Distributed Morphology and historical linguistics

Andrea Calabrese, University of Connecticut
Laura Grestenberger, Austrian Academy of Sciences

May 13, 2024

1 Introduction

1.1 Background

Distributed Morphology (DM) has only been systematically applied to problems of historical morphology and diachronic reanalysis in the past 10–15 years, but has already given rise to many 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 gaps in the existing research and desiderata for future work. We will investigate diachronic morphological changes 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 (Morphological Spell Out)
4. Phonological Spell out includes Vocabulary Insertion, Morphophonological Processes (= Readjustment Rules), and phonological processes.

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 1995, 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 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 $\mathrm{T}_{[+\textsc{past}]}$ in English, expressed by past tense morphology on finite verbs (based on Embick 2015: 169).

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

a. $\mathrm{T}_{[+\textsc{past}]} \leftrightarrow$ -*t*/ $\{\sqrt{\textsc{bend}}, \sqrt{\textsc{leave}},...\}$
b. $\mathrm{T}_{[+\textsc{past}]} \leftrightarrow$ -Ø/ $\{\sqrt{\textsc{hit}}, \sqrt{\textsc{quit}},...\}$
c. $\mathrm{T}_{[+\textsc{past}]} \leftrightarrow$ -*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". 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 4.1), without any need to refer to analogy or leveling. This type of "regularization" in favor of the Elsewhere form is also a common CLA error[1] and is of course well-represented in the historical record.

In addition to changes that affect stored vocabulary items, language-specific postsyntactic rules such as item-specific morphophonological 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 also 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 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

[1] 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.

(Section 2.2), and the rise of ornamental morphology (Section 2.3). We also provide a longer case study on the development of periphrastic constructions and reanalysis in analytic and synthetic verb forms (Section 2.4) and discuss the role of directionality and locality in reanalysis (Section 2.5). Section 2.6 treats case syncretism.

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

Section 4 discusses what we here term "morpholexical change", for want of a better term: basically a set of "lexical" changes that affect roots or tend to be root-specific, many of which are usually summarized under the term "analogical change" (Section 4.1), but also changes that affect the shape of the root for other reasons (Section 4.2). Section 5 concludes with a summary and brief discussion of future research avenues.

2 Morphosyntax

2.1 Fusion, pruning and zero morphemes

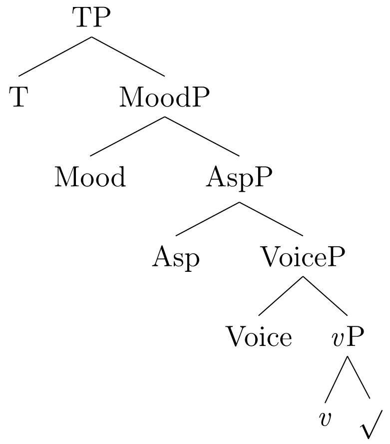
DM's ultimate goal is to define the grammatical conditions that constrain morphological exponence under the assumption that morphemes are structure-dependent, syntactic entities. Given an independently motivated morphosyntactic structure, changes in word exponence can therefore only involve changes in 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 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 on the endings is not discussed here.

(2) The Vedic Sanskrit verbal system, √*kar* 'do', 3sg.act. forms

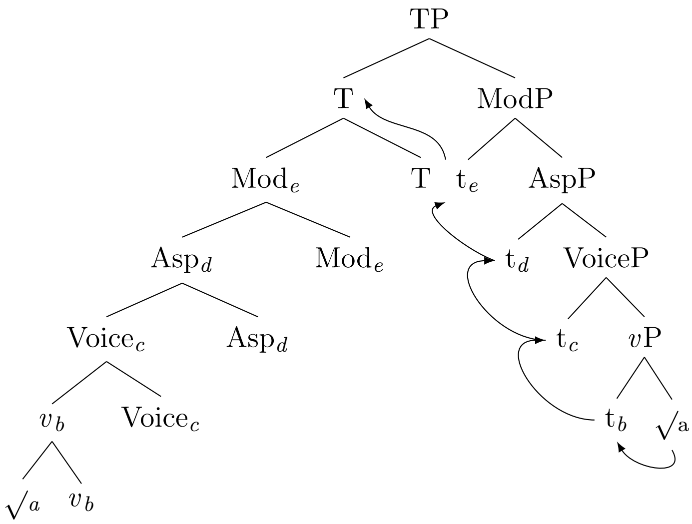
		Pres. stem		Perf. stem		Aor. stem	
Asp	[PFV]	–		+		+	
	[STAT]	–		+		–	
T	[PST]	–	+	–	+	+	
		Pres.	Ipf.	Perf.	Pluperf.	Aor.	Mood
	Ind.	***kr̥-ṇó-ti***	***á-kr̥-ṇo-t***	***ca-kā́r-a***	***á-ca-kar-/t/*** [***ácakar***]	***á-kar-/t/*** [***ákar***]	[–IRR]
	Subj.	***kr̥-ṇáv-a-t***		****cā-kár-a-t***		***kár-a-t***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

Along the lines of Wurmbrand (Wurmbrand 2015; see also Cinque 1999), we adopt the verbal functional structure in (4), which expresses the basic core temporal, aspectual, and modal structure of the "verbal spine".

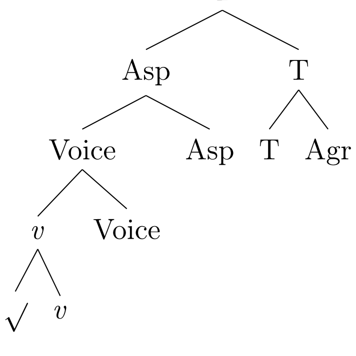
(3) 

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).[2]

(4) Head movement and synthetic verb formation



Following Halle and Marantz (1993) and Bobaljik (2008), the node AGR is inserted post-syntactically as an ornamental morpheme by a rule that adjoins AGR to the highest X_0 in the complex verbal head. Application of this rule in the case of a complex head structure that is the output of (4) generates (5).

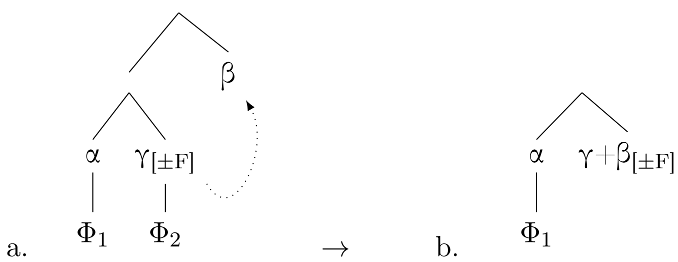
(5) 

[2]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).

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., or through resegmentation and reanalysis of phonological material as belonging to a different node (see Sections 2.4 and 2.5). 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



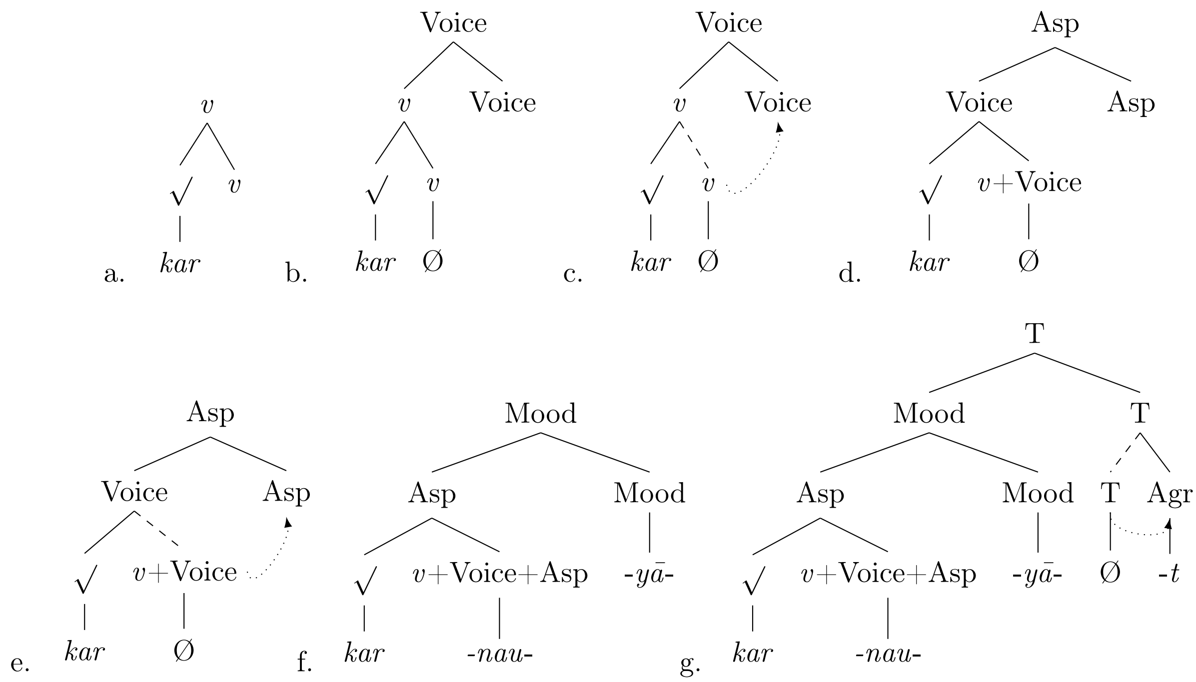
Let's see how this works in the case of Vedic Sanskrit verbal forms. The complex X^0 generated by head raising followed by AGR insertion for this form was given in (5). Phonological Spell Out operates cyclically node-by-node from the bottom up. In addition to overt exponents, Øs are inserted when independently 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 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-* $\leftrightarrow$ $\text{Asp}_{[-\textsc{pfv}]}$ / $\sqrt{}^{\text{V, VIII}}$_
b. *-a-* $\leftrightarrow$ $\text{Mood}_{[+\textsc{irr},-\textsc{desid}]}$
c. *-yā-* $\leftrightarrow$ $\text{Mood}_{[+\textsc{irr},+\textsc{desid}]}$

(8) a. Ø $\leftrightarrow$ *v*
b. Ø $\leftrightarrow$ Voice
c. Ø $\leftrightarrow$ 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* /kar-nau-yā-t/ make-IPFV-OPT-3SG.ACT.PST 'may he/she make'



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 and reanalysis

In PIE, as in ancient IE languages such as Vedic 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 $\mathrm{Asp}_{[-\text{PFV}]}$, cf. Table (10), which lists a selection of Vedic verb classes and their PIE and Ancient Greek (AG) correspondences.

(10) 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*-	-*nū̆*-
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 (cf. Ringe and Eska 2013: 167–77 for further examples of terminal node reanalysis). 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 $\mathrm{Asp}_{[+\textsc{pfv},-\textsc{stat}]}$ (aorist stem) and $\mathrm{Asp}_{[+\textsc{pfv},+\textsc{stat}]}$ (perfect stem) compete for the same position as (and never occur together with) exponents of $\mathrm{Asp}_{[-\textsc{pfv}]}$ (present stem). This is illustrated in Table (11), 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, *véda* 'knows').

(11) Vedic present, aorist, and perfect stem-forming morphology (stem formant = <u>underlined</u>)

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

One and the same root is often associated with different types of present and aorist stems (Joachim 1978; LIV²), 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 (see Grestenberger 2022c on AG). Calabrese and Petrosino (2023) propose that these 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 (12) (we use root diacritics to refer to a group of particular roots; see also Sections 3.1 and 4.1). 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.[3]

(12) VIs for PIE tense-aspect stems

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

[3] See Calabrese and Petrosino (2023) for a slightly different solution. Note that there is no Elsewhere form in (12) 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 that 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.

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.

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, (13). 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'.

