Templatic Effects as Fixed Prosody: The Verbal System in Semitic*

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1 Introduction

Templatic effects are well-attested in a variety of domains in which phonology and morphology interact. Such effects are characterized by an imposition of prosodic restrictions, and are seen throughout many of the languages of the world in reduplicative morphology. The goals of this paper are to account for templatic effects, (which I refer to as *fixed prosody*), in Semitic languages, in which the majority of the vocabulary exhibits templatic effects. This goal is achieved without reference to template-specific constraints (following recent work on reduplicative morphology of Spaelti 1997 and McCarthy & Prince 1999). In addition, I provide a parallel account of these effects within Optimality Theory (OT; Prince & Smolensky 1993). Finally, I explore the nature of the faithfulness constraints responsible for melodic overwriting, which I argue result in the appearance of "root-and-pattern morphology" (following Ussishkin 1999ab, 2000ab).

The empirical focus in this paper is on the verbal systems of Modern Hebrew and Arabic, for which I show that fixed prosody can be achieved through well-motivated demands on prosodic well-formedness, as opposed to through templatic constraints. The paper is structured as follows. Section 2 provides a brief sketch of previous approaches to nonconcatenative templatic morphology which rely on the language-specific notion of the consonantal root in conjunction with specifically templatic morphemes. Section 3 addresses the theoretical consequences of the alternative fixed prosody approach. Section 4 presents the data from the Hebrew and Arabic verbal systems. In section 5, I provide the analysis of these data, showing that there is no need for either the consonantal root or template-specific constraints, but rather that the fixed prosodic effects observed in these languages are the expected consequences of cross-linguistically motivated constraints. Section 6 discusses some directions for further research, and section 7 offers a conclusion.

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2 Previous approaches to nonconcatenative morphology

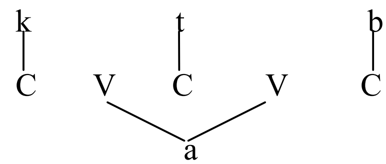
McCarthy's (1979, 1981) approach to the morphology of Semitic languages such as Arabic and Hebrew involves three different types of morpheme, extending the autosegmental framework of Goldsmith (1976), as seen below.

(1) Three types of morpheme, represented in an autosegmental framework (Goldsmith 1976):

(a) *the consonantal root*

(b) *the template*

(c) *the vocalic melody*



This framework poses several problems. For instance, the existence of the consonantal root as a distinct morpheme has been challenged in much recent work (e.g., Bat-El 1994, to appear, Ussishkin 1999ab, 2000ab). Additionally, the issue of specifically defined templates is problematic for serious theoretical reasons which I address below. Finally, generalizations regarding the prosodic structure of verbal forms in Semitic remain unexplained in this type of approach. In the following section, I briefly outline the consequences of an alternative theoretical approach to nonconcatenative templatic morphology.

3 Consequences of the fixed prosody approach

Under the approach adopted in this paper, templatic (= fixed prosodic) effects turn out to be an instantiation of The Emergence of the Unmarked (TETU; McCarthy & Prince 1994), resulting from independently motivated prosodic constraints as opposed to template-specific constraints. This approach is based on output-output correspondence (Benua 1995, 1997, *inter alia*), and claims that complex forms are derived from the concatenation of a base form with affixal material. The view that Semitic word formation is concatenative results in an account in which languages previously assumed to require very peculiar mechanisms instead much more closely resemble the languages of the rest of the world.

With respect to Semitic languages in particular, the two most important consequences of this approach is that it makes no reference to templates or to the consonantal root. Instead, output forms are taken as the base of affixation for verbal morphology in Semitic. This approach has further consequences for OT, undermining the proposed universal ranking between FAITH-STEM and FAITH-AFFIX (McCarthy & Prince 1995): A high-ranking FAITH-AFFIX constraint is required to explain apparent exceptionally long forms in the Hebrew verbal system that do not conform to the fixed prosodic maximum observed in general in the language. In the following section, I present the data to be examined in the rest of the paper.

4 The data

The data I focus on come from the verbal systems of Hebrew and Arabic. In Modern Hebrew, there are seven *binyanim*, or verbal classes; every verb in the language belongs to one of these seven classes. The following table illustrates each binyan, and provides examples of corresponding verbs. Notice the templatic effects evident in these verbs: the majority of the verbs are bisyllabic (all except for those in the hitpaʕel binyan, in fact). This bisyllabic restriction forms the core of the analysis that is presented below.

