create'
bháv-a-	*bhū́-/bhú-Ø-*	*ba-bhū̆-*	'become'
dá-dhā/dá-dh-	*dhā-/dh-Ø-*	*da-dhā́-/da-dh(i)-*	'put'
vr̥h-á-	*vr̥k-śa-*	*va-várh-*	'tear'
bhi-ná-d-/bhi-n-d-	*bhéd-/bhid-Ø-*	*bi-bhéd-/bi-bhid-*	'split'
kr̥-ṇáv-/kr̥-ṇu-	*kár-/kr-Ø*	*ca-kā́r-/ca-kr-*	'make'

One and the same root is often associated with different types of present and aorist stems (Joachim 1978; LIV^2), and different combinations of present + aorist classes are attested. Moreover, the selection of stem formants is root-dependent, and specific modifications of the root (such as ablaut grade) in turn are triggered by adjacent stem-forming suffixes. Some are moreover associated with meaning or argument structure properties that are closer to Aktionsart than to aspect, such as transitivization and causative, inchoative, or iterative meaning. Based on these observations and additional diagnostics, Grestenberger (2022c) argues that AG verbal stem formants (and by implication the Vedic ones as well) are actually *v*-exponents licensed by Asp$_{[\pm\textsc{pfv}]}$. Alternatively, Calabrese and Petrosino (2023) propose that Aktionsart features associated with *v* are inherited by Asp after zero node pruning and fusion, cf. (9). The respective stem-forming affixes are then inserted in a node that results from the bundling of *v* and Voice with Asp. One can therefore propose that Asp is realized through different root dependent VIs, as in (14) (we use root diacritics to refer to a group of particular roots; see also Sections 3.1 and 4.2). Note that we treat the theme vowel of the simple thematic conjugation (*-*e/o*-) and the zero exponent of root aorists/presents as underspecified with respect to [±PFV] because they appear in both the perfective and the imperfective stem, albeit with aspectually conditioned ablaut differences. They still need to be specified with respect to root context, however.[5]

(14) VIs for PIE tense-aspect stems

a.	*-*s*-	↔	Asp$_{[+\textsc{pfv},-\textsc{stat}]}$	/	$\sqrt{\ }^{s\text{-}}$ _	(sigmatic aorist)
b.	*-Ø-$^{\textsc{red}}$	↔	Asp$_{[+\textsc{pfv},+\textsc{stat}]}$			(perfect)
c.	*-*i̯e/o*-	↔	Asp$_{[-\textsc{pfv}]}$	/	$\sqrt{\ }^{\text{i̯e/o-}}$ _	(*-*i̯e/o*-present)
d.	*-*ne*-	↔	Asp$_{[-\textsc{pfv}]}$	/	$\sqrt{\ }^{ne\text{-}}$ _	(nasal infix present)
e.	*-*neu̯*-	↔	Asp$_{[-\textsc{pfv}]}$	/	$\sqrt{\ }^{\text{neu̯-}}$ _	(*-*nu*-present)
f.	*-*sk̂e/o*-	↔	Asp$_{[-\textsc{pfv}]}$	/	$\sqrt{\ }^{\text{sk̂e/o-}}$ _	(*-*sk̂e/o*-present)
g.	*-Ø-	↔	Asp	/	$\sqrt{\ }^{\emptyset}$ _	(root present/aorist)
h.	*-*e/o*-	↔	Asp	/	$\sqrt{\ }^{\text{-e/o-}}$ _	(thematic present/aorist)

In this scenario, the tense-aspect stem exponents would have been reanalyzed from *v*-exponents licensed by empty Asp heads to *fusional* morphology realizing *v*, Voice, and Asp together.

[5]See Calabrese and Petrosino (2023) for a slightly different solution. Note that there is no Elsewhere form in (14) because all exponents appear to be contextually dependent on the root they appear with. Judging from the evidence of the inner or nuclear IE languages (all branches except for Anatolian and Tocharian), where *-*i̯e/o*- is widely used as a verbalizer in denominal and deadjectival verb formation, it seems like this suffix became the Elsewhere form at least in the imperfective stem, though the simple thematic conjugation also expanded greatly in these branches. The synchronic status of Elsewhere exponence of Asp in these languages thus needs further study.

2.3 Morpheme addition: The development of ornamental morphology

In addition to the reanalysis of stem-forming morphemes as outlined in the previous section, new exponents may also be added to the surface representation through reanalysis. Here, we discuss ornamental morphology as a case study, specifically, the rise of vocalic themes or "theme vowels" (TV) in Latin.

Latin is traditionally described as having four conjugations characterized by root-adjacent vocalic suffixes (cf. Weiss 2020): *-ā-* (1st conj.), *-ē-* (2nd conj.), *-ĕ-* (3rd conj.), and *-ī-* (4th conj.), to which we add a fifth conjugation characterized by the vowel *-ĭ-* (usually classified as a subtype of the third conjugation; Embick and Halle 2005; Weiss 2020: 422). These suffixes were specifically referred to as theme vowels by the grammatical tradition, as they consistently occur after the root and before any other functional (aspect, mood, agreement) morphemes, (15). Thematic vowels may however be absent in specific morphological categories such as irregular perfects or past participles, and in specific verbs that continue inherited root presents, e.g., 3sg.act. *es-t* 'is'.

(15) Summary: Latin conjugational classes

conj.	TV	inf.	meaning
I	*-ā-*	*laud-**ā**-re*	'praise'
II	*-ē-*	*mon-**ē**-re*	'scold'
III	*-ĕ-*	*duc-**ĕ**-re*	'lead'
III$^{\text{i}}$	*-ĭ-*	*cap-**ĕ**-re*	'take'
IV	*-ī-*	*aud-**ī**-re*	'hear'

In his analysis of Latin morphology, Aronoff (1994) discusses the double nature of Latin TVs. On the one hand, they are legitimate morphemes, easily distinguishable from the nearby root or the derivational suffix (on the left side), and the inflectional suffixes (on right side). Moreover, they are in complementary distribution with one another and consistently occur within the same verb paradigm. On the other hand, according to Aronoff, they seem to carry no syntactico-semantic meaning, resembling purely "ornamental" elements. Much of the subsequent literature on Latin, especially in DM, has followed Aronoff's analysis and proposed that Latin TVs are the exponents of ornamental structural entities inserted in the postsyntactic component (cf. Oltra-Massuet 1999; Oltra-Massuet and Arregi 2005; Calabrese 2023; for an opposing view see Bertocci 2017).

In the development of the Latin conjugational system, the PIE "secondary", or stem-derived, verbs played a crucial role. By contrast, the original "primary" (root-derived) PIE verb forms became a closed, relic class and gave rise to the third conjugation and its various (and often irregular) subclasses. Secondary verbs were derived from verbal, nominal, or adjectival stems, mostly by using the inherited verbalizer *-*i̯e/o*-. The following derived verbal classes in particular are relevant (ex. from Weiss 2020: 423–32):

(16) a. Denominatives & factitives from adjectives in *-*eh₂-i̯e/o*-:
koiseh₂-i̯e/o- 'to care' (*Transponat* of Lat. *cūrāre* 'care', from *cūra* 'care')
neu̯eh₂-i̯e/o- 'to renew' (**neu̯-o*-, -*eh₂*- 'new'), Lat. *novāre* 'to renew'

b. Statives in *-*éh₁(-i̯e/o-)*:
h₁rudʰ-éh₁-i̯e/o- 'be red' (**h₁reu̯dʰ*- 'red'), Lat. *rubēre* 'be red'

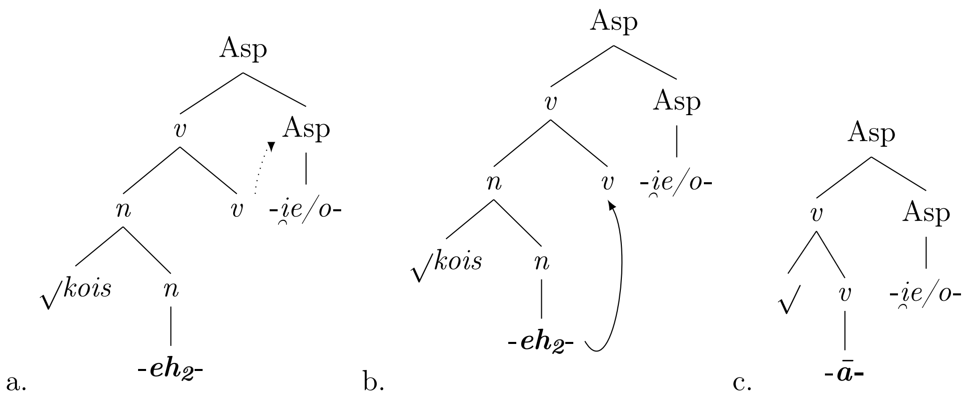
c. (root-derived) causatives and iteratives in *-*éi̯e/o*-:
tors-éi̯e/o- 'make dry', Lat. *torreō* **sorbʰ-éi̯e/o*- 'drink' (iter.), Lat. *sorbeō*

In the proto-language, these suffixes were exclusively associated with the present system and were morphologically incompatible with other aspectual markers (LIV^2; Fortson 2010: 98–100). Denominal *-*i̯e/o*- and iterative-causative *-*ei̯e/o*- in particular are in complementary distribution with the "primary" present, aorist, and perfect stem-forming suffixes discussed in Section 2.2, cf. (13). In the model developed here, this follows if we assume that these "VP-shell nodes" were bundled with Asp after pruning and docking, and their exponents were inserted there as in (17).

(17) a. *-*i̯e/o-* ↔ [*v*, Asp$_{[-\text{PFV}]}$]
b. *-*éi̯e/o-* ↔ [*v*$_{[+\text{CAUS}]}$, Asp$_{[-\text{PFV}]}$]

In the large group of Proto-Italic denominal and deadjectival verbs, however, a reanalysis took place that led to the overt exponence of root-adjacent VP-shell nodes independently from Asp. This is illustrated in (18) for a conj. I denominal verb (excluding Voice for simplicity). (18a) shows the initial stage with docking of *v* at Asp following pruning (indicated by the dotted line). (18b) illustrates the reanalysis of the nominal suffix *-*eh₂*- as a *v*-exponent, indicated by the bold arrow. (18c) is the structure for Proto-Italic, in which elements such as -*ā*-, but also the causative-iterative suffix and other VP shell exponents spell out *v*.

(18) Reanalysis: conj. I nominal > verbal "theme" -*ā*-



The same $n \to v$ reanalysis took place in Greek, where it gave rise to a number of new verbalizing suffixes and TVs (Grestenberger 2022c) and seems to be a common source of verbalizing morphology in general (Grestenberger 2023b; see also Section 2.6 on the directionality of reanalysis).

As a result, *v*-exponents such as conj. I /-ā-/ and conj. IV /-ī-/ were free to occur independently of particular aspectual features across verb forms, (19) (see also Embick 2015: 100–9, Halle 2019, Calabrese and Petrosino 2023 and Calabrese 2023 for a more detailed discussion).

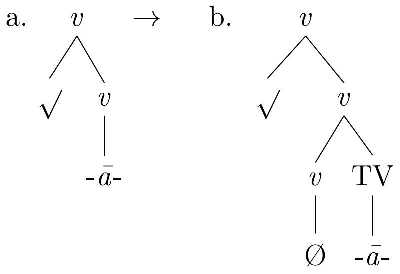
(19) 1st and 4th conj. imperfects & perfects

	conj. I	conj. IV
ipf.	[[[[√*laud*]-***ā***]$_v$ -*bā*-]$_{\text{Asp}}$ -*mus*]$_{\text{Agr}}$	[[[[√*aud*]-***ī***]$_v$ -*bā*-]$_{\text{Asp}}$ -*mus*]$_{\text{Agr}}$ (OL)
	praise-V-IPFV-1PL.ACT	praise-V-IPFV-1PL.ACT
	'we were praising'	'we were hearing'
perf.	[[[[√*laud*] -***ā***]$_v$ -*vi*-]$_{\text{Asp}}$ -*mus*]$_{\text{Agr}}$	[[[[√*aud*] -***ī***]$_v$ -*vi*-]$_{\text{Asp}}$ -*mus*]$_{\text{Agr}}$
	praise-V-PFV-1PL.ACT	praise-V-PFV-1PL.ACT
	'we praised'	'we heard'

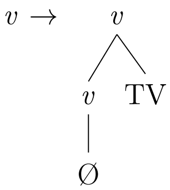
A further crucial step that took place in the development of *v*-exponents in Latin is that these overt pieces were reanalyzed as *ornamental* morphological pieces that can co-occur with other *v*-forming derivatives. Specifically, the -*ā*- of the first conjugation developed mostly from denominal verbs in *-*i̯e/o-* as in (18) (de Vaan 2012; Bertocci 2017; Weiss 2020: 423–6), while the second conjugation in -*ē*- developed mostly from verbs with the "stative" suffix *-*eh₁(-i̯e/o)*- and from iterative-causatives in *-*ei̯e/o-* (Weiss 2020: 426–9). The -*ī*- of the fourth conjugation developed mostly from denominatives (but also from primary verbs) in *-*i̯e/o*- (Weiss 2020: 432).

These pieces became "ornamental" and were added to all instances of *v* by a general rule. One can assume that this change was first caused by a loss of semantic specificity; these derivatives were bleached in meaning due to their disparate etymological sources. Thus, -*ā*- did not only develop from denominal verbs, but also from deadjectival factitives as in ex. (16a), as well as from some primary verbs in which the -*ă̄*- was originally part of the root, such as *arāre* 'to plow', *nāre* 'to swim', etc. Similar considerations hold for the other conjugation classes. Thus, once learners were no longer able to assign a clear semantic or morphosyntactic function to inflectional pieces like -*ā*- and -*ī*-, these thus became devoid of syntactic or semantic features. The same happened with the other root-adjacent vocalic pieces. We propose that it is this bleaching that led to the overarching generalization that appears to characterize Latin verbal morphophonology, namely that vocalic pieces could only be the exponents of non-functional nodes, i.e., ornamental morphology. Given this generalization, these vocalic pieces were reanalyzed as ornamental nodes as in (20), from which a rule inserting a TV postsyntactically at every *v*-node was generalized, (21) (cf. Oltra-Massuet 1999; Oltra-Massuet and Arregi 2005 on the same rule in Catalan and Spanish).

(20) Reanalysis of conjugational class markers as ornamental TVs



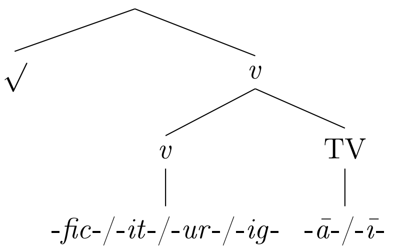
(21)



Once this happened, new verbalizers developed and were able to co-occur with the newly formed ornamental TVs. In this way, vocalic pieces such as -*ā*- and -*ī*- were able to spread across formatives and are found in structures where they were neither etymologically nor functionally expected, as in (22).

(22) a. *ex-carni-**fic-ā**-re* 'to tear to pieces, to butcher' (factitive-causative)
*vis-**it-ā**-re* 'to visit' (frequentative)
*ēs-**ur-ī**-re* 'desire to eat, be hungry' (desiderative)
*fūm-**ig-ā**-re* 'to fumigate' (factitive)

b.



Calabrese (2023) moreover proposes that the reanalysis of *v*-exponents TVs as in (20) also led to the reanalyis of the inherited Asp exponents of conj. III as ornamental TVs. Specifically, one can assume that all root adjacent vocalic pieces, regardless of their functional status, were analyzed in this way in their relevant insertion cycle (after pruning; note that the newly postulated Øs are assumed to be pruned after the reanalysis). This case study thus shows how semantic bleaching (loss of a unified morphosyntactic function of homophonous *v*-elements) caused reanalysis and the emergence of ornamental morphology.

2.4 Syntactic locality and adjacency in morphological change

The changes discussed in the previous sections crucially rely on a particular implementation of the notion of syntactic locality, which is also relevant to understanding irregular, i.e., morpheme-specific, morphology: morphological operations which are dependent on morpheme-specific information. In (23) we contrast a case of irregular morphology with a case of regular morphology. On the one hand, we have the Italian imperfect marker, which is regular in being always the same across verbs. On the other hand, we have the Italian perfect marker /s/ which appears only with certain verbal roots. In the case of this marker, we need a special vocabulary item that includes reference to root information in the structural description. No such contextual restrictions are needed for regular morphology.

(23) a. Regular morphology: Italian imperfect marker
ama-v-o/batte-v-o/parti-v-o ...: /-v-/ $\leftrightarrow$ [+imperfect]
b. Irregular morphology: Italian perfect marker /s/
per-s-i: /-s-/ $\leftrightarrow$ [+perfect]/$\surd^{\text{s}}$_ ($\surd^{\text{s}}$ = *perd*, etc.)

One of the most typical cases of irregular morphology involves morphological operations dependent on root-specific information (see also Section 4). Morpheme exponence dependent on root-specific information can be referred to as root-conditioned contextual allomorphy. In DM, root-conditioned contextual allomorphy requires vocabulary items (VI) and morphophonological rules including root-specific information in their structural description.

In discussing the irregular Latin and Italian perfect and past participle forms, Calabrese (2016, 2019, 2023) observes a striking correlation between the presence vs. absence of regular morphology and the presence vs. absence of thematic vowels, respectively.