(13) 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$^{\mathrm{i}}$	-*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):

(14) a. Denominatives & factitives from substantives and adjectives in *-*eh*$_2$*(-i̯e/o-)*:
kois-eh$_2$*-i̯e/o-* 'to care' (*Transponat* of Lat. *cūrāre* 'care', from *cūra* 'care')
neu̯-eh$_2$*-i̯e/o-* 'to renew' (**neu̯-o-*, -*eh*$_2$- 'new'), Lat. *novāre* 'to renew'

b. Statives in *-*éh*$_1$*(-i̯e/o-)*:
h$_1$*rud*^{h}*-éh*$_1$*-i̯e/o-* 'be red' (**h*$_1$*reu̯d*^{h}- 'red'), Lat. *rubēre* 'be red'

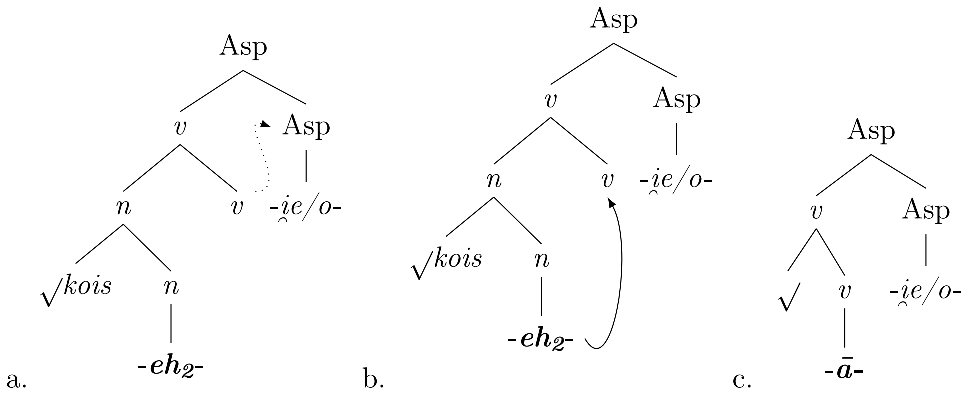
c. (root-derived) causatives and iteratives in *-*éi̯e/o*-:
tors-éi̯e/o- 'make dry', Lat. *torreō*
sorb^h*-éi̯e/o-* 'drink' (iter.), Lat. *sorbeō*

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 causative-iterative *-*éi̯e/o*- in particular are in complementary distribution with the "primary" present, aorist, and perfect stem-forming suffixes discussed in Section 2.2, cf. (11). 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 (15).

(15) 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 (16) for a denominal verb of the first conjugation (excluding Voice for simplicity). (16a) shows the initial stage with docking of v at Asp following pruning (indicated by the dotted line). (16b) illustrates the reanalysis of the nominal suffix *-*eh₂*- as a v-exponent, indicated by the bold arrow, and thus effectively the loss of the pruning operation in (16a). (16c) 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.

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



The same $n \rightarrow v$ 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 2.5).

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, (17) (see also Embick 2015: 100–9, Halle 2019, Calabrese and Petrosino 2023 and Calabrese 2023 for a more detailed discussion).

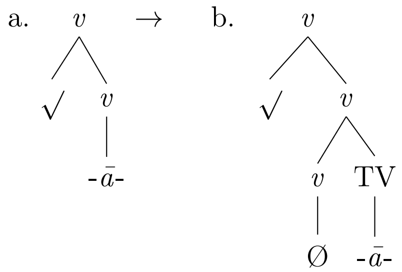
(17) 1st and 4th conj. imperfects & perfects

	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	hear-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	hear-V-PFV-1PL.ACT
	'we praised'	'we heard'

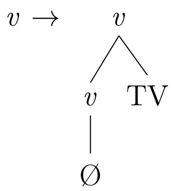
A further crucial step that took place in the development of v-exponents in Latin is that these overt pieces were reanalyzed as *ornamental* morphological pieces that can co-occur with other *v*-forming derivatives. Specifically, the -*ā*- of the first conjugation developed mostly from denominal verbs in *-*i̯e/o*- as in (16) (de Vaan 2012; Bertocci 2017; Weiss 2020: 423–6), while the second conjugation in -*ē*- developed mostly from verbs with the "stative" suffix *-eh_1*(-i̯e/o)*- and from causative-iteratives in *-*éi̯e/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. (14a), as well as from some primary verbs in which the -*ā̆*- 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. 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 (18), from which a rule inserting a TV postsyntactically at every *v*-node was generalized, (19) (cf. Oltra-Massuet 1999; Oltra-Massuet and Arregi 2005 on the same rule in Catalan and Spanish).

(18) Reanalysis of conjugational class markers as ornamental TVs



(19)



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 (20).

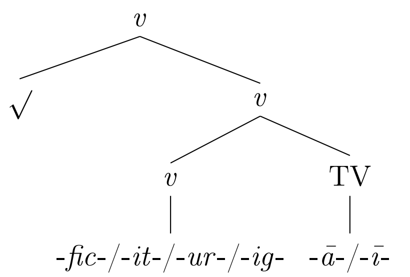
(20) a. *ex-carni-**fic-ā**-re* 'to tear to pieces, to butcher' (factitive-causative)
PRVB-meat-MAKE-TV-INF

b. *vīs-**it-ā**-re* 'to visit' (frequentative)
see-FREQ-TV-INF

c. *ēs-**ur-ī**-re* 'desire to eat, be hungry' (desiderative)
eat.PTCP-DESID-TV-INF

d. *fūm-**ig-ā**-re* 'to fumigate' (factitive)
smoke-DO-TV-INF

e.



Calabrese (2023) moreover proposes that the reanalysis of *v*-exponents as TVs also led to the reanalysis 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.

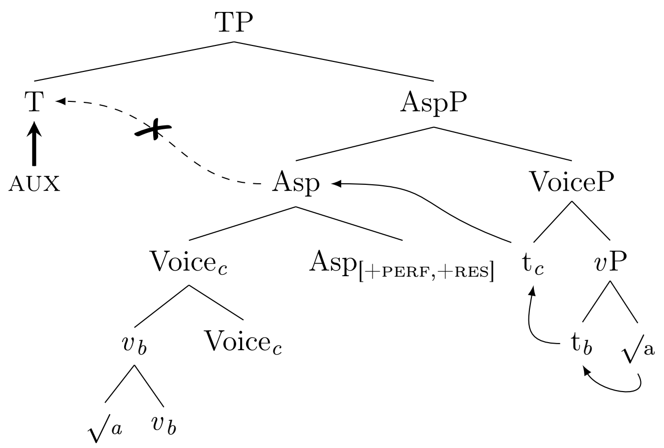
2.4 The diachrony of periphrastic formations

2.4.1 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). 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 into at least two word complexes: a lower "blocked" X^0 complex and a higher one including the higher verbal functional heads, 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 (21a) 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 (21b).

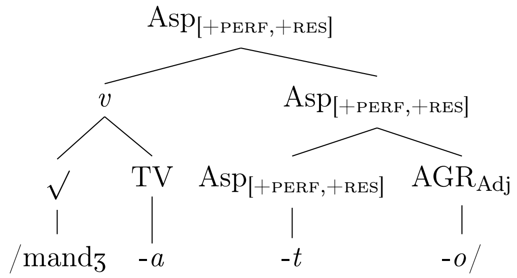
(21) a. ho mangia-to una mela
HAVE.1SG eat-PTCP an apple

b. 

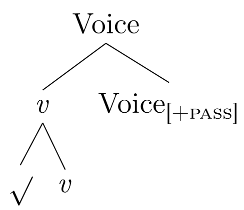
In this analysis, the participle is therefore essentially a tenseless, moodless verbal Asp constituent (Embick 2000; Embick and Halle 2005; Remberger 2012; Alexiadou et al. 2015; Grestenberger 2018, 2020, 2022b; Calabrese 2020). In the Indo-European languages, verbal forms of this type have the agreement 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 2.5). 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, (22).

(22) 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), (23).

(23) 

We can now turn to passive participles, which should have the basic structure in (24), insofar as both temporal and aspectual distinctions are marked on the auxiliary component of the periphrasis as shown in (25) (excluding future and subjunctive contrasts).

(24) 

(25) 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 (21b) and (24), 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. Remberger 2012).[4] Consider the sentences in (26)–(27). In (26), the event occurred in the past and is completed at the time of the utterance (perfective). In (27), 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.

(26) *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'

(27) *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; Grestenberger 2023a). Crucially, the compatibility of these forms with *by*-phrases in the passive use, (29a), *and* with direct objects in the case of deponent participles, (29b), suggests that Voice is contained in these forms (cf. Grestenberger 2023a).

(28) 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 (that 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'

(29) a. *quī* ... ***moni-t-us ā proximīs***, *ut*
REL.NOM.SG.M admonish-PTCP-NOM.SG.M by close.ABL.PL that

[4]The same holds for perfect/passive periphrasis in the Germanic languages, cf., e.g., Wegner 2019ab.

pūrgāret *sē*, ... *ait*: ...
excuse.IPF.SUBJ.3SG.ACT himself.ACC said
"He, **advised by the ones close to him** 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. (25); again putting aside future and subjunctive contrasts), (30).

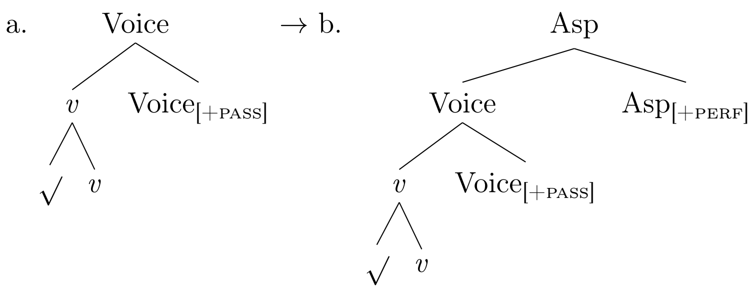
(30) Latin periphrastic passives

a.	*Līvia*	*amā-t-a*	*est*	'Livia	is/was loved'
b.			*erat*		had been
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 (30c), 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 (25), at which point the use of (30c) became in fact grammatical (see Danckaert 2017ab for a more detailed discussion of these changes). When this happened, participles from transitive verbs acquired only passive meaning in the context of the auxiliary BE. 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, (31).

(31) If $\text{Voice}_{[+\text{PASS}]}$ is present in a complex X^0, then $\text{Asp}_{[+\text{PERF}]}$ must be present.

The statement in (31) requires that a morphosyntactic structure such as that in (32a) must be converted into that in (32b) in the morphological component.

(32)


Once the pruning operations (after TV and AGR insertion) apply as discussed above, (32b) is changed into the structure in (23). Calabrese (2020) proposes that the statement in (31) 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 (33), which states that the presence of a structural component may require the presence of another structural component purely formally. The presence of $\text{Voice}_{[+\text{PASS}]}$ implies the presence of the inner v; due to (33), the presence of this latter head then requires the morphological presence of the Asp head thus leading to (32b).[5]

(33) 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 2.6), 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 (33) 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). In other words, 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. 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 2.4.4 for further consequences of (33)).

2.4.2 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 Ancient Greek.

The AG periphrastic perfect consists of the BE-auxiliary and the active or nonactive ("middle") perfect participle. A summary of its forms (excluding the future) is given in (34).

(34) 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'

[5] At this point, the feature [+PFV] would moreover be inserted in Asp, assuming that prototypical reference to an eventuality requires that it is aspectually bound. 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) $\varnothing \rightarrow$ [+PFV] / $[\ ]_{\text{Asp}}$

Unlike in Latin, in AG the perfect periphrasis involves both the active and the passive voice, which is expressed through the use of the active and the nonactive perfect participles, respectively. 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 simplified vocabulary items for "nonfinite Asp" (= participles) are given in (35), ignoring morphophonologically conditioned allomorphs of the three exponents.

