Catalan Journal of Linguistics 24/1, 2025 **41-91**

Is There Really Root-and-Pattern Morphology? Evidence from Classical Arabic*

Dominique Bobeck
Universität Leipzig. Institut für Linguistik
dom.bobeck@gmail.com
https://orcid.org/0009-0001-6897-6582

Received: May 2, 2024
Accepted: November 13, 2024
Published: February 27, 2025

Abstract

The morphologies of Semitic languages have most often been described as a system of roots and patterns suggesting a pluri-consonantal root. For example, the putative Arabic root √qbr has the derived forms *qabara* 'he buried', *qubira* 'he was buried', *ʔaqburu* 'I bury', *qabr* 'grave' (pl. *qubūr*), and *maqbar* 'cemetery' (pl. *maqābir*). Both traditional Semitist and generative morpheme-based research assume pluri-consonantal roots. However, there have been attempts to explain root-and-pattern morphology in terms of apophony instead. In these accounts, so-called Melodic Overwriting provides the morphophonological mechanism by which word-internal vowels are overwritten by vocalic affixes. The contrary approaches have been used to argue for different models of morphology (root-based vs. word-/stem-based), intermingling morphological theory with phonological representations. In this paper, a new theory of root-and-pattern morphology is proposed. It is shown that pluri-consonantal roots face several theoretical and empirical problems which are solved by assuming vocalised roots in a similar way to stem- and word-based approaches, but with the advantages of morpheme-based frameworks.

Keywords: apophony; root-and-pattern morphology; infixation; floating features; Arabic

Resum. *Hi ha realment una morfologia d'arrel i patró?*

Les morfologies de la llengua semítica s'han descrit sovint com un sistema d'arrels i patrons (*roots and patterns*) que suggereixen una arrel pluriconsonàntica. Per exemple, l'arrel àrab putativa √qbr té les formes derivades *qabara* 'va enterrar', *qubira* 'va ser enterrat', *ʔaqburu* 'entero', *qabr* 'tomba' (pl. *qubūr*) i *maqbar* 'cementiri' (pl. *maqābir*). Tant la investigació tradicional semitista com la basada en morfemes generatius assumeixen arrels pluriconsonàntiques. Tanmateix, hi ha hagut intents d'explicar la morfologia d'arrel i patró mitjançant l'apofonia. En aquests relats, l'anomenada *Melodic Overwriting* planteja el mecanisme morfofonològic pel qual les vocals internes de la paraula queden sobreescrites per afixos vocalics. Els enfocaments contraris s'han

* My thanks go to the organisers and the audience of the workshop *Nominal Inflection and Word-formation at the Phonology-Morphology Interface* and to the Friedrich-Naumann-Stiftung für die Freiheit, which funded this research with resources from the German Federal Ministry of Education and Research. I would also like to thank Hamza Khwaja for all the fruitful discussions on Semitic morphology and the morphology-phonology interface.

ISSN 1695-6885 (in press); 2014-9718 (online) https://doi.org/10.5565/rev/catjl.465

utilitzat per defensar diferents models de morfologia (*root-based vs. stem-/word-based*), barrejant la teoria morfològica amb les representacions fonològiques. En aquest article, es proposa una nova teoria de la morfologia d'arrel i patró. Es mostra que les arrels pluriconsonàntiques s'enfronten a diversos problemes teòrics i empírics que es resolen assumint arrels vocalitzades d'una manera similar als enfocaments basats en la base i la paraula, però aprofitant els avantatges dels marcs basats en morfemes.

Paraules clau: apofonia; morfologia d'arrel i patró; infix; característiques flotants; àrab

Table of Contents

1. Introduction

While some languages have morphological exponents with a clear concatenative pattern, others show pervasive word-/stem-internal changes. Well-known examples are the ab- and umlaut phenomena in Germanic languages (apophony and metaphony), such as German *werfen* 'to throw', where numerous vowel changes are a crucial part of German morphophonology. Comparing the possible derivations of *werfen*, one might get the impression that this verb is devoid of an underlying vowel, as is shown in Table 1. The respective apophonic vowel is underlined for illustration.

While the basic stem is widely accepted as *werf-*, an alternative such as **wVrf-* or even **wrf-* would challenge the analysis that most scholars of Semitic languages would make (for a similar example from English, cf. Bat-El 2002: 48-50). What prevents us from assuming such a highly marked structure?

This hypothetical consonantal root **wrf* may seem ridiculous but represents what is often found in historical linguistics. The root concept has two dimensions:

Table 1. Inflection and derivation related to the verb *werfen* in German

	Derived from *werf-*	**Gloss**
a.	*ich werfe*	'I throw'
b.	*du wirfst*	'you (sg.) throw'
c.	*ich warf*	'I threw'
d.	*ich habe geworfen*	'I have thrown'
e.	*der Wurf*	'the throw'
f.	*der Würfel*	'the dice'

a synchronic and a diachronic one. When reconstructing a proto-language, it is not uncommon to assume a rather abstract base from which the descendants in the respective daughter languages are derived. For Proto-Indo-European, the zero-graded examples **d*^{h}*ǵ*^{h}*m*- 'earth', **h*$_3$*n̥g*^{wh}- 'nail', and **ḱr̥d*- 'heart' could be named (Meier-Brügger 2010: F313, L333, L307).

Most historical linguists would agree that one characteristic of a good reconstruction is a certain degree of "naturalness". In other words, unlikely reconstructions from a typological point of view are disfavoured, and if two reconstructions are equally plausible in terms of internal and external reconstruction, the one with the greater typological frequency should be preferred (cf. Gamkrelidze 1989: 93f). The same principle should be applied to synchronic analysis.

A very similar concept emerged from the idea of a reconstructive root in synchronic linguistics. While the root is only an epiphenomenon and the lowest common denominator of synchronically related words in paradigmatic approaches to morphology, it is crucial to morpheme-based accounts, such as Distributed Morphology (DM, Halle & Marantz 1993). In DM, the members of the lexical categories are expressed by roots, opposed to functional morphemes, which express syntacticosemantic features (cf. Embick 2015: 7f). Roots are needed in order to derive different word forms from them through a set of plausible phonological and morphological processes. Furthermore, they lack a syntactic category assigned by the respective functional head.

Assuming an entirely pluri-consonantal root (henceforth called PCR, also called C-root by Bat-El 2003a; cf. Berrebi et al. 2023), as has been done for Arabic and other Semitic languages, morphological operations naturally include vowel infixation to form grammatical words (Al Kaabi & Dimitrios 2019; Arad 2003, 2005; Faust 2019; Faust & Hever 2010; Kastner 2019; McCarthy 1982; McCarthy & Prince 1990a; Tucker 2010; Wallace 2013 *i.a.*). Further derivations in these languages are achieved by various non-concatenative phenomena, such as ablaut, vowel deletion, segmental lengthening and shortening—usually accompanied by prosodic constraints. In all root-based accounts, a consonantal root, such as Classical Arabic √qbr 'to bury', is mapped onto certain prosodic shapes for distinct parts of speech. For the given example, this means that forms such as the verbal perfective base *qabar*-[1] 'x buried' in the active voice, *qubir*- 'x was buried' in the passive voice, the imperfective base *-qbur* in the active voice, its equivalent in the passive voice *-qbar*, the simple noun *qabr* 'tomb, grave' (pl. *qubūr*),[2] and the locative noun *maqbar* 'tomb, cemetery' (pl. *maqābir*), are licensed by extensive infixation of segments. These derivations of √qbr can be seen in more detail in Table 2. Note that this presupposes a direct derivation of the root, a circumstance

1. The transcription of all Arabic material not indicated by the International Phonetic Alphabet follows the standards of the Deutsche Morgenländische Gesellschaft, except for the glottal stop, the voiced pharyngeal fricative, and the voiceless uvular fricative, which are depicted as *ʔ*, *ʕ*, and *x*. Concerning Biblical Hebrew, I primarily follow the standards of Semitic studies, as shown by the transcription of the *Zeitschrift für alttestamentliche Wissenschaft*. All citation forms of verbs are represented by the 3rd person singular masculine perfective active.
2. Classical Arabic nouns are cited without case endings (nunation, *tanwīn*).

that is not necessarily stated by all root-based approaches to Semitic morphology for each of the examples in Table 2.

Prosodic nodes can also be attached to roots and stems, such as in case of the so-called Form II (also called stem, measure, type, *wazn,* or *binyan* in Arabic, Hebrew and Semitic studies), which is a causative marker in the form of a mora, illustrated in Table 3. The differences in vowel quality between Form I and II as visible in b. and d. can be left aside for the moment. We can see that these internal changes in vowel quality, vocalic and consonantal quantity are a central part of the Arabic morphological system.

As opposed to the root-based approach, there has been much work on Semitic morpho-phonology from a word- and stem-based perspective (Bat-El 1994, 2002, 2003a,b; Benmamoun 2003a,b; Buckley 2003; Ratcliffe 1997; Ussishkin 1999, 2000, 2003, 2005). Applying this to Arabic would mean that *qubira* 'x was buried', *qabr* 'tomb, grave', and *maqbar* 'tomb, cemetery' are derived from an existing word or stem, such as *qabar*.

PCRs are unproblematic in language systems where they can fully surface, such as in Georgian or Tashlhiyt Berber (cf. Hewitt 1995; Lahrouchi 2010; cf. Dell & Elmedlaoui 1985, 1989, 2003). In the view of root-and-pattern morphology, only alleged discontinuous PCRs will be considered here. I mainly follow the definitions of Faust & Lampitelli (2023: 2) for descriptive purposes of root-and-pattern morphology, as stated in (1).[3]

Table 2. Derivations of the PCR √qbr 'to bury'

	Derived word/stem	**Affix**	**Gloss**
a.	*qabar*	/a a/	'bury.PFV.ACT'
b.	*qubir*	/u i/	'bury.PFV.PASS'
c.	*qbur*	/Ø u/	'bury.IPFV.ACT'
d.	*qbar*	/Ø a/	'bury.IPFV.PASS'
e.	*qabr*	/a Ø/	'grave, tomb'
f.	*maqbar*	/ma-/, /Ø a/	'tomb, cemetery'

Table 3. Causative formations in Classical Arabic

	Base stem (Form I)		**Causative stem (Form II)**	
a.	*barada*	'to be(come) cold'	*barrada*	'to make cold, cool'
b.	*saxuna*	'to be(come) hot'	*saxxana*	'to heat'
c.	*ʕabada*	'to serve'	*ʕabbada*	'to enslave'
d.	*ʕalima*	'to know, learn'	*ʕallama*	'to teach'

3. Highlighting in boldface is original.

(1) a. No Entry-Stem principle (NES)
In a root-and-pattern system, there is no single stem (="continuous sequence of segments") such that all other stems are derived from it.

b. **Root**: the set of elements common to all word-forms of a given inflectional paradigm.

c. **Pattern**: the vocalization and/or syllabic structure shared by paradigms with different roots.

An addition must be made to the root as part of an inflectional paradigm, because derivation must be included in the definition of the root. If the definition in (1b) were sufficient, the data in (2), taken from Arad's (2003: 743f) analysis of denominal roots in Modern Hebrew, would be excluded from the investigation of the PCR √xšb.

(2) √xšb

a.	CaCaC (v)	*xašav*	'to think'
b.	CiCCeC (v)	*xišev*	'to calculate'
c.	hiCCiC (v)	*hexšiv*	'to consider'
d.	hitCaCCeC (v)	*hitxašev*	'to be considerate'
e.	maCCeC (n)	*maxšev*	'computer/calculator'
f.	maCCaCa (n)	*maxšava*	'thought'
g.	CCiCut (n)	*xašivut*	'importance'
h.	CiCCon (n)	*xešbon*	'arithmetic/bill'
i.	taCCiC (n)	*taxšiv*	'calculus'

Morphology that changes the valency structure is understood here as instance of derivational morphology since it changes the lexical meaning. Thus, a revised definition of the root is given in (3).

(3) Root: the set of elements common to all word-forms of a given inflectional or derivational paradigm.

The fact that derivation can build paradigms is accepted here. Valency-changing morphology in particular underlines this point. To give an example of a mixed inflectional and derivational paradigm, cf. Table 4, where one can see the attested forms of the PCR √qtl in Classical Arabic. The horizontal axis represents the inflectional dimension (excluding the *maṣdar*), the vertical axis the derivational one. *Maṣdar* is the traditional term for nominalisation in Arabic. Note that some of the *maṣādir* are not necessarily attested in Classical Arabic but in Modern Standard Arabic and are derived by regular rules (also called *qiyās* 'analogy' in the Arabic grammatical tradition).

Table 4. Paradigmatic relationship of valency changing morphology in Classical Arabic[4]

	Form	Perfective	Imperfective	Maṣdar	Gloss
a.	I	*qatala*	*yaqtulu*	*qatl*	'to kill'
b.	II	*qattala*	*yuqattilu*	*taqtīl*	'to massacre'
c.	III	*qātala*	*yuqātilu*	*muqātala*	'to combat'
d.	V	*taqattala*	*yataqattalu*	*taqattul*	'to humiliate one another'
e.	X	*istaqtala*	*yastaqtilu*	*istiqtāl*	'to seek slaughter'

For this reason, the term derivational paradigm (also called *lexical paradigm* by Wischer 2012: 360) is used in this paper.

Throughout this paper, the root is understood not only as a descriptive constituent, but also as a morphosyntactic root node without information about its grammatical category in a DM-framework, as has been done by Ahdout (2021), Arad (2003, 2005), Kastner (2019, 2020), Kamil (2023), and Wallace (2013) among others for Semitic.

The fact that roots cannot be directly mapped onto the output is not limited to root-and-pattern systems. For example, Latin √nokt in *nox* 'night' cannot constitute a grammatical word for both phonotactic and morphological reasons, since the word-final /kt/ is ungrammatical and there is always a suffix attached to this root. But unlike root-and-pattern systems, the Latin root √nokt comes from other parts of the paradigm than the nominative singular., e.g. in *noct-em* 'night-ACC' or *noct-ēs* 'night-NOM/ACC.PL'. The full extent of the difficulty in proposing a root in root-and-pattern morphology is illustrated in Table 5, where the derivations of the PCR √ftḥ are shown. It should be noted that Classical Arabic does not allow complex onsets and allows only very restrictively complex codas. This inevitably leads to the insertion of vowels when dealing with PCRs—be it a vowel without morphological affiliation (epenthesis) or a vowel with a specific morphosyntactic function (infixation).

The crucial question arises as to whether the morphology of Classical Arabic truly adheres to the No Entry-Stem (NES) principle, as defined by Faust & Lampitelli (2023: 2) in (1). Specifically, is it the case that there is no lexical morpheme in the form of a continuous sequence of segments serving as a base for further derivations? This can be broken down into two sub-questions: (i) Are PCRs an adequate means of capturing roots in Classical Arabic? If not, the existence of "patterns" becomes questionable. This leads to sub-question (ii): are patterns (such as CaCCaC or CiCāC) adequate primitives within the morphology of Classical Arabic? These two points can be summarised in the overarching question: does Classical Arabic genuinely exhibit root-and-pattern morphology?

The remainder of the paper is structured as follows. Section 2 outlines the primary approaches to root-and-pattern systems in phonological and morphologi-

4. Citation forms represent the 3rd person sg. m. If not indicated otherwise, the default is the perfective aspect.

Table 5. Derivations of the PCR √ftḥ in Classical Arabic (selection of attested patterns)

a.	fataḥ-a open\PST-3SG.M 'he opened; he conquered'	b.	ya-ftaḥ-u 3M-open\NPST-IND 'he opens; he conquers'
c.	yu-fattiḥ-u 3M.PLUR-open\PLUR.NPST-IND 'he opens (several times)'	d.	fātaḥ-a open\VPL.PST-3SG.M 'he addressed first'
e.	fatḥ open\NMLZ 'conquest (of a country)'	f.	mi-ftāḥ NMLZ.INS-open\NMLZ.INS 'key'
g.	futḥ-a open\NMLZ-F 'opening, intervening space'	h.	fattāḥ sit\NMLZ.AG 'opener; conquerer'
i.	futuḥ open\ADJ 'wide, open'	j.	maftūḥ open.PTCP.PASS 'opened, open'

cal theory. Section 3 presents a new approach to root-and-pattern morphology that treats it by assuming vocalised roots. A number of theoretical and empirical problems with PCRs are discussed and contrasted with this new account. Section 4 provides a summary of the advantages and disadvantages of each account of root-and-pattern morphology.

2. Roots and patterns and their theoretical background

2.1. Introduction to the analysis of root-and-pattern morphology

So far, there have been two major approaches to root-and-pattern morphology, the root-based and the stem-/word-based one. These two opposing frameworks —described in more detail below—attempt to answer the question in (4), where the answers given so far are listed.

(4) What is the phonological and morphosyntactic smallest common denominator?

- a. roots
  - i. roots are consonantal
  - ii. roots are neither vocalic nor consonantal
- b. stems/words

A crucial point of the present analysis is its limitation of the *phonological* representation of roots. To allow for a unified analysis of weak and strong suppletion, an analysis of Semitic morphology benefits from distinguishing the morphosyntactic constituent of the root (such as √$_{143}$), a phonological index as a pointer to phonological information, and its underlying representation. This model, proposed by Faust (2016), is adopted here and appears schematised in (5).