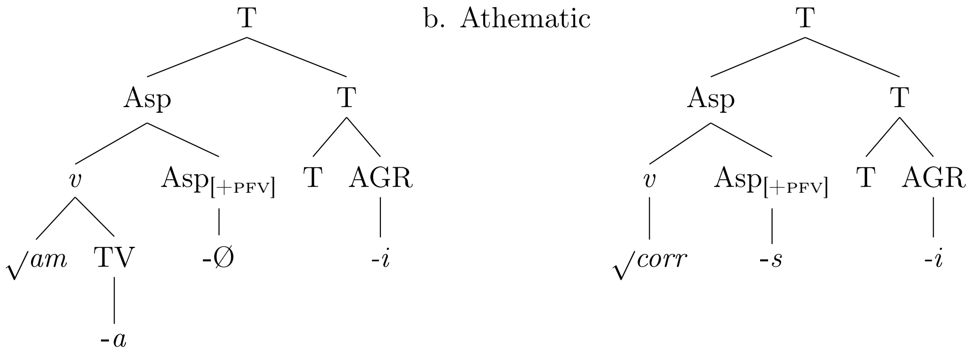
(24) Irregular morphology vs. thematic vowels in Italian and Latin

	Irregular/athematic perfects	Regular/thematic perfects
Italian	*persi* 'lost' (1sg)	*amai* 'loved' (1sg)
	$[[[[\ \textit{perd}\ ]_{\surd}\ \text{-Ø}]_v\ \text{-}\textit{s}\ ]_{\text{Asp}}\ \text{-}\textit{i}]_{\text{AGR}}$	$[[[[\textit{am}\ ]_{\surd}\ \text{-}\textit{a}_{\text{TV}}\ ]_v\ \text{-Ø}\ ]_{\text{Asp}}\ \text{-}\textit{i}\ ]_{\text{AGR}}$
	venni 'came' (1sg)	*battei* 'beat' (1sg)
	$[[[[\ \textit{ven}\ ]_{\surd}\ \text{X}\ ]_v\ \text{-}\textit{s}\ ]_{\text{Asp}}\ \text{-}\textit{i}]_{\text{AGR}}$	$[[[[\textit{batt}\ ]_{\surd}\ \text{-}\textit{e}_{\text{TV}}\ ]_v\ \text{-Ø}\ ]_{\text{Asp}}\ \text{-}\textit{i}\ ]_{\text{AGR}}$
	vidi 'saw' (1sg; $\surd$*ved* + ablaut)	*partii* 'left' (1sg)
	$[[[[\ \textit{ved}\ ]_{\surd}\ \text{X}_{\text{ABLAUT}}\ ]_v\ \text{-}\textit{s}\ ]_{\text{Asp}}\ \text{-}\textit{i}]_{\text{AGR}}$	$[[[[\textit{part}\ ]_{\surd}\ \text{-}\textit{i}_{\text{TV}}\ ]_v\ \text{-Ø}\ ]_{\text{Asp}}\ \text{-}\textit{i}\ ]_{\text{AGR}}$
Latin	*monuī* 'reminded' (1sg)	*amāvī* 'loved' (1sg)
	$[[[[\ \textit{mon}\ ]_{\surd}\ \text{-Ø}]_v\ \text{-}\textit{u}\ ]_{\text{Asp}}\ \text{-}\bar{\textit{ı}}]_{\text{AGR}}$	$[[[[\textit{am}\ ]_{\surd}\ \text{-}\bar{\textit{a}}_{\text{TV}}\ ]_v\ \text{-}\textit{v}\ ]_{\text{Asp}}\ \text{-}\bar{\textit{ı}}\ ]_{\text{AGR}}$
	dūxī 'led' (1sg)	*delēvī* 'erased' (1sg)
	$[[[[\ \textit{dūk}\ ]_{\surd}\ \text{-Ø}]_v\ \text{-}\textit{s}\ ]_{\text{Asp}}\ \text{-}\bar{\textit{ı}}]_{\text{AGR}}$	$[[[[\textit{del}\ ]_{\surd}\ \text{-}\bar{\textit{e}}_{\text{TV}}\ ]_v\ \text{-}\textit{v}\ ]_{\text{Asp}}\ \text{-}\bar{\textit{ı}}\ ]_{\text{AGR}}$
	prandī 'breakfasted' (1sg)	*audīvī* 'heard' (1sg)
	$[[[[\ \textit{prand}\ ]_{\surd}\ \text{-Ø}]_v\ \text{-Ø}]_{\text{Asp}}\ \text{-}\bar{\textit{ı}}]_{\text{AGR}}$	$[[[[\textit{aud}\ ]_{\surd}\ \text{-}\bar{\textit{ı}}_{\text{TV}}\ ]_v\ \text{-}\textit{v}\ ]_{\text{Asp}}\ \text{-}\bar{\textit{ı}}\ ]_{\text{AGR}}$

The generalization is that root-conditioned contextual allomorphy is observed only in athematic morphology. Calabrese (2015, 2019) accounted for this by assuming, following Embick (2010, 2013; see also Embick and Shwayder 2018), that the transmission of information necessary for any morpheme-to-morpheme interaction can occur only in a local configuration, where locality involves adjacency. Therefore the structure of thematic vs. athematic perfects differ slightly: in (25a), a thematic vowel has been inserted under *v*, whereas in (25b) no thematic vowel has been inserted.[6]

(25) Thematic vs. athematic verbs in Italian

a. Thematic b. Athematic



The exponents of the Italian perfects are given in (26); the ones for Latin in (27).[7]

(26) Italian perfect exponents

a.	*-s-*	$\leftrightarrow$	[+PFV]	/ $\sqrt{}^{\mathrm{S}}$ _	($\sqrt{}^{\mathrm{S}}$ = *scriv*, *muov*, etc.)
b.	X, [+round]	$\leftrightarrow$	[+PFV]	/ $\sqrt{}^{\mathrm{L}}$ _	($\sqrt{}^{\mathrm{L}}$ = *noc*, *tac*, *dʒac*, etc.)
c.	Ø	$\leftrightarrow$	[+PFV]		(Elsewhere, e.g., for *fac*, *ved*, etc.)

(27) Latin perfect exponents

a.	Ø	$\leftrightarrow$	[+PFV]	/ $\sqrt{}^{\text{Ø}}$ _	($\sqrt{}^{\text{Ø}}$ = *vert*, etc.)
b.	*-s-*	$\leftrightarrow$	[+PFV]	/ $\sqrt{}^{\mathrm{S}}$ _	($\sqrt{}^{\mathrm{S}}$ = *scrib*, etc.)
c.	*-v-*	$\leftrightarrow$	[+PFV]		

Given locality as adjacency, the Asp morpheme and the root can interact in the structure in (28a) (indicated by the double-headed arrow) but not in the structure in (28b), in which the theme vowel intervenes between the root and Asp. The VIs in (26a,b)–(27a,b) can thus only apply in athematic configurations. When vocabulary insertion reaches Asp in (28b), however, root information cannot be accessed because the root is not adjacent to Asp due to the presence of the thematic vowel. Given that root information cannot be transmitted across the thematic vowel, only default, regular morphology can appear on Asp in this case, per (26c)–(27c).

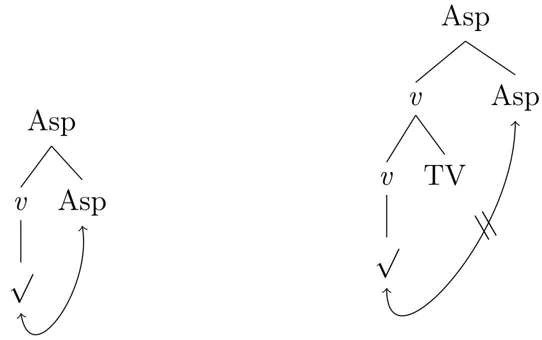
[6] For the sake of simplicity, we are assuming here that the aspectual suffix is dominated by the Asp node, but note that this node is actually a fused node containing other functional features such as Voice, and the same holds for the T node (see Section 2.1 on fusion and pruning).

[7] The exponent X in (26) b. triggers gemination and rounding of the preceding consonant as in the perfect forms in (i). Non-dorsal consonants are derounded. The exponent developed from Latin /-u-/ in post-consonantal position.

(i) Italian perfect gemination

Imperfect	Perfect (UR)		Perfect (SR)	Root	
vɛniva	*vɛn-Xw-e*	$\rightarrow$	*vɛnne*	*vɛn*	'come'
kadeva	*kad-X-e*	$\rightarrow$	*kadde*	*kad*	'fall'
notʃeva	*nok-X-e*	$\rightarrow$	*nokk^{w}e*	*nok*	'harm'

(28) Locality in athematic vs. thematic verbs



a. b.

This explains the distribution of the perfect exponents in (26) and (27): complex Asp allomorphy, in which Asp is realized by different root-conditioned exponents is only found in athematic constructions. The Latin and Italian facts suggest that thematic vowels must be analyzed as independent structural elements which affect the locality condition on morphological interactions. Note that in the diachronic changes discussed here and in Section 2.3 we do not observe preservation of forms, which may undergo phonological change and/or morphological reanalysis, but of a structural property: root-conditioned contextual allomorphy requires a local configuration. Thus, the development of Romance perfect forms essentially preserves the morphological properties of the Latin perfect system: Irregularity (allomorphy) in the athematic forms vs. regularity in the thematic forms.

Note that the morphological changes we have just observed are most adequately accounted for only in an analysis where morphological components such as roots, thematic vowels, and Asp are hierarchically organized in syntactic structures in such a way that morphological locality can govern their interactions, as expected in DM. These changes crucially show the effect of syntactic structure on the surface shape of complex word forms. This follows naturally in frameworks like DM where the input to morphology is syntax, but not in lexical models where words or stems are built prior to and independently of syntactic operations.

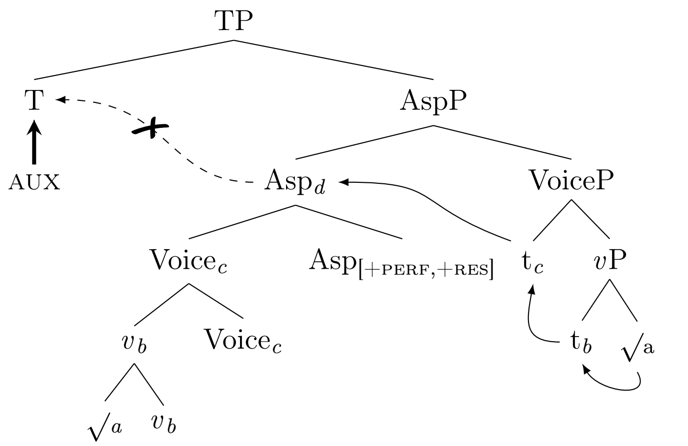
2.5 The diachrony of periphrastic formations

2.5.1 Passive periphrasis from Latin to Italian

If verbal synthetic forms are due to the cyclic application of head movement which converts the extended functional projection of a verb into a single complex X^0 head (i.e., a single word involving a root plus affixes), one can plausibly assume that, in contrast, periphrastic verbal forms in which the same verbal extended functional projections are broken into different complex X^0's (i.e. different words, auxiliaries and other verbal morphological pieces) are due to the failure of the application of this operation to certain functional heads. This approach to periphrasis, which was at first formulated in Embick (2000), has been elaborated by, e.g., Bjorkman (2011), Pietraszko (2016, 2018, 2023), Fenger (2019, 2020), Calabrese (2019), Grestenberger (2022b). In Bjorkman and Pietraszko's works, the failure of functional heads to combine with the verb is due to marked features of certain nodes acting as interveners (Rizzi 1990) for syntactic processes such as Agree that lead to head movement. For example, the *v*-complex may not raise to Tense because (marked) aspectual features intervene and prevent agreement with a higher T feature. In Calabrese's model, the failure of head movement is formalized in terms of morphological filters disallowing combinations of functional head features: postsyntactic movement is blocked to prevent the generation of such combinations. Fenger proposes that head movement may be blocked by phase boundaries such as that between the verbal thematic complex which include Aspect and the higher T-C complex (Bošković 2014, Wurmbrand 2017), though phase extension is possible if there is head movement before Spell Out, in which case synthetic forms are generated. We cannot discuss these proposals in detail here; what matters for our purposes is that periphrasis is the result of blocked head movement. A simple way of implementing this, without taking a stand with respect to the implementations mentioned above, is to propose that head movement between two adjacent nodes is parametrized with respect to whether movement from one node to the next one is allowed. If movement is blocked, the complex X^0 head that was cyclically constructed up to that point remains stuck there, and the features of the remaining higher heads need to be "rescued" by an auxiliary. This leads to a periphrastic formation in which the extended functional projection is split in at least two word complexes: a lower one, i.e, blocked X^0 complex, and a higher one including the higher functional heads of the projection, specifically tense, mood, and agreement features.

Following Embick (2004), Bjorkman (2011) and Pietraszko (2016), Calabrese (2019) argues that the Italian periphrastic perfect constructions as in (29a) are derived by blocking head movement of the lower complex including Asp to the higher T node. A dummy root - the auxiliary - is therefore inserted to pick up the stranded features on T (Bjorkman 2011), as illustrated in (29b).

(29) a. ho mangia-to una mela
HAVE.1SG eat-PTCP an apple

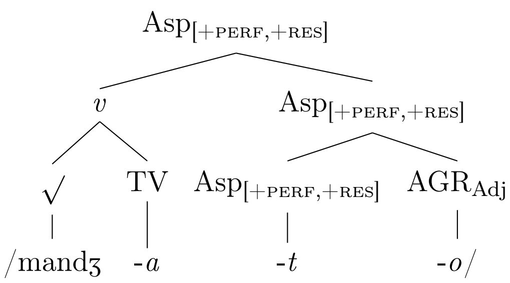
b. 

In this analysis, the participle is therefore essentially a tenseless, moodless verbal Asp constituent (Embick 2000; Embick and Halle 2005; Remberger 2012; Alexiadou et al. 2015; Grestenberger 2018, 2020, 2022b; Calabrese 2020). In the Indo-European languages, verbal forms of this type have the agreement properties typical of adjectives (i.e., concord). We assume that this is due to the type of AGR that is inserted in the verbal X^0-complex (or "m-word", see Section 2.6). AGR is inserted in absence of inherent ϕ-features, which are only found in nouns: AGR_V probes for person and number features, AGR_{Adj} probes for gender and number features (and case features in languages with overt morphological case). One can then hypothesize that AGR_V is inserted only when T is present in the same m-word, otherwise AGR_{Adj} is inserted, (30).

(30) Given a X^0-complex U not including inherent ϕ-features,
  a. Adjoin AGR_V to its highest X_0 if U contains T, otherwise:
  b. Adjoin AGR_{Adj} to its highest X^0

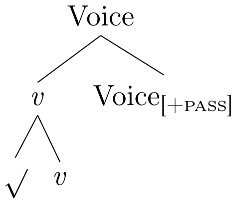
The surface structure of the participle is then derived by inserting ornamental morphological pieces (AGR and TV) and by the application of pruning operations (v and Voice have null exponence, cf. Section 2.1), (31).

(31)



We can now turn to passive participles, which should have the basic structure in (32), insofar as both temporal and aspectual distinctions are marked on the auxiliary component of the periphrasis as shown in (33) (excluding future and subjunctive contrasts).

(32)



(33) Italian periphrastic passives

Maria	*è*	*amat-a*	‘Mary	is	loved’
	era			was being	
	fu			was	
	è stat-a			has been	
	era stat-a			had been	

Given the structures in (29b) and (32), there should be two different morphological types of participle: the passive one and the perfect one. As a matter of fact, however, these two participles are always morphologically realized in the same way in Italian despite their obvious temporal and aspectual differences (cf. also Remberger 2012).[8] Consider the sentences in (34)–(35). In (34), the event occurred in the past, and is completed at the time of the utterance (perfective). In (35), it is occurring in the present, and it is not completed (imperfective) as also shown by the use of the auxiliary *venire* which indicates an ongoing event (Salvi and Vanelli 2004: 70). However, in both sentences, the auxiliary is in the present tense, so the temporal and aspectual differences of these two constructions must somehow reside in the participial forms themselves, which, however, are morphologically identical.

(34) *Carlo ha mangia-t-o il gelato*
Carlo HAVE.AUX.3SG.PRS eat-PTCP-M.SG the ice.cream
‘Carlo ate/has eaten the ice cream’

(35) *Il gelato viene mangia-t-o proprio ora da Carlo*
the ice.cream COME.AUX.3SG.PRS eat-PTCP-M.SG right now by Carlo
‘The ice cream is being eaten just now by Carlo’

Calabrese (2020) argues that this surface convergence among perfect and passive participle forms has a principled morphological reason. A brief historical digression into the Latin predecessors of these participles is necessary at this point. Latin participles realized both perfective and passive morphology where the passive feature could be syntactically motivated as in the case of transitive verbs but also be assigned morphosyntactically as in the case of deponent verbs, which were syntactically active, but morphologically nonactive (Flobert 1975; Embick 2000;

[8]The same holds is true of perfect/passive periphrasis in the Germanic languages, cf., e.g., Wegner 2019a, 2019b.

Grestenberger 2023a). Crucially, the compatibility of these forms with *by*-phrases in the passive use, (37a), *and* with direct objects in the case of deponent participles, (37b), suggests that Voice is contained in these forms (cf. Grestenberger 2023a).

(36) Perfect passive participles in Latin

a. Transitive active verbs

laud-ā-t-us/a *est*
praise-TV-PTCP-M.SG/F.SG BE.3SG.PRS
'was praised'

equ-ī *cūr-ā-t-ī*
horse-NOM.PL.M care-TV-PTCP-NOM.PL.M
'horses (hat were) taken care of'

b. Deponent verbs

secū-t-us/a *est*
follow-TV-PTCP-M.SG/F.SG BE.3SG.PRS
'(has) followed'

confess-us *reus*
confess.PTCP-NOM.SG.M accused.NOM.SG.M
'the accused that has confessed'

(37) a. *quī* ... ***moni-t-us*** ***ā proximīs***, *ut*
REL.NOM.SG.M admonish-PTCP-NOM.SG.M by close.ABL.PL that
pūrgāret *sē*, ... *ait*: ...
excuse.IPF.SUBJ.3SG.ACT himself.ACC said
"He, **advised by his closed ones** to exculpate himself, declared ..." (Liv. 1.50.8)

b. ***omnēs*** *ante* *mē* ***auctōr-ēs*** ***secū-t-us***, *exposuī* (...)
all.ACC before me author-ACC.PL follow-PTCP-NOM.SG.M expound.1SG.PF.ACT
"**Having followed all authors** before me, I have stated (that) ..." (Liv. 4.20.5)

Insofar as these participles expressed both aspect (perfect) and Voice (passive), the auxiliary component of the passive perfect periphrasis realized only temporal distinctions (differently than in Italian, cf. (33); again putting aside future and subjunctive contrasts), (38).

(38) Latin periphrastic passives

a. *Līvia* *amā-t-a* *est* 'Livia is/was loved'
b. *erat* 'had been loved'
c. **fuit*

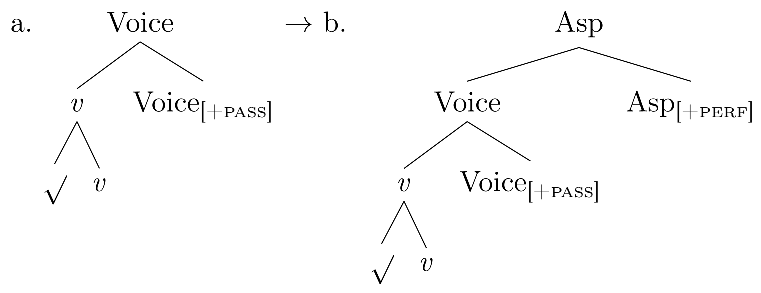
Moreover, there is a "tense mismatch" in the Latin periphrastic passives: The auxiliary *est* is the present form of the copula, but the construction expresses the perfective past. In other words, the tense and aspect features were not overtly marked on the auxiliary at this stage, as shown by the fact that the use of the perfective past tense form of the copula, 3sg. *fuit* in (38c), was illicit at that stage in this construction. The major change affecting these constructions already at the early Latin stage was a shift by which tense and aspect distinctions were realized in the auxiliary part of the periphrastic construction, as in the Italian cases in (33), at which point the use of (38c) became in fact grammatical (see Danckaert 2017ab for a more detailed discussion of these changes).

When this happened, a transitive verb participle in the context of the auxiliary BE acquired only passive meaning. Its "perfect" morphology which is seen in the Italian perfect participle forms was preserved, however. How can we model this preservation? One could propose that once the change described above occurred, the presence of a [+PASS] Voice node required a [+PERF] Asp node morphologically, (39).

(39) If $\text{Voice}_{[+\textsc{pass}]}$ is present in a complex X^0, then $\text{Asp}_{[+\textsc{perf}]}$ must be present.

The statement in (39) requires that a morphosyntactic structure such as that in (40a) must be converted into that in (40b) in the morphological component.