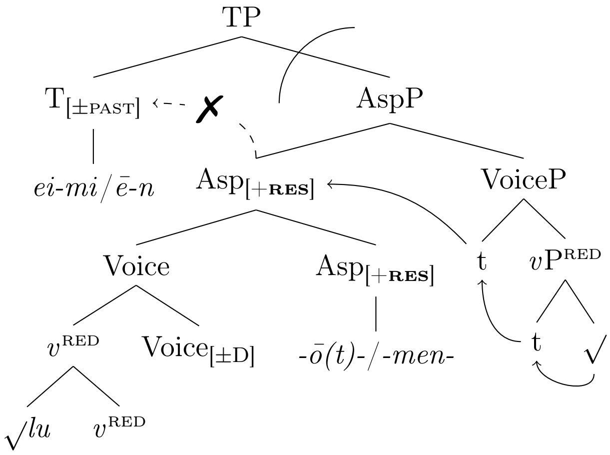
(35) Vocabulary Items for AG Asp in nonfinite contexts (Grestenberger 2022c)

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

The perfect active participial allomorph in (35a) is the most highly specified exponent since it only occurs in the perfect, while the present and aorist active use a different exponent, (35c). 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 (36). Like in Latin, the root BE is inserted to pick up the stranded features above Asp.[6]

(36) 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

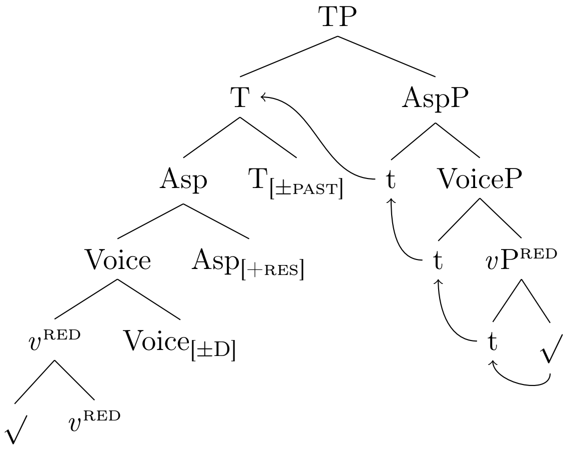


Crucially, it is the feature [+RES] that uniquely characterizes the periphrastic perfect. However, AG also had an inherited *synthetic* perfect formed by reduplicating the initial consonant of the root and using a special set of endings. At least at the Homeric/pre-classical stage, this reduplicated perfect is 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. (34) are the participles of precisely this reduplicated

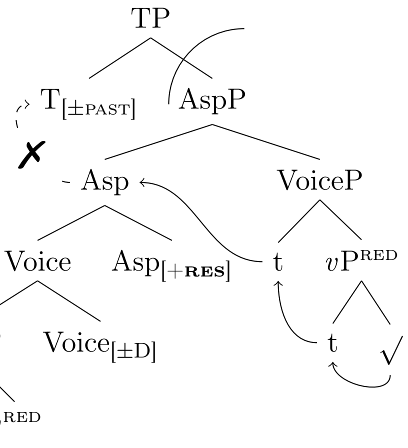
[6]We use a consistently head-initial structure in (36) for ease of exposition, but note that the participle usually precedes the auxiliary, suggesting a head-final TP (see Windhearn 2021).

perfect stem ("v^{RED}" in (36)).[7] Assuming that it is this resultative aspectual feature that distinguished the perfect from the aorist at the pre-classical stage,[8] this feature must have become associated exclusively with 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 (37).

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



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 a 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.

2.4.3 From synthetic to analytic morphology

Assuming that head movement may be blocked for each head adjunction configuration as outlined in Sections 2.4.1 and 2.4.2, we may expect to find instances in which each head of an extended functional projection is an independent word.

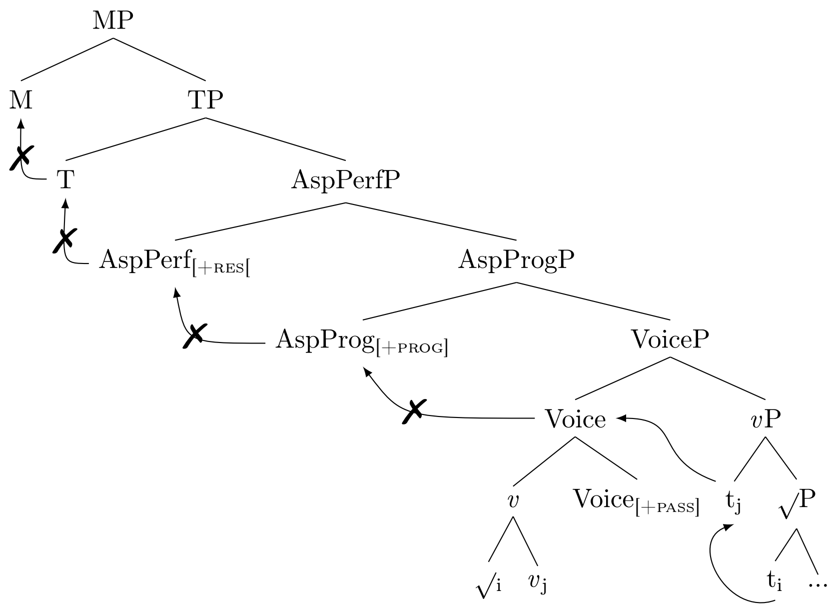
[7] Note that this analysis requires that verbal stem-forming morphology in AG spells out v rather than Asp as assumed in Sections 2.1 and 2.2 for Vedic. See Grestenberger 2022c for further arguments.

[8] 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.

English (and other modern Germanic languages) come close to satisfying that prediction, with examples like (38a) suggesting that head movement above Voice is consistently blocked, (38b). VIs and auxiliary insertion will then generate "isolating" strings such as (38a), readily accounting for the rigid ordering of English auxiliaries.

(38) 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 (38a)



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 2.4.2, 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. (34).

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"[9] grammars where word forming head movement simply does not apply, but further research is needed to confirm this hypothesis.

2.4.4 The diachrony of participles

In Sections 2.4.1 and 2.4.2, we have discussed a DM-style 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

[9] 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.

"verbal adjective" in -*t*- (-*t-ó*- m./n., *t-ḗ* f.) selects roots and forms state-denoting adjectives, as illustrated in (39). Note that the -*to*-adjectives never contain verbal stem-forming morphology, regardless of whether the corresponding finite forms are thematic or athematic.

(39) 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, which always select the verbal *stem* — contrast the participial forms in (40) with the verbal adjectives in (39).

(40) 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*- (the cognate of Latin -*tus* and AG -*tós*) selects the root, the participial suffixes are built on the stem, regardless of whether the stem formants in question are thematic or athematic, overt or zero. The ability of the Latin cognate of the Greek and Sanskrit verbal *t*-adjectives 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 2.4.1, cf. Calabrese (2019, 2020, 2023).

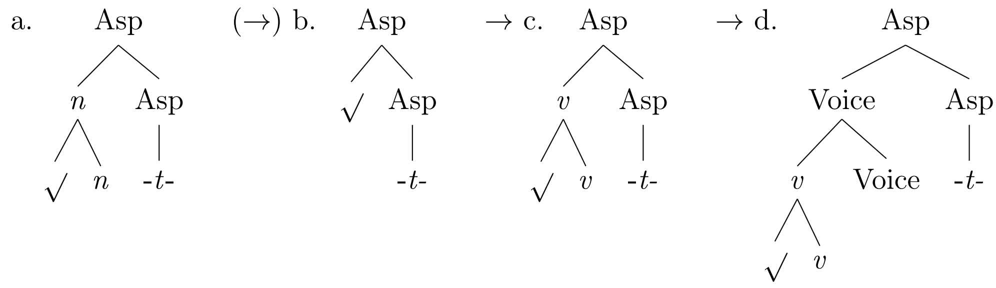
Moreover, we find *denominal* (often privative/negated) adjectives formed with the same *t*-suffix in Latin, Greek, and Sanskrit, (41).

(41) 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 (42b). This function in turn comes from an older denominal possessive adjective use of -*t*-, exemplified by the forms in (41) and illustrated in (42a).

(42) 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 affected different adjectival suffixes, 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 (42a–b). Assuming that rule (33) was already operative in pre-Latin morphology, the structure in (42b) would have become illicit and changed into that in (42c),[10] which in turn would also entail the presence of Voice in the structure, (42d) (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. (29)). A stative adjectival participle thus became a true verbal participle realized with the same verbalizing morphology (theme vowels, etc.) as the finite verb forms.

2.4.5 From analytic to synthetic: clitics and affixation in diachrony

In the preceding sections, we have 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, leading to analytic and isolating grammars. In this section, we briefly address the opposite process, namely the rise of agglutinative synthetic morphology. The development of free lexical items into clitics and of clitics into affixes has been much discussed in the grammaticalization literature. Here, we briefly provide a DM perspective on this topic from 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, (43). LD crucially applies *after* linearization/Vocabulary Insertion and targets linearly adjacent elements.

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

Calabrese (2024) observes that there is a four-way distinction in phonological contexts involving words and clitics in Serviglianese, an Italo-Romance variety spoken in central Italy: a) the basic morphological word, including the verbal roots and following grammatical suffixes but not enclitics, where stress is computed, (44); b) the verbal word and following enclitics but not proclitics, where harmonic processes are computed, (45); c) the pro-clitic sequence, but not the following verb, where harmony is also computed, (46), and finally, d) the proclitics plus following verbal word where processes such as secondary stress are computed.

(44) Simple verb: stress shift triggerd by 1pl. & 2pl. endings

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

[10]The feature [+PFV] is inserted in Asp as discussed in Footnote 5.

(45) Verb + enclitics: No stress shift, posttonic vowel harmony includes enclitics

a. *mann-ét**a**=m**a**=l**a*** (/mann-éte=m**e**=l**a**/)
send-IPV.2PL=to.me=it.F.SG
"send it-F.SG to me"

b. *mítt-i* (/mett-i/) vs. *mɛ́tt-**a**=l**a*** (/mɛ́tt-**i**-l**a**)
put-IPV.2SG put-IPV.2G=it.F.SG
"put (it.f)"

(46) Verb + proclitics: No stress shift, proclitic vowel harmony (a.), no harmony between proclitic and verb stem (b.)

a. ***te**=**se**=rópp-e* /t**i**=s**e**=rópp-e/
for.you=REFL=break-PST.3SG
"it broke affecting you"

b. *jje=tt**u**n-ímo*
to.him=cut-PRS.1PL
"'we cut (it) for him"

It follows that the constituents where posttonic and proclitic harmony are computed do not coincide with the constituent within which stress is 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 roll-up of the 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).

Cliticization is standardly accounted for in terms of: a) an operation of syntactic movement, i.e., an instance of language-specific internal merge (Uriagereka 1995; Pescarini 2021 a.o.), 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. Here, we focus on the latter.

Following Vogel (2009), cliticization involves a prosodic operation by which the clitics are grouped with the verb into a single prosodic constituent, namely the Composite Group, (47).

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

The evidence discussed above, however, suggests that the proclitics and the verb belong to different domains. This 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. A linearization of this structure is given in (48), where the clitics and the verb undergo Vocabulary Insertion in separate complex X^0 domains.

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

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.[11] Crucially, LD operates *after* Vocabulary Insertion, i.e.,

[11] See, e.g., Benincà and Cinque (1993), Luís (2004), Bermúdez-Otero and Luís (2011) for further evidence that

after the insertion of phonological exponents, as shown in (49). 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.

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

After LD, Harmony and Metaphony are computed in the domain identified by the highest X^0, which corresponds to the domain of the spelled out morphological verbal word (V), (50a), of the word + enclitic(s), (50b), and the proclitic complex X^0, i.e., proclitic "words", (50c).

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

The asymmetry with respect to metaphony and harmony between enclitics that are included in the same constituent as the morphological word 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).

(51) Lucanian: enclitics + stress shift

ví̠nnə	*vənní̠=llə*	*vinnə=mí̠=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.[12] 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.

(52) 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.

We suggest that LD/late adjunction and the associated possibility of reordering it with respect to Vocabulary Insertion can provide a "grammaticalization path" for the development of clitics to affixes as in (53), and therefore more generally for the development of agglutinative morphology.

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

We have now seen examples of morphosyntactic reanalysis leading to more and less analytic vs. synthetic grammars. 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.