(5) Root model proposed by Faust (2016)
$\sqrt{}_{143}$ → Phonological Index → Underlying Representation → Realisation

In answering the question of the existence of root-and-pattern morphology, this paper discusses only the underlying representation of roots in root-and-pattern languages, i.e. neither the morphosyntactic constituent of the root nor the phonological index, although both phenomena may play a role in understanding the data.

An issue that is less prominent in the literature, but still important, is the problem of the nature of the attested patterns that serve as morphological exponents. The various approaches to this question appear summarised in (6).

(6) What are the patterns in root-and-pattern morphology?

a. templates

b. non-segmental nodes
   i. prosodic nodes
   ii. floating features

c. fully specified segments

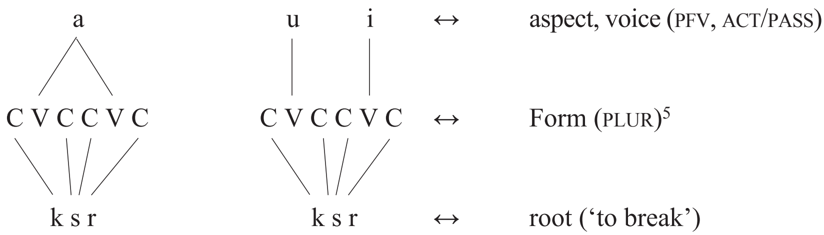
The following paragraphs provide a brief overview of previous analyses dealing with question in (6).

2.2. Skeletal approaches

The seminal works of McCarthy (1979, 1981) set off a cascade of debates about the morphological systems of Semitic languages. Here, McCarthy captured root-and-pattern morphology by relying on autosegmental phonological representations. This approach is also called the "phonology-only account" (Kastner & Tucker, forthcoming). In a left-to-right association rule, consonantal roots spread across a template. One can see how the questions in (2) and (3) are answered by McCarthy, i.e. roots are said to lack vowels (which is the traditional Semitist view) and the patterns are due to a specific template. This is formalised by means of the mapping of the PCR √ksr (roughly 'to break') onto the perfective stems *kassar*- (active, 'to smash, break several times') and *kussir*- (passive, 'to be smashed, to be broken several times'). The vocalic melody is represented by another tier in autosegmental phonology.

Compare the first and second Form of the PCR √ksr in both active and passive voice, namely *kasara* 'he broke' vs. *kassara* 'he smashed' and *kusira* 'it has been broken' vs. *kussira* 'he/it has been smashed'. The respective autosegmental representations of the stems of Form II in the manner of McCarthy (1979, 1981) can be seen in (7), cf. also Davis & Tsujimura (2014, 2019). This sheds light on the question posed in (3). Since morphemes in the autosegmental framework are distributed over different tiers, they consist of templates (such as the CVCCVC template here) and consonants associated with their respective slots in the template. This allows us to make generalisations about the verbal paradigm of Classical Arabic: The bases *kassar*- and *kussir*- share the same root and Form (*wazn*) but differ in their voice, which can be isolated as /a/ or /u-i/, respectively. If we compare them with their counterparts in Form I, i.e. *kasar-* and *kusir-*, we still obtain valid generalisations: the PCR and the vowels are equivalent to those in (7a,b) with only the pattern changing in form and meaning.

(7) a. *kassar-* b. *kussir-*



There are good reasons why the original account by McCarthy (1979, 1981) has been abandoned. One is that this approach predicts that there must be idiosyncratic sequences of C and V slots in templates, such as VCCV. However, since this is not the case in any human language, there is a major problem of overgeneration (Bye & Svenonius 2012: 451). The absence of certain templates is in line with the criticism of skeletal accounts that they only stipulate templates without external motivation so that the difference between Germanic (cf. Table 1) and Semitic languages would not only be described but explained (see Kastner & Tucker, forthcoming: §2.2.1; cf. Faust & Lampitelli 2023). Moreover, as Kastner & Tucker (forthcoming) point out, skeletal approaches say only little about the connection between syntax and semantics in identifying the boundaries between idiosyncratic and compositional semantic interpretations.

A strong argument against the skeletal approach comes from Arabic broken plurals (plural formation via internal changes), already stated by Ratcliffe (1997).[6] In Table 6, we see that the nominal plural is sensitive to the moraic structure of its singular base. Whereas CVCCVC nouns are mapped onto CVCVVCVC, there is moraic preservation if the base already contains a long vowel; thus, CVCCVVC is mapped onto CVCVVCVVC and not CVCVVCVC. Therefore, the skeletal approach requires *two* different templates to capture broken plurals of this type whereas a moraic or foot-based solution necessitates only one (see below for Prosodic Morphology). As will be shown later, cluster transfer, as in the case of broken plurals, has been used to argue for word-based analyses.

5. Note that the second form in Arabic can signify both causative and pluractional/intensive semantics.
6. For a similar problem in Levantine Arabic, see Faust (2017: 88f), cf. also Enguehard & Faust (2018) about the same problem in the NENA (Northeastern Neo-Aramaic) dialect of Qaraqosh.

Table 6. Moraic preservation in Arabic broken plurals[7]

	Singular	Plural
a.	CVCCVC	CVCVVCVC
	minbar	*manābir*
	'pulpit'	'pulpits'
	manzil	*manāzil*
	'abode'	'abodes'
b.	CVCCVVC	CVCVVCVVC
	minbār	*manābīr*
	'gut, intestines'	'guts, intestines'
	miftāḥ	*mafātīḥ*
	'key'	'keys'

An approach similar to that of McCarthy (1979, 1981) is Strict CV (Lowenstamm 1996; Scheer 2004; cf. Faust 2012, 2017 for two case studies on Modern Hebrew and Palestinian Arabic), a theory within Government Phonology (Kaye et al. 1990; cf. also Scheer & Kula 2017). Here, sequences of CV units form a skeleton, with a PCR (for Semitic) and its affixes linked to their respective positions. The concatenation of CV units with the addition of segmental spreading allows for more flexibility in the templates so that the problem of more than one template for a single phenomenon does not arise. In this way, Strict CV elegantly reduces the number of templates.

In their Strict CV approach to root-and-pattern morphology, Faust & Hever (2010) abstract away from the root as a segmental string by referring to *radicals* (a term borrowed from traditional Semitic studies). These are explicitly morphophonological abstractions (ibid.: 92). Radicals are said to be neither consonants nor vowels. Only their final realisation is vocalic or consonantal.

2.3. Prosodic Morphology

Strict CV is the only framework used in contemporary phonological research in which templates serve as morphemes since McCarthy abandoned his skeletal attempt in favour of Prosodic Morphology (McCarthy & Prince 1986/1996; McCarthy & Prince 1990a,b; Downing 2006 *i.a.*).[8] Prosodic Morphology is based on universal prosodic units, such as the prosodic word, metrical feet, syllables, and moras. For instance, McCarthy & Prince (1990b) demonstrate that broken plurals in Classical Arabic favour iambic affixation. Given that the stress-to-weight principle is active in Arabic, cf. the examples in (8).

7. Note that *minbār* 'guts, intestines' is not taken from Classical but Modern Standard Arabic.
8. Note that there have been recent attempts to explain root-and-pattern morphology by means of templates in Construction Morphology, as has been done by Davis & Tsujimura (2019).

(8) Iambs as plural markers in Classical Arabic

a. *nafs*	pl. *nufūs*	'soul(s)'
b. *kalb*	pl. *kilāb*	'dog(s)'
c. *mašhad*	pl. *mašāhid*	'assembly/-ies'
d. *mīṯāq*	pl. *mawāṯīq*	'contract(s)'
e. *xātim*	pl. *xawātim*	'ring(s)'

Though Prosodic Morphology has been used to explain root-and-pattern morphology by means of PCRs (McCarthy & Prince 1986/1996), it is not a necessary condition for any Prosodic Morphology account. The question about roots or stems (or words) is left open here. However, the question of the identity of the pattern, i.e. prosodic constituents, is partly answered.

What Prosodic Morphology leaves out are the mechanisms by which vowel qualities are modified or even introduced. Again, two answers have been given so far: Melodic Overwriting (Bat-El 1994) and PCRs with vocalic infixes. Both solutions will be outlined in the next two sections.

2.4. Augmented phonology-only accounts

Let us turn to "augmented phonology-only accounts" (cf. Kastner & Tucker, forthcoming). This approach attempts to derive words from other words without reference to roots, hence, following the paradigm of word- and stem-based morphology (Anderson 1992; Aronoff 1976, 1994). Major contributions to this approach are the works by Bat-El (2002, 2003a,b, 2008, 2017), Ussishkin (1999, 2000, 2003, 2005), Laks (2013a,b, 2014), and Buckley (2003).

The main idea originated in consonant cluster transfer in Modern Hebrew. In her analysis of denominal verbs, Bat-El (1994) finds out that consonant clusters can only be maintained if the input to the derivation is not a consonantal root but a word. For example, from the noun *praklit* 'lawyer' the verb *priklet* 'to practice law' is derived. A root-based analysis would license ungrammatical **pirklet*, as well. Therefore, the derived verb must "see" the corresponding word, not the PCR. The formal mechanism underlying constitutes Melodic Overwriting. In the case of *praklit* → *priklet*, this indicates that the vowels /i e/ are applied to *praklit* in order to overwrite the original vowels, which are replaced by /i e/.

This approach has been extended to other aspects of Semitic morphology. A hallmark of the augmented phonology-only account is that root-and-pattern morphology is epiphenomenal. In his explanation of non-concatenative morphology, Ussishkin (1999, 2000, 2003, 2005) relies on Output-Output correspondence (Benua 1997; cf. also Alderete 1999, 2001).

To give an example, the derivation of Modern Hebrew *gidel* 'he grew' (trans.) is based on the verb *gadal* 'he grew' (intr., unmarked binyan) in combination with the causative affix /i-e/. This is achieved by the interaction of the constraints Max,

Max-OO, and σ-Align (Ussishkin 2003: 518-520, 2005: 192f; cf. Buckley 2003). The constraints σ-Align and Max-OO are defined in (9) and (10).

(9) σ-Align (Ussishkin 2003: 517)
Some edge of every syllable must be aligned with the same edge of some prosodic word containing it.

(10) Max-OO (Ussishkin 2005: 191)
Every segment of the base has a correspondent in its related output.

Consequently, disyllabic outputs are favoured by σ-Align. Max-OO penalises outputs that are not derived from an existing word, i.e. that have no counterpart in the paradigm. For illustration, see the mapping of Modern Hebrew *gadal* to *gidel* in the tableau in (11), taken from Ussishkin (2003: 418). Here, fully specified vowels replace the stem-internal ones.

What sets the augmented phonology-only accounts apart from previous models is that root-and-pattern morphology is explained as a TETU phenomenon (Ussishkin 2003: 519; TETU: The Emergence of The Unmarked, McCarthy & Prince 1994). Consequently, there is no need for the consonantal root, and Semitic is not special because of a typologically unique root structure. Only a high ranking of prosodic and phonotactic constraints over output-output faithfulness gives the impression of roots that never surface as a contiguous output. The tableau in (11) shows the interaction between σ-Align and Max-OO (Ussishkin 2003: 518; cf. Ussishkin 2005: 188-192). Here, Max-OO compares the respective candidates with the output form *gadal*.

(11) Interaction of disyllabicity and Output-Output correspondence in Modern Hebrew

gadal + i e		σ-Align	Max-OO
a.	gidela	*W	*L
b.	gadile	*W	*L
c.	gadalile	*W*	L
→ d.	gidel		**

Nevertheless, the augmented phonology-only accounts have been subject to substantial criticism. One of the main arguments is the "problem of the source" (Prunet 2006; Faust & Hever 2010), also called the "problem of the missing base" (Kastner 2019: 605; cf. also Mascaró 2016). This means that there is no surface form that could serve as a basis for derivation. If we compare the paradigms of the PCRs √krt 'to cut off', √kry 'to happen', √krʔ 'to read', and √krʕ in Modern Hebrew,[9] there is no surface form derived from them that is not identical to another

9. The phonological representations are slightly simplified because Modern Hebrew lost its former guttural consonants. Note that Faust & Hever (2010: 87-91) list these roots as √krt, √kri, √krʔ, and √krA.

surface form in any cell of the paradigm. For instance, the realisations of the 3rd person sg. m. of these roots are *karat*, *kara*, *kara*, and *kara*, the infinitives *li-krot*, *li-krot*, *li-kro*, and *li-króa*.[10]

The same problem arises with the derived stems. In the derivation of Modern Hebrew *nigen* 'he/it played (music)' (cf. Faust 2022: 14-18) or Classical Arabic *waṣṣā* 'he enjoined, commanded', there is no basic stem **nagan* or **waṣā* from which the forms *nigen* and *waṣṣā* could be derived. It can be shown that *nigen* and *waṣṣā* are morphologically complex forms. Considering the CiCeC pattern in Hebrew and the CaCCaC pattern in Arabic, these forms belong, at least superficially, to the *pi'el* binyan and Form II, respectively. In Hebrew and Arabic, the *pi'el* and Form II cause allomorphy on the tense/agreement markers. This is indeed the case with *nigen* and *waṣṣā*, which are *menagen* and *ʔuwaṣṣī* in the present tense (Hebrew) and the imperfective aspect (Arabic). If *nigen* and *waṣṣā* were in the unmarked stem, the ungrammatical present/imperfective forms **nogen* and **yaṣī* would be expected.

In addition to the problem of the source, questionable derivational paths, and overgeneration issues concerning allomorphy (cf. Kastner 2019), there are also theoretical concerns with augmented phonology-only accounts because they presuppose Output-Output correspondence (OO-correspondence, also called Base-Derivative correspondence). As Kiparsky (2015) points out, allowing morphological constraints in Eval such as the transderivational Output-Output constraints in Transderivational Antifaithfulness Theory (Alderete 1999, 2001; Benua 1997), "undermine[s] three of OT's central goals: formalization, learnability, and a restrictive factorial typology" (ibid.: 9). Besides, Kiparsky (2015: 1, 10) stresses that transderivational constraints (as used by Ussishkin 1999, 2003, 2005) predict numerous possible rankings, of which only a few are attested, and thus produce a high degree of overgeneration. Note that transderivational constraints presuppose the existence of other members within a paradigm. So, a central problem with them is—if we say that form A can only be explained by its similarity to form B—why should form B not be more similar to form A in the first round? Thus, the order of derivation of these two forms is random and remains unexplained.

2.5. PCRs and epiphenomenal root-and-pattern morphology

Even though the word-/stem-based approach faces several problems as outlined above, there is the important insight that root-and-pattern morphology poses a TETU phenomenon and is, thus, epiphenomenal. This has had major implications for root-based accounts, such as Tucker's (2010, 2011) combination of PCRs and vocalic infixes to explain non-concatenative phenomena in Iraqi and Modern Standard Arabic. Infixation is a necessary process in what Tucker (2010) calls "root and prosody approach" (cf. also Kastner & Tucker, to appear: §3.2.3; Tucker 2011). Building on Kramer's (2007) work on Coptic, Tucker (2010) develops a model in which constraints on prosody and syllable structure force vocalic affixes to surface as infixes in PCRs.

10. For the matter of simplicity, postvocalic spirantisation is ignored in the given Hebrew examples.

Recall the data from Table 2, where the root √qbr constitutes the base for several surface forms. What would be required to produce the perfective active stem *qabar-*? Following the root-and-prosody approach, the PCR √qbr would be concatenated with the exponent /a-(a)/ for voice, tense, and aspect to yield /qabar/. The correct output is achieved by high-level ranked phonotactic constraints so that ONSET, *COMPLEX, NO-CODA, and NON-FINALITY(syllable) rule all other candidates out. For /qbr+a,a/, this means *[qbraa], *[qbaa<r>], *[qaab<r>], *[aqba<r>], and *[qabra] are less harmonic than [qaba<r>].[11] Therefore, though the phonology causes the respective exponents to surface non-concatenatively, morphosyntax proceeds in a concatenative procedure.

This approach has been even further developed by Wallace (2013) and Kastner (2016, 2017, 2019, 2020), based on data from Akkadian, Iraqi and Gulf Arabic, and Modern Hebrew. The greatest explanatory power of these works lies in their treatment of contextual allomorphy. In all varieties of Arabic, the vocalisation of Form I in the perfective aspect (or non-past tense, depending on the variety) must be memorised by the learner. This is illustrated by the data in (12) from Classical Arabic.

(12) Vocalisation of the perfective aspect of Form I in Classical Arabic

a. *raqaṣa* ‘to dance’

b. *salima* ‘to be(come) safe, free’

c. *ṣaġura* ‘to be(come) small, little’

But in the derived stems, the vocalisation is uniform, as visible in Form II in (13).