(40)



Once the pruning operations (after TV and AGR insertion) apply as discussed above, (40b) is changed into the structure in (31). Calabrese (2020) proposes that the statement in (39) is in fact an instance of ornamental morphology (see Section 2.3) that can be captured by a broader generalization on the morphosyntactic form of words as in (41), which states that the presence of a structural component may require the presence of another structural component purely formally. The presence of $\text{Voice}_{[+\textsc{pass}]}$ implies the presence of the inner v; due to (41), the presence of this latter head then requires the morphological presence of the Asp head thus leading to (40b).[9]

(41) If v is present in a verbal X^0 complex, then Asp is also present in this complex, and vice versa

Calabrese (2020) argues that just as there are filters governing the combination of morphosyntactic features (see Section 2.7), there are also principles governing relationships between nodes in morphosyntactic structures. Like their phonological counterparts, they can be active or deactivated depending on the language. The constraint in (41) is active in Romance, having become activated at some point in Latin as sketched out above: a morphosyntactic node not required by the syntactico-semantic component is inserted in morphological representations; a purely formal "morphological" extension of the functional structure characterizing verbal morphology which is encoded in hierarchies such as (3). One can call this an instance of morphological stereotypization: a contingent correlation becomes formally categorical; the observation that the (morphological) presence of Asp is often correlated with the presence of v becomes the categorial generalization that the presence of Asp is *always* formally correlated with the presence of v, and vice versa.[10] It follows that it becomes a morphological structural generalization similar to the one requiring the presence of ornamental morphological pieces such as the thematic vowels and leading to the insertion of morphological elements that do not have a functional syntactico-semantic motivation (see Section 2.5.4 for further consequences of (41)).

[9] At this point, the feature [+PFV] would moreover be inserted in Asp, assuming that proto-typical reference to an eventuality requires that it is aspectually bound. The progressive, habitual or continuous interpretations of an eventuality are prototypically marked. A morphological structural condition stating that the default, unmarked specification for Asp is [+PFV] as in (i) can therefore be proposed for this stage, along the lines of Embick (2000)'s interpretation of perfective as default Asp in Latin. See Calabrese (2020, 2023) for further discussion.

(i) $\varnothing \rightarrow [+\textsc{pfv}] \ / \ [\ ]_{\text{Asp}}$

[10] On the other hand, one could say that the syntactic presence of v prototypically correlates with the syntactic presence of Asp: the presence of the inner aspectual node v that modulates the eventuality type of the verbal root correlates with the presence of the outer aspectual node Asp that modulates the total aspectual properties characterizing the situation identified by the complex eventuality root + v. This abstract correlation becomes morphologized as a surface structural property of verbal forms.

2.5.2 The replacement of synthetic forms by periphrastic ones

In the previous section we saw how a reanalysis of the component parts of a periphrastic construction can lead to an extension of the contexts in which periphrasis is found. But how do periphrastic constructions replace synthetic ones in the first place? In the Latin case, the periphrastic perfect passive is the only attested perfective passive construction from the earliest time on. But an instructive example of how periphrastic forms come to replace synthetic ones is found in the history of Greek.

The Ancient Greek (AG) periphrastic perfect consists of the BE-auxiliary and the active or nonactive ("middle") perfect participle. A summary of its forms (excluding the future perfect forms) is given in (42).

(42) Periphrastic perfect constructions in AG; AUX = *eĩnai* (1sg. *eimí*) 'be'

	Participle		Auxiliary		
	act.	nonact.	act.	nonact.	
a. Perf.act.	le-lu-k-ṓs		ei-mi		'have released'
b. Perf.pass.		le-lu-mén-os	ei-mi		'have been released'
c. Pluperf.act.	le-lu-k-ṓs		ē̃-n		'had released'
d. Pluperf.pass.		le-lu-mén-os	ē̃-n		'had been released'
e. Perf.subj.act.	le-lu-k-ṓs		ō̃		'shall release'
f. Perf.subj.pass.		le-lu-mén-os	ō̃		'shall be released'
g. Perf.opt.act.	le-lu-k-ṓs		e-íē-n		'might release'
h. Perf.opt.pass.		le-lu-mén-os	e-íē-n		'might be released'

Unlike in Latin, in AG the perfect periphrasis involves both the active and the passive voice, which is expressed through the use of both the active and the nonactive perfect participle. Stem-forming (v) morphology and Asp (perfect) are also expressed on the participle, while Tense and Mood are expressed on the auxiliary. In the spirit of the proposals discussed in the previous section, Grestenberger (2018, 2020, 2022b) argues that participial morphemes spell out Asp in those cases in which it cannot combine with T through head movement, either because T is not present in the clause (in reduced adjunct clauses, for example) or because a marked feature [+RES] on Asp prevents movement. The vocabulary items for "nonfinite Asp" (= participles) are given in (43).

(43) Vocabulary Items for AG Asp in nonfinite contexts (Grestenberger 2022c)

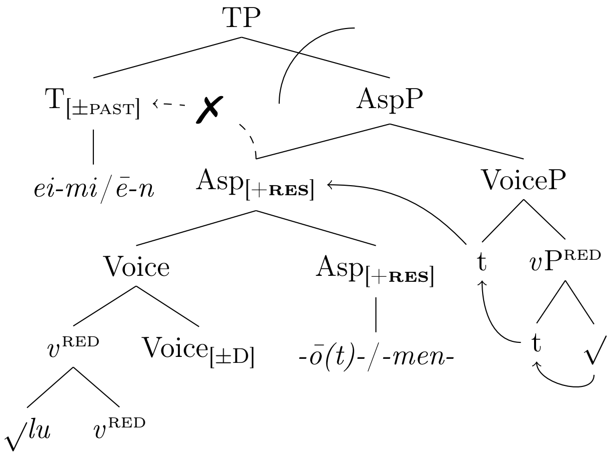
a. $\text{Asp}_{[+\text{RES}]}$	$\leftrightarrow$	*-ot-/-os-*	$/v/\text{Voice}_{[+\text{D}]}\_$
b. Asp	$\leftrightarrow$	*-men-*	$/\text{Voice}_{[-\text{D}]}\_$
c. Asp	$\leftrightarrow$	*-nt-*	

The perfect active participial allomorph in (43a) is the most highly specified exponent since it only occurs in the perfect, while the present and aorist active use a different exponent, (43c). The nonactive allomorph appears in contexts in which Voice does not introduce an external argument syntactically ($\text{Voice}_{[\text{-D}]}$, cf. Alexiadou et al. 2015; Kastner 2020; Grestenberger 2021, 2022b). The structure of an AG periphrastic perfect/pluperfect indicative form is given in (44). Like in Latin, the root BE is inserted to pick up the stranded features above Asp.[11]

[11] We use a consistently head-initial structure in (44) for ease of exposition, but note that the participle usually precedes the auxiliary, suggesting a head-final TP (see Windhearn 2021).

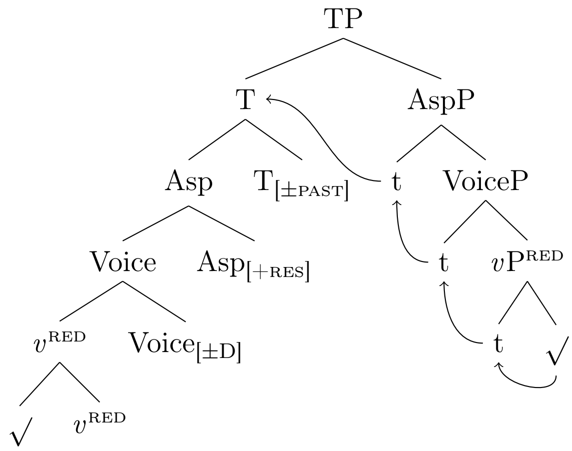
(44) AG perfect/pluperfect active/nonactive indicative:

le-lu-k-ō(t)-/-men- *ei-mi/ē-n*
PF-release-PF-PTCP.ACT/PTCP.NONACT BE-1SG.PRES.ACT/BE-1SG.PAST.ACT



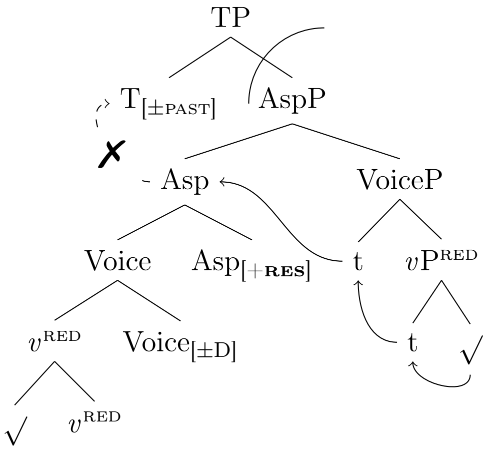
Crucially, it is the feature [+RES] that uniquely characterizes the periphrastic perfect. However, AG also had a inherited *synthetic* perfect formed by reduplicating the initial consonant of the root and using a special set of endings. At least at the Homeric/pre-classical stage, this reduplicated perfect is also usually characterized as resultative (Schwyzer 1939: 768, Haspelmath 1992, Bentein 2012a, 2012b, 2013, Napoli 2017), in particular with respect to its participial system: the reduplicated participial forms in ex. (42) are the participles of precisely this reduplicated perfect stem ("v^{RED}" in (44)). Assuming that it is this resultative aspectual feature that distinguished the perfect from the aorist at the pre-classical stage,[12] this feature must have become grammaticalized in the periphrastic perfect at the classical stage, as the synthetic perfect forms became increasingly similar in use to those of the aorist and eventually merged into a single perfective stem on the way to Modern Greek. This replacement of the inherited synthetic perfect by the newer periphrastic perfect is sketched out in the simplified structures in (45).

(45) a. Inherited synthetic perfect: no marked feature



[12] There are other ways of formalizing this: Reed (2014) argues that the perfect is [-AOR,+PERF]; Schreiner (2021) calls the relevant feature [+PERF]. Both are compatible with the analysis discussed in the main text.

b. Innovated periphrastic perfect: marked [+RES]



Note that [+RES] is not marked at stage a., hence these forms surface as synthetic reduplicated perfects. Only once the perfect participles are co-opted into the finite verbal system is [+RES] reinterpreted as marked feature, precisely because acquirers encounter it more and more in contexts in which it is found on a nonfinite form embedded under a finite copula during the CLA process. We therefore arrive at a diachronic motivation for a synchronically idiosyncratic marked (hence movement-blocking) feature: It arose through a reanalysis of the way syntactico-semantic features are morphologically realized along the verbal spine.

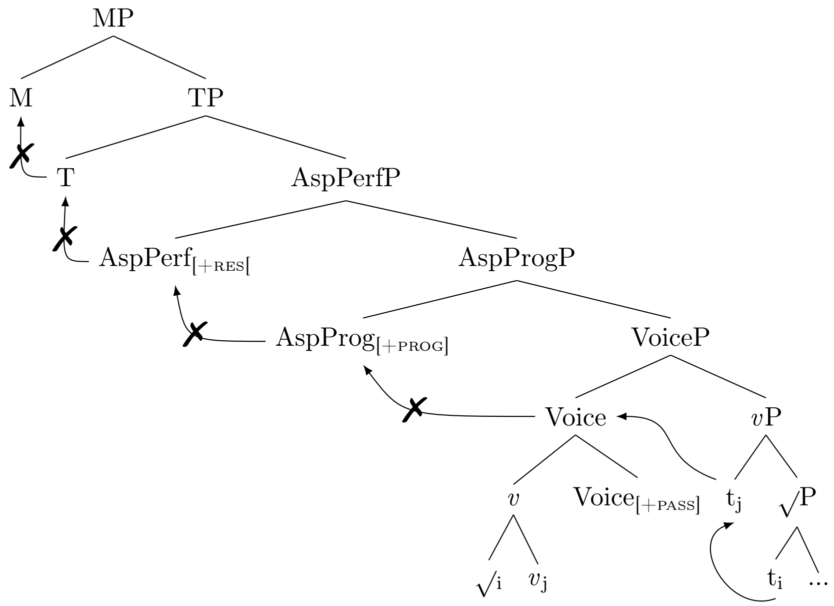
2.5.3 From synthetic to analytic morphology

Assuming that head movement may be blocked for each head adjunction configuration as outlined in Sections 2.5.1 and 2.5.2, we may expect to find instances in which each head of an extended functional projection is an independent word.

English (and other modern Germanic languages) come close to satisfying that prediction, with examples like (46a) suggesting that head movement above Voice is consistently blocked, (46b). VIs and auxiliary insertion will then generate "isolating" strings such as (46a), readily accounting for the rigid ordering of English auxiliaries.

(46) a. Cinderella could$_{\text{Mod}}$ have$_{\text{T}}$ been$_{\text{AspPerf}}$ being$_{\text{AspProg}}$ hassled$_{\text{Voice}}$ by her stepsisters. (Harwood 2014: 298)

b. Structure of (46a)



This is further suggested by the existence of "intermediate" languages, which block head movement between specific heads but allow it between others. Ancient Greek, for example, blocks head movement of $\text{Asp}_{[+\text{RES}]}$, cf. Section 2.5.2, but allows head movement up to $\text{Asp}_{[+\text{RES}]}$ as well as above it: subjunctive and optative mood are expressed together with tense and agreement on the auxiliary, instead of separately as in English, cf. (42).

This approach to periphrasis could therefore provide a possible way to account for the development of complex analytic constructions and eventually for the rise of "isolating"[13] grammars where word forming head movement simply does not apply, but further research is needed to confirm this hypothesis.

2.5.4 The diachrony of participles

In Sections 2.5.1 and 2.5.2, we have discussed the DM-analysis of participles as nonfinite verbal Asp forms in periphrastic contexts, in which they contain the verbal functional projections *v*, Voice, and Asp. But there is further diachronic evidence that participles develop out of (denominal) adjectival affixes that do not initially contain event- and argument structure-related functional projections (Haspelmath 1994; Remberger 2012; Lowe 2015; Grestenberger 2020). The predecessor of the Latin *t*-participle is a case in point: While in Latin it is clearly built on verbal *stems*, as evidenced by the presence of theme vowels in forms such as *am-**ā**-tus/a*, etc., in other ancient IE languages it is built directly on the root rather than the verbal stem, unlike the active and nonactive participles with which it contrasts in this respect. Thus, the Ancient Greek "verbal adjective" in -*t*- (-*t-ó-* m./n., *t-ḗ* f.) selects roots and forms state-denoting adjectives, as illustrated in (47). Note that the -*to*-adjectives never contain verbal stem-forming morphology, regardless of whether the corresponding finite forms are thematic or athematic.

[13]We recognize that "fusional", "isolating", etc., are very broad labels and use them merely descriptively for certain word formation properties, acknowledging that most languages use more than one strategy in different domains of their grammar.

(47) AG finite verbs (augment excluded) vs. verbal adjectives; underlined = verbal stem, **bold** = root (Grestenberger 2022c: 21)

	a. Redupl. pres.	b. *nŭ̄*-pres.	c. them. present	d. *s(a)*-aor.
finite: 1Pl.	tí-**the**-Ø-men	eks-**ai**-nú-metha	**eukh**-ó-metha	**euk**-sá-metha
	RED-place-V-1PL.ACT	PRVB-choose-V-1PL.MID	pray-V-1PL.MID	pray-V-1PL.MID
verbal	**the**-tós	éks-**ai**-tos	**euk**-tós	
adj.	'placed, put'	'chosen; choice'	'prayed for, desired'	

The verbal adjectives in *-t-* differ in this regard from the participial suffixes *-nt-* (pres./aor. active participle), *-(w)ŏ̄s/-uia* (m.-n./f. perf.act. participle) and *-men-o/ē-* (nonactive/"middle" participle), which always select the verbal *stem*—contrast the participial forms in (48) with the verbal adjectives in (47).

(48) AG (1pl) finite verbs vs. participles, underlined = verbal stem, **bold** = root (Grestenberger 2022c: 22)

		Redupl. pres.	*nŭ̄*-pres.	Them. present	*s(a)*-aor.
Finite	1pl.act.	tí-**the**-Ø-men	**deík**-nu-men	**lū́**-o-men	**deík**-sa-men
	1pl.mid.	ti-**thé**-Ø-metha	**deik**-nú-metha	**lū**-ó-metha	**deik**-sá-metha
Ptcp.	act. ptcp.	ti-**thé**-Ø-nt-	**deik**-nú-nt-	**lū́**-o-nt-	**deík**-sa-nt-
	mid. ptcp.	ti-**thé**-Ø-men-o-	**deik**-nú-men-o-	**lū**-ó-men-o-	**deik**-sá-men-o-

The same contrast between verbal adjectives and participles holds in Sanskrit: while the verbal adjective in *-tá-* selects the root, the participial suffixes are built on the stem, (49). Again, this holds regardless of whether the stem formants in question are thematic or athematic, overt or zero.

(49) Sanskrit verbal adjectives, participles, and finite verb forms

	present		aorist		perfect	
	act	mid	act	mid	act	mid
3pl.	**kr̥**-ṇv-ánti	**kr̥**-ṇv-áte	(á-)**kr**-Ø-an	(á-)**kr**-Ø-ata	ca-**kr**-úr	ca-**kr**-iré
ptcp.	**kr̥**-ṇv-ánt-	**kr̥**-ṇv-āná-	**kr**-Ø-ánt-	**kr**-Ø-āṇá-	ca-**kr̥**-vát-	ca-**kr**-āṇá-
verbal adj.			**kr̥**-tá-'done'			
3pl.	**várdh**-a-nti	**várdh**-a-ante	(á-)**vr̥dh**-a-n	(á-)**vr̥dh**-a-nta	vā-**vr̥dh**-úr	vā-**vr̥dh**-iré
ptcp.	**várdh**-a-nt-	**várdh**-a-māna-	**vr̥dh**-á-nt-	***vr̥dh**-á-māna-	vā-**vr̥dh**-vát-	vā-**vr̥dh**-āná-
verbal adj.			vr̥ddhá- (< ***vr̥dh**-tá-) 'grown'			

The ability of the Latin cognate of the Greek and Sanskrit verbal adjectives in *-t-* to select verb *stems* must therefore be an Italic innovation, presumably connected to the rise of conjugational class markers as theme vowels and the reanalysis of the participial forms discussed in Section 2.5.1, cf. Calabrese (2019, 2020, 2023).

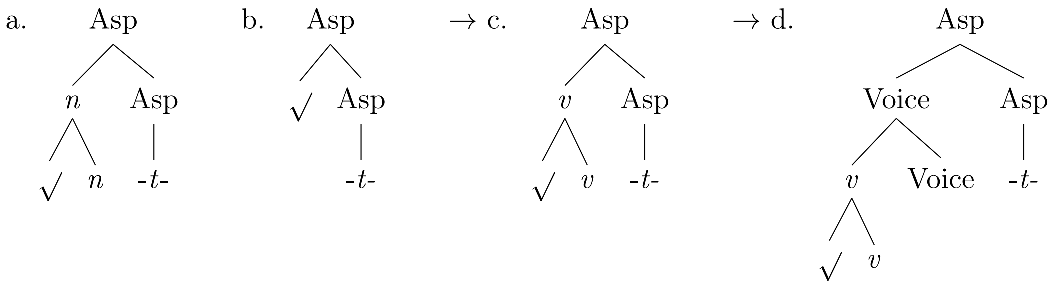
Moreover, we find *denominal* (often privative/negated) adjectives formed with the same *t*-suffix in Latin, Greek, and Sanskrit, (50).