2.5 Directionality in morphosyntactic reanalysis

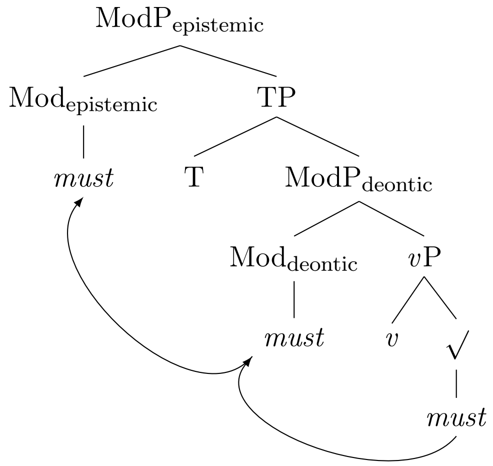
In the domain of syntactic change, reanalysis is usually conceptualized as occurring in "cycles" by which lexical material becomes semantically impoverished or "bleached", acquiring more abstract

proclitics in Romance display a clear morphosyntactic independence with respect to the host verb, differently from enclitics.

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

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" illustrated in (54) for Engl. *must* (root > deontic > epistemic).

(54) 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 roots (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 (55), modified slightly from Embick (2015: 68).

(55) 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 (54) (thus explicitly Grestenberger 2022a, 2023b). In suffixing languages, this means we expect that reanalysis within m-words 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 (56) are possible.

(56) 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 (56) 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 (56a), and from marking (collective or singulative) number into a feminine derivational suffix, instantiating (56b). Crucially, they argue that the presence of nodes with zero exponence creates the potential for missegmentation because an exponent can be mistaken as belonging to the node immediately to the left or the right of it, (57).

(57) a. [X Y Ø]

b. [X Ø Y]

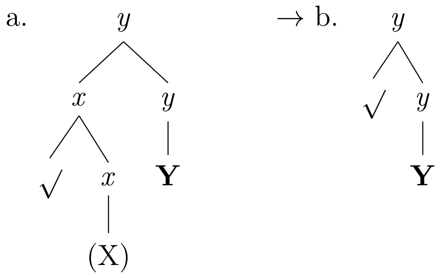
Despite these arguments, we believe that there are several reasons to assume that only (56a) is a naturally occurring type of subword reanalysis, and hence to adopt "strict" unidirectionality in the guise of UR. First, the bulk of the cross-linguistic empirical evidence overwhelmingly points towards "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 4.2) 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. This would not be surprising, since it is one of the reasons why "grammaticalization" both as a mechanism[13] 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. Cases like these will give the impression that an exponent Y has moved closer to the root (leftwards), (58), 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).

[13] See Walkden (2021).

(58) “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 (58a) 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 2.4.1 and 2.4.4 above; further examples are discussed in Diertani 2011: ch. 7).

2.6 Syncretism and defectiveness in case and pronominal systems

2.6.1 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 (59), 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 items is given in (60).

(59) A paradigm
Consider three features X, Y, Z of a given terminal node of the morphosyntax in a language L. The set of their possible combinations is a paradigm.

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

(60) 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 (61) for the paradigm in (59), (60) leads to the VIs in (62).

(61) Exponents for (60)

$$
\begin{array}{cccccccc}
| & | & | & | & | & | & | & | \\
+\mathrm{X} & +\mathrm{X} & -\mathrm{X} & -\mathrm{X} & +\mathrm{X} & +\mathrm{X} & -\mathrm{X} & -\mathrm{X} \\
+\mathrm{Y} & +\mathrm{Y} & +\mathrm{Y} & +\mathrm{Y} & -\mathrm{Y} & -\mathrm{Y} & -\mathrm{Y} & -\mathrm{Y} \\
+\mathrm{Z} & -\mathrm{Z} & +\mathrm{Z} & -\mathrm{Z} & +\mathrm{Z} & -\mathrm{Z} & +\mathrm{Z} & -\mathrm{Z} \\
\Psi & \Delta & \Psi & \Psi & \Phi & \Sigma & \Phi & \Phi
\end{array}
$$

(62) Vocabulary Items for (62):

a. $\Delta \leftrightarrow$ [+X, +Y, –Z]
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 (63). Now, the VIs in (62c–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 (64a), and that there is a morphological operation of **impoverishment** that deletes or removes features from the morpheme in a terminal node, i.e., (64b) in this case.

(63)

$$
\begin{array}{cccccccc}
| & | & | & | & | & | & | & | \\
+\mathrm{X} & +\mathrm{X} & -\mathrm{X} & -\mathrm{X} & +\mathrm{X} & +\mathrm{X} & -\mathrm{X} & -\mathrm{X} \\
+\mathrm{Y} & +\mathrm{Y} & +\mathrm{Y} & +\mathrm{Y} & -\mathrm{Y} & -\mathrm{Y} & -\mathrm{Y} & -\mathrm{Y} \\
+\mathrm{Z} & -\mathrm{Z} & +\mathrm{Z} & -\mathrm{Z} & +\mathrm{Z} & -\mathrm{Z} & +\mathrm{Z} & -\mathrm{Z} \\
\Psi & \Delta & \Psi & \Phi & \Phi & \Sigma & \Phi & \Phi
\end{array}
$$

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

Thus impoverishment blocks the insertion of a more specific vocabulary item, i.e., (62d), and allows the insertion of a less specified one, i.e., (64a).

2.6.2 Markedness effects in morphological changes

Calabrese (1995) notes that there is a problem when trying to account for diachronic syncretic changes by using impoverishment and underspecification. For example, consider the syncretism targeting dative clitics in Southern Italo-Romance varieties: From an original system as in (65a), both locative-dative syncretism as in (65b) and genitive-dative syncretism as in (65c) developed.

(65) Syncretism in Southern Italian pronominal systems

b.

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

(Barese & other central and northern Italian dialects)

a.

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

c.

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

(Southern Salentino, southern Calabrese)

If diachronic syncretic changes were due to feature impoverishment leading to the extension of the underspecified "Elsewhere" vocabulary item, we would expect that (65b) developed from a system where the locative **ci/ni* was underspecified, (66a), and that (65c) developed from a system where the locative **nde* was underspecified, (66b).

(66) a. **ci/nci* ↔ [ ]
b. **nde* ↔ [ ]

The problem with the underspecification patterns in (66) is that there is no independent motivation to assume them other than the syncretism in (65b–c). Evidence for underspecification is only provided *ex post facto* by the occurrence of the syncretism. Therefore Calabrese (1995) argues that the use of underspecification, unless it is independently motivated by (60) and thus grounded in the structure of the systems, leads to opportunistic and ultimately circular analyses. The changes in (65) 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 Noyer (1992) (see also Arregi and Nevins 2012). This line of work argues that repairs triggered by morphological constraints may manipulate syntactic structures and generate structures that are not motivated synctactically or semantically but only morphologically, creating mismatches between syntactico-semantic structure and surface morphological exponents.

The idea that there are morphological repairs of this type can be used to formalize the notion of morphological markedness and its effect on language change. 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 the realization with idiosyncratic affixal exponents for categories such as the singular or the plural but not for the dual. Calabrese (1995, 1998, 2008, 2011) proposes that such 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 "markedness statements" target the feature combinations of the terminal nodes of the morphosyntax. For example, the following markedness statement characterizes morphological realization of duality in affixes as costly (cf. Bobaljik 2008): [+plural, +dual] = [+augmented, +restricted], [+plural, –dual] = [+augmented, –restricted]), the string / + _]$_W$ indicates that the preceding configuration is found in a word-bound affix.

(67) *[+augmented, +restricted]/ + _]$_W$

Markedness statements may be active or deactivated on a language-specific basis. If a markedness 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:

(68) *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:

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

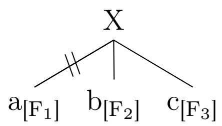
The claim here is that the affixal exponents that tend to "go out of use" are those of marked feature configurations. "Going out of use" for an affixal exponent means that the relevant markedness statement has become active. In the case of later stages of Greek, one can then say that the markedness statement in (67) has become active, and the idiosyncratic dual exponents were eliminated as a result. The diachronic replacement of these exponents with those of the plural can be accounted for by assuming the repair in (70) that changed the feature configuration of the dual into that of the plural.

(70)
a. [+restricted] $\leftrightarrow$ Ø / [+augmented, _] $]_{W}$
b. Ø $\leftrightarrow$ [–restricted] / [+augmented, _] $]_{W}$

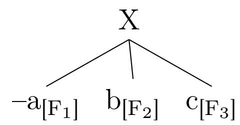
Thus, learning the morphology of a language A involves learning which morphological markedness statements are active in A. This determines which morphological feature combinations are allowed in A; all other feature combinations are eliminated by repairs.[14]

As discussed by Calabrese (2005) for phonology, active morphological markedness statements may trigger different types of morphological repairs. The repair relevant for our analysis in this article is feature deletion; this repair deletes a terminal node's feature specifications of a disallowed morphological configuration. If the dominating node is present, the dependent terminal features should be present as well, and its feature must be always specified. 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 (71), as proposed by Noyer (1998), Arregi and Nevins (2007), Calabrese (2008). At the same time, deletion operations are always triggered by active markedness restrictions. The operation is formalized in (71).

(71) Feature deletion

a.


b. $a_{[F_1]} \rightarrow$ Ø / [_, $b_{[F_2]}$] because of *[$a_{[F_1]}$, $b_{[F_2]}$]
c. Ø $\rightarrow -a_{[F_1]}$ [_, $b_{[F2]}$] (by default)
d. after the application of b. and c.:



[14] 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. 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: morphological markedness statements and their rankings are a way of expressing functional or cognitive considerations in grammatical terms. One could speculate that the reasons for morphological markedness are to be found in the cognitive centrality vs. marginality of certain morphosyntactic/-semantic features or human communicative needs (van Langendonck 1986, Mayerthaler 1988). 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.

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 2.6.4 below for further discussion of absolute syncretism).

2.6.3 Contextual syncretism

Calabrese (2008) (see also Meiser 1992, Ringe 1995) 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 leveling (see Section 4.1), 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 (60). 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 five declensions of the Latin case system, listed in (72) in a simplified format focusing on the accusative case.

(72) Latin declension classes: acc. case forms

Conj.	Nom.sg.	Acc.sg.	Acc.pl		
I	*porta*, *-ae*	*port-a-m*	*port-ā-s*	f.	'gate'
II	*amīcus*, *-ī*	*amīc-u-m*	*amīc-ō-s*	m.	'friend'
	dōnum, *-ī*	*dōn-um*	*dōn-a*	n.	'gift'
III	*rēx*, *rēgis*	*rēg-e-m*	*rēg-ē-s*	m.	'king'
	urbs, *-is*	*urb-e-m*	*urb-ē-s*	f.	'city'
	corpus, *corporis*	*corpus*	*corpor-a*	n.	'body'
	mare, *-is*	*mar-e*	*mar-i-a*	n.	'sea'
IV	*frūctūs*, *-us*	*frūct-u-m*	*frūct-ū-s*	m.	'fruit'
	cornu, *-ūs*	*corn-ū*	*corn-u-a*	n.	'horn'
V	*di-ē-s*, *-ēī*	*di-e-m*	*di-ē-s*	m.	'day'

In their morphological analysis of Latin declension classes, Halle and Vaux (1998) and Calabrese

(1998) assume the basic constituent structure in (73) for nominal forms.

(73) $[[[\text{root}] + \text{Thematic Vowel}]_N + \text{Number-Case}]_N$

The nominal thematic vowels of Latin are given in (74).

(74) Latin nominal theme vowels

TV	→	*a*	in the env. [I]
TV	→	*o*	in the env. [II]
TV	→	*i*	in the env. [III]
TV	→	*u*	in the env. [IV]
TV	→	*ē*	in the env. [V]

The surface shape of the thematic vowels is determined by various processes of lengthening, lowering, raising and deletion (see Halle and Vaux 1998 and Calabrese 1998 for details). Once we subtract the thematic vowel from the desinences, we obtain the Case-Number endings listed in (75). They are inserted in the fused Case-Number terminal node of the constituent structure in (73).