(13) Uniform vocalisation of the perfective aspect of Form II in Classical Arabic

a. *raqqaṣa* ‘to cause to dance’

b. *sallama* ‘to rescue, to free’

c. *ṣaġġara* ‘to make small, little’

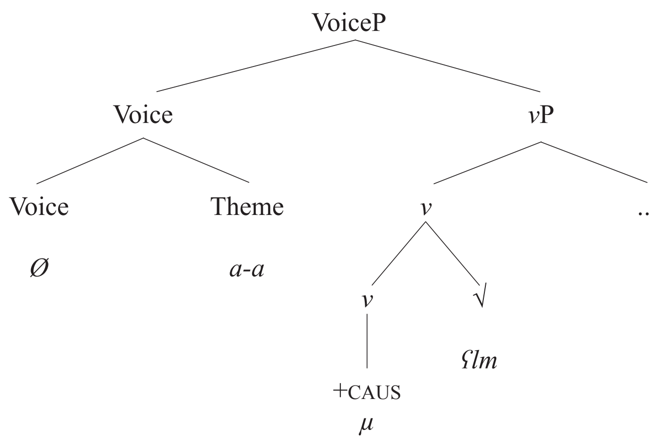
This is reminiscent of the contextual allomorphy of English past tense markers, which can be explained by linear adjacency (Adger, Bejár & Harbour 2001; Bobaljik 1999, 2000; Embick 2010). If the root is adjacent to Tense, it can cause contextual allomorphy within a cycle. This means some roots require ablaut (e.g. *break/broke*), others zero exponence (e.g. *put/put*), others the suffix *-ed* (e.g. *walk/walked*), to name just a few examples. But if a verbaliser interferes, as in the case of *-en* in *darken* or *-ise* in *vaporise*, the root can no longer “see” the Tense node. In this way, contextual allomorphy depending on the root is impossible. There is no verb in English marked by the suffix *-ise/-ize* with ablaut or a zero exponent.

11. The narrow brackets indicate extrametricality.

Wallace (2013) applies this to Arabic, attributing the vowels within PCRs as markers of the Theme node. If the PCR is adjacent to Theme, the root can demand listed realisations of Theme. The locality of Form II in her analysis is the verbaliser *v.* As can be seen in (14) for the perfective active base *ʕallam*- 'to teach', *v* blocks contextual allomorphy between the root and the Theme node. But now *v* itself can trigger contextual allomorphy.

Forms that are not root-derived can be generated by assuming floating features (Kastner 2019: 599-601; 2020: 171f). In this way, the base *gudál* as in Modern Hebrew *yegudál* 'he will be raised' can be derived from *gedál* whereby the first vowel is altered to *u*.

(14) Contextual allomorphy of Form II in Arabic (Wallace 2013: 4)



In summary, the augmented phonology-only accounts rely on fully specified vowels to create non-concatenative effects whereas Kastner's (2019, 2020) analyses rely on both full vowels, which are infixed into a PCR, and "defective" vowels in the form of floating features that represent vowel quality. However, both accounts treat root-and-pattern morphology as epiphenomenon.

2.6. A recapitulation of previous approaches

In summing up the preceding morphophonological approaches to root-and-pattern morphology, it can be stated that the skeletal approaches of McCarthy (1979, 1981), despite representing a significant breakthrough in formalising the first generalisations about the distribution of roots and patterns in Semitic, are now considered outdated. The same can be said of augmented phonology-only accounts. While these works provide an improved explanation of root-and-pattern morphology as a TETU phenomenon, they are unable to predict contextual allomorphy. Furthermore, a stem- or word-based account is significantly challenged by the problem of the source (Prunet 2006; Faust & Hever 2010). While it has been demonstrated that certain words cannot be derived from the root (Bat-El 1994; Laks 2014), this does not falsify the morphosyntactic constituent of the root. Importantly, it has not been claimed that all forms are derived from the root. In a theory of cyclicity and locality, such as DM, it is agreed that a morphosyntactic derivation proceeds stepwise. Consequently, demonstrating that some forms are derived from existing words (as an argument against the root) represents a strawman, as Faust (2019) points out (cf. also Faust & Lampitelli 2023).

The subsequent section will present a novel account of root-and-pattern morphology. The current consensus in DM (cf. Kastner & Tucker, to appear: 2) will be embraced, namely that non-concatenative morphology "is not grammatically special except that it involves a particular combination of modular interactions that allow for non-concatenative phonology" (ibid.). It should be noted that this is not necessarily the case for root-and-pattern morphology according to the definition by Faust & Lampitelli (2023) stated in (1). As opposed to the position of Kastner & Tucker (forthcoming), Faust & Lampitelli (2023) consider root-and-pattern morphology, including PCRs, to be a unique feature of Semitic and potentially some Berber languages.

3. Root-and-pattern morphology without PCRs

3.1. The heuristic motivation for vocalised roots

In attempting to establish a coherent division of labour between phonology and morphosyntax, this account primarily draws upon the approach of Generalized Nonlinear Affixation (GNA; Bermúdez-Otero 2012; cf. also Bye & Svenonius 2012; Trommer & Zimmermann 2014; Zimmermann 2017, 2023; Trommer 2011). To reduce analytic underdetermination, it is necessary to prevent any linguistic module (such as morphology or syntax) from directly manipulating phonological content. Rather than relying on powerful lexicon rules or co-phonologies, sub- and suprasegmental phonological material should be used to accommodate non-concatenative morphology in GNA approaches.[12]

As we will see below, the use of PCRs gives rise to a number of theoretical and empirical issues. It would be erroneous to assume that the phonological representation is irrelevant. Although it is a reasonable assertion "that roots do not themselves contain phonological information but are instead pointers to phonological information" (Kastner & Tucker, forthcoming: 30; cf. also Faust & Hever 2010), ultimately there must be an input that can be interpreted by the phonology. It is worthwhile to recall the model proposed by Faust (2016), as previously stated in (5). Note that neither the root as a syntactic terminal node nor the phonological index represents an underlying representation. But the phonological index points

12. Also, Kastner & Tucker (forthcoming: § 3.3.3) highlight the importance of a good division of labour: "Obviously on heuristic or modularity grounds alone, approaches which dispensed with access to morphological structure at PF would be preferred, but work remains to be done to see if a purely phonological approach can attain maximal empirical coverage in all NM languages."

to it. So, the question "is the consonantal root real" is not as trivial as Kastner & Tucker (forthcoming: 30) propose.

The issue is not that PCRs are unpronounceable due to fatal violations of phonotactic constraints. As Faust & Lampitelli (2023) elucidate, a PCR can be compared to the relationship between Spanish *comer* 'to eat' and its stem /kom/. In fact, [kom] can never be an output since [m] is completely forbidden in word-final position in Spanish. To illustrate this point, we may consider the English root *astr-* (Faust 2022: 17f), which is ungrammatical when considered in isolation, but it can be seen in derived forms such as *astral*, *astronomy*, *astrology*, or *astronaut*.

Rather than pointing to the root as unpronounceable unit, it is the phonological form from a typological perspective that is open to question. In most natural languages, roots are expressed by mono- or disyllabic units. This can be formulated as the Root Length Constraint in (15), stated by Haspelmath (2023: 10; cf. Urban 2024).

(15) The Root Length Constraint
Roots are preferably monosyllabic or bisyllabic, and longer roots are less preferred the longer they are.

This implies that roots typically exhibit syllabic structure. Consequently, roots rarely exceed two syllables and seldom fall below this threshold. While this observation does not challenge linguistic theory, it is nevertheless a curiosity. It should be noted that, while consonants may function as syllable nuclei in certain languages, this is not the case in Classical Arabic, the majority of eastern Arabic dialects, Amharic, Modern Hebrew, or Northeastern Neo-Aramaic (NENA).[13] So, consonants cannot be employed for the purpose of syllabification in these Semitic languages, with the consequence that PCRs lack syllabic structure.

Prior to addressing the more challenging problems with PCRs, we need to distinguish between consonants and vowels. At the morphosyntactic level, it is perfectly valid to refer to radicals, which are neither vowels nor consonants. Nevertheless, the underlying representation must ultimately be based on these concepts. This perspective is supported by two key arguments.

The first argument stems from gemination and strengthening targets in South Ethio-Semitic. Here, it becomes clear that at the subphonological level, the radical is a useful concept, as argued by Faust & Hever (2010), cf. also Faust (2022: 24-26). The past tense of Amharic is indicated by the gemination of the second *radical*. If this radical is vocalic or non-existent, gemination does not apply. The same holds true for the unmarked verbal stem in the Gurage language Chaha, where the second radical undergoes strengthening, unless it is vocalic or zero.[14] These observations are depicted in Table 7, which presents the stems of the past

13. For Amharic cf. Leslau (1995: 41-44). For NENA cf. Khan (2008: 105-111; 2009: 43-47; 2016: 200-212), Fox (1997: 19f) and Talay (2008: 155-159) *i.a.*
14. Simplifying a bit, strengthening in Chaha means that voiced obstruents become voiceless, and /r/ becomes [n]. For a more detailed picture, see Rose (2007: 406-408).

Table 7. Strengthening and gemination in Chaha and Amharic

	Chaha		**Amharic**	
a.	*sä**p**är-*	'to break'	*sä**bb**är-*	'to break'
b.	*bä**n**äs-*	'to demolish a dam'	*fä**ll**äg-*	'to desire, wish'
c.	*bä**n**a-*	'to eat'	*sä**mm**a-*	'to hear'
d.	*xär-*	'to be, become'	*mot-*	'to die'
e.	*dar-*	'to bless'	*lak-*	'to send'

tense in Chaha and Amharic. The Chaha data are taken from Faust & Hever (2010: 98), while the Amharic data are from Leslau (1995: 280-290, 508f, 533-535, 538f; cf. Faust 2022: 24-26). Strengthened and geminated segments are highlighted in boldface.

The conclusion of Faust & Hever (2010) and Faust (2022) is that if the second radical is either zero or vocalic, then strengthening and gemination do not apply. To illustrate this, we may consider the radical structure of the Amharic words *mot-* and *lak-*, which would be represented as √m-u-t and √l-a-k, respectively. For Chaha *xär-* and *dar-*, Faust & Hever (2010: 98) propose the roots √x-Ø-r and √d-ä-r. The necessity for a root comprising morpho-phonological abstractions, i.e. radicals, follows from the fact that it is not the second *consonant* in the base that is subject to strengthening/gemination but the second *radical*.

In contrast, for underlying representations, this implies that the radical must "know" whether it is a vowel or a consonant at the pure phonological level. In the absence of a vowel/consonant distinction, it would be impossible to ascertain whether a given segment undergoes strengthening or gemination. Hence, phonology requires a distinction between vowels and consonants.

The second argument in favour of this distinction pertains to glides. It could be argued that the consonants /w j/ and vowels /u i/ represent the same phonemes, i.e. /u~w/ and /i~j/, and only have an allophonic relationship depending on their distribution within the syllable. If we take German *jung* 'young' (pronounced as [jʊŋ]) as an example, it is reasonable to assume an underlying representation of /iʊŋ/. This analysis by Raffelsiefen (2012) leads to a minimisation of the phoneme inventory of German.[15] Nevertheless, it is not evident that this analysis can be universally applied to all languages. For Chaha and Amharic, we have already seen that the consonant/vowel distinction is crucial for predicting the occurrence of morphophonological strengthening and gemination. But the difference between /w j/ and /u i/ is also necessary to account for certain phonological effects caused by vowels but not by consonants.

15. The structure in /iʊŋ/ cannot be analysed as a diphthong for two reasons. First, diphthongs that are neither rising nor falling are prohibited in German. Second, there would be no onset. Since every stressed syllable in Standard German must have an onset, the diphthong analysis must be rejected.

In (16), we can see some examples of postvocalic spirantisation in Syriac (an Aramaic language from the late antiquity, cf. Muraoka 2005: 4f, 11-13; Edzard 2001; Knudsen 2015: 40-45). In Syriac, non-geminated non-pharyngealised stops become fricatives in postvocalic position.[16] The data in (16) show that /t/ is mapped onto the interdental fricative [θ] when preceded by a vowel. When /t/ follows a glide, spirantisation does not apply. Therefore, a representation of *baytā* as /baita:/ and *mawtā* as /mauta:/ would predict the ungrammatical forms **baiθā* and **mauθā.* For the roots of *baytā* and *mawtā*, it can be concluded that in a PCR analysis they must be /bjt/ and /mwt/, not /bit/ and /mut/.

(16) Syriac postvocalic spirantisation

a. *baytā* ‘house’

b. *brīθā* ‘creature’

c. *keθbaθ* ‘she wrote’

d. *mawtā* ‘death’

e. *nmūθ* ‘he dies’

f. *kuθbūn* ‘write (pl.) to me!’

In the light of the evidence of strengthening, gemination, and postvocalic spirantisation in the Semitic languages Chaha, Amharic and Syriac, it can be concluded that consonants and vowels are principally distinct segments. This means that a PCR analysis must deal with the typologically exceptional structure of roots, which lack syllabic structure.

3.2. Basic structure of the proposed model

To benefit from both stem- and root-based approaches that have been proposed so far, the phonological insights of the augmented phonology-only and the root-and-prosody account will be combined with the morphosyntactic findings of recent Semitic DM analyses, such as Wallace (2013) and Kastner (2019, 2020).

In the case of Classical Arabic, the underlying representation will not be a PCR, but a vocalised root with the prototypical structure CCVC. Instead of /ktb/, /ʕlm/, and /bʕd/, the phonological bases /ktab/, /ʕlim/, and /bʕud/ are proposed. From these roots, forms such as *kataba* ‘he wrote’, *ʕalima* ‘he knew’, and *baʕuda* ‘he was far away’ are derived.

As can be observed, the proposed roots are mostly equivalent to their perfective bases without the first vowel /a/. This makes the CCVC-roots more similar to the respective surface forms, although they would still violate undominated phonotactic constraints such as *COMPLEX-ONSET if they were surface forms. The

16. Note that serial interaction of spirantisation and vowel deletion plays an important role in Syriac phonology. Besides, some fricatives have reached phonemic status (cf. Edzard 2001).

assumption of the CCVC structure is slightly reminiscent of Spanish *com-* and English *astr-* from the discussion above, since the root structure proposed for Classical Arabic has no possibility of being a surface form. Nevertheless, this approach provides a solution to the issue of vowelless roots.

The question thus arises as to the origin of this root-internal vowel and why it does not correspond to the imperfective base, as opposed to the perfective base. In accordance with the views of McCarthy (1981: 402-404) and Guerssel & Lowenstamm (1996), it is preferable to predict the imperfective from the perfective aspect, as illustrated in Table 8.[17] For the sake of simplicity, we will temporarily disregard line c. An examination of the remaining data in Table 8 reveals that /a/ becomes [+high] (i.e. either /u/ or /i/), /i/ becomes [+low], and /u/ remains unaltered. We now turn to line c., where we find the verb *faʕala/yafʕalu*. To fully understand the relationship between these two grammatical aspects, it is necessary to include verbs that have a guttural as the second or third root consonant. The term "guttural" stands for /ʔ h ʕ ħ/, to a lesser extent also /χ/ and /ʁ/. In the event that the perfective base contains a guttural as the second or third consonant, the imperfective aspect is marked by the vowel /a/. It should be noted that there are some exceptions to this rule, particularly in the case of /χ/ and /ʁ/. However, this process applies to most guttural verbs in Classical Arabic.

On the assumption that /a/ is the root vowel in *faʕala/yafʕalu*, it can be predicted that the imperfective will exhibit /a/, rather than /u/ or /i/. Contrast this with *baʕuda/yabʕudu* in line e. of Table 8. A derivation from an imperfective-like root cannot predict whether gutturals will influence the perfective or not. This means guttural verbs that have /a/ in the imperfective, do not necessarily have /a/ in the perfective aspect, as is demonstrated by the comparison of *faʕala/yafʕalu* 'to do' and *kariha/yakrahu* 'to hate'. Furthermore, the presence of /u/ in the perfective aspect implies the presence of the same vowel in the imperfective. But vice versa, a /u/ in the imperfective aspect of these verbs does not necessarily indicate /u/ in the perfective aspect.

Table 8. Stem vowels in the perfective and imperfective aspects of Classical Arabic

	Perfective	**Imperfective**	**Gloss**	**Vowel alternation**
a.	*kat**a**ba*	*yakt**u**bu*	'to write'	*a – u*
b.	*sar**a**qa*	*yasr**i**qu*	'to steal'	*a – i*
c.	*faʕ**a**la*	*yafʕ**a**lu*	'to do'	*a – a*
d.	*ʕal**i**ma*	*yaʕl**a**mu*	'to know'	*i – a*
e.	*baʕ**u**da*	*yabʕ**u**du*	'to be distant'	*u – u*

17. For a different opinion from a word-based perspective, see Benmamoun (2003a,b).

Table 9. Predicting the vowel from the perfective and imperfective in Classical Arabic

perfective → imperfective				imperfective → perfective			
*CaC**a**Ca*	⋯→	*yaCC**u**Cu*	*kataba/yaktubu*	*yaCC**u**Cu*	⋯→	*CaC**a**la*	*kataba/yaktubu*
	⋯→	*yaCC**i**Cu*	*saraqa/yasriqu*		⋯→	*CaC**u**Ca*	*baʕuda/yabʕudu*
	→	*yaCC**a**Cu*	*faʕala/yafʕalu*				
*CaC**i**Ca*	→	*yaCC**a**Cu*	*ʕalima/yaʕlamu*	*yaCC**i**Cu*	→	*CaC**a**Ca*	*saraqa/yasriqu*
*CaC**u**Ca*	→	*yaCC**u**Cu*	*baʕuda/yabʕudu*	*yaCC**a**Cu*	⋯→	*CaC**a**Ca*	*faʕala/yafʕalu*
					⋯→	*CaC**i**Ca*	*ʕalima/yaʕlamu*

Table 9 summarises the relationship between the perfective and the imperfective aspect in Classical Arabic. Solid lines indicate that the aspect on the right can be predicted, dotted lines indicate that this relationship is opaque.