(50) Denominal *t*-adjectives in Latin, Greek, and Sanskrit (Leumann 1977: 333–5; Weiss 2020: 311–2; Schwyzer 1939: 503; AiG II,2: 588)

	t-adj.	meaning	base	meaning
Latin	*barbā-**t**-us*	'bearded'	*barba*	'beard'
	*hones-**t**-us*	'honored'	*honor* (< **hono/es-*)	'high esteem'
Greek	*thauma-**t**-ós*	'marvelous'	*thaũma*	'marvel'
	*thusanō-**t**-ós*	'tasseled, with tassels'	*thúsano-s*	'tassel'
Sanskrit	*án-ap-**t**-a-*	'without water'	*ā́p-/áp-*	'water'
	*(a-)sū́r-**t**-a-*	'(not) sunny'	*s$_{ú}$var-/sū́r-*	'sun'

We analyze root-derived -*t*- as spelling out stative Asp here (following, e.g., Embick 2000; Anagnostopoulou 2003; Anagnostopoulou and Samioti 2014; Alexiadou et al. 2015; Grestenberger 2018, 2022b; Calabrese 2020), as in (51b). This function in turn comes from an older denominal possessive adjective use of -*t*-, exemplified by the forms in (50) and illustrated in (51a).

(51) Diachronic development of stative -*t*-



The reanalysis of denominal adjectives as root-derived adjectives occurred several times in the history of the (older) IE languages and to different adjectival suffixes and was probably facilitated by the fact that these languages inherited a class of "root nouns" with zero nominalizers, and that *t*-adjectives from such root nouns were thus string-identical to *t*-adjectives derived from (eventive or other) roots (e.g., Avestan *hu-kərəp-**t**-a-* 'of/with a beautiful form' to *kəhrp-* 'form, shape'). Crucially, the Italic branch must have inherited both the older denominal and the younger root-derived structures in (51a–b). Assuming that rule (41) was already operative in pre-Latin morphology, the structure in (51b) would have become illicit and changed into that in (51c),[14] which in turn would also entail the presence of Voice in the structure, (51d) (recall that this is independently confirmed by the compatibility of *tus*-participles both with passive *by*-phrases and with accusative objects for deponents, cf. ex. (37)). A stative adjectival participle thus became a true verbal participle realized with the same verbalizing morphology (theme vowels, etc.) as the finite verb forms.

In the preceding sections, we have now seen a step-by-step case study of how participles can gain "functional load" within the verbal system through resegmentation and reanalysis of the syntactico-semantic features of the verbal spine. The question is whether this type of reanalysis can be constrained in some systematic way or if "anything goes" when it comes to morphology-syntax mapping errors during the language acquisition process. We briefly discuss this issue in the next section.

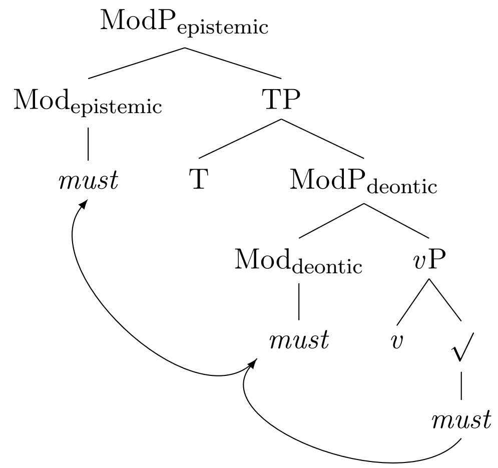
2.6 Directionality in morphosyntactic reanalysis

In the domain of syntactic change, reanalysis is usually conceptualized as occurring in "cycles" by which lexical material becomes semantically impoverished or "bleached", acquiring more abstract

[14]The feature [+PFV] is inserted in Asp as discussed in Footnote 9.

morphosyntactic functions and eventually becoming replaced by new material. This type of "Upwards Reanalyis" or raising of roots (Roberts and Roussou 2003; Roberts 2010; Cournane 2014, 2015) removes the ability of roots to identify and describe an independent eventuality but preserves its abstract logical framework, as for example in the "modal cycle" with example such as the development of Engl. *will* 'want' > *will* FUT, or Italo-Romance AVERE 'have' > 'must'. This cycle is illustrated in (52) for Engl. *must* (root > deontic > epistemic).

(52) UR in the modal cycle



This type of reanalysis is crucially unidirectional: material that realizes abstract syntactico-semantic features pertaining to tense and mood in the cycle are not expected to develop into new lexical verbs (though they can and do sometimes retain their older lexical use). The motivation behind this directionality is rooted in the interaction of computational economy ("third factor principles") with the CLA process, assuming that acquirers aim to generalize as much as possible and make maximal use of the lexical items they acquire and/or the derivational steps they have to posit to derive a particular structure (e.g., van Gelderen 2004, 2009, 2013; Biberauer 2017, 2019; Biberauer and Roberts 2017; Cardinaletti and Starke 1999; Breitbarth 2017). Linearly, this means that lexical material will move further to the left in head-initial phrases/clauses and to the right in head-final ones by syntactico-semantic "bleaching" and reanalysis.

The question now is whether the same is also true for so-called subword reanalysis, that is, the reanalysis of terminal nodes within a single m-word. The definitions of m-word and subword are given in (53), modified slightly from Embick (2015: 68).

(53) a. M-Word: (Potentially complex) head not dominated by a further head-projection.
b. Subword: A terminal node; thus, a morpheme (either a functional morpheme, or a Root).

Assuming that word structure reflects syntactic structure and the order of morphemes in an m-word mirrors the hierarchical order of functional projections (Baker 1985), we would actually expect subword change to be unidirectional, just like cyclical UR changes such as (52) (thus explicitly Grestenberger 2022a, 2023b). In suffixing languages, this means we expect that reanalysis within m-word moves the exponents of subwords linearly *rightwards*. By contrast, Diertani (2011) and Dali and Mathieu (2021) argue that there is no inherent directionality to subword reanalysis: in a string of morphemes X - Y - Z, both reanalyses in (54) are possible.

(54) a. [X Y Z]
b. [X Y Z]

That is, the exponent of Y can become reanalyzed as the exponent of Z and vice versa. The latter would be counterdirectional in a suffixing language. Dali and Mathieu (2021) argue that both types illustrated in (54) are attested in the historical development of the Proto-Semitic suffix *-*a(t)* into Classical Arabic: *-*a(t)* turned from a derivational suffix exponing n into an inflectional Number marker, instantiating (54a), and from marking (collective or singulative) number into a feminine derivational suffix, instantiating (54b). Crucially, they argue that the presence of nodes with zero exponence creates the potential for missegmentation, in that an exponent can be mistaken for belonging to the node immediately to the left or the right of it, (55).

(55) a. [X Y Ø]
b. [X Ø Y]

Despite these arguments, we believe that there are several reasons to assume that only (54a) is a naturally occurring type of subword reanalysis, and hence to adopt "strict" unidirectionality in the guise of UR. First, the bulk of the cross-linguistic empirical evidence overwhelmingly points towards "rightwards" movement of affixal reanalysis in m-words (see, e.g., Haspelmath 1995, 2004; Diertani 2011; Halm 2020; Alexiadou 2021; Grestenberger 2022a, 2023b for examples). Counterexamples center around two contexts: missegmentation of phonological material as belonging to the root rather than an adjacent affix (see Section 4.3) and de-affixation or "affix exodus" (Diertani 2011), by which affixes gain prosodic independence and become independent particles (English -*ish* is one of the most famous examples, see also Norde 2009). However, while the cases of affix exodus discussed in Diertani (2011) do indeed show increased *prosodic* independence, which is a problem for traditional theories of grammaticalization, they are also consistently reanalyzed "upwards" in the respective structure, in which they come to occupy structurally higher (i.e., more rightwards) positions than before the reanalysis. This suggests that prosodic and morphosyntactic reanalysis may be subject to different types of constraints and hence may go different ways, which in and of itself would not be surprising, since this is one of the reasons why "grammaticalization" both as a mechanism[15] and as a theory has been widely criticized in the first place: prosodic, morphosyntactic, and pragmatic grammaticalization criteria do not necessarily coincide in a given diachronic development, but can "conspire" to give rise to the epiphenomenon of grammaticalization (Joseph 2001, 2004; Roberts and Roussou 2003; Norde 2009; Giomi 2023).

Second, following Diertani (2011), Dali and Mathieu (2021) argue that missegmentation and "affix migration" are especially common "when there is one (or more) phonologically null morpheme in the string of words" (Dali and Mathieu 2021: 8). Haspelmath (1995) also proposes that phonological erosion of morpheme boundaries can lead to resegmentation. But there are plenty of examples collected in these works in which affixal reanalysis took place in the absence of morpheme-boundary obscuring sound change and without the need to posit zero nodes within the structure (Grestenberger 2023b), hence zero exponence is neither necessary nor sufficient, nor is it usually posited as a condition on *syntactic* reanalysis. If anything, we would expect economy and CLA principles to *constrain* the possible reanalysis space in such situations, independent of whether exponence is zero or not.

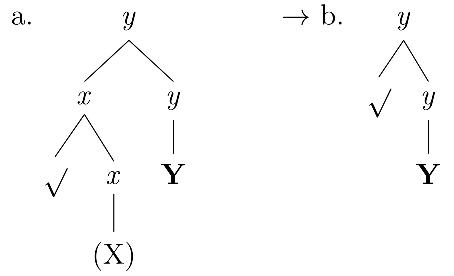
Finally, many apparently counterdirectional examples are actually ambiguous with respect to their structural reanalysis or involve the loss of syntactico-semantic features ("semantic bleaching"), and hence arguably the loss of the functional projection(s) these features were associated with. One such case is the development of the Ancient Greek nonactive/"middle" participial suffix -*menos*, which in Modern Greek is only found in the perfective passive and at least in its "target state" use (Anagnostopoulou 2003; Alexiadou et al. 2015) seems to have lost the projection Voice.[16] Cases like these will give the impression that an exponent Y has moved closer

[15]See Walkden (2021).

[16]Another potential case is illustrated in (51) a–b, provided the denominal use of -*t*- is indeed older than the

to the root (leftwards), (56), but the loss of the syntactico-semantic content of x suggests that this projection has become semantically bleached and lost, while the content associated with Y itself has not changed (note that this type of change therefore differs from synchronic pruning as discussed in Section 2.1, in which the semantic content of pruned nodes is preserved).

(56) "Semantic bleaching" as loss of functional projections/features (Grestenberger 2022a)



In cases in which Y has been previously reanalyzed upwards (e.g., from exponing x in (56a) to exponing y), the subsequent loss of the projection x will look even more like leftwards (counterdirectional) reanalysis. We believe that a careful morphosemantic re-examination of these possible counterdirectional examples will reveal more such instances.

To conclude, the problem of directionality in m-word and subword reanalysis is essentially an empirical one, and more research is needed to determine whether the stricter directionality definition that we have argued for here based on the empirical evidence and the parallelism with syntactic reanalysis does indeed hold. Importantly, both in the bidirectional and in the unidirectional model, locality also constrains possible "recuttings", in that the reanalyzed nodes must be adjacent. However, once they have become reanalyzed and the respective VIs have changed with respect to their conditions on insertion, they can then be found in new contexts that are not adjacent to the same nodes as before the reanalysis (see the discussion in Sections 2.5.1 and 2.5.4 above; further examples are discussed in Diertani 2011: ch. 7).

2.7 Syncretism and defectiveness in case and pronominal systems

2.7.1 Impoverishment and underspecification

Synchronic cases of syncretism are usually accounted for by postulating underspecification and impoverishment of vocabulary items (Bonet 1991; Noyer 1992, 1998; Halle and Marantz 1993; Halle 1997, Bobaljik 2002; Harley 2008; Nevins 2011; on syncretism in diachrony cf. also Ringe and Eska 2013: 160–4; 181–93). Underspecification allows a radical simplification of the lists of vocabulary items in inventories and a more adequate account of the distributional patterns of their exponents. Assuming the abstract notion of paradigm as in (57), defined as the set of feature bundles formed by feature combinations in a given terminal node of the morphosyntax, the principle that governs feature assignments to vocabulary item is given in (58).

(57) A paradigm
Consider three features X, Z, Y, of a given terminal node of the morphosyntax in a language L. We have the following combinations. The set of these combinations is a paradigm.

|	|	|	|	|	|	|	|
+X	+X	–X	–X	+X	+X	–X	–X
+Z	–Z	+Z	–Z	+Z	–Z	+Z	–Z
+Y	+Y	+Y	+Y	–Y	–Y	–Y	–Y

root-derived one.

(58) For each exponent E in a paradigm P in a language L, the minimal feature set that can account for the maximal distribution of E in P is assigned to the Vocabulary Item (VI) inserting E in P. (Calabrese 2008)

Thus given the exponents in (59) for the paradigm in (57), (58) leads to the VIs in (60).

(59) Exponents for (58)

$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$
+X	+X	–X	–X	+X	+X	–X	–X
+Z	–Z	+Z	–Z	+Z	–Z	+Z	–Z
+Y	+Y	+Y	+Y	–Y	–Y	–Y	–Y
Ψ	Δ	Ψ	Ψ	Φ	Σ	Φ	Φ

(60) Vocabulary Items for (60):

a. $\Delta \leftrightarrow$ [+X, –Z, +Y]
b. $\Sigma \leftrightarrow$ [+X, –Z]
c. $\Psi \leftrightarrow$ [+Y]
d. $\Phi \leftrightarrow$ [–Y]

Insertion of phonological exponents is governed by the Subset Principle (Halle 1997), according to which the phonological exponent of a Vocabulary Item is inserted into a morpheme in the terminal string if the item matches all or a subset of the grammatical features specified. Where several Vocabulary items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen in the terminal morpheme. Therefore, Δ wins the competition over Σ, Ψ and Φ; and Σ over Φ. There is no competition between Ψ and Φ. Bonet (1991) observed that there are cases that needed further steps. Suppose that Φ has a slightly different distribution, as in (61). Now, the VIs in (60c–d) can no longer account for the distribution of Ψ and Φ. For similar cases Bonet proposed that Φ is a featurally unspecified "Elsewhere" item as in (62a), and that there is a morphological operation of **impoverishment** that deletes or removes features from the morpheme in a terminal node, i.e., (62b) in this case.

(61)

$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$
+X	+X	–X	–X	+X	+X	–X	–X
+Z	–Z	+Z	–Z	+Z	–Z	+Z	–Z
+Y	+Y	+Y	+Y	–Y	–Y	–Y	–Y
Ψ	Δ	Ψ	Φ	Φ	Σ	Φ	Φ

(62) a. $\Phi \leftrightarrow$ [ ]
b. $[+Y] \rightarrow \emptyset / [\ \_\ , +Z]$

Thus impoverishment blocks the insertion of a more specific vocabulary item, i.e., (60d), and allows the insertion of a less specified one, i.e., (62a).

The syncretism occurring in Spanish pronominal clitic clusters has played an important role in the discussion of impoverishment and underspecification in the account of syncretic changes. The Spanish pronominal clitic system is given below in (63).

(63) Spanish pronominal clitics

<table>
<tr><td></td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td>sg</td><td>pl</td><td>sg</td><td>pl</td><td>sg</td><td>pl</td></tr>
<tr><td>ACC</td><td rowspan="3">me</td><td rowspan="3">nos</td><td rowspan="3">te</td><td rowspan="3">vos</td><td>lo/la</td><td>los/las</td></tr>
<tr><td>DAT</td><td>le</td><td>les</td></tr>
<tr><td>Reflexive</td><td colspan="2">se</td></tr>
</table>

Examples with simple 3rd singular accusative and dative pronominal clitics are given in (64). However, when the dative and the accusative are clustered together as in (65), the dative clitic must be replaced by the reflexive, (65b).

(64) a. Juan le comprò un libro.
Juan 3.DAT bought a book
'Juan bought a book for him/her'
b. Juan lo comprò.
Juan 3.ACC bought
'Juan bought it'

(65) a. *Juan le lo comprò.
Juan 3.DAT 3.ACC bought
'Juan bought it for him/her'
b. Juan se lo comprò.
Juan 3.DAT 3.ACC bought
'Juan bought it for him/her'

Harris (1994, 1997) accounted for this syncretic change by proposing the vocabulary insertion rules in (66) for Spanish clitics and assuming the impoverishment rule in (67). The crucial assumption is that the reflexive is underspecified due to the variety of functions this clitic has in Spanish morphosyntax: in addition to reflexive, it can mark impersonal, middle and passive constructions.

(66)

a.	stem	$\rightarrow$	*n-*	/	_ 1,pl
		$\rightarrow$	*m-*	/	_ 1
		$\rightarrow$	Ø	/	_ 2,pl
		$\rightarrow$	*t-*	/	_ 2
		$\rightarrow$	*l-*	/	_ Kase
		$\rightarrow$	*s-*		
b.	Pl	$\rightarrow$	*-s*		
	Ø	$\rightarrow$	Ø		
c.	TV	$\rightarrow$	*e*	/	[III] _
	TV	$\rightarrow$	*a*	/	[II] _
	TV	$\rightarrow$	*o*		

(67) Impoverish K in dative clitics in clusters.

Calabrese (1995b) noted that the dislike for the 3rd person dat. + acc. pronominal clitic clusters is common across Romance varieties. However, the dative clitic is not usually replaced by the reflexive one, but can also be replaced by the locative and genitive ones, if present in the system. Furthermore, Pescarini (2010) shows that the phenomenon is not restricted to dat.–acc. clusters, but rather to clusters of identical clitic *stems*. He then proposes that it is due to an active OCP-like constraint as in (68). In line with Harris' proposal, he also shows that the clitic that is inserted to repair the disliked cluster in the different systems is already syncretic in the system, i.e., the item that has an unrestricted distribution and is therefore the Elsewhere item of the system.

(68) Morphological OCP/counter-leveling constraint (Grimshaw 1997, Pescarini 2010)
It is not possible to have clusters of identical clitic stems.