(75) Latin Case-Number endings

		a-stems (I)	*o*-stems (II)	C-stems (III)	Mixed *i*-stems (III)	*u*-stems (IV)	*ē*-stems (V)
Sg.	Nom	-Ø	*-s*	*-s*	*-s*	*-s*	*-s*
	Gen	*-i:*	*-i:*	*-s*	*-s-*	*-s*	*-i:*
	Dat	*-i:*	-Ø	*-i:*	*-i:*	*-i:*	*-i:*
	Acc	*-m*	*-m*	*-m*	*-m*	*-m*	*-m*
	Abl	-Ø	-Ø	-Ø	-Ø	-Ø	-Ø
Pl	Nom	*-i:*	*-i:*	*-s*	*-s*	*-s*	*-s*
	Gen	*-r-um*	*-r-um*	*-um*	*-um*	*-um*	*-um*
	Acc	*-s*	*-s*	*-s*	*-s*	*-s*	*-s*
	Dat	*-s*	*-s*	*-bu-s*	*-bu-s*	*-bu-s*	*-bu-s*

We observe various cases of contextual syncretism, for example:

(76) a. between nominative and accusative in neuters
b. between the genitive and the dative in the singular of declensions I and V
c. between the dative and the ablative in the II^{nd} declension
d. between the dative and the ablative in the plural of all declensions
e. between nominative and accusative in the plural of declensions III, IV, V

Given the paradigm in (77), Principle (60) leads to the VIs in (78).

(77) Latin case paradigm (feature specifications based on Calabrese 2008)

	Nom.	Acc.	Gen.	Dat.	Abl.
Peripheral	−	−	+	+	+
Source	−	−	+	−	+
Location	−	−	−	−	+
Motion	−	+	−	+	+

(78) VIs for Latin noun cases [15]

[15] Further operations are needed to account for the exponence of case endings in addition to the VIs in (78).

a.	/-um/	↔	[+periph, –motion, +pl]		(gen.pl.)
b.	/-i:/	↔	[–periph, –motion, +pl]	/[–neut, I, II] +_	(nom.pl. I, II)
c.	/-bu-/	↔	[+periph, +motion, +pl]	/[III, IV, V] + _	(dat.abl.pl. III-V)
d.	/-i:/	↔	[+periph, –location, –pl]		(gen.dat.sg)
e.	/-a/	↔	[–periph, +pl]	/[+neut]+ _	(nom.acc.pl.n)
f.	/-m/	↔	[+motion, –pl]		(acc.sg.)
g.	Ø	↔	[–pl]		(sg. default)
h.	/-s/	↔	[ ]		(Elsewhere)

The difference between absolute and contextual syncretism is shown by concord. In Latin, adjectives agree with their head noun for case, number and gender. Adjectives belong either to the first and second declensions (e.g., *bon-us* m., *bon-a* f., *bon-um* n.) or to the third (e.g., *tristis* m. & f., *triste* n.). When an adjective makes more distinctions than the noun it modifies, the appropriate case form of the adjective is chosen.

(79) Latin adjectival concord

Genitive:	*tristis*	*puellae*/	*regis*/	*diēī*	'of the sad girl/king/day'
Dative:	*tristī*	*puellae*/	*regī*/	*diēī*	'to the sad girl/king/day'

In the word form *puellae* of declension I in (79), for instance, there is contextual syncretism between genitive and dative: the ending /-ae/ can realize the genitive or the dative. If it is modified by a third declension adjective like *tristis*, which distinguishes between gen. *tristis* and dat. *tristī*, the form of the adjective appropriate to the syntactic context is chosen. This suggests that concord copies only the feature of the terminal node of the morphosyntax, i.e., the output of absolute syncretism. The presence of contextual syncretism in the forms of the head noun does not matter. The locative case demonstrates the difference between the two types of syncretism. Location in Latin is normally expressed by the ablative, usually governed by the preposition *in*. However, with singular names of towns and small islands, where no preposition is used, location is expressed by case forms identical to the genitive/dative of names belonging to the first or second declension singular: *Rōmae* 'at Rome', *Mīlētī* 'at Miletus' (as well as nouns such as *proximae* 'in proximity'). There are a few third and fourth declension singular names with locative forms identical to the dative: *Karthāginī* 'in Carthage', *rūrī* 'in the country', etc.; *domus* 'home' with loc. *domī* 'at home' has a mixture of second and fourth declension forms. In all of these cases we can say that we are dealing with the vocabulary item /-i:/ identical to that of the dative-genitive sg., cf. (78).[16]

Impoverishment of the feature [–plural] accounts for the insertion of elsewhere /s/ in the nominative of declensions II–IV and in the genitive of declensions III–IV, and impoverishment of the feature [–location] for the insertion of /Ø/ in the dative singular of the declension II and in the neuters of declension IV. Furthermore, the complex ending /-bu-s/ for the plural dative-ablative of declensions III–V and /-s-um/ for the genitive plural of the declensions I-II are generated through fission. Finally, a set of morphophonological and phonological operations account for the surface allomorphy of the theme vowels. For example, the following morphophonological rules account for the surface shape of the ablative case forms (Calabrese 2008):

- Rules lengthening the thematic vowels in dative-ablatives of declensions I–II and in the neuter ablative singular of declensions III and IV.
- A rule fronting the thematic vowels of the dative-ablative plural of declensions I, II, and IV.
- A rule lowering the thematic /i/ to [e] in the IIIrd declension non-neuter ablative.

For a more detailed analysis of the complex morphophonology of the Latin case endings see, e.g., Halle and Vaux (1998) and Calabrese (1998, 2008).

[16]Historically, these locatives continue the inherited IE locative sg. ending *-*i* in combination with the stem vowels of the first and second conjugation, i.e., *-*o-i* (or *-*e-i*) > -*ī* and *-*ā-i* > -*ai* <ae>. The thematic locative allomorph -*ī* was moreover analogically extended to athematic/third declension nouns, hence *rūrī*, *Karthāginī* for expected *rūre*, *Karthāgine*. These latter forms exist, of course: they are the phonologically regular reflexes of athematic locative singulars in *-*i*, the diachronic source of the regular third declension ablative singular ending. See Weiss (2020: 231–2, 240, 252) for discussion.

One could account for these patterns by hypothesizing that Latin has a locative case and that there is contextual syncretism between this case and the genitive/dative in singular nouns of towns and small islands (and a few others). In all other nouns and in the plural nouns, instead, there would be contextual syncretism between the locative and the ablative. This hypothesis, however, is easily rejected when we consider concord in the phrases in (80).

(80) a. *meae domī* (Pl. *Au* 432) 'at my home' vs. *villā meā* 'at my villa'
b. *domī suae* (Cic. N.D. 381) 'at his home' vs. *urbe copiosā* 'in a wealthy town'

Consider the first two phrases *meae domī* and *villā meā*. The case form *villā* is ablative. The form *domī* is a genitive/dative-syncretic locative. If we account for the contrast between *domī* and *villā* in terms of contextual syncretism, we are assuming that both forms are inserted in a terminal node characterized by the same feature bundle, the locative in this case. Therefore, we expect only one form of the adjective to appear insofar as concord depends only of the feature specifications of the terminal node. But then we have to explain the opposition between the two forms of the adjective in (80a): *meae* (gen.), which agrees with *domī* and *meā* (abl.), which agrees with *villā*. This difference in concord cannot be due to contextual syncretism since as shown in (79), contextual syncretism patterns found in the head noun are not transmitted to the modifying adjective. Therefore, we have to conclude that the contrast between *domī* and *villā* must be accounted for by changing the feature bundle of the terminal node. The morphological alternations we observe in Latin locatives are thus due to absolute syncretism, which we discuss next.

2.6.4 Absolute syncretism

Blake (2004) observes that there are clear implicational relationships between cases in different case systems (see also Caha 2009). His implicational hierarchy of cases is given in (81). If we assume that the presence of more marked entities implies the presence of less marked ones (Jakobson 1941), the hierarchy in (81) tells us that the nominative is the least marked case and the instrumental the most marked one.

(81) 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 markedness 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 (82), the case MSs in (83) can be proposed.

(82) Case feature specifications (Calabrese 2008)

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

(83) 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 an MS is in the hierarchy, the more probable it 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. In this way all irrelevant noncontrastive feature combinations are eliminated and vocabulary items need to refer only to the limited set of contrastive features.

Concerning the Latin locative cases discussed in Section 2.6.3, we assume that a syntactic locational phrase is mapped into a "locative" feature bundle in Latin. This feature bundle is disallowed by the active case restriction in (84) in this language.

(84) *[+location, –source]

This active restriction leads to repairs in the feature bundles of the terminal nodes of the locative in the morphosyntax. The first repair occurs in singular nouns of towns and small islands and changes the locative into a dative. The other — most general — repair occurs in all other nouns and changes the locative into the ablative;[17] see Calabrese (2008) for details.

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 (85), regardless of their exponents 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.

(85) 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*)

Syncretic changes like those in (85) 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

[17]This analysis requires access to the lexical properties of the head nouns — one must know whether or not they are names of towns and small islands — before the insertion of the case exponent. This follows if one assumes a cyclic model of VI (see Bobaljik 2000) in which modifications of the feature bundles of the terminal nodes in outer morphological cycles occur after vocabulary insertion in the inner cycles. In this way the idiosyncratic morphological properties of nouns of towns and small islands can be made available for the repairs.

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. This suggests that syncretic changes cannot be reduced to modifications in the phonological shape of exponents even though those can lead to phonological neutralizations between exponents.

To conclude, this section has developed various aspects of morphosyntactic change from a DM point of view, focusing on the way in which syntactic nodes and features are structured and linearized synchronically and diachronically. In the next section, we focus on how these nodes interact with the phonological component during Spell Out and address morphophonological change.

3 Morphophonology

3.1 A typology of morphophonological processes in DM

A core aspect of morphophonological analysis 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., 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. This method can be illustrated with the allomorphic alternations in English nominal plurals in (86)–(87), where it results in the postulation of the VIs in (88) and the morphophonological and phonological rules in (89) and (90).

(86) Sample English plurals:
- a. *seraf/serafim*, *cherub/cherubim*
- b. *radi-us/radi-i*, *mag-us/mag-i*, *alumn-us/alumn-i*
- c. *sheep/sheep*, *fish/fish*, *deer/deer*, *moose/moose*
- d. *goose/geese*, *foot/feet*, *tooth/teeth*, *mouse/mice*
- e. *ox/ox-en*, *child/children*
- f. *dog/dog-s*, *cat/cat-s*, *bush/bush-es*

(87) Another case of plural allomorphy in English:
- a. *wife/wives* [v], *house/houses* [z] vs.
- b. *fife/fifes*

(88) 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] / $\sqrt{\ }^{\varnothing}$_ ($\sqrt{\ }^{\varnothing}$ = *sheep*, *fish*, *moose*, etc.)
- d. /-en/ $\leftrightarrow$ [+plural] / $\sqrt{\ }^{en}$ _ ($\sqrt{\ }^{en}$ = *ox*, *child*, etc.)
- e. /-z/ $\leftrightarrow$

Assuming the possibility of morphophonological rules, i.e., phonological rules with morphological conditioning, alternations such as those in (86b), *mag-us/mag-i*, (86d), *foot/feet*, (86e), *child/child-r-en*, and (87a), *wife/wi[v]e-[z]* can be accounted for by rules such as those in (89), some of which crucially rely on lexical diacritics.

(89) 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.)

(90) Phonological rules

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

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.[18] The cross-classification of target/trigger interactions yields four potential types, (91) (Embick and Shwayder 2018).

(91) Classification of phonological alternations

	Phon-Triggered	Morph-Triggered
Phon-Target	a	b
Morph-Target	c	d

The rules in (90) are morphologically target indifferent and phonologically triggered, therefore plain phonological rules, i.e., (91a). The ablaut rule in (89c) is a typical phonologically targeted and morphologically triggered rule, i.e., (91b). 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 (89d) is a typical rule of the morphologically target specific type, i.e., (91c). Cases of this type involve what is traditionally called lexicalization and must be accounted for by morphophonological rules whose application is restricted by lexical diacritics characterizing certain morphemes, usually roots. A rule like (92) 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., (91d). 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., $\sqrt{}^{u}$.

(92) [–cons] → [+high,+back] / [_]$_{\sqrt{}^{u}}$[+past] ($\sqrt{}^{u}$ = *shall*, *will*, *can*, *stand*)

In the following, we discuss how morphophonological rules and lexical diacritics develop diachronically.

3.2 The diachrony of morphophonological rules

Morphophonological alternations of the different types in (91) 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, (93). In such a system, stressed mid vowels undergo the changes in (94) before high vowels (only vowel but not consonant shape is reconstructed here).