We can see that a prediction using the perfective vowel has only one weakness, since /a/ can be mapped onto two possible high vowels. Yet, the assumption that roots contain the vowel found in the imperfective harbours even greater problems as can be seen for *kataba/yaktubu, baʕuda/yabʕudu, faʕala/yafʕalu* and *kariha/yakrahu*. Considering the better predictions based on the perfective aspect, it can be assumed that the vowel found in the perfective is the respective root vowel.

The unpredictable behaviour of the vowel /a/ to /u/~/i/ in *kataba/yaktubu* and *saraqa/yasriqu* is explained by Guerssel & Lowenstamm (1996) by means of a fourth stem vowel (see also Guerssel 2003). It is proposed that this vowel is /Ø/. So instead of the stem /sraq/, the root /srq/ is assumed to account for the vowel /i/ in the imperfective. This allows for a very elegant apophonic chain, as illustrated in (17).

(17) Apophonic chain (Guerssel & Lowenstamm 1996)

Ø → *i* → *a* → *u* → *u*

In the mapping of /sarØq/ to *yasriq-*, /Ø/ becomes *i*. Similarly, /ʕalim/ is mapped to *(ya)ʕlam-*, /katab/ to *(ya)ktub-*, and /baʕud/ to *(ya)bʕud-*. The perfective base of /sarØq/ is generated by allowing /a/ to spread rightwards (Guerssel & Lowenstamm 1996) or alternatively by *a*-epenthesis (Guerssel 2003). In the latter sense, /a/ is the default epenthetic vowel in Classical Arabic, as explicitly argued by Guerssel (2003).

Despite the elegance of the apophonic chain, the view of Guerssel & Lowenstamm (1996) and Guerssel (2003) is rejected here. This stance is informed by three key considerations. First, the present analysis is rooted in GNA and thus tries to avoid any confusion between phonology and morphosyntax. The pivotal issue is whether apophony constitutes a case for process-based or morpheme-based morphology. The former is implied by the apophonic chain in (17). The rejection of process-based morphology necessitates the presence of a specific exponent for apophony.

The second argument against the apophonic chain can be linked to other apophonic patterns in Classical Arabic. If the apophonic chain in (17) were to be applied to all patterns of morphologically conditioned changes in vowel quality, it would be impossible to establish a connection between the nouns of place (*nomina loci, ʔasmāʔ aẓ-ẓarf/al-makān*) and the verbal stem of the imperfective active. In fact, the stem vowel of the nouns denoting places can be predicted by looking at the imperfective aspect. If the imperfective has /i/, it is typically /i/ in the *ʔism aẓ-ẓarf*. If it is /a/ or /u/, the corresponding *ʔism aẓ-ẓarf* shows /a/ (Wright 2005: §220 D; Fischer 2006: §78; cf. Benmamoun 2003a: 110f).[18] This can be seen in Table 10. Thus, the apophonic chain is not an appropriate means of describing all ablaut phenomena in Classical Arabic. Rather, it seems that independent morphemes apply to the imperfective (active) and nominalisation.

The third problem of the apophonic chain is provided by syllable-related repair mechanisms in Classical Arabic. A mapping of /sarØq/ to /saraq/ via vowel spreading can only be achieved by a true zero element (yielding /sarq/ → /saraq/) or by a vocalic slot that is associated with zero. Although the latter explains the correct ablaut patterns, it would represent an underspecified vowel V that exists solely to explain this specific phenomenon. It is therefore rather *ad hoc*.

The alternative hypothesis that /Ø/ represents a zero phoneme is even more problematic, as it would entail that complex codas (or alternatively unsyllabified consonants) are repaired by an epenthetic vowel that copies the features of the vowel of the syllable to its left. This presupposes a constraint ranking {*COMPLEX-CODA, EXHAUSTIVITY(syllable)} >> DEP-V. But as the pausal forms of nouns of the shape CVCC show, complex codas are not repaired, cf. *qabr* 'grave, tomb', *šaxṣ* 'person', and *kalb* 'dog'.

The same problem exists with the repair of complex onsets. Guerssel (2003) posits that *a*-epenthesis not only elucidates the pattern of *saraqa/yasriqu* type

Table 10. Nouns of place in Classical Arabic

	Imperfective	Gloss	Nomen loci	Gloss
a.	*yağ**li**su*	'to sit (down)'	*mağ**li**s*	'sitting place, session room'
b.	*yak**tu**bu*	'to write'	*mak**ta**b*	'school (for writing)'
c.	*yal**ʕa**bu*	'to play'	*mal**ʕa**b*	'playground, place for sports'

18. There are a few scattered exceptions, such as *masğid* 'mosque' from *sağada/yasğudu* 'to bow down, be humble'.

verbs but also the imperfective aspect of Form VII. Guerssel (ibid.) explains that the form *yanfatiq-* 'it becomes slit, unstitched' has the underlying representation /ja+n+ftiq/. In order to prevent the formation of the ungrammatical form **yanftiq*, the vowel *a* is inserted. This suggests that *COMPLEX-ONSET dominates DEP-V, which is indeed the case for Classical Arabic since it lacks complex onsets. But here is the crux. Complex onsets are repaired by a *prosthetic* vowel. This vowel is *u* if the next syllable also contains *u*. Otherwise, it is *i*. For illustration, see the imperative forms in (18). This is in stark contrast to the repair mechanism proposed by Guerssel (2003). According to this model, the incorrect forms **fataḥ, *šarib,* and **katub* would be predicted.

(18) Imperatives in Classical Arabic

a. /ftaħ/ → [ʔɪftaħ] 'open!' (sg. m.)

b. /ʃrib/ → [ʔɪʃrɪb] 'drink!' (sg. m.)

c. /ktub/ → [ʔʊktʊb] 'write!' (sg. m.)

In light of the aforementioned considerations, the apophonic chain is rejected here. Instead, designated infixes and floating features accompanied by phonologically conditioned allomorphy are proposed.

Before addressing the derivation of the imperfective, we will turn our attention to the phonological aspects of the perfective. The perfective and the imperfective bases show two differences: the root vowel (as in case of /a i u/ in /ktab/, /ʕlim/, and /bʕud/) and the (non-)adjacency of the first two root consonants. Instead of proposing a repair of complex onsets (Guerssel 2003), the exponent of the perfective active is simply the infix *-a-*. Infixation can be achieved elegantly by lexical antitropism (Bye & Svenonius 2012), as is demonstrated by the Vocabulary Item (VI) in (19). In contrast, the approach of alignment constraints indexed by a specific morpheme (Prince & Smolensky 1994/2004: §4.1) is considered inferior because it allows morphology to directly manipulate phonology. In accordance with the analysis presented by Kastner (2019, 2020: 45-48), I will treat this morpheme as an exponent of Voice, depending on Tense/Aspect.

(19) VI for the perfective active

a. Voice ↔ $[_{\omega}$ • *a* / T[PFV]

For the sake of simplicity, I will treat the perfective/imperfective distinction as a feature of Tense. The symbol '•' indicates 'does not align with'. In this case, this pertains to the left edge of a prosodic word. Apart from this restriction, *-a-* can be considered to function as a prefix.

The status as prefix or suffix is considered to be determined by the morphosyntax. This edge-shy behaviour can be captured by the constraint IDENT[antitropal] (Bye & Svenonius 2012: 470), as defined in (20).

(20) Ident[antitropal]
Correspondent nodes are identical in their orthotropism.

We shall now examine the perfective stem *katab*. Let us assume that the root, which has the phonological form /ktab/, is concatenated with an empty head *v*. In the subsequent step, Voice (as it is adjacent to T[pfv]) is added, and thus, the *a*-infix. (21) shows an evaluation at the stem level. For illustrative purposes, the infixed vowel is underlined. It is assumed that *ʔ*-epenthesis occurs at the word or phrase level, where Onset is in undominated position.

(21) Derivation of the perfective base *ktab* → *katab*

$[_\omega$ • a̱ + /ktab/		*Ident[antitropal]	Linearity	O-Contiguity
a.	a̱ktab	*W	L	L
→ b.	ka̱tab		*	*
c.	kta̱ab		**W	*
d.	ktaba̱		**W**	L

The other constraints relevant to (21) are Linearity and O-Contiguity. The former requires that the directionality of an affix shall be preserved. As a segmental position moves away from the specific word edge, a violation mark is incurred (McCarthy & Prince 1995: 371; Bye & Svenonius 2012: 447). The latter penalises those candidates that exhibit intrusion (McCarthy & Prince 1995: 371, Bye & Svenonius 2012: 455f). The derivation of /ʕalim/ and /baʕud/ proceeds in the same way as in (21).

For the imperfective active, the VIs in (22) produce the correct changes of the root vowel. (22a) maps *ʕlim* to *ʕlam*, (22b) *bʕud* to *bʕud*, and (22c) *ktab* to *ktub*.

(22) VIs for Voice in the imperfective active

a. Voice ↔ [−high] / T[ipfv] __ [+high −back]

b. Voice ↔ Ø / T[ipfv] __ [+high +back]

c. Voice ↔ [+high] / T[ipfv] __ [−high]

The question of whether floating features are forced to be realised by an active constraint *Float or MaxFlt (“All autosegments that are floating in the input have output correspondents”, Wolf 2007) or by means of constraints that require associations between featural and segmental nodes (Trommer 2011) remains unanswered here. For simplicity, the constraint *Float can be assumed in correspondence theory for the present analysis.

How can the variable vowel patterns of the imperfective be explained if the CCVC-root contains /a/? This was the ambiguous case, where the vowel in the imperfective base is either /i/ or /u/. In other words, how can be determined whether /sraq/ finally yields *yasriqu* and not **yasruqu*, and /ktab/ yields *yaktubu* and not

**yaktibu*? The solution proposed here is based on Anttila's (1997) approach to the variation of genitive exponents in Finnish. Anttila (ibid.) suggests that a *partial* ranking of constraints can give rise to linguistic variation. In the absence of such a ranking for a given language, a tie emerges, whereby one of two candidates is selected on the basis of statistical probability. This is formalised by the tableau presented in (27).

The constraints relevant to (27) are defined in (23-26). Candidate (27a) is filtered out by high ranked *Float since the floating feature [+high] does not have an output correspondent in being unrealised. Candidate (27b) is less harmonic than the winner (27d) due to the overspecification of the root-vowel, which has two association lines to the feature [±high].

(23) *OverSpec
Assign a violation mark for every segment that is dominated by more than one feature node of the same type.

(24) MaxAssoc
Assign a violation mark for every association line that is present in the input but not in the corresponding output.

(25) *V[+back]
Assign a violation mark for every vowel bearing the feature [+back].

(26) *V[−back]
Assign a violation mark for every vowel bearing the feature [−back].

*OverSpec penalises candidates that comprise overspecified segments. MaxAssociate poses the weak spot of the winner(s) because it requires that association lines should be maintained, which is the case for the candidates (27c) and (27d). The constraints *V[+back] and *V[−back] are notably simple in their assessment of candidates with [+back] or [−back] vowels (cf. Prince & Smolensky 1993/2004: §9.1.2). Since *V[+back] and *V[−back] are not ranked in relation to each other, the tableau in (27) does not indicate whether candidate (27c) or (27d) will win.

Once more, the evaluation in (27) is slightly simplified, and a more appropriate analysis would dispense with the constraint *Float, which serves no other purpose than to handle floating features. Due to space limitations, the reader is referred to Trommer (2011) for a comprehensive examination of mutation in containment theory.

(27) Derivation of the imperfective base *ktab* → *ktub*

[−high] [+high] /ktab/		*Float	*OverSpec	MaxAssoc	*V[−back]	*V[+back]
a.	[+high] [−high] [ktab]	*W		L	L	*
b.	[+high] [−high] [ktab]		*W	L		*
☛ c.	[+high] [−high] [ktib]			*	*W	L
→ d.	[+high] [−high] [ktub]			*		*

In order to select a winner, it is necessary to employ additional machinery. This is achieved through the utilisation of the concept of nonanalytic listing in Stratal OT at the stem level, as elucidated by Bermúdez-Otero (2012). It is of crucial importance to note that the domain of nonanalytical listing is the stem level. This implies that derivational outcomes of this stratum can be stored, which is contrary to the dominant view of the DM mainstream (cf. Embick 2015). In this way, stem level outputs can block on-line applications of competing forms. In this case, **ktib* is blocked by the existence of listed *ktub*.

An additional benefit of this analysis is that it captures the fact that there are several verbs in Classical Arabic that allow both the *i*- and the *u*-imperfective forms. Some examples can be found in (28).

(28) Selection of verbs with both *i* and *u* in the imperfective

a. *qabara* *yaqburu* ~ *yaqbiru* 'to bury'
b. *ḥabaka* *yaḥbuku* ~ *yaḥbiku* 'to weave, tie'
c. *batala* *yabtulu* ~ *yabtilu* 'to cut off'
d. *ṣadara* *yaṣduru* ~ *yaṣdiru* 'to return'
e. *ġadara* *yaġduru* ~ *yaġdiru* 'to betray'
f. *fakara* *yafkuru* ~ *yafkiru* 'to think'

Therefore, partial ranking *may* result in blocking and nonanalytical listing, yet it may also facilitate variation.

Before we proceed to the morphosyntactic conditions of the imperfective, it is worth noting that floating features have the same function as full vowels in Melodic Overwriting. In principle, it could be assumed that Voice is spelled-out as full vowel /a/ in the context of high vowels and as /u/ or /i/ in the context of low vowels. This would imply that this vowel functions as a suffix but cannot be directly attached to the right word edge due to the ranking of an alignment constraint over LINEARITY. This alignment constraint, also known as ALIGN-WORD (Kastner 2019: 585; cf. also σ-ALIGN, see above; cf. also Tucker 2010: 42), would impose a violation mark on stems that are not aligned with the right word edge.

Having explained the phonological aspects of the derivation of the imperfective base /ktub/ in *yaktubu*, some important distinctions from previous root- and stem-based analyses must be emphasised. The theory proposed here represents a mixture of DM and Stratal OT. Although the possibility of nonanalytical listing and blocking may be distantly reminiscent of paradigmatic approaches in stem- and word-based morphology, the phonological representations /ktab/, /ʕlim/, and /bʕud/ are not stems in the sense of stem-based morphology but *roots* in terms of DM. First of all, the proposed CCVC-roots lack a morphosyntactic category. If concatenated with a categoriser such as *n* or *a*, these roots yield nouns and adjectives, as can be seen by means of *ʕilm* 'knowledge; science' and *baʕīd* 'far, distant'. This indicates that roots, as is argued here, constitute "pieces" in the sense of piece-based (also called morpheme-based) morphology. Such a view is genuinely accepted in DM (cf. Embick 2015) but stands in harsh contrast to stem- and word-based morphology (see Bat-El 2003: 21-23; cf. Anderson 1992; Aronoff 1976, 1994). Because the proposed roots are morphemes, there is no derivation of an existing word to another word. Hence, the following statement by Aronoff (1976: 21) is rejected here in favour of a piece-based architecture of morphology.

> All regular word-formation processes are word-based. A new word is formed by applying a regular rule to a single already existing word. Both the new word and the existing one are members of major lexical categories.

For this reason, /ktab/, /ʕlim/, and /bʕud/ are not derived from pre-existing words and stems, such as *katab-, ʕalim-,* and *baʕud-*, but represent terminal nodes of a piece-based derivation. Consequently, there is no need for OO-correspondence or constraints that refer to the phonological structure of paradigmatically related word forms as indicator of morphosyntactic functions, as can be seen in the tableau in (11) (Ussishkin 2003: 418). Due to the lack of OO-constraints, the respective problems do not arise, in particular the problem of the source (cf. section 2.4 for discussion).

Furthermore, this piece-based approach provides an explanation for limited allomorphic interaction between different morphemes. This is best illustrated by the way in which the CCVC root approach addresses the problem of contextual allomorphy, a problem that could be more effectively addressed by PCR analyses,

Table 11. Comparison of Form I and II

	Form I	**Form II**
a.	*kasar-a*	*kassar-a*
b.	*baʕud-a*	*baʕʕad-a*
c.	*ya-ksir-u*	*yu-kassir-u*
d.	*ya-bʕud-u*	*yu-baʕʕid-u*

but not by those analyses that assume more surface-oriented bases as in stem-based approaches. Some example data for *kasara* ‘to break’ (tr.) and *baʕada* ‘to be distant’ are given in Table 11. Lines a. and b. show the perfective, lines c. and d. the imperfective aspect. While agreement for the 3^{rd} person sg. m. is indicated by *ya-* in the imperfective of form, it is *-a* in the perfective. But in Form II (and thus in Form III and IV), the imperfective agreement marker is *yu-*. In fact, the prefixes *ya-* and *yu-* can be decomposed even further into *y-* for person and *a-/u-* for tense/aspect. This distinction between *a-* and *u-* depends on Voice. Final *-u* in the imperfective aspect indicates the indicative mood.

I will adapt Kastner’s (2019, 2020) analysis by which the Hebrew *pi’el* is expressed as a root √ACTION under the Voice node. In both diachronic and functional terms, the *pi’el* is analogous to Form II in Arabic. Table 11 shows that Form II is distinguished by two characteristics: the gemination of the second root consonant and a specific vocalic pattern, namely *a-a* in the perfective and *a-i* in the imperfective, regardless of the root vowel.