4.1 The binyanim of Hebrew

(2) The Modern Hebrew verbal system (adapted from Horvath 1981)[1]:

Binyan[2]	*Function*	*Examples*	*Gloss*
paʕal	• Unmarked, basic pattern	gadal paxad katav badak ʔaxal	'he grew' 'he feared' 'he wrote' 'he checked' 'he ate'
nifʕal	• Passive of paʕal • Ingressive (change of state) from paʕal • Intransitive form of a transitive hifʕil form	nirdam nifrad nivdak nixtav	'he fell asleep' 'he separated (intrans.)' 'he was checked' 'it was written'
piʕel	• A typically transitive basic pattern • Intensified form of paʕal	gidel ʔikel diber kibel	'he raised 'he consumed' 'he spoke' 'he received'
puʕal	• Passive of piʕel	gudal dubar	'he was raised' 'it was spoken'
hitpaʕel	• Middle voice reflex of transitives in piʕel • Reflexive • Reciprocal • Repetitive action	hitkabel hitraxet͡s hitnaʃek hitnadned hitkatev	'he was received' 'he washed (himself)' 'he kissed (recip.)' 'it oscillated' 'he corresponded'
hifʕil	• Causative of paʕal • Transitive reflex of nifʕal	higdil hifxid hifrid hixtiv	'he enlarged' 'he frightened' 'he separated (trans.)' 'he dictated'
hufʕal	• Passive of hifʕil	hugdal hufxad huxtav	'he was enlarged' 'he was frightened' 'it was dictated'

[1] As Horvath (1981), among many others, has pointed out, two of the binyanim, the *puʕal* and the *hufʕal* are clearly derived from the *piʕel* and *hifʕil*, respectively. Both of the dependent binyanim have unexceptionally predictable meanings (both are always passive), and both lack imperative and infinitive forms, which exist for all other binyanim.

[2] The system of binyan names stems from the practice of associating (in traditional parlance) the consonantal root *p, ʕ, l* (to which the meaning 'to act' is attributed) with the appropriate vocalic melody and template.

In Arabic, there exist more verbal classes than in Modern Hebrew, and they are traditionally numbered with Roman numerals, as the following illustrative table shows (only productive verbal classes are given). Again, note the templatic effects evident in these verbs: all except for V and VI are bisyllabic.

4.2 The binyanim of Arabic

(3) The Arabic verbal system:

Verbal class	*Binyan name*	*Function*	*Examples*	*Gloss*
I	faʕal	• unmarked, basic pattern	katab dakar	'he wrote' 'he remembered'
IV	ʔafʕal	• causative of faʕal	ʔaktab ʔadkar	'he dictated' 'he reminded'
VII	nfaʕal	• passive of faʕal	nkatab	'he subscribed'
VIII	ftaʕal	• passive of faʕal • middle of faʕal	ktatab	'he was registered'
X	stafʕal	• reflexive of faʕal • reflexive of ʔafʕal	staktab stadkar	'he asked to write' 'he kept in mind'
II	faʕʕal	• causative of faʕal	kattab dakkar	'he made (s.o.) write' 'he reminded'
V	tafaʕʕal	• reflexive of faʕʕal	tadakkar	'he bore in mind'
III	faaʕal	• reciprocal of faʕal	kaatab daakar	'he corresponded' 'he negotiated'
VI	tafaaʕal	• reflexive of faaʕal	takaatab tadaakar	'he kept up correspondence' 'he conferred'

In the following section, I provide the analysis of fixed prosodic effects, beginning with the Modern Hebrew case.

5 The analysis

5.1 The Hebrew binyanim: Fixed prosody and affix faithfulness

Below is a sample paradigm of related verbs.