(93) 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'

(94) Metaphony & diphthongization

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

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

First, a synchronic, phonological metaphony rule spreads the [+high] feature of high vowels onto a preceding stressed mid vowel. Diphthongization of the resulting [+high,–ATR] vowels then 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).

A subsequent phonological change that occurred in many varieties reduced the post-tonic vowels to schwas. This led to alternations like those in (95). 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. The metaphonic change in (94) was therefore 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.

(95) Neapolitan

+ATR mid vowels			–ATR mid vowels		
Sg	Pl		Sg	Pl	
*ˈ**me**sə*	*ˈ**mi**sə*	‘month’	*ˈ**pɛ**tə*	*ˈ**pje**tə*	‘foot’
*ˈ**no**tʃə*	*ˈ**nu**tʃə*	‘nut’	*ˈ**kɔ**rə*	*ˈ**kwo**rə*	‘heart’

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 ex. (93). 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.

(96) Northern Salentino (intermediate representations before tensing in unstressed syllables)

–ATR mid vowels, no diphthongization			–ATR mid vowels, diphthongization		
Sg	Pl		Sg	Pl	
*ˈ**mɛ**sɛ*	*ˈ**mi**si*	‘month’	*ˈ**pɛ**tɛ*	*ˈ**pje**ti*	‘foot’
*ˈ**nɔ**tʃɛ*	*ˈ**nu**tʃi*	‘nut’	*ˈ**kɔ**rɛ*	*ˈ**kwe**ri* (< *ˈ**kwo**ri*)	‘heart’

(97) I, U → *jɛ*, *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 (98). This system, which is morph-triggered and target specific, requires both the metaphony rule seen in (95) and a diphthongization rule such as (97): only specific morphemes trigger the phonological alternation and only certain roots/morphemes undergo it (note that these are intermediate representations before processes affecting stressed vowels in open syllables).

(98) 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'

Finally, DM allows not only morphophonological rules but also idiosyncratic or "crazy" phonological rules. An example of such a rule is Polish back vowel raising, (99), which accounts for the alternations in (100). In itself, this rule cannot be motivated phonetically; it is phonetically "crazy".

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

(100) 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'

Polish [o]-raising cannot be decomposed into more basic processes, but is the result of the merger and "fossilization" of previously natural phonological processes such as vowel lengthening, raising of long vowels and loss of phonemic length that were diachronically reanalyzed (Calabrese 2005). 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.

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 (99) from step-by-step reanalysis of erstwhile phonological rules. 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 and how they can be analogically extended (Anderson 1988; Garrett and Blevins 2009).

4 Morpholexical change

4.1 Analogy and regularization: Losing and gaining diacritics

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.

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

(101) 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 (101c), examples include the ones in (102).

(102)
- 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 (103). As in Section 3.1, we are assuming that the roots that undergo the special treatments are characterized by a special diacritic (A, B, C).

(103) 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 (102).

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

The regularization we observe in (102) 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 (102) lost the lexical markings $^{A,\,D}$ that are required for the application of the rules in (103) and (104).

(105) $\sqrt{}^{X} \rightarrow$ impoverishment $\rightarrow \sqrt{}$

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 based on the diacritics that are posited for each stage.

Loss of diacritics also straightforwardly accounts for cases of "extension" of regular inflectional morphology as in (101a): 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.

A proportion (or "analogical model") is in fact only needed for cases such as (101b) 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 also 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" morphophonological patterns are extended to new lexical contexts, such as the proportional analogy cases in (101b), 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 morphophonological 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.

4.2 Reanalysis and root extension

Throughout the previous sections, we have seen cases in which morphosyntactic or morphophonological processes are triggered contextually by specific lexical items/roots, which form 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, (106).

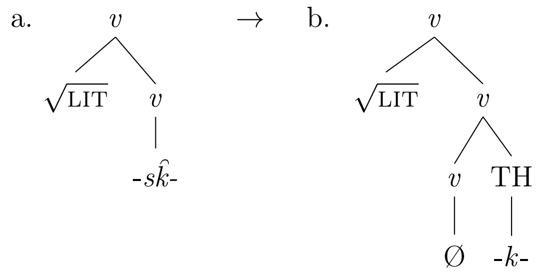
(106) A scale from 'empty' roots to 'contentful' roots (Alexiadou and Lohndal 2017: 99)
Hebrew > Greek > Old English > English

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. 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-marking morphology through sound changes between Old and Middle English), but if this property can change, then we expect that roots may impose different morphophonological 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 *-*sḱ(e/o)*- (Melchert 1978; Malzahn 2010: 460ff.); the sequence *-*Tsk*- then developed into *-*Tk*-. Some examples are given in (107).

(107) Tocharian B *tk*-roots

Toch. B	meaning	etymology
lit$k^{\bar{a}}$-	'avert, remove'	$*\sqrt{lit}$-*sḱe/o*-
wät$k^{(\bar{a})}$-	'decide'	***u̯i-$\sqrt{d^h h_1}$-*sḱe/o*-
nät$k^{\bar{a}}$-	'push away'	$*\sqrt{nud}$-*sḱe/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 √-*v*-. 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 a *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 (108b) rather than exponents of *v* itself as they were at the older stage, (108a) (cf. the discussion of ornamental morphology in Section 2.3).

(108)


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 denoting events, (109a), but to the root + verbalizing suffix for others, (109b), (Anagnostopoulou and Samioti 2013, 2014). Moreover, -*tos* does not combine with roots expressing a state, with or without the verbalizer, (109c).

(109) 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'

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, while event-denoting roots such as those in column a. can combine with -*tos* directly (Anagnostopoulou and Samioti 2014). The verbalizers that appear with the roots in column b. are 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.

To conclude, bringing insights from DM to bear on the diachrony of root morphology and root-adjacent exponence could lead to a better understanding of the cross-linguistically expected typology of the morphosemantic 'content' 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 (and vice versa). In the nominal system, we have discussed various ways of handling case syncretism synchronically and diachronically, focusing on impoverishment and markedness.

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. 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.

A lot has been omitted 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 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.

Acknowledgements

We are grateful to Artemis Alexiadou, Nora Dehmke, Gabriel Pantillon and Viktoria Reiter for comments and feedback on the draft. Laura Grestenberger's research was supported by the Austrian Science Fund, grant FWF V850-G.

References

Acquaviva, Paolo. 2022. Word meaning: a linguistic dimension of conceptualization. *Synthese* 200 (427). `https://doi.org/10.1007/s11229-022-03910-9`.

AiG II,2 = Debrunner, Albert. 1954. *Altindische Grammatik*, volume II,2: *Die Nominalsuffixe*. Göttingen: Vandenhoeck & Ruprecht.

Alexiadou, Artemis. 2021. Reanalysis of morphological exponence: A cross-linguistic perspective. *Journal of Historical Syntax* 5:1–27.

Alexiadou, Artemis, Elena Anagnostopoulou, and Florian Schäfer. 2015. *External arguments in transitivity alternations: a layering approach*. Oxford: Oxford University Press.

Alexiadou, Artemis, and Terje Lohndal. 2017. On the division of labor between roots and functional structure. In *The verbal domain*, ed. Roberta D'Alessandro, Irene Franco, and Ángel J. Gallego, 85–102. Oxford: Oxford University Press.

Anagnostopoulou, Elena. 2003. Participles and voice. In *Perfect explorations*, ed. Artemis Alexiadou, Monika Rathert, and Arnim von Stechow, 1–36. Berlin: Mouton de Gruyter.

Anagnostopoulou, Elena, and Yota Samioti. 2013. Allosemy, idioms and their domains: Evidence from adjectival participles. In *On linguistic interfaces*, ed. Raffaella Folli, Christina Sevdali, and Robert Truswell, 218–250. Oxford: Oxford University Press, 2 edition.

Anagnostopoulou, Elena, and Yota Samioti. 2014. Domains within words and their meanings: A case study. In *The syntax of roots and the roots of syntax*, ed. Artemis Alexiadou, Hagit Borer, and Florian Schäfer, 81–111. Oxford: Oxford University Press.

Anderson, Stephen R. 1981. Why phonology isn't 'natural'. *Linguistic Inquiry* 12:493–539.

Anderson, Stephen R. 1988. Morphological change. In *Linguistics: The Cambridge survey,* vol. 1, ed. Frederick Newmeyer, 324–362. Cambridge: Cambridge University Press.

Arad, Maya. 2003. Locality constraints on the interpretation of roots: The case of Hebrew denominal verbs. *Natural Language & Linguistic Theory* 21:737–778.

Arad, Maya. 2005. *Roots and patterns: Hebrew morpho-syntax*. Dordrecht: Springer.

Aronoff, Mark. 1994. *Morphology by itself: Stems and inflectional classes*. Cambridge, MA: MIT Press.

Arregi, Karlos, and Andrew Nevins. 2007. Obliteration vs. impoverishment in the Basque *g-*/*z-*constraint. In *University of Pennsylvania Working Papers in Linguistics 13 (1): Proceedings of the 30th Annual Penn Linguistics Colloquium*, ed. Tatjana Scheffler, Joshua Tauberer, Aviad Eilam, and Laia Mayol, 1–14. Philadelphia, PA: University of Pennsylvania, Department of Linguistics. `http://ling.auf.net/lingBuzz/000280`.

Arregi, Karlos, and Andrew Nevins. 2012. *Morphotactics: Basque auxiliaries and the structure of spellout*. Dordrecht: Springer.

Baker, Mark. 1985. The Mirror Principle and morphosyntactic explanation. *Linguistic Inquiry* 16(3):373–415.

Benincà, Paola, and Guglielmo Cinque. 1993. Su alcune differenze tra enclisi e proclisi. In *Omaggio a Gianfranco Folena*, 2313–2326. Padova: Editoriale Programma.

Bentein, Klaas. 2012a. Perfect periphrases in Post-Classical and Early Byzantine Greek: An ecological-evolutionary account. *Journal of Greek Linguistics* 12:205–275.

Bentein, Klaas. 2012b. The periphrastic perfect in Ancient Greek: A diachronic mental space analysis. *Transactions of the Philological Society* 110:171–211.

Bentein, Klaas. 2013. Perfect. In *Encyclopedia of Ancient Greek language and linguistics*. Leiden:

Brill. Accessed 10/10/2020. URL http://dx.doi.org/10.1163/2214-448X_eagll_COM_00000274.

Bermúdez-Otero, Ricardo, and Ana R. Luís. 2011. Cyclic domains and prosodic spans in the phonology of European Portuguese functional morphs. Paper presented at the Old World Conference in Phonology 6, Edinburgh, Jan. 24, 2009 [updated Aug. 31, 2011].

Bertocci, Davide. 2017. Latin 1st class -*ā*- verbs as thematic formations: On the deficiency of IE roots. *Pallas* 103:45–52.

Biberauer, Theresa. 2017. Factors 2 and 3: A principled approach. In *Cambridge occasional papers in linguistics 10*, ed. C. Song and J. Baker, 38–65. Cambridge.

Biberauer, Theresa. 2019. Children always go beyond the input: The Maximise Minimal Means perspective. *Theoretical Linguistics* 45(3-4):211–224.

Biberauer, Theresa, and Ian Roberts. 2017. Parameter setting. In *The Cambridge handbook of historical syntax*, ed. Adam Ledgeway and Ian Roberts, 134–162. Cambridge: Cambridge University Press.

Bjorkman, Bronwyn. 2011. BE-ing default: The morphosyntax of auxiliaries. Doctoral Dissertation, Cambridge, MA: Massachusetts Institute of Technology.

Blake, Barry J. 2004. *Case*. Cambridge: Cambridge University Press, 2nd edition.

Blevins, Juliette, and Andrew Garrett. 1993. The evolution of Ponapeic nasal substitution. *Oceanic Linguistics* 32(2):199–236.

Bobaljik, Jonathan D. 2000. The ins and outs of contextual allomorphy. In *University of Maryland Working Papers in Linguistics*, ed. K. Grohmann and C. Struijke, 35–71. College Park: University of Maryland, Dept. of Linguistics.