In order to generate the correct forms of Form II, the VIs in (29) are proposed.

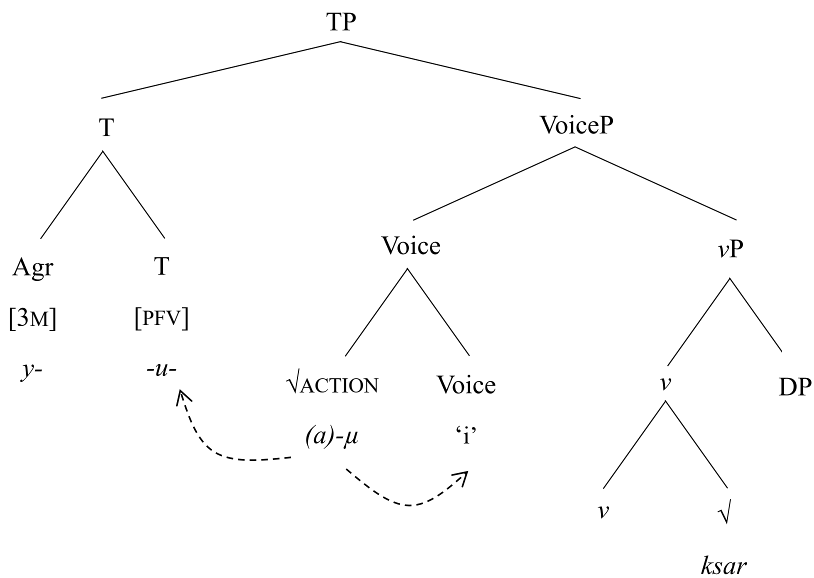
(29) VIs (in)dependent of √ACTION

a.	T[IPFV]	↔ *u-*	/ __ √ACTION
b.	T[IPFV]	↔ *a-*	
c.	√ACTION	↔ $[_{\omega}$ • *(a), μ*	
d.	Voice	↔ [+high −back]	/ T[IPFV] __ √ACTION
e.	Voice	↔ [+low]	/ T[PFV] __ √ACTION

For the purpose of this analysis, final *-u*, which indicates indicative mood, can be disregarded. Both gemination and the vocalic pattern can be explained by the model in (30). The abbreviation ‘i’ indicates the floating feature [+high −back]. The dotted arrows symbolise that √ACTION triggers contextual allomorphy on Tense and Voice. Importantly, the vowel /a/ as part of a bipartite exponent surfaces only when required. This means that the morphology passes both /a/ and the mora to the phonology, which determines the presence or absence of /a/ as a TETU phenomenon. Since **yukssiru* would fatally violate the phonotactic constraints of Classical Arabic, the full form of the exponent for √ACTION is chosen. Hence, /a/ constitutes a "ghost" or "latent" segment (cf. Archangeli 1991, Zoll 1996, Bonet et al. 2007, and Zimmermann 2019), comparable to /n/ in the English indefinite article *a(n)*. In the absence of √ACTION, the default exponents for Tense and Voice apply. These are the prefix *a-* and the apophonic vowel, as defined in (22).

We may now proceed to conclude our description of the imperfective aspect. In example (22), the VI for the stem-internal vowel of the imperfective in Form I has been identified. The vowel in question is dependent on the realisation of Tense, which is described in (29d-e). Note that this is somewhat simplified as it only encompasses Forms I and II. The VI in (29c) shows a bipartite exponent consisting of the prefix *a-* and a mora. This produces the vocalic pattern *a-i* in the imperfective of Form II and *a-a* in the perfective aspect of Form II.

(30) Derivation of *yukassir(u)* 'he smashes'



The derivation of *yukassir(u)* in (30) shows that initially the root /ksar/ is merged with an empty verbaliser. Subsequently, the floating feature as realisation of Voice causes the vowel /a/ to change to /i/. It is important to note that the /i/ in *yukassir(u)* does not inherit its vowel quality from *yaksir(u)* in Form I, but is rather due to the realisation of Voice in adjacency to √ACTION. The reason for this is that the high front vowel in question is always /i/ irrespective of Form I. For example, the imperfective aspect in Form I of *baʕuda/yabʕudu* is /u/ whereas in Form II, it is /i/, as in *yubaʕʕidu* 'he removes'.

The present analysis has many parallels with Kastner's (2019, 2020) analyses but diverges from them in some relevant respects. In both models, √ACTION causes allomorphy on Tense (or Tense+Agreement, respectively). This affects the quality of the stem vowel(s); here, "stem" should be understood in a purely descriptive way. While these vowels are *introduced* by Voice in Kastner's PCR analysis, they are *altered* in the apophonic analysis presented here.

For a PCR approach to Classical Arabic, this means that the form *yaktubu* 'he writes' consists of the Tense+Agreement prefix /ja/, the mood suffix /u/, the PCR /ktb/, and the vowel /u/ for Voice in the context of T[IPFV]. After the concatenation of /ktb+u/, the phonology licenses /ktub/. Referring to Tucker (2010: 40f, 58-60), this can be achieved by a high ranking of an alignment constraint requiring that the right edge of a root should correspond to the right edge of a prosodic word, so that *[ktbu] is filtered out. As an alternative to this alignment constraint, Wallace (2013: 6) suggests the constraint FINAL-C, which penalises candidates with a stem-final vowel. Under either of these constraints, a ranking of *COMPLEX-CODA >> *COMPLEX-ONSET prevents *[kutb] from being optimal.

Contrary to these PCR analyses, we have seen above that a vocalised root /ktab/ is mapped onto [ktub] by a floating feature, which can surface due to the ranking *FLOAT >> *OVERSPEC >> MAXASSOC. But in both accounts of Semitic morphology, contextual vowels for the perfective and for the imperfective underlie local restrictions of allomorphy. Apart from the question of whether vowels are infixed or changed by morphemes, the primary difference consists in the treatment of the unmarked *wazn/binyan*. In the PCR analysis, this vowel is stored under Voice in adjacency to the root, which necessitates the presence of lists of root classes with their respective (theme) vowels (cf. Wallace 2013: 19f). In the CCVC-root approach, however, these vowels are part of the root and are replaced by other vowels in the respective morphosyntactic context.

Having delineated the fundamental tenets of the proposed approach, the subsequent sections address four issues pertaining to PCR analyses that do not pose a problem for the model presented here.

3.3. Richness of the Base and Morpheme Structure Constraints

The most salient peculiarity of PCRs is that they appear to be exclusive to the Semitic language family. For instance, Ratcliffe (1997: 151), a proponent of the word-based account ascertains "the notion of a consonantal root as a morpheme has generally proved to be unworkable for other languages" than Arabic and other Semitic languages. Similarly, within root-based explanations, Semitic seems to be special in having this remarkable root structure, or in Kastner's (2019: 573) words:

> Semitic differs from other language families not in having unique kinds of morphemes but in generalizations about what the phonology of individual elements is like: a root is triconsonantal, for example, and a functional head might be spelled out as a prefix and an infix.

Consequently, roots comprising solely of consonants constitute a particularly infrequent phenomenon. It would be expected that the presence of PCRs would imply the presence of vocalised roots. This is because marked features typically implicate their unmarked counterparts, such as the presence of dual number implicating the presence of plural number or rounded front vowels implicating their unrounded equivalents. Following the principle of *Harmonic Completeness* (Prince & Smolensky 1993/2004: §8.2.1), it would be expected that PCRs can only exist within a given language if there are also roots containing both consonants and vowels. Given that all output forms in nearly all Semitic languages are required to have vowels as syllable nuclei (thus the typologically least marked structure; see Joo & Hsu 2024: 20f), the absence of vowels within roots necessitates an explanation.

From a theoretical perspective, the same problem concerns the *Richness of the Base* (Prince & Smolensky 1993/2004) and Morpheme Structure Constraints. It is crucial to highlight that the argument about Richness of the Base is only an OT internal problem. Furthermore, the problem outlined in the following sections only applies to those analyses of root-and-pattern morphology that never assume vowels as part of the root. Hence, Modern Hebrew and South Ethio-Semitic languages are excluded from this discussion, given that former gutturals have undergone a diachronic shift towards low vowels (Enguehard & Faust 2018; Prunet 1996).

Richness of the Base would suggest that any segment can appear in a root, including, of course, vowels. Their presumed absence suggests an active Morpheme Structure Constraint *V, as defined in (31).

(31) *V
Assign one violation mark for every vowel.

There are multiple ways of addressing Morpheme Structure Constraints in OT. For the purposes of this discussion, we will assume that there is a separate root level in terms of Stratal OT (Trommer 2011).[19] *V must be undominated in the root domain to prevent roots from having vowels. But since the presence of vowels is a universal phenomenon across languages, this markedness constraint is at odds with the insights of language typology. It can therefore be seen that the constraint *V is highly implausible, despite its theoretical necessity in accounting for PCRs.

The presence of PCRs not only presupposes an undominated ranking of a constraint of questionable legitimacy, but also raises questions about the nature of the potential rankings themselves. This is because PCRs and *V result in overgeneration. In line with a stratal architecture of phonology and morphology where each domain may have its own constraint (re)rankings (Kiparsky 2000, 2015; Bermúdez-Otero 2012, 2018), the phenomenon of infixation offers valuable insights (cf. Yu 2003).

Suppose there is indeed a constraint *V in the root domain. If apophony is a type of infix into a root as has been argued in all root-based accounts for Semitic,

19. Since this paper is not concerned with the interplay of Richness of the Base and Morpheme Structure Constraints, it is only worth mentioning that Stratal OT alone overgenerates in this respect. A solution to this problem is provided by the theory of Morphoprosodic Hierarchical Structure proposed by Tebay (2021).

specific predictions follow. With regard to the interaction of infixes into a root, there are three possibilities (Tebay 2021: chapter 3):

(i) no interaction at all,
(ii) the infix violates constraints of the root domain, and
(iii) the infix obeys the constraints of the root domain.

According to Tebay (2021: 92-95), the first possibility is the most common one. If there is interaction, the second option is less prevalent than the third one. Type two indicates the existence of two separate domains: a root level and a stem level where the infix is added to the root. Note that the third type is (although most frequently attested) narrowly distributed and typical of Austronesian languages. Nevertheless, the existence of the third type of infixation (where the infix and the root constitute one domain) suggests that there are languages in which vocalic infixes cannot surface at the root level, where vowels are completely forbidden. However, they should manifest in other domains, such as the stem or phrase level in terms of Stratal OT. In other words, although *V may be undominated at the root level, it may be dominated by a faithfulness constraint at a higher stratum, i.e., MAX-V >> *V, or a markedness constraint, such as HEADEDNESS(syllable)[20] on the assumption that only vowels are permitted syllable nuclei.

Consider the subsequent example of a hypothetical language. This language has undominated *V at the root stratum. Suppose there is a root √kl 'to sit, lie (intr.)'. Since syllabic consonants and syllables without a nucleus are forbidden at the root level of this language, biconsonantal roots are resolved by vowel epenthesis at a higher level, with [ə] being the default epenthetic vowel. At the stem level, /kl/ is mapped to [kəl] by default with a zero exponent as a verbaliser (little *v*).

Suppose there is a causative suffix /-aq/ as spell-out of the verbal head little *v* at the stem level. Consequently, the causative of /kl/ is [klaq] 'x puts, lays (sth.)'. Assume there is an unmarked non-past and an exponent for the past tense /i/ that either overrides the vowel quality of the stem or is simply infixed. This may be described as Melodic Overwriting, as shown for *gadal → gidel* in Modern Hebrew, cf. (11). An alternative hypothesis is that this is a floating feature [+high −back], which creates its own vocalic slot if there is no vowel to be linked to. In either case, the stem /klaq/ and floating *i* as a past tense marker are mapped to [kliq] 'x put (sth.)'. Assume that the *i*-infix adjusts oneself to the domain it is added to. If the *i*-infix obeys the constraints of the root domain with the ranking *V >> MAX-V, the infix could not be realised at the surface in the predicted output [kəl] 'x sat' at the stem level.

If the hypothesis about the non-existence of purely consonantal roots is accurate, the pattern described for this hypothetical scenario should be unattested. It would appear that this is indeed the case. On the assumption that PCRs presuppose the presence of the constraint *V, PCR-analyses predict this unattested pattern.

To summarise the argument about a root level constraint *V, a Stratal OT analysis operating on PCRs would predict that apophonic vowels can never surface

20. Also known as HAVE-NUCLEUS.

at the root stratum. The output of the root cycle would be passed on to the stem level, which would therefore no longer have any information about the exponent of the verbaliser. However, if we do not assume PCRs and, hence, no constraint *V, the non-occurrence of this pattern would be correctly expected.

The morphophonological behaviour of infixes provides further evidence against PCRs. Suppose *V is undominated at root level but not at stem or word level in a language that does not allow infixes to surface faithfully, i.e. a language in which the infix must obey the constraint ranking of the root domain. Furthermore, this language is a putative candidate of root-and-pattern morphology. This is indeed the case in the context of Akkadian.[21] As the majority of Semitic languages, Akkadian roots are subject to an OCP constraint ("Obligatory Contour Principle"), which prohibits adjacent homorganic obstruents within a root (Greenberg 1950; McCarthy 1986: 209; Bachra 2001: 14; Lubowicz 2010; Tebay 2021: cha. 3). Therefore, a root such as *√dtm is not feasible since /d/ and /t/ are in adjacent positions and share the place of articulation.

It can be observed that each Semitic language has a middle infix/prefix (depending on the respective language and the precise morphosyntactic function) *-ta-* ~ *t(a)-*. In Akkadian, it indicates both the middle voice and the perfect tense. While this infix can surface faithfully in Classical Arabic, such as in *ik**ta**taba* 'to transcribe', violating the OCP constraint, the *ta*-morpheme obeys OCP in Akkadian, resulting in assimilation and gemination of the first root consonant: *id**da**miq* 'he has improved', *is**sa**ḫar* 'he has covered', *iz**za**qar* 'he has spoken'—instead of expected **id**ta**miq, *is**ta**ḫar*, and **iz**ta**qar* (cf. Lubowicz 2010; Tebay 2021: 100-102; von Soden 1995: §80, §92). In non-assimilated contexts, *-ta-* can appear faithfully, as in *iš**ta**kan* 'he places permanently' and *im**ta**lik* 'he discussed'.

From these Akkadian data, we learn that infixes must obey to the constraint ranking of the root stratum. But in the event that infixes (such as vocalic infixes in PCRs) are unable to occur due to the presence of the undominated constraint *V, the question arises as to how the vowel *a* can be accounted for in the *ta*-affix. Recall the necessity of undominated *V to account for PCRs. If the fulfilment of *V is obligatory in Akkadian roots, why can *-ta-* containing a vowel be infixed, but not other morphemes that violate the constraints of the root domain? This paradox arises for root-and-pattern morphology only by assuming PCRs.

In accordance with the recommendation of an anonymous reviewer, this vowel may be considered epenthetic at a subsequent stratum. Let us consider this possibility. This would imply that /a/ is the default vowel in Akkadian (cf. Guerssel 2003 for Arabic). According to this view, the vowel *a* in *imtalik* is a repair mechanism to avoid **imtlik*, which violates *Complex. Indeed, both complex onsets and complex codas are absent in Akkadian so that *Complex can be assumed to be undominated. In contrast to Classical Arabic, as has been shown in (18) above, Akkadian uses epenthetic vowels (not prosthetic vowels) to avoid complex onsets and codas. This can be seen in (32).

21. Akkadian is an extinct language, formerly spoken in Ancient Mesopotamia, the only East Semitic language on the assumption of Eblaitic as Akkadian dialect.

(32) Vowel epenthesis as repair mechanism in Akkadian

a. /prus/ → [pu.rus] 'decide!' (sg. m.)

b. /ʃrik'/ → [ʃi.rik'] 'steal!' (sg. m.)

c. /kalb/ → [ka.lab] 'dog of …'

d. /ʃipr+ʃu/ → [ʃi.pir.ʃu] 'his mission'

The data in (32) demonstrate that the default vowel of Akkadian is not /a/ but harmonises with the vowel in the adjacent syllable. So, /a/ in the *ta*-infix must belong to the infix. This gives rise to a contradiction: if we can observe that infixes adjust themselves to the root domain, i.e. a stratum with undominated *V as a necessary condition to account for the absence of vowels in roots, then this vowel cannot be /a/, but should share its vowel quality with the vowel of an adjacent syllable. So, a PCR analysis predicts **imtilik* rather than *imtalik.* In an analysis that posits vocalised roots, such as /mlik/, there is no need for the activity of *V at any morpho-phonological level. Therefore, the infixation of *-ta-* is a viable option.

3.4. Idiosyncratic asymmetries between parts of speech

A strong argument against PCRs concerns inconsistency—again supported by Arabic data. Given that roots lack a morphological category, they should have the same distribution of structural properties within the lexicon, regardless of whether they form nouns, verbs, or adjectives. If there is an asymmetry between roots in different word classes, this would either challenge the proposed root structures or cast doubt on the existence of the root itself.