(4) Sample verbal paradigm

Binyan	*Hebrew verb*	*Gloss*
paʕal	gadal	'he grew' (intransitive)
piʕel	gidel	'he raised'
puʕal	gudal	'he was raised'
hifʕil	higdil	'he enlarged'
hufʕal	hugdal	'he was enlarged'

As seen in these data, these verbs all share a meaning having to do with 'bigness' or 'size'. Previous approaches to this type of semantic relatedness in a Semitic verbal paradigm recognize that the only common phonological material shared by these related forms is the set of consonants *g d l*. In fact, these earlier approaches attribute to this set of consonants the status of morpheme, claiming that this "consonantal root" is the basis from which all these related forms are derived. I argue, however, that no such entity is necessary. In fact, all of these related forms, I claim, are derived from the basic paʕal verbal pattern; in this case the verb *gadal* 'he grew'. That is, rather than a system in which forms are derived from an entity that never occurs in isolation on the surface, the account presented here is surface-based and states that related forms are derived from actually occurring (or actually possible) words.

The important issue, therefore, is to identify which verbal form serves as the base of affixation for the others. In fact, there is evidence (to be presented below) that the paʕal binyan serves as the base of affixation for all other binyanim. Based on this, the analysis presented below shows that fixed prosodic effects (implemented through a maximally bisyllabic stem-size restriction) result in melodic overwriting. This gives the appearance of so-called "root-and-pattern" morphology, because when the vowels of an existing form are overwritten by the affixal vowels, the only remaining constant material from one form to another is the consonants. The realization of affixal material, as stated above, is accomplished through a high-ranking FAITH-AFFIX constraint. However, this is accomplished without resorting to the consonantal root.

Previous work on Modern Hebrew has argued that the paʕal forms have the least semantic transparency of all the binyanim (Horvath 1981). Similar proposals have been advanced for the verbal system of Arabic, essentially arguing that the equivalent of the paʕal in Arabic serves as the base of affixation for the rest of the verbal classes (cf. McCarthy 1993 for a pre-OT account of templatic effects in the Arabic verbal system). Phonologically, the paʕal binyan has the most exceptionality, and is therefore a likely candidate for being lexically specified (Horvath 1981, Ussishkin 2000b). This exceptionality is manifested in the more diverse range of prosodic shapes available to the paʕal: besides the typical bisyllabic patterns, the paʕal is the only binyan that contains monosyllabic verbs, as the data below exemplify.

(5) The paʕal is the only binyan with monosyllabic verbs

	Monosyllabic paʕal forms	*Gloss*
a.	kam	'he got up'
b.	rac	'he ran'
c.	sam	'he put'
d.	ba	'he came'
e.	gar	'he lived'
f.	xas	'he pitied'

etc.

The formal portion of our analysis begins with an account of fixed prosodic effects. The principal issue addressed here concerns the mechanism by which the bisyllabic restriction is enforced in Modern Hebrew verbs. There are (at least) two potential resolutions for this issue: Either (i) fixed prosody arises as a result of some high-ranking templatic constraint such as *Verb* = *[*σ σ*]*, or (ii) fixed prosody arises as a result of prosodic constraints that are independently motivated. The claim in this paper is that the second of these options is correct.

This claim is supported by recent optimality-theoretic work on reduplication in prosodic morphology, which has shown that adopting templatic constraints to account for reduplicative templates leads to unattested typologies (Spaelti 1997, McCarthy & Prince 1999). This is known as the "Kager-Hamilton problem": allowing templatic constraints predicts templatic back-copying. No language, however, back-copies reduplicative templatic shapes onto the base of reduplication. Until now, this work has not been extended to languages where the majority of the vocabulary is templatic. Semitic languages are a prime candidate for such an approach, given the templatic effects that are widely observed in their word formation phenomena.

As for how to implement this approach in Modern Hebrew, I claim that fixed prosodic effects result from independently needed prosodic constraints.[3] These constraints are markedness (or structural) constraints: they evaluate potential output forms. They are implemented as size restrictions that are imposed on prosodic structure, and are divided into two types: a constraint enforcing a minimal prosodic word size (i.e. a minimality condition) and a constraint limiting maximal prosodic word size (i.e. a maximality restriction).