Bobaljik, Jonathan D. 2008. Where's phi? Agreement as a post-syntactic operation. In *Phi-theory: Phi features across interfaces and modules*, ed. Daniel Harbour, David Adger, and Susana Béjar, 295–328. Oxford: Oxford University Press.

Bobaljik, Jonathan David. 2002. Syncretism without paradigms: Remarks on Williams 1981, 1994. In *Yearbook of Morphology 2001*, ed. Geert Booij and Jaap van Marle, 53–85. Dordrecht: Kluwer.

Bonet, Eulàlia. 1991. Morphology after syntax. Doctoral Dissertation, Massachusetts Institute of Technology, Cambridge, MA.

Bonet, Eulàlia. 1995. Feature structure of Romance clitics. *Natural Language and Linguistic Theory* 13:607–647.

Borer, Hagit. 2013. *Structuring sense, vol. 3: Taking form*. Oxford: Oxford University Press.

Borer, Hagit. 2014. The category of roots. In *The syntax of roots and the roots of syntax*, ed. Artemis Alexiadou, Hagit Borer, and Florian Schäfer. Oxford: Oxford University Press.

Breitbarth, Anne. 2017. Jespersen's Cycle = Minimize Structure + Feature Economy. In *Studies on negation: Syntax, semantics, and variation*, 21–47. Göttingen: Vandenhoeck & Ruprecht / University of Vienna Press.

Caha, Pavel. 2009. The nanosyntax of case. Doctoral Dissertation, Tromsø: University of Tromsø.

Calabrese, Andrea. 1985. Metaphony in Salentino. *Rivista di grammatica generative* IX–X:3–140.

Calabrese, Andrea. 1988. Towards a theory of phonological alphabets. Doctoral Dissertation, Cambridge, MA: Massachusetts Institute of Technology.

Calabrese, Andrea. 1995. Syncretism phenomena in the clitic systems of Italian and Sardinian dialects and the notion of morphological change. In *Proceedings of NELS 25*, ed. Jill N. Beckman, 151–173.

Calabrese, Andrea. 1998. Some remarks on the Latin case system and its development in Romance. In *Theoretical advances on Romance languages*, ed. J. Lema and E. Trevino, 71–126. Amsterdam: Benjamins.

Calabrese, Andrea. 2005. *Markedness and economy in a derivational model of phonology*. Berlin: Mouton de Gruyter.

Calabrese, Andrea. 2008. On absolute and contextual syncretism: Remarks on the structure of paradigms and on how to derive it. In *The bases of inflectional identity*, ed. Andrew Nevins and Asef Bachrach, 156–205. Oxford: Oxford University Press.

Calabrese, Andrea. 2011. Investigations on markedeness, syncretism and zero exponence in morphology. *Morphology* 21(2):283–325. Https://doi.org/10.1007/s11525-010-9169-y.

Calabrese, Andrea. 2019. Morpho-phonological investigations: A theory of PF. From syntax to phonology in Sanskrit and Italian verbal systems. Ms., University of Connecticut. Available at `https://andrea-calabrese.uconn.edu/publications/`.

Calabrese, Andrea. 2020. Remarks on the role of the perfect participle in Italian morphology and on its history. *Probus* 32(2):209–269.

Calabrese, Andrea. 2023. Latin verbal morphology and the diachronic development of its thematic and athematic constructions. *Probus* 35:399–480.

Calabrese, Andrea. 2024. Morphosyntactic asymmetries in Serviglianese vowel harmony domains. In *The Oxford handbook of vowel harmony*, ed. Harry van der Hulst and Nancy Ritter. Oxford: Oxford University Press.

Calabrese, Andrea, and Laura Grestenberger. 2023. Accent and zero grade in Vedic Sanskrit verbal morphophonology: Evidence for cyclicity. Ms., University of Connecticut & Austrian Academy of Sciences.

Calabrese, Andrea, and Roberto Petrosino. 2023. Root-adjacent exponence in the Sanskrit, Ancient Greek, and Latin verbal systems. *Glossa: a journal of general linguistics* 8(1). `https://doi.org/10.16995/glossa.8932`.

Cardinaletti, Anna, and Michal Starke. 1999. The typology of structural deficiency: A case study of the three classes of pronouns. In *Clitics in the languages of Europe*, ed. Henk van Riemsdijk, 145–233. Berlin: de Gryuter.

Cinque, Guglielmo. 1999. *Adverbs and functional heads: A cross-linguistic perspective*. Oxford: xford University Press.

Cole, Jennifer. 1998. Deconstructing metaphony. *Rivista di Linguistica* 10:69–98.

Cournane, Ailís. 2014. In search of L1 evidence for diachronic reanalysis: Mapping modal verbs. *Language Acquisition* 21(1):103–117.

Cournane, Ailís. 2015. Modal development: Input-divergent L1 acquisition in the direction of diachronic reanalysis. Doctoral Dissertation, University of Toronto.

Dali, Myriam, and Éric Mathieu. 2021. Historical changes in sub-word formation: The case of Arabic -*a(t)*. *Journal of Historical Syntax* 5:1–34. `https://doi.org/10.18148/hs/2021.v5i16-25.61`.

Danckaert, Lieven. 2017a. *The development of Latin clause structure: A study of the extended ver phrase*. Oxford: Oxford University Press.

Danckaert, Lieven. 2017b. The origins of the Romance analytic passive: Evidence from word order. In *Micro-change and macro-change in diachronic syntax*, ed. Éric Mathieu and Robert Truswell. Oxford: Oxford University Press.

Diertani, Chaya Eliana Ariel. 2011. Morpheme boundaries and structural change: Affixes running amok. Doctoral Dissertation, University of Pennsylvania, Philadelphia, PA.

Embick, David. 2000. Features, syntax, and categories in the Latin perfect. *Linguistic Inquiry* 31:185–230.

Embick, David. 2004. On the structure of resultative participles in English. *Linguistic Inquiry* 35(3):355–392.

Embick, David. 2015. *The morpheme*. De Gruyter Mouton.

Embick, David, and Morris Halle. 2005. On the status of stems in morphological theory. In *Romance languages and linguistic theory 2003*, ed. Twan Geerts, Ivo van Ginneken, and Haike Jacobs, 59–88. Amsterdam: Benjamins.

Embick, David, and Rolf Noyer. 2001. Movement operations after syntax. *Linguistic Inquiry* 32(4):555–595.

Embick, David, and Kobey Shwayder. 2018. Deriving morphophonological (mis)applications. In *From sounds to structures: Beyond the veil of Maya*, ed. Roberto Petrosino, Pietro Cerrone, and Harry van der Hulst, 195–250. Berlin: Mouton de Gruyter.

Fenger, Paula. 2019. Size matters: Auxiliary formation in the morpho-syntax and morpho-phonology. In *Proceedings of NELS 49*, ed. Maggie Baird and Jonathan Pesetsky, 237–250. Amherst, MA: GSLA.

Fenger, Paula. 2020. Words within words: The internal syntax of verbs. Doctoral Dissertation, University of Connecticut.

Fertig, David. 1993. *Analogy and morphological change*. Edinburgh: Edinburgh University Press.

Flobert, Pierre. 1975. *Les verbes déponents latins des origines à Charlemagne*. Paris: Belles Lettres.

Fortson, Benjamin W. IV. 2010. *Indo-European language and culture: An introduction*. Malden, MA: Wiley-Blackwell, 2 edition.

Garrett, Andrew, and Juliette Blevins. 2009. Analogical morphophonology. In *The nature of the word: Essays in honor of Paul Kiparsky*, ed. Kristin Hanson and Sharon Inkelas, 527–545. Cambridge, MA: MIT Press.

van Gelderen, Elly. 2004. *Grammaticalization as economy*. Amsterdam: Benjamins.

van Gelderen, Elly, ed. 2009. *Cyclical change*. Amsterdam: Benjamins.

van Gelderen, Elly. 2013. The linguistic cycle and the language faculty. *Language and Linguistics Compass* 7(4):233–250.

Giomi, Riccardo. 2023. *A functional discourse grammar theory of grammaticalization,* vol. II: *formal change*. Leiden: Brill.

Greenberg, Joseph H. 1963. Some universals of grammar with particular reference to the order of meaningful elements. In *Universals of language*, ed. Joseph H. Greenberg, 58–90. Cambridge, MA: MIT Press.

Grestenberger, Laura. 2018. Deponency in finite and nonfinite contexts. *Language* 94(3):487–526.

Grestenberger, Laura. 2020. The diachrony of participles in the (pre)history of Greek and Hittite: Losing and gaining functional structure. *Diachronica* 37(2):215–263.

Grestenberger, Laura. 2021. Two types of passive? Voice morphology and "low passives" in Vedic Sanskrit and Ancient Greek. In *Passives cross-linguistically: Theoretical and experimental approaches*, ed. Kleanthes K. Grohmann, Akemi Matsuya, and Eva-Maria Remberger, 210–245. Leiden: Brill.

Grestenberger, Laura. 2022a. Diachronically distributed morphology: Misparsing, reanalysis and the directionality of change. Paper presented at the 3rd Angus McIntosh Centre for Historical Linguistics Symposium ' Change in syntax and phonology: the same or different?', University of Edinburgh, Dec. 5–7, 2022.

Grestenberger, Laura. 2022b. Periphrastic perfects in Greek and Sanskrit. In *Ha! Linguistic Studies in Honor of Mark R. Hale*, ed. Laura Grestenberger, Charles Reiss, Hannes A. Fellner, and Gabriel Z. Pantillon, 93–115. Wiesbaden: Reichert.

Grestenberger, Laura. 2022c. To *v* or not to *v*? Theme vowels, verbalizers, and the structure of the Ancient Greek verb. *Glossa: a journal of general linguistics* 47(1):1–42.

Grestenberger, Laura. 2023a. Deponency. In *The Wiley Blackwell Companion to Morphology*, ed. Eulalia Bonet & Antonio Fábregas Peter Ackema, Sabrina Bendjaballah. Hoboken: Wiley Blackwell. `https://doi.org/10.1002/9781119693604.morphcom025`.

Grestenberger, Laura. 2023b. The diachrony of verbalizers in Indo-European: Where does *v* come from? *Journal of Historical Syntax* .

Grestenberger, Laura, and Itamar Kastner. 2022. Directionality in cross-categorial derivations. *Glossa: a journal of general linguistics* 7(1). `https://doi.org/10.16995/glossa.8710`.

Halle, Morris. 1990. An approach to morphology. In NELS *20(1)*, ed. Juli Carter, Rose-Marie Déchaine, Bill Philip, and Tim Sherer, 150–184. Amherst, MA: GLSA.

Halle, Morris. 1997. Distributed Morphology: Impoverishment and fission. *MIT Working Papers in Linguistics* 30:425–449.

Halle, Morris. 2019. Aspects of the morphophonology of the verb in Latin and in German and English. *Linguistic Inquiry* 50(1):3–12. 10.1162/ling_a_00313.

Halle, Morris, and Alec Marantz. 1993. Distributed Morphology and the pieces of inflection. In *The view from building 20:*, ed. K. Hale and S.J. Keyser, 111–176. Cambridge: MIT Press.

Halle, Morris, and Bert Vaux. 1998. Theoretical aspects of Indo-European nominal morphology: The nominal declensions of Latin and Armenian. In *Mír Curad: Studies in honor of Calvert Watkins*, ed. Jay H. Jasanoff, H. Craig Melchert, and Lisi Oliver. Innsbruck: Institut für Sprachwissenschaft der Universität Innsbruck.

Halm, Tamás. 2020. Grammaticalization without Feature Economy: Evidence from the voice cycle in Hungarian. *Diachronica* 37:1–42.

Harley, Heidi. 2008. When is a syncretism more than a syncretism? Impoverishment, metasyncretism, and underspecification. In *Phi theory: Phi-features across modules and interfaces*, ed. David Adger, Susana Béjar, and Daniel Harbour, 251–294. Oxford: Oxford University Press.

Harley, Heidi. 2014. On the identity of roots. *Theoretical Linguistics* 40:225–276.

Harwood, William. 2014. Rise of the auxiliaries: a case for auxiliary raising vs. affix lowering. *The Linguistic Review* 31(2):295–362. https://doi.org/10.1515/tlr-2014-0001.