Let us consider three Arabic nouns having the simplest nominal structure, which is CVCC, depicted in (33). These are not particularly special words and at least two of them belong to a common Semitic lexicon.[22] For (33a) and (33b), no verbs of these roots with the respective semantics are attested in Classical Arabic. Arabic *ǧurn* in (33c) may correspond to the verb *ǧarana* 'to grind grain'. Because this is only scarcely attested, *ǧarana* is neglected here and may be deverbal.

(33) Exemplary CVCC nouns in Classical Arabic

a. *faʔr* 'mouse' b. *qird* 'monkey' c. *ǧurn* 'threshing floor'

Nonetheless, the instances in (33) can be assumed to be primary nouns and thus underived (cf. Benmamoun 2003a: 104; Ratcliffe 1997: 151). What are the underlying roots here? These forms can be analysed in two ways. One explanation is that the root could contain a vowel (√faʔr, √qird, √ǧurn) and the head *n* is

22. Cf. Akkadian *pērūrūtu(m)* 'mouse'; Biblical Hebrew *goræn* 'threshing floor', Gəʕəz *gʷərn~gorn~gurn* 'ibid.'

phonologically empty. This analysis would yield roots of a typologically ordinary structure, but the language-specific root structure would be inconsistent with the purely consonantal roots attested for verbs opposed to nouns which can include vowels. This asymmetry is not predicted by root-based morphology and therefore cannot be explained by this theory.

The position of syllabic roots without a certain template is taken by Arad (2005: 31-44). She explains the same asymmetry in Modern Hebrew by assuming that "[s]ome phonological properties are inserted merely for PF convergence" (ibid.: 40).[23] Under the hypothesis that nominal morphology (such as such as noun class markers, case, and agreement) proceeds post-syntactically in the PF component (cf. Marantz 1992; Embick & Noyer 2001), nouns are not necessarily combined with a template (as in case of verbs) that satisfies the phonological requirements of the language. Having this in mind, the following assertion becomes crucial (Arad 2005: 41):

> Morpho-phonological features not present in the syntax may or may not be inserted, depending on their phonological environments and PF convergence.

Therefore, templatic nouns are concatenated with a specific template that simultaneously satisfies the phonological requirements of Hebrew or Arabic. As the argument goes, nouns with syllabic roots do not take a template, since it is not required by the phonology.

It seems that the modular place of vowels within non-templatic nouns is shifted from morpho-syntax to phonology by Arad (2005). This argument obviously treats the PF component as phonology waste bin of the morphosyntax, creating a bad division of labour between these two modules. This is exactly what Bermúdez-Otero (2012: 50) warns against:

> To be strict about module *X* and lax about module *Y* amounts in practice to turning *Y* into a waste bin for all the problems encountered by one's theory of *X*, and vice versa: in either case, empirical content evaporates[.]

For the moment, let us detect what happens if the phonology inserts features that are not present in the syntax. In this case, there is no representation that serves as phonological input in an OT evaluation. Thus, no faithfulness constraint has the ability to influence the selection of the winning candidate. Consequently, only markedness constraints can be considered. In other words, a TETU effect is expected to occur. Building on Modern Hebrew, the least marked vowel should be realised, which is /ə/ in Hebrew.

Unlike Akkadian, which inserts vowels corresponding to the vowels in adjacent syllables (see (32) for illustration), Modern Hebrew is characterised by schwa-epenthesis, as is shown in (34). In (34a-b), no epenthesis occurs since onsets with rising sonority are permitted. But if the onset has falling sonority as in (34c-d),

23. PF stands for Phonological Form as opposed to the LF (Logical Form) component of the grammar.

/e/ is inserted. In the light of the data in (34), non-templatic roots as those in *sus* 'horse' or *bdolax* 'crystal' are expected to surface as **ses* and **bdelex* if their vowels represent a requirement of the phonology, rather than because an underlying representation from the morphosyntax to the phonology is provided. The same could be applied to Classical Arabic. Why should the phonology yield the vowels /u/ and /a/ in *ǧurn* 'threshing floor' and *faʔr* 'mouse' if the unrounded high front vowel is the most unmarked vowel in Classical Arabic, as we have seen in (18). Therefore, Arad's (2005) explanation for the noun-verb asymmetry in Hebrew and Arabic is inadequate.

(34) Schwa-epenthesis in Modern Hebrew

a.	/ʃlax/	→	[ʃlax]	'send!' (sg. m.)
b.	/gnov/	→	[gnov]	'steal!' (sg. m.)
c.	/lmad/	→	[le.mad]	'learn!' (sg. m.)
d.	/ʁkod/	→	[ʁe.kod]	'dance!' (sg. m.)

As an alternative to the explanation based on a noun-verb assymetry, we could analyse the roots in (33) as √fʔr, √qrd, and √ǧrn, which are combined with the head *n* realised as /a/, /i/, or /u/ depending on the root in the manner of contextual allomorphy. Such an account would require an allomorphic rule assigning these roots the respective vowels. This, in fact, depicts the vowels in *faʔr*, *qird*, and *ǧurn* as morphemes thereby ascribing to them a grammatical function. However, the functional status of these vowels seems to be dubious as there is no discernible inner regularity. In other words, the analysis based on consonantal roots throws arbitrary vowels in Arabic morphosyntax into the same pot with obvious morphemes such as highly consistent patterns (e.g. the *a-ī* pattern for adjectives, e.g. *kabīr* 'big', *ṣaġīr* 'small', *naẓīf* 'clean', *ʕamīq* 'deep'). One might posit that these vowels function as singular exponents. But it seems reasonable to suggest that this should not be the case with regard to a marked singular.

Considering the possibility of the vowels in *faʔr*, *qird*, and *ǧurn* as morphemes, the perspective of the learner highlights the problematic status of such an allomorphic analysis. Nothing directs the learner to assume that these forms are morphologically complex. In the absence of other morphologically related forms, there is no reason to think that these forms consist of a PCR and a vowel as a nominaliser. Even if we allow for storage of complex forms, there is no clue to assume *faʔr*, *qird*, and *ǧurn* to consist of two morphemes.

The second possibility of morphemic vowels in underived words has already been criticised by Ratcliffe (1997: 151), who argues on the basis of both nominal and verbal examples (e.g. *ya-ḍrib-u* 'he hits', *ya-ktub-u* 'he writes', *ya-šrab-u* 'he drinks'). Ratcliffe's (ibid.) argument here is that these stems lack morphological complexity.

As has been explained in the previous section, the absence of internal morphological structure is obviously true for many Arabic (and in general Semitic) nouns. However, this is not as straightforward for verbs as suggested by Ratcliffe (1997). Indeed, the quality of this vowel in verbs expresses Voice (cf. Kastner 2019, 2020; cf. Wallace 2013 for a similar analysis based on Theme and little *v*). In this respect, the passive counterparts of the Arabic examples given by Ratcliffe (1997) are *yu-ḍrab-u*, *yu-ktab-u*, and *yu-šrab-u*. It appears that the stem internal *-a-* is the respective voice marker. This would follow from the analyses presented by Kastner (2019, 2020). It can therefore be reasonably proposed that the passive forms *yuḍrabu*, *yuktabu*, and *yušrabu* are morphologically complex. The account proposed in this paper could easily handle this regular pattern in the same way as the floating feature analysis for the realisation of Voice, cf. (19) and (22).

3.5. An unseen derived environment effect

The suggestion that the second vowel in the perfective base does not constitute a morpheme is supported by the phonology of laryngeals and pharyngeals. Please refer to the data presented in Table 8, which shows the ablaut patterns of the perfective and imperfective in Classical Arabic. With only very few exceptions, the imperfective vowel is *u* or *i* when the perfective exhibits an *a*; this is the biggest class of verbs in Classical and Modern Standard Arabic (Fischer 2006: §216), cf. *ḥas**a**ba/yaḥs**u**bu* 'to count, calculate' and *sar**a**qa/yasr**i**qu* 'to steal'.

Again, this rule does not apply if the second or third consonant is a laryngeal (/ʔ h/) or pharyngeal (/ʕ ħ/) consonant. This process can be seen in (35) and is understood here as instance of assimilation (contra Guerssel 2003). Note that both the consonants /ʔ h ʕ ħ/ and the vowel /a/ are characterised by the feature [GUTTURAL] (Hayward & Hayward 1989; Watson 2002: 37-39, 47f, 270-286; cf. McCarthy 1991, 1994). The first row in (35) shows the perfective aspect, the second row the imperfective.

(35) Guttural assimilation in the imperfective of Form I

a.	*faʕala*	*yafʕalu*	'to do'
b.	*baḥaṯa*	*yabḥaṯu*	'to search'
c.	*saʔala*	*yasʔalu*	'to ask'
d.	*rahana*	*yarhanu*	'to continue, endure'
e.	*dafaʕa*	*yadfaʕu*	'to push, repell'
f.	*fataḥa*	*yaftaḥu*	'to open'
g.	*qaraʔa*	*yaqraʔu*	'to put together'
h.	*badaha*	*yabdahu*	'to happen unexpectedly'

However, guttural assimilation is restricted to the imperfective aspect of Form I. It neither occurs with other Forms, nor in underived forms. Sequences of a guttural plus high vowel (and vice versa) are not forbidden per se. Examples such as *ḏiʔb* 'wolf', *Yasūʕ* 'Jesus', and *ʕulba* 'can' make this clear. It appears that these sequences are only disfavoured across morpheme boundaries, i.e. in the mapping of the verbal stem to the imperfective of Form I. This phenomenon can be described as a derived environment effect (Mascaró 1976; Kiparsky 1982, 1993; cf. Burzio 2011), i.e. a phonological process that is triggered only in case of a phonologically or morphologically derived environment. For the present discussion, we are dealing with a morphologically derived environment, and thus the circumstance that two different exponents, such as the root and a Voice marker, come together. Consequently, morphologically simple words do not show morphologically derived environment effects.

If a PCR is concatenated with a Tense or Voice marker in form of vocalic infixes, how do we explain that the /ʕu/-sequence is grammatical in *baʕuda/yabʕudu* 'to be far, distant' but not in **yafʕulu* (*yafʕalu* 'he does')? Let us assume that the verbs *baʕuda* and *faʕala* have the PCRs √bʕd and √fʕl and [GUTTURAL] assimilation is triggered by the realisation of Voice. This is illustrated in Table 12 by means of *qaruba/yaqrubu* 'to be close', *faʕala/yafʕalu* 'to do', and *baʕuda/yabʕudu* 'to be distant'. For the root √qrb, no derived environment effect is expected, since there is no guttural present. But for √fʕl and √bʕd, this effect is indeed expected. The cell with a light grey shading shows a correct prediction of guttural assimilation whereas the dark shaded cells represent incorrectly predicted guttural assimilation.

The only possible way of explanation is the attribution of /u/ in *baʕuda* to a root status, not to a morpheme status, yielding the root /bʕud/. Let us first assume the PCRs √qrb, √fʕl, and √bʕd. Because the derived environment effect does not distinguish what kind of morpheme interacts with a stem, it is irrelevant whether /u/ in *baʕuda* is attributed to Voice, Tense or little *v*. In other words, since the stem vowels in *baʕ**u**da/yabʕ**u**du*, and *faʕ**a**la/yafʕ**a**lu (*yafʕ**u**lu)* belong to the same terminal node regardless of its precise locality, they cannot interact with each other. If we permit the supposition that an apophonic morpheme of a specific morphosyntactic "colour" is capable of interacting with a vowel of another colour (pertaining to the root or stem), then the derived environment effect applies. If the exponent is zero, the conditions for a derived environment effect are not met because there is no combination of two distinct exponents.

In Table 13, vocalised roots are assumed. The Voice marker [+high] cannot change /fʕal/ to *[fʕul] or *[fʕil] since the derived environment effect requires that

Table 12. Guttural assimilation as a derived environment effect in a PCR analysis

	Spell-out	√qrb	√fʕl	√bʕd
a.	Voice in the context of T[IPFV]	/qrb/+/u/ → [qrub]	/fʕl/ + /u~i/ → [fʕal]	/bʕd/ + /u/ → *[bʕad]
b.	Voice in the context of T[PFV]	/qrb/ + /a, u/ → [qarub]	/fʕl/ + /a, a/ → [faʕal]	/bʕd/ + /a, u/ → *[baʕad]

Table 13. Guttural assimilation as derived environment effect with vocalised roots

	Spell-out	√qrb	√fʕal	√bʕud
a.	Voice in the context of T[IPFV]	/qrub/ + Ø → [qrub]	/fʕal/ + [+high] → [fʕal]	/bʕd/ + /u/ → *[bʕad]
b.	Voice in the context of T[PFV]	/qrub/ + /a/ → [qarub]	/fʕal/ + /a/ → [faʕal]	/bʕud/ + /a/ → [baʕud]

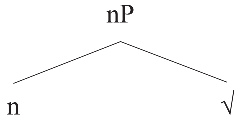
the respective vowel and the adjacent guttural share the feature [GUTTURAL]. This correctly licenses the imperfective *(ya)fʕal(u)*. For the imperfective base *bʕud*, there is no exponent that could trigger this effect. The same applies to the perfective: instead of two infixed vowels, only /a/ is infixed. Since this vowel bears the feature [GUTTURAL], guttural assimilation vacuously applies. So, Table 13 shows how the CCVC-root approach can handle the application and non-application of this derived environment effect.

3.6. Accidental homophony in nominalisation

In the PCR-based approaches proposed by Kastner (2019, 2020) and Wallace (2013), the stem vowels are assigned to their roots when the Voice or Theme node, respectively, is concatenated with the root. Here, it is crucial that the information about the vowel within a PCR has a relatively high locality. We would expect that a derivation operating on a node lower than Voice or Theme would not have access to these stem vowels. If we accept the model of referential nominals (R-Nominals, RNs) put forth by Bruening (2013), we will not anticipate the vowels associated with Voice/Theme to manifest in the RN. Furthermore, the vowel of the RN should not be sensitive to the vowels indicating Voice/Theme. This RN model is illustrated in (36).

In accordance with (36), it can be posited that in an RN, the stem vowel should be unrelated to the vowel present in the verbal paradigm. However, this vowel is indeed dependent on the vowel occurring in the fully vocalised verbal stem, that is to say, the vowels as a spell-out of Voice or Theme.

(36) Referential Nominal



With only a small number of exceptions, verbs exhibiting an /u/ after the second root consonant have /u/ in the respective nominalisations (Wright 2005: §198; Rauscher 2022). This is the case in both RNs and Argument Structure Nominals

(ASNs). If the stem vowel of the perfective aspect is /i/, most transitive verbs are mapped onto nouns with the shape CaCaC. A selection of Arabic RNs can be seen in (37).

(37) Selections RNs in Classical Arabic

a.	*buʕd*	‘distance’	↔	*baʕuda*	‘to be far, distant’
b.	*qurb*	‘nearness, vicinity’	↔	*qaruba*	‘to be near, close’
c.	*suxn*	‘heat’	↔	*saxuna*	‘to be near, close’
d.	*ʕamal*	‘work, labour’	↔	*ʕamila*	‘to work’
e.	*ġalaṭ*	‘mistake, error’	↔	*ġaliṭa*	‘to commit an error’
f.	*ʕağab*	‘wonder’	↔	*ʕağiba*	‘to wonder’
g.	*rabaḥ*	‘profit, gain’	↔	*rabiḥa*	‘to profit, gain’

Note that it is difficult to say whether the correspondences of verbs with their RNs are sufficiently regular to posit full generalisations. Although they are at least strong trends (cf. Rauscher 2022), they are many exceptions, especially in case of the CaCaC type, such as *samʕ* ‘(sense of) hearing, report’ (*samiʕa* ‘to hear’), *karh~kurh* ‘hatred’ (*kariha* ‘to hate’), and *karam* ‘generosity’ (*karuma* ‘to be(come) noble, highly esteemed’).

If such generalisations can be made, a PCR-based explanation that stores the vocalisation of a root under Voice or Theme is inadequate for accounting for RNs such as *buʕd* ‘distance’ and for treating regular mappings as mere coincidence. The vowel in *buʕd* is clearly related to the verb *baʕuda*—a fact that is expected and even predicted by assuming a CCVC-shaped root /bʕud/.

Determining the specific exponent for the RNs of the shape CaCaC is more challenging. Nevertheless, it can be stated that the nominalisation of CaCaC and CuCC nouns can “see” the respective stem vowel, which must be present at the root. Even if we ascertain two noun classes for these types of roots (the *u*-type and the *i/a*-type) in a PCR analysis, these exponents have to be spelled out as exponent of some morpheme. Let us assume that this morpheme is very close to the root, as in case of the verbaliser *v*, the nominaliser *n* cannot “see” *v*, since an RN does not make reference to verbalisers. This is because *n* is directly adjoined to the root according to the model in (36).

However, it is not clear whether the structure of RNs in (36) is correct, as there have been doubts about potential verbal material in RNs, such as English *general**is**ation*, where the suffix *-ise* represents an evident verbaliser (cf. e.g. Alexiadou 2009). This suggests that RNs do not concatenate *n* and the root but *n* and the complex head *v*. In her analysis of Modern Hebrew nominalisation, Ahdout (2021) takes precisely this position. For PCR analyses, this means that the respective stem vowels must belong to *v* in order to account for the observed RNs in Arabic. Under this assumption, noun classes as mentioned above could indeed account for the patterns of the RNs in (37).