(69) Varieties displaying an Elsewhere deriving from Lat. *ince/hic*: Vailate (Lombardy)

<table>
<tr><td></td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td>sg</td><td>pl</td><td>sg</td><td>pl</td><td>sg</td><td>pl</td></tr>
<tr><td>Dir.obj.</td><td rowspan="3">ma</td><td rowspan="2">ga</td><td rowspan="3">ta</td><td rowspan="3">va</td><td>al/la</td><td>i/le</td></tr>
<tr><td>Indir.obj.</td><td colspan="2">ga</td></tr>
<tr><td>Reflexive</td><td>sa</td><td colspan="2">sa</td></tr>
<tr><td>Partitive</td><td colspan="6">na</td></tr>
<tr><td>Locative</td><td colspan="6">ga</td></tr>
</table>

(70) a. *sa* + *sa* → *ga sa* (**sa sa*)
REFL IMP

b. *ga* + *ga* → *ga* (**ga ga*)
LOC 1PL

(71) Varieties displaying an Elsewhere deriving from Lat. *sibi*: Sarroch (Sardinia)

<table>
<tr><td></td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td>sg</td><td>pl</td><td>sg</td><td>pl</td><td>sg</td><td>pl</td></tr>
<tr><td>Dir.obj.</td><td rowspan="3">mi</td><td rowspan="3">si</td><td rowspan="3">ti</td><td rowspan="3">si</td><td>ddu/dda</td><td>ddus/ddas</td></tr>
<tr><td>Indir.obj.</td><td colspan="2">ddi</td></tr>
<tr><td>Reflexive</td><td colspan="2">si</td></tr>
<tr><td>Partitive</td><td colspan="6">ndi</td></tr>
<tr><td>Locative</td><td colspan="6">(n)ci</td></tr>
</table>

(72) a. *ddi* + *ddu* → *si ddu* (**ddi ddu*)
3.DAT 3.ACC

b. *ddi* + *ndi* → *si ndi* (**ddi ndi*)
3.DAT PART

c. *si* + *si* → *si* (**si si*)
1/2.PL REFL

(73) Varieties displaying an Elsewhere deriving from Lat. *inde*: Rocca Imperiale (Calabria)

<table>
<tr><td></td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td></td><td>sg</td><td>pl</td><td>sg</td><td>pl</td><td>sg</td><td>pl</td></tr>
<tr><td>Dir.obj.</td><td rowspan="3">mə</td><td rowspan="3">nə</td><td rowspan="3">tə</td><td rowspan="3">və</td><td>u/a</td><td>i</td></tr>
<tr><td>Indir.obj.</td><td colspan="2">i</td></tr>
<tr><td>Reflexive</td><td colspan="2">sə</td></tr>
<tr><td>Partitive</td><td colspan="6">nə</td></tr>
<tr><td>Locative</td><td colspan="6">ci</td></tr>
</table>

(74) *i* + *i* → *ni* (**i i*)
3.DAT 3.ACC.PL

The problem is how to account for the diachronic syncretic changes in the clitic systems. For example, consider the syncretism targeting dative clitics in Southern Italo-Romance varieties:

From an original system as in (75a), both locative-dative syncretism as in (75b) and genitive-dative syncretism as in (75c) developed.

(75) Syncretism in Southern Italian pronominal systems

a.

gen.	dat.	loc.
**nde*	**li*	**ci/nci*

$\nearrow$

b.

gen.	dat.	loc.
**nde*	**ci/nci*	

(Barese & other central and northern Italian dialects)

$\searrow$

c.

gen.	dat.	loc.
**nde*		**ci/nci*

(Southern Salentino, southern Calabrese)

However, there are several reasons not to appeal to impoverishment and underspecification to account for these syncretic changes. If diachronic syncretic changes were due to feature impoverishment leading to the extension of the underspecified "Elsewhere" vocabulary item, we would expected that (75b) developed from a system where the locative **ci/ni* was underspecified, (76a), and that (75c) developed from a system where the locative **nde* was underspecified, (76b).

(76) a. **ci/nci* $\leftrightarrow$ [ ]
b. **nde* $\leftrightarrow$ [ ]

The problem with the underspecification patterns in (76) is that there is no independent motivation to assume them other than the syncretism in (75b–c). Evidence for underspecification is only provided *ex post facto* by the occurrence of the syncretism. Prior to the syncretism there is no evidence whatsoever that those particular lexical items are underspecified.

2.7.2 Markedness and obliteration

Because of the issues discussed in the previous section, Calabrese (1995b) argues that the use of underspecification, unless it is independently motivated by (58) and thus grounded in the structure of the systems, leads to opportunistic and ultimately circular analyses. The changes in (75) rather need to be accounted for by operations on the feature bundles of the relevant morphosyntactic terminal nodes. It is only after these changes in the feature bundles of the morphosyntax that the exponents of the clitics may be reanalyzed. This idea was developed in more detail in Calabrese (1998, 2008, 2011), based on seminal research by Noyer (1992) (see also Arregi and Nevins 2012), where it was proposed that morphosyntactic structures, and therefore their surface allomorphy, can also be determined by repairs due to morphological constraints affecting the feature bundles of these structures. According to this idea, repairs triggered by morphological constraints may manipulate syntactic structures, and may generate arbitrary morpho-structures, structures that are not motivated synctactically or semantically but only morphologically because of these repairs. Mismatches between syntactico-semantic structure and surface morphological exponents are thus created. The idea that there are morphological repairs of this type can be used to formalize the notion of morphological markedness and its effect on historical changes. Languages, in fact, appear to display an asymmetry in the morphological behavior of feature configurations of functional categories. For example, Greenberg (1963) observed that languages seem to prefer realization with idiosyncratic affixal exponents for categories such as the singular or the plural but not for the dual. The same is true for Case affixes such as nominative or accusative vs. instrumental or locative. In the case of verbal morphology, the same holds for indicative vs. subjunctive. Calabrese (1995b, 1998, 2008, 2011) proposed that morphological markedness effects, like phonological ones, can be accounted for by constraints on combinations of morphological features (Noyer 1998; Arregi and Nevins 2012). These feature constraints or "marking statements" target the feature combinations of the terminal nodes of the morphosyntax. For example, the following marking statement characterizes morphological realization of duality in affixes as costly (cf. Bobaljik 2008): [+plural, +dual] = [+augmented, +restricted], [+plural, –dual] = [+augmented, –restricted]).

(77) *[+augmented, +restricted]/ + _]W

Marking statements may be active or deactivated on a language-specific basis. If a marking statement is active, the relevant combination of morphological features must be repaired and therefore eliminated. Consider the dual in Ancient Greek, which is still used in Homeric Greek:

(78) *t-ṑ ophthalm-ṓ* 'the-NOM.ACC.DUAL (two) eye-NOM.ACC.DUAL'

In later stages of the language, namely in Koiné Greek, the dual "went out of use" and was replaced by the plural:

(79) *h-oì ophthalm-oí* 'the-NOM.PL (two) eye-NOM.PL'

The question now is what "going out of use" means for synthetic morphology. The claim here is that the affixal exponents that tend to "go out of use" are those of marked feature configurations. "Going out of use" for an affixal exponent means that the relevant marking statement has become active. In the case of later stages of Greek, one can then say that the marking statement in (77) has become active, and the idiosyncratic dual exponents were eliminated as a result. The replacement of these exponents with those of the plural can be accounted for by assuming the repair in (80) that changed the feature configuration of the dual into that of the plural.

(80) a. [+restricted] ↔ Ø / [+augmented, _]]W
b. Ø ↔ [–restricted] / [+augmented, _]]W

(80) is an historical innovation, a diachronic event. Thus, learning the morphology of a language A involves learning which morphological marking statements are active in A. This determines which morphological feature combinations are allowed in A; all other feature combinations are eliminated by repairs.[17]

In the following, we will use Calabrese (2011)'s analysis of variation in the structure of subject clitic inventories in northern Italian varieties to illustrate the theory of morphological markedness. The relevant microvariantion in the subject clitic inventories is illustrated in (81) (from Manzini and Savoia 2005; gender distinctions in the third person add a further level of complexity in the systems and are disregarded here).

[17] An important issue that cannot be discussed here at length concerns the reasons for why languages tend to avoid exponence of marked morphological configurations or, more specifically, the reasons for the morphological markedness statements. Calabrese (1988, 2005) proposed that in the case of phonology, markedness statements are interface conditions, i.e., the means through which the linguistic computational system is able to interpret and categorize the physiological, articulatory or acoustic properties of the sensorimotor system so that they can interact with grammatical principles and operations in phonological derivations. The same could be the case for morphological markedness. The morphological marking statements are the way in which functional or cognitive considerations are expressed in grammatical terms (through morphological features). One could speculate that the reasons for morphological markedness are to be found in the cognitive centrality vs. marginality of certain morphosyntactic or semantic features/properties in the human experience of the world or in human communicative needs. Unmarked properties could involve prototypical properties of our experiential or perceptual interpretation of the world (van Langendonck 1986, Mayerthaler 1988) that are easy to access in memory, whereas the exponents of more marginal feature configurations could be more difficult to access, or more easily forgotten. The important point, however, is that all of these functional reasons are formally encoded in the grammar through markedness statements and do not need to directly inform linguistic analysis.

(81) Microvation in northern Italian subject clitics (‘to sleep’, pres.; Manzini and Savoia 2005, vol. I: 72–114)

	Pigna	Cortemilia	Fornero Strona	Càsola
1sg	e ˈdormu	a ˈdrøːm	i ˈdɔrm	a ˈðɔrm
2sg	ti ˈdorme	it ˈdrømi	ti ˈdørmi	tə ˈðɔrm
3sg	u/a ˈdorme	u/a ˈdrøːm	al/la ˈdɔrm	i/la ˈðɔrm
1pl	e dorˈmemu	a driˈmuma	i durˈmuma	a ðurmiˈaŋ
2pl	e dorˈmei	i ˈdrømi	i durˈmiː	və ðurˈmi
3pl	i ˈdorme	i ˈdrømu	i ˈdɔrmu	i/la ˈðɔrmənə
	Pieve S.Lorenzo	Faeto	Chioggia	Forni di Sopra
1sg	i ˈðɔrmə	ddʒə dˈdɔrmə	ˈdɔrmo	i duˈarmi
2sg	tə ˈðɔrmə	tə dˈdɔrmə	ti ˈdɔrmi	a tu duˈarms
3sg	i dˈdɔrmə/la ˈðɔrmə	i dˈdɔrmə	a/la ˈdɔrme	al/a duˈarm
1pl	durmiˈa	nə durˈmunnə	dorˈmimo	i durˈmɔŋ
2pl	durˈmitə	və durˈmijə	dorˈmi	i durˈmiːs
3pl	i dˈdɔrmənə/la ˈðɔrmənə	i durˈmundə	i/le ˈdɔrme	i/as duˈarm

The variation we observe in (81) is in part due to phonological changes that have affected the clitics, but also to widespread morphological changes. One of these changes is syncretism. In addition, many dialects display defective paradigms where some of the clitics are missing. Crucially, the clitics that undergo syncretism and the clitics that are missing tend to be the same: the first person singular and plural, the second plural, and, less frequently, the third plural. Calabrese (2011) proposed that these clitics are the target of markedness constraints that trigger repairs leading to either syncretism or “obliteration”, the removal of forms from a paradigm. Given that the exponents of the different clitics can vary quite a lot due to phonological changes, the basic patterns are given below in terms of the etymological base of the different exponents. The proto-Italian subject pronoun system is given in (82).

(82) Proto-Italian pronominal system

		–Pl	+ Pl
1	+Part, +Speak	*io	*no
2	+Part, –Speak	*tu	*vo
3	–Part, –Speak	*ille	*illi

The basic syncretic and defective inventory patterns can be observed in the tables in (83)–(84) based on the inventories listed in Manzini and Savoia 2004.

(83) Basic patterns of syncretism per number of exponents

<table>
<tr><td></td><td colspan="2">a. 3 exp. (26/183)</td><td colspan="2">b. 4 exp. (65/183)</td><td colspan="2">c. 4 exp. (10/183)</td><td colspan="2">d. 5 exp. (2/183)</td><td colspan="2">e. 5 exp. (2/183)</td></tr>
<tr><td></td><td>Sg</td><td>Pl</td><td>Sg</td><td>Pl</td><td>Sg</td><td>Pl</td><td>Sg</td><td>Pl</td><td>Sg</td><td>Pl</td></tr>
<tr><td>1</td><td></td><td rowspan="3">illi</td><td></td><td rowspan="2">io</td><td colspan="2">io</td><td>io</td><td rowspan="2">vo</td><td colspan="2">io</td></tr>
<tr><td>2</td><td>tu</td><td>tu</td><td>tu</td><td rowspan="2">illi</td><td>tu</td><td>tu</td><td>vo</td></tr>
<tr><td>3</td><td>ille</td><td>ille</td><td>illi</td><td>ille</td><td>ille</td><td>illi</td><td>ille</td><td>illi</td></tr>
</table>

(84) Basic patterns of subject clitic defectiveness

	a. 2 exp. (4/183)		b. 3 exp. (39/183)		c. 4 exp. (3/183)		d. 2 exp. (6/183)		e. 1 exp. (3/183)	
	Sg	Pl	Sg	Pl	Sg	Pl	Sg	Pl	Sg	Pl
1				Ø	io	Ø	Ø			
2	tu	Ø	tu		tu				tu	Ø
3	ille		ille	illi	ille	illi	ille	illi		

It is important to consider the rates of occurrence of idiosyncratic exponents for the subject clitics, i.e., of their non-syncretic exponents. The numbers are given in (85).

(85) Number of occurence of overt non-syncretic subject clitics in the sample

io	tu	ille	no	vo	illi
8/183	175/183	157/183	5/183	5/183	118/183
4.37%	95.62%	85.79%	2.73%	2.73%	64.48%

The tendency is that exponents of the 1pl and 2pl and of the 1sg tend to be generally avoided. The idiosyncratic exponent of the 3pl is then avoided more frequently than that of the 3sg; and that of the 3sg more often than that of the 2sg. These rates, therefore, point to the markedness ranking in (86), where the morphological categories on the right are more marked/complex than those on the left.

(86) **tu* < **ille* < **illi* < **io* < **vo*/**no*

Thus, we can hypothesize that the avoidance of an idiosyncratic exponent for a certain morphological category is a morphological markedness effect. The first and second person plural are the clitics that are most commonly avoided. They are either absent or replaced: the first by the 1sg or by the 2pl, the second by the 1pl or by the 3pl. After that, it is the 1sg that is avoided, followed by the 3pl. Calabrese (2011) formalized these effects by hypothesizing that that subject clitic inventories are governed by the set of marking statement in (87), where the notation "[[_]$_{\text{Subj}}$ + V]$_{\text{V}}$" indicates that this ranking holds for subject proclitics.

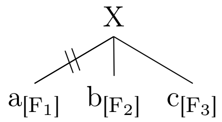
(87) In the context [_ + V]$_{\text{V}}$

a.	*[+PART, −SPEAK, —PL]$_{\text{Subj}}$	**tu*	Less complex
b.	*[−PART, −PL]$_{\text{Subj}}$	**ille*	
c.	*[−PART, +PL]$_{\text{Subj}}$	**illi*	
d.	*[+SPEAK, −PL]$_{\text{Subj}}$	**io*	
e.	*[+PART, −SPEAK, +PL]$_{\text{Subj}}$	**vo*	
f.	*[+SPEAK, +PL]$_{\text{Subj}}$	**no*	More complex

In phonology, the less complex marking statements can be deactivated only if the more complex ones are also deactivated. It follows that if a less complex marking statement is active, the more complex ones are also active. Active morphological marking statements may trigger different types of morphological repairs. Two are relevant in the case of this analysis: One is feature deletion; this repair deletes a terminal node's feature specifications of a disallowed morphological configuration. The other one is obliteration (see Arregi and Nevins 2007); this repair deletes the node directly dominating the disallowed configuration. Both operations create underspecified representations. However, there is a fundamental difference between the two cases. In the morphosyntactic literature, absence of a functional head in a given language is interpreted as inactivity of the morphological category represented by that functional head in that language. If there is no gender, no gender head is assumed. The relevant morpheme is simply absent.

In the case of terminal features the situation is different. If the dominating node is present, the dependent terminal features should be present as well, and its feature must be always specified. Therefore, following Noyer (1998) and Calabrese (2008), the operation of feature deletion is automatically followed by the insertion of the opposite value of the deleted feature due to the full specification requirement. The relevant morpheme is present, but its exponent is syncretic.[18] We will see that feature deletion leads to across-the-board syncretism. Obliteration, instead, requires neither node nor feature insertion. This operation creates morphological "voids": defective paradigms. Since only terminal nodes (morphemes) need to be fully specified, removing the terminal node eliminates all of the features dominated by the terminal node and nothing can be reinserted. The terminal node, the morpheme, is simply eliminated. Instead of syncretism, this operation causes defective gaps. The two operation are formalized in (88) and (89).

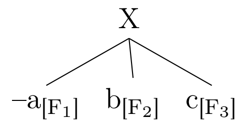
(88) Feature deletion

a.


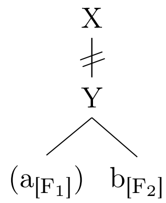
b. $a_{[F_1]} \rightarrow \emptyset$ / [_, $b_{[F_2]}$] because of *[$a_{[F_1]}$, $b_{[F_2]}$]

c. $\emptyset \rightarrow -a_{[F_1]}$ [_, $b_{[F_2]}$] (by default)

d. after the application of b. and c.:



(89) Obliteration: if *[$a_{[F_1]}$, $b_{[F_2]}$]



Thus the syncretism between 1sg and 1pl which characterizes many of the dialects mentioned above is formalized as involving feature deletion, (90).

(90) 1pl → 1sg syncretism:

Input:	[+PART, +SPEAK, +PL]	Active constraint: *[+SPEAK, +PL] (**no*)
Repair:		
Delete [+PL]	[+PART, +SPEAK, _]	
Insert opposite value	[+PART, +SPEAK, −PL]	
Output:	[+PART, +SPEAK, −PL]	
Vocabulary Insertion:	*io*	

On the other hand, the instances of defectiveness found in many of the dialects in (81) can be accounted for in terms of the operation of Obliteration that removes the subject clitic node as in (91) in the case of the removal of 1pl *no*:

[18] A fundamental assumption is that the features of morphosyntactic terminal nodes are always fully specified. Therefore, if a feature specification is deleted it is automatically replaced with the opposite value as in (88), as proposed by Noyer (1998); Arregi and Nevins (2007), Calabrese (2008) (for the same proposal in phonology cf. Calabrese 1988, 1995a, 2005). At the same time, deletion operations are always triggered by active markedness restrictions.

(91) Obliteration due to *[+SPEAK, +PL]

CL

[+PART] [+SPEAK] [+PL]

The syncretism and defectiveness patterns observed in the paradigms in (81) thus involve applications of feature change and obliteration triggered by the constraints in (87). In this model, there is thus no issue with the subject clitics from the point of view of the syntax: all clitics are born with their regular feature configurations and appear in their designated morphosyntactic position. It is only postsyntactically at the level of morphological realization that unexpected gaps and complexities of surface exponence as well as mismatches between the syntax and the surface PF structures are introduced.

Moreover, feature deletion and insertion lead to what Calabrese (2008) called "absolute syncretisms". In the case of absolute syncretism, two morphosyntactic categories which may have different morphological realization in language A have the same morphological realization across the morphology of language B. For example, the ablative and the instrumental cases, which are morphologically distinct in Sanskrit, are both morphologically realized by syncretic ablative morphology in Latin, whereas in Greek the first function (ablative) is realized with genitive and the second (instrumental) with dative morphology. If what is proposed is right, absolute syncretism must be accounted for by changing the feature bundle of a (marked) morphosyntactic category, e.g., the instrumental case, into the feature bundle of another (unmarked) category by feature deletion, followed by feature insertion, where the first is triggered by a markedness constraint (see Section 2.7.4 below for further discussion of absolute syncretism).