Haspelmath, Martin. 1992. From resultative to perfect in Ancient Greek. In *Nuevos estudios sobre construcciones resultativos*, ed. Iturrioz Leza. J. L., 187–224. Universidad de Guadalajara: Centro de Investigación de Lenguas Indígenas.

Haspelmath, Martin. 1994. Passive participles across languages. In *Voice: Form and function*, ed. Barbara A. Fox and Paul J. Hopper, 151–177. Amsterdam: Benjamins.

Haspelmath, Martin. 1995. The growth of affixes in morphological reanalysis. In *Yearbook of Morphology 1994*, ed. Geert Booij and Jaap van Marle, 1–29. Dordrecht: Kluwer.

Haspelmath, Martin. 2004. On directionality in language change with particular reference to grammaticalization. In *Up and down the cline: The nature of grammaticalization*, ed. Olga Fischer, Muriel Norde, and Harry Perridon, 17–44. Amsterdam: Benjamins.

Hoffmann, Karl. 1970. Das Kategoriensystem des urindogermanischen Verbums. *Münchener Studien zur Sprachwissenschaft* 28:19–41.

Jakobson, Roman. 1941. *Child language, aphasia, and phonological universals*. The Hague: Mouton.

Joachim, Ulrike. 1978. *Mehrfachpräsentien im R̥gveda*. Frankfurt a. Main: Peter Lang.

Joseph, Brian D. 2001. Is there such a thing as "grammaticalization?". *Languages Sciences* 23:163–186.

Joseph, Brian D. 2004. Rescuing traditional (historical) linguistics from grammaticalization theory. In *Up and down the cline: The nature of grammaticalization*, ed. Olga Fischer, Muriel Norde, and Harry Perridon, 45–72. Amsterdam: Benjamins.

Kastner, Itamar. 2020. *Voice at the interfaces: The syntax, semantics and morphology of the Hebrew verb*. Berlin: Language Science Press.

Kaze, Jeffery. 1989. Metaphony in Spanish and Italian dialects revisited. Doctoral Dissertation, Urbana-Champaign: University of Illinois.

Kenstowicz, Michael J., and Charles W. Kisseberth. 1977. *Topics in phonological theory*. University of Michigan Academic Press.

Kenstowicz, Michael J., and Charles W. Kisseberth. 1979. *Generative phonology: Description and theory*. University of Michigan Academic Press.

Koller, Bernhard. 2008. An approach to Tocharian schwa-zero alternations in Government Phonology. Master's thesis, University of Vienna.

van Langendonck, Willy. 1986. Markedness, prototypes, and language acquisition. *Cahiers de l'Institut de Linguistique de Louvain* 12:39–76.

Leumann, Manu. 1977. *Lateinische Laut- und Formenlehre*. Lateinische Grammatik, vol. I.

München: Beck.

LIV^2 = Rix, Helmut. 2001. *Lexikon der Indogermanischen Verben. Bearbeitet von Martin Kümmel, Thomas Zehnder, Reiner Lipp und Brigitte Schirmer*. Wiesbaden: Reichert, 2 edition.

Loporcaro, Michele. 1988. *Grammatica storica del dialetto di Altamura*. Pisa: Giardini.

Lowe, John J. 2015. *Participles in Rigvedic Sanskrit: the Syntax and Semantics of Adjectival Verb Forms*. Oxford: Oxford University Press.

Luís, Ana R. 2004. Clitics as morphology. Doctoral Dissertation, University of Essex, Colchester.

Maiden, Martin. 1991. *Interactive morphonology: Metaphony in Italy*. New York: Routledge.

Malzahn, Melanie. 2010. *The Tocharian verbal system*. Leiden: Brill.

Marcus, Gary F., Steven Pinker, Michael Ullman, Michelle Hollander, T. John Rosen, Fei Xu, and Harald Clahsen. 1992. *Overgeneralization in language acquisition*, volume 57(4) of *Monographs of the Society for Research in Child Development*. Wiley.

Mayerthaler, Willi. 1988. *Morphological naturalness*. Ann Arbor: Karoma.

Meier-Brügger, Michael. 2010. *Indogermanische Sprachwissenschaft*. Berlin: de Gruyter, 9 edition.

Meiser, Gerhard. 1992. Syncretism in Indo-European languages — motives, processes, and results. *Transactions of the Philological Society* 90:187–218.

Melchert, Craig. 1978. Tocharian verb stems in *-tk-*. *Historische Sprachforschung* 91:93–130.

Napoli, Maria. 2017. To what extent does the Greek participle participate in the passive voice system? In *"In participle we predicate": Contributions of the comparative and historical linguistics to grammar and semantics of participle*, ed. Paola Cotticelli-Kurras and Velizar Sadovski, 109–127. Wien: Holzhausen.

Nevins, Andrew. 2011. Marked targets versus marked triggers and impoverishment of the dual. *Linguistic Inquiry* 42:413–444.

Norde, Muriel. 2009. *Degrammaticalization*. Oxford: Oxford University Press.

Noyer, Rolf. 1992. Features, affixes, and positions in autonomous morphological structure. Doctoral Dissertation, Massachusetts Institute of Technology, Cambridge, MA.

Noyer, Rolf. 1998. Impoverishment theory and morpho-syntactic markedness. In *Morphology and its relation to phonology and syntax*, ed. In Steven G. Lapointe, Diane K. Brentari, and Patrick M. Farrell, 264–285. Stanford, CA: CSLI.

Oltra-Massuet, Isabel, and Karlos Arregi. 2005. Stress-by-Structure in Spanish. *Linguistic Inquiry* 36/1:43–84.

Oltra-Massuet, Maria Isabel. 1999. On the notion of theme vowel: A new approach to Catalan verbal morphology. Master's thesis, MIT.

Panagiotidis, Phoevos. 2014. A Minimalist approach to roots. In *Minimalism and beyond: Radicalizing the interfaces*, ed. P. Kosta, S. Franks, L. Schürcks, and T. Radeva-Bork, 287–303. Amsterdam: Benjamins.

Panagiotidis, Phoevos, and Vitor Nóbrega. to appear. Why we need roots in Minimalism. In *The Cambridge handbook of Minimalism*. Cambridge: Cambridge University Press. `https://ling.auf.net/lingbuzz/006497`.

Panagiotidis, Phoevos, Vassilios Spyropoulos, and Anthi Revithiadou. 2017. Little v as a categorizing verbal head: evidence from Greek. In *The verbal domain*, ed. Roberta D'Alessandro, Irene Franco, and Ángel J. Gallego, 29–48. Oxford: Oxford University Press.

Peperkamp, Sharon. 1997. *Prosodic words*. HIL dissertations 34. [The Hague: Holland Academic Graphics.

Pescarini, Diego. 2021. *Romance object clitics: Microvariation and linguistic change*. Oxford: Oxford University Press.

Pietraszko, Asia. 2016. The syntax of simple and compound tenses in Ndebele. In *Proceedings of the Linguistic Society of America*, volume 1(18), 1–15. `https://journals.linguisticsociety.org/proceedings/index.php/PLSA/issue/view/152`.

Pietraszko, Asia. 2018. Auxiliary vs Infl in Bantu: The syntactic and phonological complexity

of Ndebele verbs. *Natural Language and Linguistic Theory* 36(1):265–308.
Pietraszko, Asia. 2023. Cyclic selection: Auxiliaries are merged, not inserted. *Linguistic Inquiry* 54(2):350–377.
Pöchtrager, Markus A., and Connor G. Youngberg. 2023. *Ablaut*, 1–31. Hoboken: Wiley-Blackwell.
Reed, Sylvia. 2014. A distributed morphology analysis of tense and aspect in Greek. In *The Greek Verb: Morphology, Syntax, and Semantics. Proceedings of the 8th International Meeting of Greek Linguistics*, ed. Annamaria Bartolotta, 277–290. Louvain-la-Neuve: Peeters.
Reiss, Charles. 2003. Language change without constraint reranking. In *Optimality Theory and language change*, ed. D. Eric Holt, 143–168. Dordrecht: Kluwer.
Reiss, Charles. 2006. Morphological change, paradigm leveling and analogy. In *Encyclopedia of Language & Linguistics*, ed. Keith Brown, 277–278. Amsterdam: Elsevier, 2nd edition.
Remberger, Eva. 2012. Participles and nominal aspect. In *Inflection and word formation in Romance languages*, ed. Sascha Gaglia and Marc-Olivier Hinzelin. Amsterdam: Benjamins.
Ringe, Don. 1995. Nominative-accusative syncretism and syntactic case. *Penn Working Papers in Linguistics* 2:45–81.
Ringe, Don, and Joseph F. Eska. 2013. *Historical linguistics: Toward a twenty-first century reintegration*. Cambridge: Cambridge University Press.
Rix, Helmut. 1986. *Zur Entstehung des urindogermanischen Modussystems*. Number 36 in Innsbrucker Beiträge zur Sprachwissenschaft. Innsbruck: Institut für Sprachwissenschaft der Universität Innsbruck.
Roberts, Ian. 2010. *Agreement and head movement: Clitics, incorporation, and defective goals*. Cambridge, MA: MIT Press.
Roberts, Ian, and Anna Roussou. 2003. *Syntactic change: A minimalist approach to grammaticalization*. Cambridge: Cambridge University Press.
Salvi, Giampaolo, and Laura Vanelli. 2004. *Nuova grammatica italiana*. Bologna: il Mulino.
Schreiner, Sylvia L. R. 2021. Span-conditioned allomorphy and late linearization: Evidence from the Classical Greek perfect. *Glossa* 6(1).64:1–28. `https://doi.org/10.5334/gjgl.1400`.
Schwyzer, Eduard. 1939. *Griechische Grammatik. Erster Band: Allgemeiner teil, Lautlehre, Wortbildung, Flexion*. München: Beck.
Spyropoulos, Vassilios, Anthi Revithiadou, and Phoevos Panagiotidis. 2015. Verbalizers leave marks: evidence from Greek. *Morphology* 25:299–325.
Strunk, Klaus. 1994. Relative chronology and Indo-European verb-system: The case of present- and aorist-system. *Journal of Indo-European Studies* 22:417–434.
Uriagereka, Juan. 1995. Aspects of the syntax of clitic placement in Western Romance. *Linguistic Inquiry* 26(1):79–123.
de Vaan, Michiel. 2012. Latin deverbal presents in -*ā*-. In *The Indo-European Verb. Proceedings of the Conference of the Society for Indo-European Studies, Los Angeles, 13–15 September 2010*, ed. H. Craig Melchert, 315–332. Wiesbaden: Reichert.
Vogel, Irene. 2009. The status of the clitic group. In *Phonological domains: Universals and deviations*, ed. Janet Grijzenhout and Baris Kabak, 15–46. Berlin: Mouton de Gruyter.
Walkden, George. 2021. Against mechanisms: Towards a minimal theory of change. *Journal of Historical Syntax* 5:1–27.
Walker, Rachel. 2005. Weak triggers in vowel harmony. *Natural Language and Linguistic Theory* 23:917–989.
Wegner, Dennis. 2019a. The properties of perfect(ive) and (eventive) passive participles: An identity approach. *Glossa* 4:1–33.
Wegner, Dennis. 2019b. *The underspecification of past participles: On the identity of passive and perfect(ive) participles*. Berlin: De Gruyter.
Weiss, Michael. 2020. *Outline of the historical and comparative grammar of Latin*. Ann Arbor: Beech Stave, 2 edition.

Windhearn, Ryan. 2021. Disharmonic headedness in Homeric Greek and Tocharian and implications for Proto-Indo-European reconstruction. *Journal of Historical Syntax* 5(1–13):1–29. `https://doi.org/10.18148/hs/2`.

Wurmbrand, Susi. 2015. Restructuring cross-linguistically. In *Proceedings of the North Eastern Linguistics Society Annual Meeting 45*, ed. Thuy Bui and Deniz Özyıldız, 227–240. Amherst, MA: GLSA.

Xu, Fei, and Steven Pinker. 1995. Weird past tense forms. *Journal of Child Language* 22:531–556.