It is unclear whether this locality can still yield the generalisations concerning allomorphy on Tense and Voice, as outlined above. In contrast, a CCVC-analysis does not present this issue. As has been demonstrated thus far, contextual allomorphy can be explained within the CCVC-approach. If the roots of *baʕuda* and *ʕamila* have the underlying representations /bʕud/ and /ʕmil/, the question of the precise structure of RNs is rendered superfluous.

4. Conclusions and outlook

Proponents of the opposing frameworks have used arguments about the internal morphosyntactic structure of words as well as their phonological form. The conflation of phonological representations with solely morphosyntactic constituents has been misused for the purpose of advancing arguments in favour of or against distinct grammatical theories, while simultaneously obscuring the manner in which so-called root-and-pattern morphology functions.

The account presented in this paper benefits from both approaches to root-and-pattern morphology. First, as in word- and stem-based accounts, vocalised bases are proposed. In this way, a root structure that is only found in a single language family, i.e. in Semitic, is avoided. Such an analysis does not run into problems with the principle of Harmonic Completeness. If we consider that all languages have vowels, it seems strange that some languages do not tolerate them within roots. At the same time, vocalised roots avoid theoretical OT-problems concerning Richness of the Base and Morpheme Structure Constraints.

Furthermore, the assumption that roots contain both consonants and vowels solves the problem of underived nouns. There is no assumption of idiosyncratic asymmetries in root structure, nor of unlearnable morphological complexity.

Considering a derived environment effect in Classical Arabic, the CCVC-root analysis neatly accounts for morphophonological interactions between stems and apophonic affixes. Moreover, such an analysis seems unproblematic with respect to the derivation of Referential Nominals.

Although some of the advantages of word- and stem-based morphology do also apply to the account proposed here, the root as a morphosyntactic unit is still obligatory. Thus, I disagree with Bat-El (2003a: 44) on the claim that "direct arguments against the C-root necessarily support the word-based view".

The assumption of the root naturally improves the analysis in two respects, namely the problem of the source and the prediction of contextual allomorphy. By following the Strict Linear Adjacency Hypothesis, the attested patterns are not only expected but also predicted, whereas unattested patterns are excluded (cf. Kastner 2019, 2020).

From a phonological perspective, a strict delineation between phonology and morphology is achieved by prohibiting the direct manipulation of phonological structure by morphology (or morphosyntax, respectively). Therefore, the problem of overgeneration associated with too powerful morphology does not arise. In this respect, the CCVC-root account benefits greatly from the findings of previous research indicating that root-and-pattern morphology is epiphenomenal. Here, templatic effects are achieved through the interaction of infixation, floating features, syllabic and prosodic constraints. Therefore, the answer to the question posed in the title of this paper is negative: there is no root-and-pattern morphology, only at a descriptive level. PCRs are an inadequate means of capturing the morphology of Classical Arabic. Consequently, the respective patterns do not represent primitives of Arabic morphology since they are not morphemes but an epiphenomenon. The inadequacy of root-and-pattern morphology is also the reason why there is no "inverse Semitic system" (Kastner & Tucker, forthcoming: 29), which would be characterised by roots consisting of vowels only.

Future research may show whether the approach presented here can account for the entire morphology of Classical Arabic, given that only a subset of the available data has been analysed here. In addition, the inclusion of Arabic dialects is an important test for the present approach in the context of living languages.

In this paper, I have merely had the chance to present this approach to root-and-pattern morphology using the Arabic language as an example. However, given the broad scope of the claim, it is necessary to consider other Semitic languages. Given the significant influence of Hebrew on the pro-root/no-root debate, the CCVC-root approach would be enhanced by an effort to incorporate Hebrew morphology. Of course, valid claims about root-and-pattern morphology can only be made if the entire Semitic language family is considered, including the less prominent languages such as Modern South Arabian, (Neo-)Aramaic, and Ethio-Semitic. Mehri and NENA (see Faust 2019), for instance, pose a challenging candidate for any account that eschews PCRs. Additionally, other Afroasiatic languages have been proposed to exhibit root-and-pattern morphology, such as Tamazight (Berber), Beja (Cushitic), and Mubi (Chadic). Future research will show whether this approach can account for these languages, as well.

References

Adger, David, Bejár, Susana & Harbour, Daniel. 2001. *Allomorphy: Adjacency and Agree*. paper presented at the 23rd GLOW Colloquium, Braga, Portugal.

Ahdout, Odelia. 2021. *Deverbal Nouns in Modern Hebrew: Between Grammar and Competition*. Doctoral dissertation. Humboldt-Universität zu Berlin.

Al Kaabi, Meera & Dimitrios, Ntelitheos. 2019. Rethinking templates: A syntactic analysis of verbal morphology in Emirati Arabic. *Glossa: A Journal of General Linguistics* 4(1): 132.
<https://doi.org/10.5334/gjgl.428>

Alderete, John. 1999. *Morphologically Governed Accent in Optimality Theory.* Ph.D. thesis, University of Massachusetts. Amherst, MA, ROA 309.

Alderete, John. 2001. Dominance Effects as Transderivational Anti-Faithfulness. *Phonology* 18: 201-253.
<https://doi.org/10.1017/S0952675701004067>

Alexiadou, Artemis. 2009. On the role of syntactic locality in morphological processes: the case of (Greek) derived nominals. In Rathert, Monika & Giannakidou, Anastasia (eds.). *Quantification, definiteness and nominalization*, 253-280. Oxford: Oxford University Press.

Anderson, Stephen. 1992. *A-morphous Morphology*. Cambridge: Cambridge University Press.
<https://doi.org/10.1017/CBO9780511586262>

Anttila, Arto. 1997. Deriving variation from grammar. In Hinskens, Frans, van Hout, Roeland & Wetzels, W. Leo (eds.). *Variation, Change, and Phonological Theory*, 35-68. Amsterdam: John Benjamins.

Arad, Maya. 2003. Locality Constraints on the Interpretation of Roots: The Case of Hebrew Denominal Verbs. *Natural Language and Linguistic Theory* 21(4): 737-778.
<https://doi.org/10.1023/A:1025533719905>

Arad, Maya. 2005. Roots and patterns: Hebrew morpho-syntax. Dordrecht: Springer.
<https://doi.org/10.1007/1-4020-3244-7>

Archangeli, Diana. 1991. Syllabification and prosodic templates in Yawelmani. *Natural Language and Linguistic Theory* 9: 231-284.

Aronoff, Mark. 1976. *Word Formation in Generative Grammar*. Cambridge, MA: MIT Press.

Aronoff, Mark. 1994. *Morphology by Itself: Stems and Inflectional Classes*. Cambridge, MA: MIT Press.
<https://doi.org/10.2307/416331>

Bachra, Bernard. 2001. *The phonological structure of the verbal roots in Arabic and Hebrew*. Leiden: Brill.
<https://doi.org/10.1163/9789004348523>

Bat-El, Outi. 1994. Stem modification and cluster transfer in Modern Hebrew. *Natural Language and Linguistic Theory* 12: 571-596.
<https://doi.org/10.1007/BF00992928>

Bat-El, Outi. 2002. Semitic verb structure within a universal perspective. In: Shimron, Joseph (ed.). *Language processing and acquisition in languages of Semitic, root-based, morphology*, 29-59. Amsterdam: Benjamins.
<https://doi.org/10.1075/lald.28.02bat>

Bat-El, Outi. 2003a. The fate of the consonantal root and the binyan in Optimality Theory. *Recherches Linguistiques de Vincennes* 32: 31-60.
<https://doi.org/10.4000/rlv.442>

Bat-El, Outi. 2003b. Antifaithfulness: An inherent morphological property. In Lecarme, Jacqueline (ed.). *Research in Afroasiatic Grammar II*, 21-34. Amsterdam: John Benjamins.

Bat-El, Outi. 2008. Morphologically conditioned v–ø alternation in Hebrew: Distinction among nouns, adjectives and participles, and verbs. In Armon-Lotem, Sharon, Danon, Gabi & Rothstein, Susan (eds.). *Current issues in generative Hebrew linguistics*, 27-60. Amsterdam: Benjamins.
<https://doi.org/10.1075/la.134.02mor>

Bat-El, Outi. 2017. Word-based items and processes (WoBIP): evidence from Hebrew morphology. In Bowern, Claire, Horn, Laurence & Zanuttini, Raffaella (eds.). *On looking into words (and beyond)*, 115-135. Berlin: Language Sciences Press.
<https://doi.org/10.5281/zenodo.495441>

Benmamoun, Elabbas. 2003a. The Role of the Imperfective Template in Arabic Morphology. In Shimron, Joseph (ed.). *Language processing and acquisition in languages of Semitic, root-based, morphology*, 99-114. Amsterdam: Benjamins.
<https://doi.org/10.1075/lald.28.05ben>

Benmamoun, Elabbas. 2003b. Reciprocals as plurals in Arabic. In Lecarme, Jacqueline (ed.). *Research in Afroasiatic Grammar II*, 53-62. Amsterdam: John Benjamins.

Benua, Laura. 1997. *Transderivational Identity: Phonological Relations between Words.* PhD thesis. University of Massachusetts: Amherst.

Bermúdez-Otero, Ricardo. 2012. The Architecture of Grammar and the Division of Labour in Exponence. In Trommer, Jochen (ed.). *The Morphology and Phonology of Exponence: The State of the Art*, 8-83. Oxford: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199573721.003.0002>

Bermúdez-Otero, Ricardo. 2018. Stratal phonology. In Hannahs, S. J. & Bosch, Anna R. K. (eds.). *The Routledge handbook of phonological theory*, 100-134. Abingdon: Routledge.

Berrebi, Si, Bat-El, Outi & Meltzer-Asscher, Aya. 2023. The roots of consonant bias in semitic languages: a critical review of psycholinguistic studies of languages with non-concatenative morphology. *Morphology* 33: 225-260. <https://doi.org/10.1007/s11525-023-09409-4>

Bobaljik, Jonathan D. 1999. Implications of Itelmen agreement asymmetries. In Chang, Steve S., Liaw, Lily & Ruppenhofer, Josef (eds.). *Proceedings of Berkeley Linguistics Society* 25, 299-310. Berkeley: University of California, Berkeley Linguistics Society. <https://doi.org/10.3765/bls.v25i1.1190>

Bobaljik, Jonathan D. 2000. The ins and outs of contextual allomorphy. In Grohmann, Kleanthes K. & Struijke, Caro (eds.). *Proceedings of the Maryland Mayfest on Morphology 1999*. University of Maryland Working Papers in Linguistics 10, 35-71. College Park, MD: University of Maryland, Department of Linguistics.

Bonet, Eulàlia, Lloret, Maria-Rosa & Mascaró, Joan. 2007. Allomorph selection and lexical preferences: two case studies. *Lingua* 117(6): 903-927. <https://doi.org/10.1016/j.lingua.2006.04.009>.

Bruening, Benjamin. 2013. *By* phrases in passives and nominals. *Syntax* 16: 1-41. <https://doi.org/10.1111/j.1467-9612.2012.00171.x>

Buckley, Eugene. 2003. Emergent vowels in Tigrinya templates. In Lecarme, Jacqueline (ed.). *Research in Afroasiatic Grammar II*, 105-125. Amsterdam: John Benjamins.

Burzio, Luigi. 2011. Derived environment effects. In van Oostendorp, Ewen, Marc C., Hume, Elizabeth Hume & Rice, Keren. (eds.). *The Blackwell Companion to Phonology 4: Phonological interfaces*, 1-26. Malden, MA: John Wiley & Sons. <https://doi.org/10.1002/9781444335262.wbctp0088>

Bye, Patrik & Svenonius, Peter. 2012. Non-concatenative morphology as epiphenomenon. In Trommer, Jochen (ed.). *The Morphology and Phonology of Exponence: The State of the Art*, 427-495. Oxford: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199573721.003.0013>

Davis, Stuart. 2016. The Arabic Comparative and the Nature of Templatic Mapping in Arabic. In Körtvélyessy, Lívia, Štekauer, Pavol & Valera, Salvador (eds.). *Word-formation across languages*, 73-90. Newcastle upon Tyne: Cambridge Scholars Publishing.

Davis, Stuart & Tsujimura, Natsuko. 2014. Non-concatenative derivation: other processes. In Lieber, Rochelle & Štekauer, Pavel (eds.). *The Oxford Handbook of Derivational Morphology*, 190-218. Oxford: Oxford University Press. <https://doi.org/10.1093/oxfordhb/9780199641642.013.0012>

Davis, Stuart & Tsujimura, Natsuko. 2018. Arabic Nonconcatenative Morphology in Construction Morphology. In Booij, Geert (ed.). *The Construction of Words: Advances in Construction Morphology*. Studies in Morphology 4, 315-339. Cham: Springer International Publishing AG.
<https://doi.org/10.1007/978-3-319-74394-3_12>

Dell, François & Elmedlaoui, Mohamed. 1985. Syllabic consonants and syllabification in Imdlawn Tashlhiyt Berber. *Journal of African Languages and Linguistics* 7: 105-130.
<https://doi.org/10.1515/jall.1985.7.2.105>

Dell, François & Elmedlaoui, Mohamed. 1988. Syllabic consonants in Berber: some new evidence. *Journal of African Languages and Linguistics* 10: 1-17.
<https://doi.org/10.1515/jall.1988.10.1.1>

Dell, François & Elmedlaoui, Mohamed. 1989. Quantitative transfer in the nonconcatenative morphology of Imdlawn Tashlhiyt Berber. *Journal of Afroasiatic Languages* 3: 89-125.

Dell, François & Mohamed Elmedlaoui. 2003. *Syllables in Tashlhiyt Berber and Moroccan Arabic*. Kluwer International Handbooks of Linguistics, 2. Dordrecht: Kluwer.

Downing, Laura J. 2006. *Canonical Forms in Prosodic Morphology*. Oxford: Oxford University Press.
<https://doi.org/10.1093/acprof:oso/9780199286393.001.0001>

Edzard, Lutz. 2001. Problems with post-vocalic spirantization in Syriac: Cyclic rule ordering vs. 'early phonemization and paradigmatic levelling'. *Journal of Semitic Studies* 46(1): 77-95.
<https://doi.org/10.1093/jss/XLVI.1.77>

Embick, David. 2010. *Localism versus Globalism in Morphology and Phonology*. Cambridge, MA & London, England: The MIT Press.
<https://doi.org/10.7551/mitpress/9780262014229.001.0001>

Embick, David. 2015. *The Morpheme: A Theoretical Introduction*. Boston/Berlin: De Gruyter Mouton.
<https://doi.org/10.1515/9781501502569>

Embick, David & Noyer, Rolf. 2001. Movement operations after syntax. *Linguistic Inquiry* 32(4): 555-595.
<https://doi.org/10.1162/002438901753373005>

Enguehard, Guillaume & Faust, Noam. 2018. Guttural Ghosts in Modern Hebrew. *Linguistic Inquiry* 49(4): 685-722.
<https://doi.org/10.1162/ling_a_00287>

Faust, Noam. 2012. Non-concatenative realization in the verbal inflection of Modern Hebrew. *Morphology* 22: 453-484.
<https://doi.org/10.1007/s11525-012-9206-0>

Faust, Noam. 2016. Weak radicals, weak suppletion, and phonological indices in Semitic. *Morphology* 26: 79-397.
<https://doi.org/10.1007/s11525-016-9278-3>

Faust, Noam. 2017. The apophonic chain and the form of weak and strong verbs in Palestinian Arabic. *The Linguistic Review* 34(1): 83-121.
<https://doi.org/10.1515/tlr-2016-0006>

Faust, Noam. 2019. New reasons to root for the Semitic root from Mehri and Neo-Aramaic. *The Linguistic Review* 36(3): 575-599. <https://doi.org/10.1515/tlr-2019-2030>

Faust, Noam. 2022. *The Pro-Root No-Root debate, with reasons to root for the root*. Presentation at the Université Paris 8, CNRS SFL. Slides available at <https://noamfaust.wordpress.com/wp-content/uploads/2022/04/e2889a4e2889a.pptx> [last accessed: 2024-08-29].

Faust, Noam & Hever, Ya'ar. 2010. Empirical and Theoretical Arguments in Favor of the Discontinuous Root in Semitic Languages. *Brill's Annual of Afroasiatic Languages and Linguistics* 2: 80-118. <https://doi.org/10.1163/187666310X12688137960704>

Faust, Noam & Lampitelli, Nicola. 2023. Root and Pattern in Semitic – and Beyond. In Ackema, Peter, Bendjaballah, Sabrina, Bonet, Eulàlia & Fábregas, Antonio (eds.). *The Wiley Blackwell Companion to Morphology*. Malden, MA: Wiley Blackwell. <https://doi.org/10.1002/9781119693604.morphcom075>

Fischer, Wolfdietrich. 2006. *Grammatik des Klassischen Arabisch*. Porta Linguarum Orientalium, Neue Serie 11. Wiesbaden: Harrassowitz Verlag.

Fox, Samuel E. 1997. *The Neo-Aramaic Dialect of Jilu*. Semitica Viva, vol. 16. Wiesbaden: Harrassowitz.

Gamkrelidze, Tamaz. 1989. Markedness, sound change and linguistic reconstruction. In Tomic, Olga M. (ed.). *Markedness in synchrony and diachrony*, 87-102. Berlin & New York: De Gruyter Mouton. <https://doi.org/10.1515/9783110862010.87>

Greenberg, Joseph. 1950. The Patterning of Root Morphemes in Semitic. *Word* 5: 162-181.