2.7.3 Contextual syncretism

Calabrese (2008) proposes that there is also another type of syncretism, contextual syncretism. In the case of contextual syncretism, in a certain morphological context, language A has the same morphological realization for two different morphosyntactic categories that are otherwise morphologically distinct in other contexts in A. For example, whereas Latin distinguishes between the dative and the ablative in singular nouns of the first, second, and fifth declension and in singular non-neuter nouns of the third and fourth declension, this distinction is not present in plural nouns of all declensions and in the neuter singular nouns of the third and fourth declension. Thus, while absolute syncretism is brought about by the systematic modification of feature bundles due to active markedness restrictions, the reasons for contextual syncretism can be of a different, either phonological or morphological, nature: for example contextual syncretism can involve accidental homophony between exponents brought about by phonological changes, or reanalysis of exponents due to analogical leveling (see Section 4.2), or by other morphological changes including those classified under the traditional rubric of analogy. Thus, for contextual syncretism the hypothesis is that the feature bundles of the morphosyntax are always fully specified. The featural assignments of the exponents of the vocabulary items can however be underspecified. Underspecification in this case allows a radical simplification of the lists of vocabulary items and a more adequate account of the distributional patterns of exponents in inventories. The featural assignments of the exponents are governed by the principle in (58). In the same way in which the structural description of phonological rules can be specified as including only certain feature sets so that the rules can apply in a Paninian fashion, exponent insertion instructions can be formulated to obtain the same effect. Consider the status of the syncretism processes that led to the disappearance of 1sg *io*, 1pl *no*, and 2pl *vo* in some Italian dialects. Obviously, these were historical innovations that affected the subject clitic systems of the Italian dialects, as discussed above. Once the innovations were implemented, transmitted and established in the different communities, however, there was no longer evidence for the lost exponents. Principle (58) requires the most adequate and economical featural assignments for the remaining exponents of these inventories that account for their distribution. The table in (92) provides a sample list of exponents for some of the northern Italian dialects in (81) with the featural assignments that govern their distribution according to (58).

(92) List of exponents for selected northern Italian subject clitic systems (verb 'to sleep', pres.)

	Pigna	Cortemilia
1sg	e ˈdormu	a ˈdɾøːm
2sg	ti ˈdorme	it ˈdɾømi
3sg	u/a ˈdorme	u/a ˈdɾøːm
1pl	e dorˈmemu	a dɾiˈmuma
2pl	e dorˈmei	i ˈdɾømi
3pl	i ˈdorme	i ˈdɾømu
	ti ↔ [+PART, −SPEAK, −PL] a ↔ [−PART, −PL, +F] u ↔ [−PART, −PL] i ↔ [−PART, +PL] e ↔	it ↔ [+PART, −SPEAK, −PL] a ↔ [−PART, −PL, +F] u ↔ [−PART, −PL] a ↔ [+SPEAK] i ↔
	Fornero Strona	Casola
1sg	i ˈdɔrm	a ˈðɔrm
2sg	ti ˈdørmi	tə ˈðɔrm
3sg	al/la ˈdɔrm	i/la ˈðɔrm
1pl	i durˈmuma	a ðurmiˈaŋ
2pl	i durˈmiː	və ðurˈmi
3pl	i ˈdɔrmu	i/la ˈðɔrmənə
	ti ↔[+PART, −SPEAK, −PL] la ↔ ↔[−PART, −PL, +F] al ↔[−PART, −PL] i ↔	və ↔ [+PART, −SPEAK, +PL] tə ↔ [+PART, −SPEAK] la ↔ [−PART, +F] a ↔ [+SPEAK] i ↔

After the syncretic processes have been reanalyzed as in (92), there is no evidence for the activity of the markedness constraint any more. Therefore, the markedness constraints that originally triggered the syncretism processes must have been lost as part of the diachrony of these syncretism patterns.

2.7.4 Absolute syncretism

Next, we turn to absolute Case syncretism. Concerning Case systems, Blake (2004) observes that there are clear implicational relationships between the different Cases (see also Caha 2009 for an implementation). An implicational hierarchy of Cases is given in (93). If we assume that the presence of more marked entities implies the presence of less marked ones, as originally proposed by Jakobson (1941), the hierarchy in (93) tells us that the nominative is the least marked Case and the locative the most marked one.

(93) Blake's hierarchy (Blake 2004: 156; Caha 2009: 31)
NOM > ACC > GEN > DAT > LOC > ABL > INST (> others)

Calabrese (1998) proposed that each Case is characteristically identified by a marking condition that constrains the Case's features combination, i.e., a Case Marking Statement (MS). These MSs represent Case feature combinations whose affixal realization is marked as costly. Given the Case feature specifications in (94) (see Calabrese 2008), the Case MSs in (95) can be proposed.

(94) Case feature specifications (Calabrese 2008)

	Nom.	Acc.	Gen.	Dat.	Loc.	Abl.	Inst.
Peripheral	–	–	+	+	+	+	+
Source	–	–	+	–	–	+	–
Location	–	–	–	–	+	+	+
Motion	–	+	–	+	–	+	+

(95) The Case Marking Statements:

a.	*Accusative:	*[–peripheral, +motion]	Less complex
b.	*Genitive:	*[+peripheral]	
c.	*Dative:	*[–location, –source] /[_, +peripheral	
d.	*Locative:	*[+location, –source]	
e.	*Ablative:	*[+location, +source]	
f.	*Instrumental:	*[–source, +location]/_, +motion]	More complex

These Case MSs may be active or inactive in a language. If a Case MS is active in a language the relevant Case is not present in the language. If it is inactive, the relevant Case is present. The Case MSs are organized hierarchically. The more complex a MS in the hierarchy, the more probable is that it is active across languages. In their default state, Case MSs are active. A Case MS is deactivated in a language L only if there is evidence that the relevant Case is morphologically realized in L. Furthermore, one can assume that a Case MS can be deactivated in a language only if Case MSs in less complex positions in the hierarchy are also deactivated.

Absolute Case syncretisms are due to active Case MSs. These active Case MSs trigger repair operations that adjust the disallowed feature configurations of the morphosyntactic terminal nodes. Consider, for example, the syncretism between dative and instrumental in Greek, which was due to the activity of the markedness restriction in (97i.) that triggered the feature deletion in (96iia.), which is then followed by the insertion of the opposite value of the deleted feature as in (97iib). This leads to the change in (97iii.), by which the feature bundle of the instrumental became the feature bundle of the dative.

(96) Absolute instrumental-dative syncretism in Ancient Greek:

i. *Instrumental: *[–source, +location] / [_ , +motion]

ii. Repair:

	a. [+location]	→	Ø	/	[_ , –source, +motion]
	b. Ø	→	[-location]	/	[_ , –source, +motion]
iii.	Instrumental	→	Dative		
	+peripheral		+peripheral		
	–source		–source		
	+location		–location		
	+motion		+motion		

In this way all irrelevant noncontrastive feature combinations are eliminated and vocabulary items need to refer only to the limited set of contrastive features.

Calabrese (1998, 2008) also showed that Case syncretism does not involve the distributional extension of underspecified exponents. Syncretic changes appear in fact not to involve exponents, but the actual Cases. Thus, for example, in Late Latin the dative was replaced by the genitive, as shown in (97), regardless of the exponents that they had in the different declension classes and most importantly regardless of the distribution of these exponents, that is, the syncretism patterns specific to the declension classes.

(97) a.

quod	vinclum,	quaeso,	deest	nostrae	coniunctionis
what	bond	ask.1SG.ACT	be.absent.3SG	our.GEN	relationship.GEN

"What bond, I ask, is absent from our relationship?" (Cic. *Ad Fam.* v,15,2; instead of dat. *nostrae coniunctioni*)

b.

qui	eorum	auxiliare	presumpserat
who	DEM.PRON.GEN.PL	help.INF	undertake.PLUPF.3SG

"(he) who had taken to help them' (Fredeg., sec.VI or VIII,3, 51; instead of dat.pl. *eis*)

c.

viriliter	eorum	resistens
courageously	DEM.PRON.GEN.PL	resisting.NOM.SG

"resisting them courageously" (*Chronicon Salernitanum*, ca. 974; instead of dat.pl. *eis*)

Syncretic changes like those in (97) operate across vocabulary items, regardless of the different exponents of the Cases. Calabrese (2008) also showed that phonological changes alone cannot account for Case syncretism. For example, in the development of the Latin Case system into Romance, the phonological processes characterizing Late Latin and Proto-Romance (loss of coda consonants and lowering and surface disappearance of the short high vowels) could not have neutralized all of the relevant morphological contrasts between the different Cases.[19] To conclude, syncretic changes cannot be reduced to modifications in the phonological shape of exponents even though those can lead to phonological neutralizations between exponents.

3 Morphophonology

3.1 Morphophonological rules in DM

A crucial feature of DM is the assumption of both morphophonological and phonological rules.

(98) a. Morphophonological (MP) rules: morphosyntactically conditioned phonological rules
b. Plain phonological (P) rules: rules and repairs triggered by phonological filters.

A core aspect of morphophonological analysis (both synchronically and diachronically) is to account for *allomorphy*, that is, alternations in the surface shape (exponence) of morphosyntactic nodes. To do this, morphophonological analysis always starts at the lowest level of abstraction. Alternations are first analyzed as involving suppletion, i.e., in terms of different VIs. If there is evidence that they can be accounted for in terms of phonologically plausible processes, MP rules are postulated unless there is also evidence for a purely phonological analysis, in which case phonological rules are postulated.

The allomorphic alternations in the case of the English plurals can illustrate these different types of allomorphy. If one considers the allomorphic alternations in (99)–(100), the morphological analytic method outlined above leads to the postulation of the VIs in (101) and of the morphophonological and phonological rules in (102) and (103) to account for the distribution of the different alternants.

[19] Similarly, Allen (2008) observes that phonological change and syncretism alone cannot explain the shift from synthetic to analytic nominal Case in Old English. Nor is phonological reduction or "erosion" a necessary condition for the reanalysis of synthetic word forms (Grestenberger 2023b).

(99) Sample English plurals:

a. *seraf/serafim*, *cherub/cherubim*
b. *radi-us/radi-i*, *mag-us/mag-i*, *alumn-us/alumn-i*, *sarcophag-us/sarcophag–i*
c. *sheep/sheep*, *fish/fish*, *deer/deer*, *moose/moose*
d. *goose/geese*, *foot/feet*, *tooth/teeth*, *mouse/mice*, *man/men*, *woman/women*
e. *ox/ox-en*, *child/children*
f. *dog/dog-s*, *cat/cat-s*, *bush/bush-es*

(100) Another case of plural allomorphy in English:

a. *wife/wives* [v], *house/houses* [z] vs.
b. *fife/fifes*

(101) VIs (i.e., rules inserting exponents)

a. /-im/ $\leftrightarrow$ [+plural] / $\sqrt{}^{\mathrm{H}}$ _ ($\sqrt{}^{\mathrm{H}}$ = *cherub*, *seraf*, etc.)
b. /-i/ $\leftrightarrow$ [+plural] / $\sqrt{}$.../-us/_
c. Ø $\leftrightarrow$ [+plural] / $\sqrt{}^{\emptyset}$ _ ($\sqrt{}^{\emptyset}$ = *sheep*, *fish*, *moose*, etc.)
d. /-en/ $\leftrightarrow$ [+plural] / $\sqrt{}^{en}$ _ ($\sqrt{}^{en}$ = *ox*, *child*, etc.)
e. /-z/ $\leftrightarrow$

If one assumes the possibility of morphophonological rules, i.e., phonological rules with morphological conditioning, alternations such as those in (99b), *mag-us/mag-i*, (99d), *foot/feet*, (99e), *child/child-r-en*, and (100a), *wife/wi[v]e-[z]* can be accounted for by rules such as those in (102), some of which crucially rely on lexical diacritics.

(102) Morphophonological rules in the environment _ [+plural]

a. Ø $\leftrightarrow$ /r/ / $\sqrt{}$*child* _
b. /us/ $\leftrightarrow$ Ø / _ [-i]
c. [–cons] $\rightarrow$ [–back,–low] / [_]$_{\sqrt{}^{\mathrm{abl}}}$ ($\sqrt{}^{\mathrm{abl}}$ = *foot*, *tooth*, *woman*, *man*, etc.)
d. [+cons] $\rightarrow$ [+voice] / [_]$_{\sqrt{}\mathrm{v}}$ ($\sqrt{}\mathrm{v}$ = *calf*, *leaf*, *life*, *shelf*, *wife*, *wolf*, *house*, etc.)

(103) Phonological rules

a. [–son] $\leftrightarrow$ [–voice] / [–voice] _
b. Ø $\leftrightarrow$ [ɪ] / [–son,+cont,+cor] _ [–son,+cont,+cor]

See Embick and Halle (2005) and Calabrese (2016) on the necessity of MP rules as opposed to a suppletive analysis or an analysis using floating features. In the following sections, we discuss how morphophonological rules and lexical diacritics develop diachronically.

3.2 The development of morphophonological processes (irregular morphology)

3.2.1 A typology of morphophonological processes

Morphophonological processes can be classified into whether they are restricted to the exponents of certain morphemes (target Specific), or not (target indifferent); moreover, they can be triggered by morphological features or by phonological features.[20] The cross-classification of target/trigger interactions yields four potential types, (104) (Embick and Shwayder 2018).

(104) Classification of phonological alternations

	Phon-Triggered	Morph-Triggered
Phon-Target	1	2
Morph-Target	3	4

[20] For the sake of exposition, only right-to-left processes are considered here, but they could also be left-to-right ones.

The rules in (103) are morphologically target indifferent and phonologically triggered, therefore plain phonological rules (i.e., 1 in (104)). The ablaut rule in (102c) is a typical phonologically targeted and morphologically triggered rule (i.e., 2 in (104)). Cases of this type involve what is traditionally called morphologization. They must be accounted for by morphophonological rules triggered by morphological (“grammatical”) features. The rule of fricative voicing in (102d) is a typical rule of the morphologically target specific type (i.e., 3 in (104)). Cases of this type involve what is traditionally called lexicalization. They must be accounted for by morphophonological rules whose application is restricted by lexical diacritics characterizing certain morphemes, usually roots. A rule like (105) below (Halle and Marantz 1993), which accounts for the shapes *should*, *would*, *could*, *stood* of the verbs *shall*, *will*, *can*, *stand* in the past tense, is both target specific and morphologically triggered (i.e., 4 in (104)). The rule is triggered by the morphosyntactic feature ([+past]) when this is linearly adjacent to particular roots, namely those characterized by the relevant lexical diacritic, i.e., $\sqrt{}^{\text{u}}$.

(105) $[-\text{cons}] \rightarrow [+\text{high},+\text{back}]\ /\ [\ \_\ ]_{\sqrt{}^{\text{u}}}[+\text{past}]$ ($\sqrt{}^{\text{u}}$ = *shall*, *will*, *can*, *stand*)

Morphophonological alternations of the different types in (104) can be observed in the development of so-called metaphonic processes (umlaut) in many southern Italo-Romance varieties. Comparative evidence (Loporcaro 1988, Maiden 1991, Calabrese 1985, 1998, 2011) shows that they developed from a traditional “Neapolitan” type system of metaphony as found in Southern Campano, (106). In such a system, stressed mid vowels undergo the changes in (107) before high vowels (only vowel but not consonant shape is reconstructed here).

(106) Historical metaphony/Southern Campano: raising of stressed vowels to [+high] before high vowels. [+high,–ATR] vowels are diphthongized.

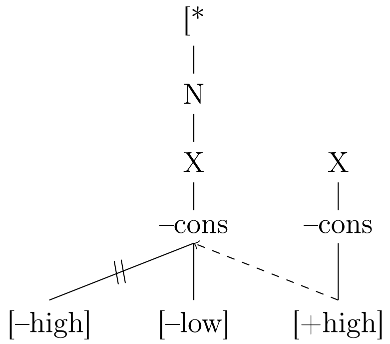
+ATR mid vowels			–ATR mid vowels		
Sg	Pl		Sg	Pl	
*ˈm**e**se*	*ˈm**i**si*	‘month’	*ˈp**ɛ**te*	*ˈp**je**ti*	‘foot’
*ˈn**o**tʃe*	*ˈn**u**tʃi*	‘nut’	*ˈk**ɔ**re*	*ˈk**wo**ri*	‘heart’

(107) Metaphony & diphthongization

Stressed	[–high]	Metaphony	[+high]	Diphthongization
[+ATR]	e	↔	i	
[–ATR]	ɛ	↔	ɪ	ye
[+ATR]	o	↔	u	
[–ATR]	ɔ	↔	ʊ	wo (or [we])

The metaphony rule spreading the [+high] feature of high vowels onto a preceding stressed mid vowel is given in (108). Diphthongization of the resulting [+high,–ATR] vowels results from an independently motivated phonological process which cannot be dealt with here (see Calabrese 1985, 1998, 2011; Kaze 1989; Maiden 1991; Cole 1998; Walker 2005 for further discussion).

(108) Metaphony rule for (106)



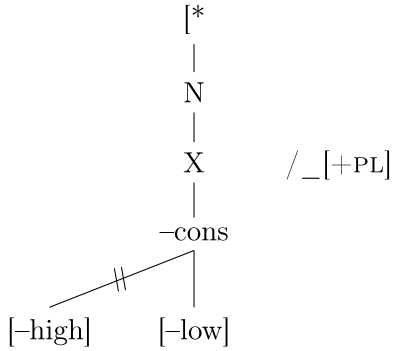
A subsequent phonological change that occurred in many varieties reduced the post-tonic vowels to schwas. This led to alternations like those in (109). In many of the varieties where this occurred, there is no synchronic evidence that would suggest that this reduction process is still active synchronically, which means that there is no reason to postulate any underlying final vowels for these varieties. This change therefore eliminated evidence for inflectional high vowels, the vowels that triggered metaphony. The metaphonic change in (108) was reanalyzed as being triggered by the *morphosyntactic* context, namely the number feature [+PLURAL], i.e., a type of **ablaut** that developed from former umlaut (see Pöchtrager and Youngberg 2023 for a recent survey of ablaut).

It is important to observe, though, that metaphonic changes have not simply become the morphological index of [+PLURAL]: metaphony still remains a phonological process targeting stressed mid vowels. Thus, only when the stressed vowel of a nominal stem is mid do we observe it. If the stem stressed vowel is low or high, there are no alternations, but the neutralization of the morphological contrast between singular and plural. The metaphony rule has been morphologized: It is morph-triggered but target-indifferent, in that a specific abstract morpheme triggers the phonological alternation, but the targets are defined phonologically; there are no "item-specific" (lexical) exceptions.

(109) Neapolitan

+ATR mid vowels			–ATR mid vowels		
Sg	Pl		Sg	Pl	
*ˈm**e**sə*	*ˈm**i**sə*	'month'	*ˈp**ɛ**tə*	*ˈp**je**tə*	'foot'
*ˈn**o**tʃə*	*ˈn**u**tʃə*	'nut'	*ˈk**ɔ**rə*	*ˈk**wo**rə*	'heart'

(110) Metaphony rule for (110)



In other varieties, the original seven vowel system collapsed into a five vowel system by the neutralization of the [±ATR] contrasts in mid-vowels into [–ATR] ones. In these varieties, metaphony is phonologically triggered as in (108). However, the diphthongization that occurred in the case of the [+high,–ATR] vowels generated by this rule can no longer be phonologically motivated as before but becomes a process that affects only certain roots, which must therefore be characterized by diacritics. Thus, this rule is phon-triggered and target-specific: There is a phonological trigger for the process, but only certain roots/morphemes undergo it.

(111) Northern Salentino

–ATR mid vowels, no diphthongization			–ATR mid vowels, diphthongization		
Sg	Pl		Sg	Pl	
*ˈm**ɛ**se*	*ˈm**i**si*	'month'	*ˈp**ɛ**te*	*ˈp**je**ti*	'foot'
*ˈn**ɔ**tʃe*	*ˈn**u**tʃi*	'nut'	*ˈk**ɔ**re*	*ˈk**we**ri* (< *ˈk**wo**ri*)	'heart'

(112) I, U → *yɛ*, *wɛ* / [_]$_{\sqrt{}^{\text{Diphthong}}}$ ($\sqrt{}^{\text{Diphthong}}$ = *pɛt-*, *kɔr-*, etc.)

Finally, other varieties displayed both changes mentioned above: schwa reduction of post-tonic vowels and neutralization of ATR contrasts as shown in (113). This system, which is morph-triggered and target-specific, requires both the metaphony rule (110) and a diphthongization rule such as (112): only a specific morphemes triggers the phonological alternation and only certain roots/morphemes undergo it (note that these are intermediate representations before processes affecting stressed vowels in open syllables).

(113) Pugliese

–ATR mid vowels, no diphthongization			–ATR mid vowels, diphthongization		
Sg	Pl		Sg	Pl	
*ˈm**ɛ**sə*	*ˈm**i**sə*	'month'	*ˈp**ɛ**tə*	*ˈp**je**tə*	'foot'
*ˈn**ɔ**tʃə*	*ˈn**u**tʃə*	'nut'	*ˈk**ɔ**rə*	*ˈk**wo**rə*	'heart'

3.2.2 The development of language-specific idiosyncratic phonology

DM allows not only morphophonological rules (phonological rules conditioned by morphological triggers, see Section 3.2.1) but also idiosyncratic phonological rules or "crazy" rules. An example of a crazy phonological rule is Polish back vowel raising, (114), which accounts for the alternations in (115). In itself, this rule cannot be motivated by any true phonetic reason, it is indeed phonetically "crazy". It is the outcome of the telescoping of a diachronic sequence of natural phonological changes such as vowel lengthening, raising of long vowels and loss of phonemic length (Calabrese 2005).

(114) [+back,+round,–low] ↔ [+high] / _ [+cons,+voice,–nasal] #

(115) Polish back vowel raising

Sg.	Pl.	
klup	*klubi*	'club'
trup	*trupi*	'corpse'
snop	*snopi*	'sheaf'
zwup	*zwobi*	'crib'
dzvon	*dzvoni*	'bell'
grus	*gruzi*	'rubble'
nos	*nosi*	'nose'
vus	*vozi*	'cart'
vuw	*vowi*	'ox'
sul	*sole*	'salt'

Note that there is no plausible alternative way of accounting for Polish raising by means of an interaction of simpler natural constraints. Polish [o]-raising cannot be decomposed into more basic processes, but is the result of the merger and "fossilization" of previously natural phonological processes that were diachronically reanalyzed. In order to understand rules such as (114), we therefore have to reconstruct their prehistory. From a synchronic point of view, however, this process must be accounted for by a special statement, a " crazy rule" (see Anderson 1981; Kenstowicz and Kisseberth 1977, 1979; Blevins and Garrett 1993; Garrett and Blevins 2009 a.o. for further examples). Such rules may be idiosyncratically associated with lexical or grammatical categories; they can be restricted by idiosyncratic phonological and morphological conditions, and most importantly they can be characterized by all types of idiosyncratic and unmotivated exceptions.

In particular, Calabrese (2005) argues that all processes must be represented by rules unless there is evidence to the contrary, such as the presence of a conspiracy in which case a filter is required. It follows that not only idiosyncratic phonological processes like those mentioned above but also non-suppletive contextual allomorphy is governed by rules, morphophonological ones in the latter case. This leads to an expansion of morphophonological processes in a piece-based morphology model like DM. While this aspect of DM is often criticized as unelegant and lacking parsimony, there are clear diachronic motivations for the rise of rules such as (114) from step-by-step reanalysis of erstwhile phonological rules (see also the umlaut-to-ablaut examples in Section 3.2). We thus maintain that positing *synchronically* "crazy" rules is still the most economical way of dealing with lexically conditioned or otherwise idiosyncratic morphophonological processes in a piece-based model. However, more research is needed to determine the limits (if any) on what kinds of rules can arise under which precise circumstances, especially given the additional complication of analogically extended morphophonological rules (Anderson 1988; Garrett and Blevins 2009).

3.2.3 The diachrony of morphophonological changes

At this point, a basic question must be addressed: why are idiosyncratic processes and surface exceptions due to opaque processes interactions preserved in the process of language change? Why aren't they readily wiped out in these changes by rule generalizations? Or, more basically, why aren't languages characterized by minimal allomorphy, minimal phonological processes and minimal exceptions? This is also a pertinent issue in constraint-based frameworks: why aren't constraints applied transparently? The fact is that opaque processes, idiosyncratic processes, lexical exceptions, and all types of phonological idiosyncrasies emerge and are preserved in languages across time.

We believe that the reason lies in the nature of the language acquisition process itself: Grammar transmission is discontinuous and must be recreated by each language acquirer on the basis of the data he or she is exposed to. Acquirers only have direct access to the surface forms, from which they must deduce the exponents and the underlying representations of abstract morphosyntactic items and the rules that account for the surface shape of these items. If the application of the hypothesized rules to the hypothesized underlying representation generates a representation that matches the representation of the stored auditory inputs, the UR and rules are adopted as part of the grammar. The goal of the learners is to construct a grammar which can generate the representations of the productions of the speakers of the same community. It follows that the speaker's and the hearer's knowledge of the words and morphemes includes a synchronic analysis.

If the goal of the learner is to construct a grammar whose outputs representations converge with the representations of the productions of the speakers of the same community, it follows that the only possible changes to surface representations —innovations — can occur during production when parity is not required. Changes then start as innovative adjustments to the outputs of the grammar in production during acquisition. We assume that they are motivated mostly by markedness reasons and reasons of computational economy, but other causes such as hypercorrection, misparsing of inputs resulting in a different pronunciation of an exponent, play, etc., may also be relevant. Diffusion of the innovation occurs when it is adopted by other members of the community (see Hale 2007 on the important distinction between change and diffusion).

Because each new generation of speakers inherits the phonology (morphology, syntax ...) of the previous one, it can implement only a limited number of changes to it. The accumulation of processes can then give rise to a situation in which alternations can no longer be accounted for in terms of rule ordering and need to be analyzed by a different grammar. In this case, reanalysis gives rise to idiosyncratic processes. Reanalysis refers to a difference between the grammar constructed by the learner and the grammar of those whose speech constituted his linguistic experience.[21] However, because of it, synchronic processes are not simply identical to those that occurred in history, and synchronic grammar cannot simply be reduced to the accumulation of historical processes; rather, it is independently constrained by principles of UG and the "diachronic filter" ("there are systems which, given initial conditions and possible paths of change, cannot come into existence", Hale 2019: 13).

The accretion of sound changes may also have an effect on grammatical systems by obscuring transparent relations between related morphological forms. The results of these changes are traditionally referred to as analogical innovations, which we discuss in Section 4.2.

3.3 Clitics, affixes and Local Dislocation in diachrony

The development of free lexical items into clitics and of clitics into affixes has been much discussed in the grammaticalization literature. In this section, we briefly provide a DM perspective on this topic by discussing a case study on the development of clitics into affixes through an intermediate stage of Local Dislocation (LD, Embick and Noyer 2001), a postsyntactic process of adjunction that rebrackets an independent X into an adjacent morphological word, (116). LD crucially applies *after* linearization/Vocabulary Insertion and targets linearly adjacent elements.

(116) $[\mathrm{X} * [\mathrm{Z} * \mathrm{Y}]] \rightarrow [[_{\mathrm{Z}^0}\ \mathrm{Z{+}X}] * \mathrm{Y}]$

In the following, we will show how LD interacts with various morphophonological processes that affect cliticization and affixation in Serviglianese, an Italo-Romance variety spoken in the Marche region of Italy. Serviglianese is characterized by a complex system of regressive vowel-harmonic processes (Tonic Metaphony (/fj**ó**r-i/ → [fj**ú**r-i] 'flower-PL'), Pretonic Metaphony (/l**e**g-ímo/ → [l**i**g-ímo] 'we read'), Posttonic Total Harmony (/mètt-**i**=tʃ**e**=l**o**/ → [mètt-**o**=tʃ**o**=l**o**] 'put it-N there'), and Proclitic Total Harmony (/m**e**=ss**e**=l**a**=píjj-**a**/ → [m**a**=ss**a**=l**a**=píjj-a] 'he takes-REFL it-F on me') (Camilli 1929, Mascaró 2011). These processes interact with a morphosyntactic process that moves and attaches complement pronominals as clitics to verbal forms. Depending on the syntactic context, the resulting clitics can appear before the verbal form (as proclitics) or after it (as enclitics). Here we will be mostly concerned with Total Harmony. It involves total regressive assimilation of an unstressed vowel to a domain-final unstressed vowel. In the case of words without enclitics, it appears only in proparoxytones where the posttonic internal vowel assimilates all features of the final vowel of the word, as in (117). When one or more enclitics are added to a word, for example, in imperative and infinitive verbal forms, it is the last vowel in the clitic sequence that triggers Posttonic Harmony, affecting preceding clitics, inflectional vowels and the stressed vowel (by Tonic Metaphony), as in (118).

(117) a. *árv**u**l-**u** árv**i**l-**i** arvulát-a*
tree-SG tree-PL tree.grove-F.SG

[21] See Walkden (2021).

b. *domén**ak**-**a*** *domén**ek**-**e***
sunday-F.SG sunday-F.PL

c. *tórv**ad**-**a*** *túrv**ud**-**u*** *ntórv**od**-**o*** *ntorved-á*
turbid-F.SG turbid-M.SG make.turbid-1SG.PRS make.turbid-INF

(118) a. *mítt-i* (/mett-i/) *métt-**a**=l**a*** *métt-**o**=l**o*** *métt-**e**=l**e***
put-IPV.2SG put-IPV.2G=it.F.SG put-IPV.2SG=it.MASS put-IPV.2SG=it.F.PL
*mítt-**u**=l**u***
put-IPV.2SG=it.M.SG
"put (it/them)"

b. *mítt-i* (/mett-i/) *métt-**a**=tʃ**a**=l**a*** *métt-**o**=tʃ**o**=l**o***
put-IPV.2SG put-IPV.2SG=there=it.F.SG put-IPV.2SG=there=it.MASS
*mítt-**i**=tʃ**i**=l**i***
put-IPV.2SG=there=it.M.PL
"put (it/them there)"

The application of Posttonic Harmony must precede Tonic Metaphony, as shown by the fact that the former bleeds the latter in cases like /mett-i=la/ → [métt-**a**=**la**], cf. (118a). In this case, the underlying inflectional /i/ has no independent metaphonic effect on the stressed vowel (cf. /mett-i/ → *mítt-i* in (118)); only the last clitic vowel triggers the derivation leading to raising of the stressed vowel. This ordering between the two processes is also seen in cases where the former feeds the latter, e.g., /tórved-u/ → [túrv**ud**-**u**], /métt-i=lu/ → [mítt-**u**=l**u**] and /métt-i=tʃe=li/ → [mítt-**i**=tʃ**i**=l**i**]. It follows that Tonic metaphony must apply to the posttonic string, which includes enclitics, if present, after Posttonic Harmony.

Total harmony also affects proclitic sequences (Proclitic Harmony). In this case, the application of harmony is limited to the proclitic sequence: the last vowel in the proclitic sequence is the trigger and causes regressive total assimilation of the other proclitics, (119).

(119) a. ***te**=**se**=rópp-e*
for.you=REFL=break-PST.3SG
"it broke affecting you"

b. *jj**e**=s**e**=fá*
for.him=REFL=make-PRS.3SG
"one does (it) for him"

c. ***ta**=**la**=pág-o*
to.you=it.F.SG=pay-PRS.1SG
"I pay it-F.SG to you"

Note that the first vowel of the verb does not act as a trigger of harmony on proclitics, even if unstressed (*jje=tt**u**n-ímo* to.him=cut-PRS.1PL 'we cut (it) for him'; *ne=m**i**tt-í* of.them=put-PST.3SG 's/he put (some) of them (there)'). In the same way, pretonic metaphony cannot apply across the verb boundary onto the proclitic (*to=lo=dík-o* to.you=it.M.SG=say-PRS.1SG 'I say it to you'). Simply put, there are no interactions between the verb and the proclitics. The proclitics appear to involve an independent constituent from the verb.

Crucially, observe that whereas enclitics trigger harmony processes, they do not trigger stress shifts, (120), unlike verbal endings, (121a), and suffixes, including evaluative ones like diminutives, (121b). It follows that the constituent where posttonic harmony is computed does not coincide with the constituent within which stress is computed.

(120) Enclitics: no stress shift

*mann-ẹ́t**a**=m**a**=l**a*** (/mann-ẹ́te=me=la/)
send-IPV.2PL=to.me=it.F.SG
"send it-F.SG to me"

(121) a. Verbal endings: stress shift

vɔ́jj-o *vó-i* *vul-ímo* *vol-éte*
want-PRS.1SG want-PRS.2SG want-PRS.1PL want-PRS.2PL

b. Derivational suffixes: stress shift

(i) *ʃtómuk-u* *ʃtommek-ós-a*
stomach-M.SG stomach-related-F.SG (‘nauseous’)

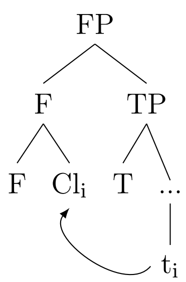
(ii) *merɛ́nn-a* *merenn-étt-a*
lunch-F.SG lunch-DIM-F.SG (‘afternoon snack’)

Therefore, there is a four-way distinction in phonological contexts involving words and clitics: a) the basic morphological word—including the verbal roots and following grammatical suffixes, but not enclitics, where stress is computed; b) the verbal word and following enclitics but not proclitics, where harmonic processes are computed; c) the pro-clitic sequence, but not the following verb, where harmony is also computed, and finally, d) the proclitics plus following verbal word where processes such as secondary stress are computed. Calabrese (2024) shows that these contextual asymmetries can be readily accounted for by how phonology interacts with the derivational steps employed to construct morphosyntactic structure. The crucial first step is the generation of morphological words as discussed in Section 2.1, resulting in a complex X^0 by cyclic, iterated head-rollup of the root Root through *v*, Asp, T, (M) and the insertion of AGR and TV nodes. It can be assumed that stress computation in Serviglianese occurs during the phonological Spell Out of the resulting X^0-complex, i.e., during the generation of the morphological word (though we cannot discuss the details here).

Let us now turn to “cliticization” in Romance. It is standardly accounted for in terms of two different kinds of procedures: a) an operation of syntactic movement, i.e., an instance of language-specific internal merge (Chomsky 2001), which determines the position of the clitic in the structure of the clause; b) a further operation of verb movement that accounts for the difference between proclitics and enclitics. These are followed by c) subsequent operations which determine the morphophonological relationship of the clitic to its host.

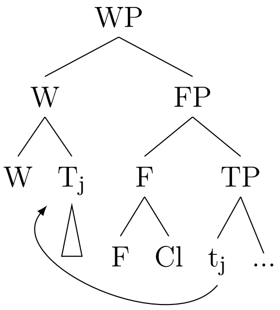
It follows that proclitics are moved from their thematic position in the verb phrase to their landing site. Following Uriagereka (1995), one can assume that clitics move to the left periphery — high in the inflectional domain — to the head of a functional projection which he calls FP (the nature of this projection is not relevant here), (122). Multiple clitics can be adjoined to the F^0 head (Uriagereka 1995) and form an X^0 complex there.

(122) Clitic movement



Enclitics are due to the further movement of the verb. Imperative inversion is normally viewed as evidence for movement of the inflected verb to a higher position in the left-peripheral area, crossing the object clitic, as in (123). A similar operation accounts for enclisis in the case of infinitives (Kayne 1991).

(123) Enclitics



We can now turn to the morphophonological relationship of the clitic to its host. Following Vogel (2009), "cliticization" also involves a prosodic operation by which the clitics are grouped with the verb into a single prosodic constituent, namely the Composite Group (see Calabrese 2024 for a further discussion).

(124) $[_{\text{Composite Group}}\ [_{\omega}\ (\ldots \text{CL} +)\ \text{CL}\ ]_{\omega}\ [_{\omega}\ \textit{Verb form}\ ]_{\omega}\ ]_{\text{Composite Group}}$

The evidence discussed above, however, suggests that the proclitics and the verb belong to different domains. This is what follows if we assume that composite group formation occurs late in the derivation and does not affect the morphosyntactic structure of the clitic + verb string in (123). A linearization of the latter is given in (125), where the clitics and the verb undergo Vocabulary Insertion in separate complex X^0 domains.

(125) $[_{X^0}\ (\text{CL} +)\ \text{CL}\ ]_{X^0}\ [_{\text{TP}}\ [_{X^0}\ \text{V}\ ]_{X^0}\ ]$

Harmony and metaphony, and other phonological operations, are, therefore, blocked by the fact that the proclitic and the following verb belong to independent X^0 constituents.

However, in terms of the composite group, there is no difference between proclitics and enclitics: they have the same constituency with just a difference in linear order. Calabrese (2024) argues that enclitics undergo a further process of incorporation into the preceding word, namely *string-vacuous* Local Dislocation, which we here assume to involve adjunction of the enclitic to the verbal X^0 complex.[22] Crucially, LD operates *after* Vocabulary Insertion, i.e., after the insertion of phonological exponents, as shown in (126). By applying after VI and phonological Spell Out, LD operates on a fully phonologically spelled-out word, which explains why enclitics do not affect stress.

(126) $[_{X^0}\ \text{V}\ ]_{X^0}\ [_{X^0}\ \text{CL}\ (+\text{CL})\ ]_{X^0} \rightarrow [_{X^0}\ \text{V}+\text{CL}\ (+\text{CL})\ ]_{X^0}$

After LD, Harmony and Metaphony are computed in the domain identified by the highest X^0, which corresponds, after the application of (123), to the domain of the spelled out morphological verbal word (V), (127a), of the word + enclitic(s), (127b), and the proclitic complex X^0, i.e., proclitic "words", (127c).

(127) a. $[_{X^0}\ \text{V}\ ]_{X^0}$
b. $[_{X^0}\ \text{V}+\text{CL}\ (+\text{CL})\ ]_{X^0}$
c. $[_{X^0}\ \text{CL}\ (+\text{CL})\ ]_{X^0}$

[22] It is important to observe that, as pointed out by Benincà and Cinque (1993) (see also Luís 2004, Bermúdez-Otero and Luís 2011), proclitics in Romance display a clear morphosyntactic independence with respect to the host verb, differently from enclitics that do not: for example, their verbal hosts can be conjoined, something that is impossible with enclitics. This follows from the analysis proposed here insofar as enclitics, after Local Dislocation, become an integral part of the preceding verbal word. This is not the case for proclitics that remain independent X^0s.

The asymmetry between enclitics that are included in the same constituent as the morphological word for metaphony and harmony and proclitics that are not can therefore be accounted for.

Finally, we need to explain why enclitics do affect stress in other Italian varieties, for example in Lucanian (cf. Peperkamp 1997).

(128) Lucanian: enclitics + stress shift

ví̱nnə	*vənní̱=llə*	*vinnə=mí̱=llə*
sell.IPV.2SG	sell.IPV.2SG=it	sell.IPV.2SG=me=it

In Lucanian, stress shifts rightward from the verb form in the presence of enclitics, specifically to the penultimate syllable of an encliticized string regardless of the number of syllables. This can be accounted for if LD applies *before* Vocabulary Insertion, instead of applying after it as in Serviglianese.[23] In this way, in fact, enclitics become indistinguishable from X^0's undergoing head movement, and will therefore behave like affixal elements triggering stress shifts.