Guerssel, Mohand & Lowenstamm, Jean. 1996. Ablaut in Classical Arabic Measure I Active Verbal Forms. In Lecarme, Jacqueline, Lowenstamm, Jean & Shlonsky, Ur (eds.). *Studies in Afroasiatic Grammar*, 123-134. The Hague: Holland Academic Graphics.

Halle, Morris & Marantz, Alec. 1993. Distributed Morphology and the pieces of inflection. In Hale, Kenneth H. & Keyser, Samuel J. (eds.). *The view from building 20: Essays in linguistics in honor of Sylvain Bromberger*, 111-176. Cambridge: MIT Press.

Hammond, Michael. 1988. Templatic transfer in Arabic broken plurals. *Natural Language and Linguistic Theory* 6: 247-270. <https://doi.org/10.1007/BF00134231>

Haspelmath, Martin. 2023. Coexpression and synexpression patterns across languages: comparative concepts and possible explanations. *Frontiers in Psychology* 14: 1236853. <https://doi.org/10.3389/fpsyg.2023.1236853>

Hayward, K. M. & Hayward, R. J. 1989. "Guttural" arguments for a new distinctive feature. *Transactions of the Philological Society* 87: 179-193. <https://doi.org/10.1111/j.1467-968X.1989.tb00626.x>

Hewitt, George B. 1995. *Georgian: A Structural Reference Grammar*. London Oriental and African Language Library, 2. Amsterdam & Philadelphia: John Benjamins. <https://doi.org/10.1075/loall.2>

Idrissi, Ali. 1997. Plural formation in Arabic. In Eid, Mushira & Ratcliffe, Robert (eds.). *Perspectives on Arabic Linguistics X*, 123-145. Amsterdam & Philadelphia: John Benjamins.

Inkelas, Sharon. 2014. *The interplay of morphology and phonology*. Oxford: Oxford University Press. <https://doi.org/10.1093/acprof:oso/9780199280476.001.0001>

Joo, Ian & Hsu, Yu-Yin. 2024. Phonotacticon: a cross-linguistic phonotactic database. *Linguistic Typology*: 1-20. <https://doi.org/10.1515/lingty-2023-0094>

Kamil, Iris. 2023. *t*-Forms of the Akkadian Stative. *Brill's Journal of Afroasiatic Language and Linguistics* 15(1): 262-290. <https://doi.org/10.1163/18776930-01501008>

Kastner, Itamar. 2016. *Form and meaning in the Hebrew verb*. Doctoral dissertation, New York University, New York, NY.

Kastner, Itamar. 2017. Reflexive verbs in Hebrew: Deep unaccusativity meets lexical semantics. *Glossa: A Journal of General Linguistics* 2(1): 75. <https://doi.org/10.5334/gjgl.299>

Kastner, Itamar. 2019. Templatic morphology as an emergent property: Roots and functional heads in Hebrew. *Natural Language and Linguist Theory* 37: 571-619. <https://doi.org/10.1007/s11049-018-9419-y>

Kastner, Itamar. 2020. *Voice at the interfaces: The syntax, semantics, and morphology of the Hebrew verb*. Language Science Press. <https://doi.org/10.5281/zenodo.3865067>

Kastner, Itamar & Tucker, Matthew. Forthcoming. Non-concatenative morphology. In Alexiadou, Artemis, Kramer, Ruth, Marantz, Alec & Oltra Massuet, Isabel (eds.). *The Cambridge Handbook of Distributed Morphology*. Cambridge: Cambridge University Press. <https://blogs.ed.ac.uk/itamar/wp-content/uploads/sites/1083/2020/07/kastnertucker20.pdf> [last accessed: 2024-08-26].

Kaye, Jonathan, Lowenstamm, Jean & Vergnaud, Jean-Roger. 1990. Constituent Structure and Government in Phonology. *Phonology Yearbook* 7: 193-231.

Khan, Geoffrey. 2008. *The Neo-Aramaic Dialect of Barwar. Volume One: Grammar*. Leiden & Boston: Brill.

Khan, Geoffrey. 2009. *The Jewish Neo-Aramaic Dialect of Sanandaj*. Piscataway, NJ: Giorgias Press. <https://doi.org/10.31826/9781463217334>

Khan, Geoffrey. 2016. *The Neo-Aramaic Dialect of the Assyrian Christians of Urmi. Volume 1. Grammar: Phonology and Morphology*. Leiden & Boston: Brill. <https://doi.org/10.1515/olzg-2018-0077>

Kiparsky, Paul. 1982. From cyclic phonology to Lexical Phonology. In van der Hulst, Harry & Smith, Norval (eds.). *The structure of phonological representations*. Vol. 2, 131-176. Berlin/Boston: De Gruyter. <https://doi.org/10.1515/9783112328088-008>

Kiparsky, Paul. 1993. Blocking in nonderived environments. In Anderson, Stephen A., Hargus, Sharon, Kaisse, Ellen M. & Keating, Patricia A. (eds.). *Phonetics and phonology, IV: Studies in Lexical Phonology*, 277-313. San Diego: Academic Press. <https://doi.org/10.1016/B978-0-12-325071-1.50016-9>

Kiparsky, Paul. 2000. Opacity and Cyclicity. *The Linguistic Review* 17: 351-367. <https://doi.org/10.1515/tlir.2000.17.2-4.351>

Kiparsky, Paul. 2015. Stratal OT: A Synopsis and FAQs. In Hsiao, Yuchau E., Wee, Lian-Hee (eds.). *Capturing Phonological Shades*, 2-44. Cambridge: Cambridge Scholars Publishing.

Knudsen, Ebbe E. 2015. *Classical Syriac Phonology*. Piscataway, NJ: Gorgias Press. <https://doi.org/10.31826/9781463236847>

Kramer, Ruth. 2007. Non-concatenative morphology in Coptic. In Kaplan, Aaron & Teeple, David (eds.). *Phonology at Santa Cruz* 7. Santa Cruz, CA: Linguistics Research Center.

Lahrouchi, Mohamed. 2010. On the Internal Structure of Tashlhiyt Berber Triconsonantal Roots. *Linguistic Inquiry* 41(2): 255-285. <https://doi.org/10.1162/ling.2010.41.2.255>

Laks, Lior. 2013a. Passive formation in Palestinian and Standard Arabic: Lexical vs. syntactic operations. *Word Structure* 6: 156-180. <https://doi.org/10.3366/word.2013.0043>

Laks, Lior. 2013b. Why and how do Hebrew verbs change their form? A morpho-thematic account. *Morphology* 23: 351-383. <https://doi.org/10.1007/s11525-013-9227-3>

Laks, Lior 2014. Morpho-thematic mismatches in Hebrew: What happens when morphological and thematic criteria collide? *Lingua* 138: 107-127. <https://doi.org/10.1016/j.lingua.2013.10.011>

Lowenstamm, Jean. 1996. CV as the only syllable type. In Durand, Jacques & Laks, Lior (eds.). *Current Trends in Phonology: Models and Methods*, 419-441. Salford, Manchester: ESRI.

Lubowicz, Anna. 2010. Infixation as morpheme-absorption. In Parker, Steve (ed.). *Phonological argumentation. Essays on evidence and motivation*, 261-284. London: Equinox.

Marantz, Alec. 1992. Case and licensing. In Westphal, G., Ao, B. & Chae, H.-R. (eds.). *ESCOL '91*. Columbus, OH. 234-253.

Mascaró, Joan. 1976. *Catalan phonology and the phonological cycle*. PhD dissertation, MIT, distributed 1978. Bloomington: Indiana University Linguistics Club.

Mascaró, Joan. 2016. Morphological Exceptions to Vowel Reduction in Central Catalan and the Problem of the Missing Base. *Catalan Journal of Linguistics* 15: 27-51. <https://doi.org/10.5565/rev/catjl.184>

McCarthy, John. 1979. *Formal Problems in Semitic Phonology and Morphology*. PhD thesis. Massachusetts Institute of Technology.

McCarthy, John. 1981. A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry* 12: 373-418.

McCarthy, John. 1986. OCP Effects: Gemination and Antigemination. *Linguistic Inquiry* 17: 207-364.

McCarthy, John. 1991. Guttural phonology. In Comrie, Bernard & Eid, Mushira (eds.). *Perspectives on Arabic Linguistics III*, 63-92. Amsterdam, Philadelphia: John Benjamins.

McCarthy, John. 1994. The phonetics and phonology of Semitic pharyngeals. In Keating, P. A. (ed.). *Phonological Structure and Phonetic Form: Papers in Laboratory Phonology III*, 191-233. Cambridge: Cambridge University Press.

McCarthy, John & Prince, Alan. 1986/1996. *Prosodic morphology 1986, Technical Report* 32. Rutgers University Center for Cognitive Science, 1996. Available online at: <http://works.bepress.com/john_j_mccarthy/> [last accessed: 2024-11-05].

McCarthy, John & Prince, Alan. 1990a. Prosodic morphology and templatic morphology. In Eid, Mushira & McCarthy, John (eds.). *Perspectives on Arabic Linguistics II*, 1-54. Amsterdam: Benjamins.

McCarthy, John & Prince, Alan. 1990b. Foot and word in prosodic morphology: The Arabic broken plural. *Natural Language and Linguistic Theory* 8(2): 209-283. <https://doi.org/10.1007/BF00208524>

McCarthy, John & Prince, Alan. 1994. The emergence of the unmarked: Optimality in prosodic morphology. In Gonzàlez, Mercè (ed.). *Proceedings of the North East Linguistic Society* 24, 333-379. Amherst, MA: GLSA Publications. ROA-13.

Meier-Brügger, Michael. 2010. *Indogermanische Sprachwissenschaft*. Berlin & New York: De Gruyter.

Muraoka, Takamitsu. 2005. *Classical Syriac: A basic grammar with a chrestomathy*. Wiesbaden, Harrassowitz.

Prince, Alan & Smolensky, Paul. 1993/2004. *Optimality Theory: Constraint Interaction in Generative Grammar*. Malden & Oxford: Blackwell. <https://doi.org/10.1002/9780470759400>

Prunet, Jean-François. 1996. Guttural Vowels. In Hudson, Grover (ed.). *Essays on Gurage Language and Culture*, 175-203. Wiesbaden: Harrassowitz.

Prunet, Jean-François. 2006. External Evidence and the Semitic Root. *Morphology* 16: 41-67. <https://doi.org/10.1007/s11525-006-0003-5>

Raffelsiefen, Renate. 2012. Die Silbifizierung hoher Vokoide: das Deutsche im Sprachvergleich. In Gunkel, Lutz & Zifonun, Gisela (eds.). *Deutsch im Sprachvergleich: Grammatische Kontraste und Konvergenzen*, 99-134. Berlin & Boston: de Gruyter. <https://doi.org/10.1515/9783110284768.99>

Ratcliffe, Robert. 1997. Prosodic Templates in a Word-Based Morphological Analysis of Arabic. In Eid, Mushira & Ratcliffe, Robert (eds.). *Perspectives on Arabic Linguistics X*, 147-171. Amsterdam & Philadelphia: John Benjamins.

Rauscher, Maria. 2022. *Die vokalische Gestalt des arabischen Wortstamms: Ihr Kodierungspotential im drei-radikaligen Maṣdar*. Abhandlungen für die Kunde des Morgenlandes 127. Wiesbaden: Harrassowitz.

Rose, Sharon. 2007. Chaha (Gurage) morphology. In Kaye, Alan S. (ed.). *Morphologies of Asia and Africa*, vol. 1, 403-427. Winona Lake: Eisenbrauns. <https://doi.org/10.1515/9781575065663-021>

Scheer, Tobias. 2004. *A Lateral Theory of Phonology. Vol 1: What is CVCV, and why should it be?* Berlin: Mouton de Gruyter. <https://doi.org/10.1515/9783110908336>

Scheer, Tobias & Kula, Nancy C. 2017. Government Phonology: Element Theory, conceptual issues and introduction. In Hannahs, S.J. & Bosch, Anna (eds.). *The Routledge Handbook of Phonological Theory*, 226-261. Abingdon & New York. <https://doi.org/10.4324/9781315675428-9>

Talay, Shabo. 2008. *Die neuaramäischen Dialekte der Khabur-Assyrer in Nordostsyrien: Einführung, Phonologie und Morphologie*. Semitica Viva, vol. 40. Wiesbaden: Harrassowitz Verlag.

Tebay, Sören E. 2021. *Interacting (with) Morpheme Structure Constraints: Representational Solutions to Richness of the Base Problems in Optimality Theory*. Doctoral dissertation. Universität Leipzig.

Trommer, Jochen. 2001. *Distributed Optimality*. Doctoral dissertation. Universität Potsdam.

Trommer, Jochen. 2011. *Phonological Aspects of Western Nilotic Mutation Morphology*. Habilitation dissertation, Universität Leipzig.

Trommer, Jochen & Zimmermann, Eva. 2014. Generalised mora affixation and quantity manipulating morphology. *Phonology* 31(3): 463-510.
<https://doi.org/10.1017/S0952675714000220>

Tucker, Matthew. 2010. Roots and prosody: The Iraqi Arabic derivational verb. *Recherches Linguistique de Vincennes: Racine et Radical* 39: 31-68.
<https://doi.org/10.4000/rlv.1833>

Tucker, Matthew. 2011. The morphosyntax of the Arabic verb. In LaCara, Nicholas, Thompson, Anie & Tucker, Matthew (eds.). *Morphology at Santa Cruz: Papers in honor of Jorge Hankamer*, 177-211. Santa Cruz, CA: LRC Publications.

Urban, Matthias. 2024. *Radical typology: on root length and structure cross-linguistically*. Presentation at the Vielfaltslinguistik 6, Universität Graz, abstract available at <https://static.uni-graz.at/fileadmin/_files/_administrative_sites/_treffpunkt-sprachen/PDF/Pluri/uni-graz-treffpunktsprachen-abstracts_alle_vielfalt_2024.pdf> [last accessed: 2024-08-29].

Ussishkin, Adam. 1999. The Inadequacy of the Consonantal Root: Modern Hebrew Denominal Verbs and Output-Output Correspondence. *Phonology* 16(3): 401-442.
<https://doi.org/10.1017/S0952675799003796>

Ussishkin, Adam. 2000. *The Emergence of Fixed Prosody*. Doctoral dissertation, University of California, Santa Cruz.

Ussishkin, Adam. 2003. Templatic Effects as Fixed Prosody: The Verbal System in Semitic. In Lecarme, Jacqueline (ed.). *Research in Afroasiatic Grammar II*, 511-530. Amsterdam: John Benjamins.

Ussishkin, Adam. 2005. A Fixed Prosodic Theory of Nonconcatenative Templatic Morphology. *Natural Language & Linguistic Theory* 23(1): 169-218.
<https://doi.org/10.1007/s11049-003-7790-8>

Ussishkin, Adam. 2006. Affix-favored contrast inequity and psycholinguistic grounding for nonconcatenative morphology. *Morphology* 16: 107-125.
<https://doi.org/10.1007/s11525-006-0005-3>

von Soden, Wolfram. 1995. *Grundriss der akkadischen Grammatik*. Analecta Orientalia 33. Rome: Pontificum Institutum Biblicum.

Wallace, Katherine 2013. *A Concatenative Approach to Semitic Templatic Morphology*. Ms. NYU. lingbuzz/002299.

Watson, Janet, C. 2002. *The Phonology and Morphology of Arabic*. Oxford: Oxford University Press.
<https://doi.org/10.1093/oso/9780199257591.001.0001>

Wischer, Ilse 2012. Grammaticalization and word formation. In Heine, Bernd & Narrog, Heiko (eds.). *The Oxford Handbook of Grammaticalization*, 356-364. Oxford: Oxford University Press.
<https://doi.org/10.1093/oxfordhb/9780199586783.013.0028>

Wolf, Matthew. 2007. For an autosegmental theory of mutation. In Bateman, L., O'Keefe, M., Reilly, E. & Werle, A. (eds.). *University of Massachusetts Occasional Papers in Linguistics* 32: 315-404. Amherst: GLSA.

Wright, William. 2005 [1896]. *Arabic Grammar*, vol. 1. Mineola: Dover Publications Inc.

Yu, Alan C. 2003. *The morphology and phonology of infixation*. PhD dissertation. University of California, Berkeley.

Zimmermann, Eva. 2017. *Morphological Length and Prosodically Defective Morphemes*. Oxford: Oxford University Press.
<https://doi.org/10.1093/oso/9780198747321.001.0001>

Zimmermann, Eva. 2019. Gradient Symbolic Representations and the Typology of Ghost Segments. In Hout, Katherine, Mai, Anna, McCollum, Adam, Rose, Sharon & Zaslansky, Matthew (eds.). *Proceedings of AMP 2018, LSA*.
<https://doi.org/10.3765/amp.v7i0.4576>

Zimmermann, Eva. 2023. Non-Segmental Morphology. In Ackema, Peter, Bendjaballah, Sabrina, Bonet, Eulàlia & Fábregas, Antonio (eds.). *The Wiley Blackwell Companion to Morphology*. Malden, MA: Wiley Blackwell.
<https://doi.org/10.1002/9781119693604.morphcom054>

Zoll, Cheryl. 1996. *Parsing below the segment in a constraint-based framework*. PhD dissertation. University of California, Berkeley.