(129) a. $[_{X^0}$ V ... Agr $]_{X^0}$ $[_{X^0}$ CL (+CL) $]_{X^0}$ $\rightarrow$
b. $[_{X^0}$ $[_{X^0}$ V ... Agr $]_{X^0}$ CL (+CL) $]_{X^0}$

Evidence for this type of LD of enclitics comes from the fact that in many of the varieties where they trigger stress shifts, they may also undergo mesoclisis, by which the enclitics switch position with the verbal ending, suggesting that they belong to the same affixal domain.

(130) Albidona (Calabria; Manzini and Savoia 2005); mesoclitic sequences underlined

a.	*pɔrˈt-a-llə/ pɔrˈt-a-mmə* bring-TV-him/me 'bring him/ me'	d.	*pɔrt-a-λλə-ˈmu-llə* bring-TV-him-1PL-it 'Let us bring it to him'
b.	*pɔrt-a-λˈλ-illə* bring-TV-to.him-it 'bring it to him'	e.	*da-λλə-ˈtɛ-llə* give-him-2PL-it 'give it to him'
c.	*pɔrt-a-ˈtɛ-λλə* bring-TV-2PL-to.him 'bring it to him'	f.	*da-mə-ˈtɛ-llə* give-me-2PL-it 'give it to me'

We suggest that LD/late adjunction and the associated possibility of reordering it with respect to Vocabulary Insertion can provide a "grammaticalization pathway" for the development of clitics to affixes as in (131), and therefore more generally for the development of agglutinative morphology.

(131) (proclitic >) enclitic, LD after VI > enclitic, LD before VI > affix/complex X^0.

4 Morpholexical change

4.1 Background: On diacritics and why they are needed

The goal of this section is to briefly discuss morphological changes that affect the lexical entries of roots, that is, the DM analogue to what is commonly referred to as "lexical" (as opposed to functional) categories or open-class items. The literature on roots and root content in Minimalism/DM is vast and we cannot do it justice here (e.g., Harley 2014; Borer 2013, 2014; Panagiotidis 2014, to appear; Alexiadou and Lohndal 2017; to name but a few). Instead, we focus on two processes that affect the exponents of roots themselves: those traditionally termed "analogy", and something we might call root extension.

[23] On ordering reversals between LD and Vocabulary Insertion see also Arregi and Nevins (2012).

A central issue regarding VIs and MP rules that is that of how to express lexically restricted generalizations. In DM, lexically restricted generalizations require diacritics identifying the forms characterized by a certain property. Any theory must state something similar: for example, even if listing is used, a lexically restricted set of forms is nothing else than a set of forms identified by a special property (a diacritic). The role of diacritics in the case of VIs is obvious and cannot be disputed. Diacritics have a crucial role in determining the context for the application of a particular VIs and MP-rules. Moreover, the diachronic loss of particular diacritics and the development of new ones can explain one of the most controversial phenomena in historical morphophonology: analogy.

4.2 Analogy and regularization: Losing and gaining diacritics

As we have seen in Section 2.7.1, impoverishment blocks the insertion of Vocabulary Items by deleting morphosyntactic features; here we propose that impoverishment can also delete lexical diacritics to account for cases of regularization that are usually called analogy.

There are three broad types of analogy that we want to address here (see Fertig 1993 for a more in-depth discussion):

(132) Types of analogy

a. Extension: e.g., OE *cū*, pl. *cȳ* → *cow*, pl. *cow-s*

b. Four-part proportional analogy: e.g., *sing* : *sang* = *bring* : x, x = *brang*; *drive* : *drove* = *dive* : x, x = *dove*, etc.

c. Paradigm leveling: e.g., *reach* : *raught* → *reach* : *reached*, *melt* : *molt* : *molten* → *melt* : *melted* : *melted*, etc.

We will start with paradigm leveling. Cases in which the strong past tense forms of English verbs were regularized abound in the history of English. In addition to (132c), examples include the ones in (133).

(133) a. *clomb* ⇒ *climbed*

b. *crope* ⇒ *crept*

c. *lough* ⇒ *laughed*

d. *yold* ⇒ *yielded*

e. *holpen* ⇒ *helped*

How does DM account for these cases? A simplified sketch of the Vocabulary Items and MP Rules needed for the relevant verbal morphophonology of English is given in (134). As in Section 3.2, we are assuming that the roots that undergo the special treatments are characterized by a special diacritic (A, B, C).

(134) I (= fused T and AGR)

a. [+ptcp, +past] ↔ -*n* / $\sqrt{}^{A}$ _ (where $\sqrt{}^{A}$ = *go*, *beat*, *hew*, etc.)

b. [+past] ↔ -Ø / $\sqrt{}^{B}$ _ (where $\sqrt{}^{B}$ = *beat*, *hit*, *put*, etc.)

c. [+past] ↔ -*t* / $\sqrt{}^{C}$ _ (where $\sqrt{}^{C}$ = *dwell*, *buy*, *send*, etc.)

d. [+past] ↔ -*d*

We will not consider all of the MP rules needed to account for stem allomorphy in English strong verbs (see, e.g., Halle and Marantz 1993), but only the rule of vowel backing that is relevant in the forms in (133).

(135) $V \rightarrow [+\text{back},+\text{round}] \;/\; [C_1\_C_2]_{\sqrt{}^{D}}[+\text{past}]$ (where $\sqrt{}^{D}$ = *sell*, *tell*, etc.)

The regularization we observe in (133) can be achieved through making the lexical information required for the application of special Vocabulary Items and the MP rules unavailable by impoverishing the special root index required for their application. Therefore, the regular forms appear. Formally we can say that *climb*, etc., in (133) lost the lexical markings $^{\mathrm{A,\,D}}$ that are required for the application of the rules in (134) and (135).

(136) $\sqrt{}^{\mathrm{X}} \rightarrow$ impoverishment $\rightarrow$ root

Loss of an irregular pattern is therefore reduced to loss of the relevant root diacritic in the context of its application. One could object that this amounts to no more than a formalization of the observed lexical idiosyncracies and exceptions, but there are two reasons why it is not "just" that: 1) a stringent formalization that reduces the observed irregularities to as few rules as possible is a desirable outcome of any theory, and 2) this particular implementation actually predicts which regularizations are possible at any given stage of a synchronic system and which ones are not. For example, Hill (2020) observes that in the course of paradigm leveling in the history of English irregular verbs such as *melt*, *molt*, *molten* to *melt*, *melted*, *melted*, not all theoretically possible combinations of root + suffix allomorph are actually attested in the historical record: "intermediate forms as English †*melt-en* and †*molt-ed* seem not to occur in the transmitted English texts" (Hill 2020: e43). But assuming that ablaut is synchronically triggered through root diacritics as in (135), the form †*melt-en* is excluded under the assumption that the root shape of the base is MELT and that this is stored with the relevant diacritic(s) for ablaut-triggering -*en*. Once the diacritic is lost by diachronic impoverishment as in (136), we expect the Elsewhere allomorph (136) to surface.[24] In the same vein, we exclude †*molt-ed* as long as the base is MELT without a root diacritic (that is, as long as it is unspecified and therefore expected to take the Elsewhere inflection).

Loss of diacritics also straightforwardly accounts for cases of "extension" of regular inflectional morphology as in (132a): Here, too, impoverishment erases root diacritics, for example, when acquirers fail to store a root diacritic for the form in question — without the need to appeal to an analogical proportion of some kind.[25]

A proportion (or "analogical model") is in fact only needed for cases such as (132b) in which an irregular (diacritically marked) pattern is extended to a new context/root. In these cases, "accidental priming effects" (Reiss 2006: 277) seem to play a crucial role, either phonological or semantic ones. That is, learners misassign diacritics to roots or functional morphemes based on a perceived similarity with the members of the group marked by the same diacritic. These changes essentially rely on a metalinguistic analysis on the part of the learner and can lead to the extension of morphophonological rules, giving rise to "crazy rules" (see Section 3.2). We propose that it is also at play in other instances in which "unnatural" morphonological patterns are extended to new lexical contexts, such as the proportional analogy cases in (132b), which involve phonological triggers — in this case, root shape generalizations, e.g., certain ablaut types for roots in /-ɪŋ/, /-ajv/, etc. Further research is needed to determine how these rules develop diachronically, but it is important to emphasize that in DM, there is no need for positing a "proportion" in addition to the independently needed morphonological generalization (e.g., /-ɪŋ/ ≈ /-æŋ/ ablaut in English) and the assumption that CLA can lead to the extension of these rules to lexical or morphological targets beyond those of the input grammar.

4.3 Reanalysis and root extension

Throughout the previous sections, we have seen cases in which morphosyntactic or morphonological processes are triggered contextually by specific lexical items/specific roots, which form

[24] Hill points out that non-ablauting -*en* forms would be theoretically possible, e.g., *lade*, *lad-en*; *fall*, *fall-en*. But to generate such a form, the root MELT would have to become reanalyzed as belonging to the set of roots that behave in this way, which didn't happen - possibly because it didn't have the right root vowel.

[25] That extension is just failure to store the irregular form seems to be the consensus across theoretical approaches to morphology, see Fertig 1993: ch. 8 for a survey.

groups designated via root diacritics. Before concluding, we briefly want to address changes in root content itself, specifically the "size" of roots. There is no consensus as to the extent to which *semantic* root content — what can and cannot be lexicalized as a single atomic root — is cross-linguistically stable or even universal, or what the exact relationship between roots and "concepts" is (cf. Harley 2014 and the responses in the same volume; Acquaviva 2022). Nevertheless, Alexiadou and Lohndal (2017) argue that it is possible to parametrize the content of roots cross-linguistically, essentially arguing that roots carry more content in some languages than in others, (137).

(137) A scale from 'empty' roots to 'contentful' roots (Alexiadou and Lohndal 2017: 99)
Hebrew > Greek > Old English > English

Essentially, roots in languages on the left of the scale need syntactic context, i.e., categorizers, to be interpreted, while roots on the right of the scale are contentful and determine the meaning of a word. Another way of understanding this scale is as a diachronic generalization about root-adjacent exponence (Calabrese and Petrosino 2023) in the first cycle, that is, whether or not roots require overt categorizing morphology (Hebrew: yes, English: no), and whether this is parametrized depending on the type of root. Effectively, the question is what the overt morphological realization of the semantic generalization called the "Marantz/Arad Hypothesis" (e.g., Marantz 1997, Arad 2003), (138), is.

(138) The Marantz/Arad Hypothesis (Anagnostopoulou and Samioti 2014: 81; Alexiadou and Lohndal 2017: 96)
Roots are assigned an interpretation in the context of the first category assigning head/phase head merged with them, which is then fixed throughout the derivation.

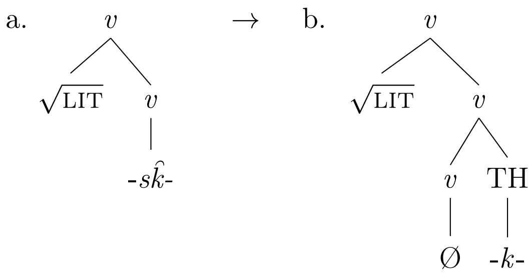
The Marantz/Arad hypothesis basically states that root meaning is determined in the first phase, that is, via merger with a category-forming head. The proposal now is that these heads can be overt or covert, or subject to root-specific insertion requirements due to language-specific diachronic developments. Thus, Arad (2003, 2005) has argued that Hebrew roots only receive their interpretation in the context of specific categorizing morphology, whereas much of the inherited English lexicon is ambiguous between nominal and verbal use without the need for overt categorization (*run*, *walk*, *shine*, *hammer*, *talk*, etc.; see Grestenberger and Kastner 2022: 49ff. for further discussion). The reason is ultimately diachronic (loss of inflectional class morphology through sound change between Old and Middle English), but if this property can change, then we expect that roots may impose different morphonological and morphosyntactic requirements on their syntactic environment, depending on the language, including conjugational class morphology ("ornamental morphology", cf. Section 2.3) and root extensions. One such case comes from Tocharian (Indo-European): Tocharian has a set of roots (ca. 25) that end in the sequence -*tk*-, historically from PIE roots ending in dental stop plus the verbal stem forming suffix *-*sk̂(e/o)*- (Melchert 1978; Malzahn 2010: 460ff.); the sequence *-*Tsk*- then developed into *-*Tk*-. Some examples are given in (139).

(139) Tocharian B *tk*-roots

Toch.	meaning	etymology
litk$^{\bar{a}}$-	'avert, remove'	**lit-sk̂e/o-*
wätk$^{(\bar{a})}$-	'decide'	**u̯i-d*^{h}*h*$_{1}$*-sk̂e/o-*
nätk$^{\bar{a}}$-	'push away'	**nud-sk̂e/o-*

One way of describing this change would be to say that segmental recutting took place, leading to a new phonological form for the roots that mean 'remove', 'decide', etc., in Tocharian B: e.g., *lit-(s)k-* → *litk-Ø-* to spell out the sequence $\sqrt{}$-*v*-, a "counterdirectional" reanalysis of the type discussed in Section 2.6. Such a recutting is perfectly plausible at the root level, assuming that acquirers do not apply principles of computational economy to roots (i.e., open class items that do not allow synonymy) and hence have no preconceived notion as to where the "cut-off point" of a given root should be, giving rise to such well-known examples as Engl. *an ekename* → *a nickname*, *a nadder* → *an adder* (see Diertani 2011: 212–4 for discussion). But in the Tocharian case, this type of reanalysis affected a broader group of roots, making an alternative interpretation more likely, namely that -*tk*- became reanalyzed as root extension. Thus, Koller (2008: 25ff.) argues that -*tk*- (and -*Cw*-) roots violate the synchronic phonotactic rules of Tocharian and provides arguments that these ""roots" are actually morphologically complex structures" and hence "root extensions" (Koller 2008: 27). This suggests that the -*k*-'s and -*w*-'s in these sequences were actually reanalyzed as postsyntactic "thematic" adjuncts to *v* as in (140b) rather than exponents of *v* itself as they were at the older stage, (140a) (cf. the discussion of ornamental morphology in Section 2.3).

(140)



Roots can also become morphologically differentiated according to semantic class. In Modern Greek, for example, the adjectival passive/participial suffix -*tos* (nom.sg.m.) attaches directly to the root for a specific class of verbs, but to the root + verbalizing suffix for others (and is ungrammatical with a verbalizer for yet another class), (141) (Anagnostopoulou and Samioti 2013, 2014).

(141) Modern Greek adjectival -*tos* (ex. from Anagnostopoulou and Samioti 2014: 96–99)

a. root-derived		b. root + *v*-derived -*tos*		c. *root + *v*-derived -*tos*	
verb	adj.	verb	adj.	verb	adj.
din-o	*do-tos*	*axn-**iz**-o*	*axn-**is**-tos*	*aspr-**iz**-o*	**aspr-**is**-tos*
'give'	'give'	'steam'	'steaming hot'	'whiten'	'whitened'
plek-o	*plek-tos*	*magir-**ev**-o*	*magir-**ef**-tos*	*sten-**ev**-o*	**sten-**ef**-tos*
'knit'	'knitted'	'cooked'	'cook'	'tighten'	'tightened'
per-n-o	*par-tos*	*vathoul-**on**-o*	*vathoul-**o**-tos*	*pag-**on**-o*	**pag-**o**-tos*
'take'	'taken'	'hollow'	'hollow out'	'freeze'	'frozen'

To explain this distribution, Anagnostopoulou and Samioti (2014: 99) propose that "-*tos* selects expressions naming events" and adopt the root ontology of Harley 2005, in which roots denote events, things, or states. Event-denoting roots like those of *klino* 'close', *dino* 'give', *perno* 'take', etc., can combine with -*tos* directly, while roots that denote things need to first combine with a verbalizer in order to be compatible with -*tos*. This is the case for instrument verbs and other denominal-looking verbs such as *afrizo* 'foam', *axnizo* 'steam', *vidono* 'screw', *koumbono* 'button', etc., that Anagnostopoulou and Samioti argue to be root- rather than *n*-derived based on the diagnostics of Kiparsky 1982 (see also Kiparsky 1997). Crucially, despite the presence of verbalizing morphology in this class of *tos*-participles, these forms are not eventive participles, but denote characteristic *states*: they are incompatible with adverbial modification, instrumental phrases ("hollowed out *with a spoon*") or agent *by*-phrases.

Finally, -*tos* does not combine with roots expressing a state, with or without the verbalizer, because in these cases a primary adjective exists that blocks the -*tos*-adjective (Alexiadou and

Anagnostopoulou 2008).[26] Crucially, what this distribution suggests is that the presence of verbalizing morphology in this context is a morphosemantic requirement of specific root classes, namely roots that denote things. The verbalizers that appear with these roots are moreover diachronically reanalyzed nominal stem formants (Spyropoulos et al. 2015; Panagiotidis et al. 2017; Grestenberger 2023b) whose development therefore resembles that of the Latin conjugational class markers discussed in Section 2.3, which also originate (at least partly) in reanalyzed nominal morphology. The Greek ones differ, however, in that they appear to be sensitive to the broad denotational root classes.

Summarizing, we think that there is a lot of untapped potential in bringing insights from DM to bear on the diachrony of root morphology and root-adjacent exponence, and hence on the cross-linguistically expected typology of the morphosemantics of roots.

5 Conclusions and outlook

In this article, we have provided an overview of current research in historical linguistics from a DM perspective. In the domain of morphosyntactic analysis and change, we have focused on fusion, pruning, resegmentation and reanalysis in the verbal system, syntactic locality and adjacency, the problem of directionality in reanalysis, and the development of analytic/periphrastic morphology from synthetic systems. In the nominal system, we have discussed various ways of handling syncretism synchronically and diachronically, including impoverishment, markedness and obliteration.

In the domain of morphophonological change, we have focused on the diachrony of "irregular" morphophonology and different types of morpheme-specific rules such as metaphony and ablaut, and the development of clitics into affixes. We have also discussed "morpholexical" changes that are usually summarized under the term "analogy" and have shown how DM handles these, namely by losing item-specific diacritics (in the case of regularization and "paradigm leveling") or by gaining them diachronically through overgeneralizations on the part of language acquirers. Finally, we have briefly touched on the diachrony of the form side of root VIs, in particular root extensions.

There is a lot we haven't discussed for reasons of space, such as the diachrony of Fission, the interaction of morphosyntactic change with argument structure and alignment change, or the rise of morphophonological processes such as reduplication and infixation. We leave this to future research and once again stress the importance of studying these phenomena in a variety of typologically diverse languages, which will doubtlessly provide a clearer picture of the relevant diachronic generalizations and universals of change.

Many of the case studies and their analyses proposed here are based on ongoing work that is open to debate and revision. Our main goal is thus not to argue that this is the only way these case studies can be analyzed, but to provide a starting point for what a DM analysis of them could look like once one adopts the assumptions outlined in Section 1.1. We hope to have shown that DM provides a fruitful avenue for understanding the morphology of "dead" languages as well as the typology of morphological change itself and that it will inspire further work in historical morphology from a DM perspective.

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[26]Though it is unclear why the primary adjective should block the formation of the derived adjective, and such forms do seem to exist with a specialized meaning, as Anagnostopoulou and Samioti (2014: 101) themselves point out.

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