The first of these constraints, which forces a prosodic word to be at least bisyllabic, is formalized as PRWDBRANCH:

(6) PR(OSODIC)W(OR)DBRANCH(ING)[4]

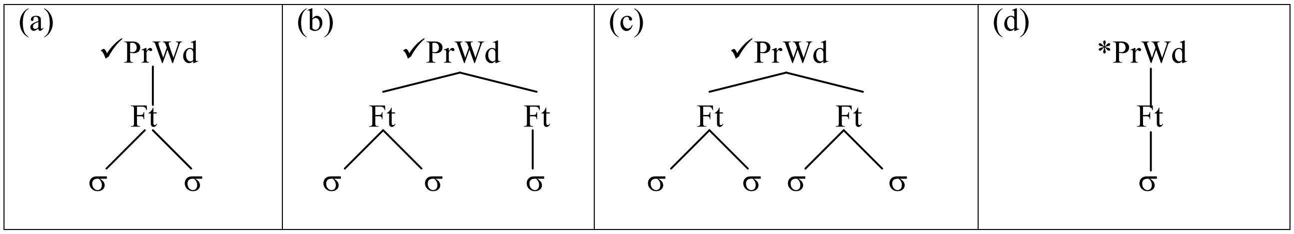
A PrWd must branch, either at the foot level or the syllable level.

The following diagrams illustrate satisfaction ((a) – (c)) and violation ((d)) of this constraint.

[3] See Bat-El (to appear) for a similar claim, in an analysis which also derives prosodic characteristics of the binyanim from universally recognized constraints. See also Ussishkin (2000b) for cross-linguistic motivation for each of the constraints discussed here, as well as a more detailed discussion of the implementation of these constraints.

[4] PRWDBRANCH is modeled after Ito (1990), Ito & Mester (1992), who formalize a similar requirement for word binarity in Japanese truncations.

(7) PrWdBranch



As seen in these examples, PrWdBranch penalizes structures containing any prosodic word that does not branch into at least two syllables. Any prosodic word containing two or more syllables satisfies this constraint.

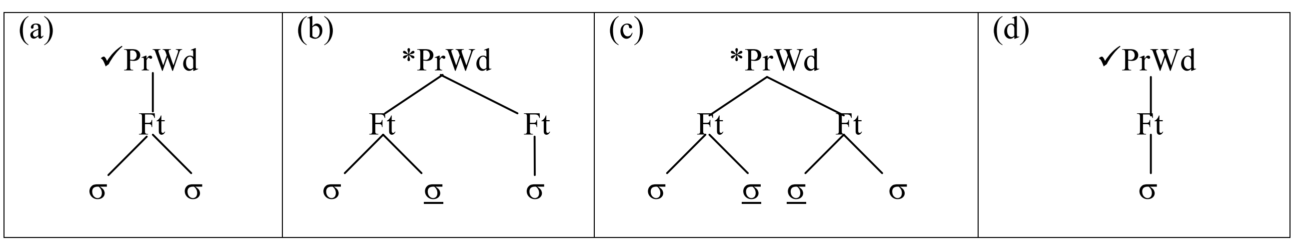
The next constraint is responsible for restricting word size to two syllables, and, as we have seen for Hebrew, is satisfied by verbs in every binyan except for the hitpaʕel. This constraint is formalized below:

(8) σ-Align[5]

$\forall\sigma\ \exists PrWd\ [PrWd \supset \sigma\ \&\ \text{Align}\ (\sigma, PrWd)]$
("Some edge of every syllable must be aligned with the same edge of some prosodic word containing it.")

σ-Align, in effect, acts as a maximal limit on prosodic word size, assessing violations for every form longer than two syllables. This is illustrated by the following structures:

(9) σ-Align (offending syllables are underlined)



When we take into account the data from Modern Hebrew, since even paʕal forms are never longer than two syllables, the constraint σ-Align must outrank the constraint that demands that input forms surface faithfully. This constraint, Faith-IO, demands that outputs are faithful to

[5] This alignment constraint is an extension of Ito, Kitagawa, & Mester's (1996:242) Hierarchical Alignment:

Every prosodic constituent is aligned with some prosodic constituent, containing it.
($\forall Pcat1\ \exists Pcat2\ [Pcat2 \supset Pcat1\ \&\ \text{Align}\ (Pcat1, Pcat2)]$, where Pcat stands for a prosodic category.)

their inputs.[6] For a hypothetical input containing a paʕal form with three syllables, FAITH-IO violations will be incurred in order to satisfy σ-ALIGN.

(10) Paʕal forms may never be greater than two syllables:

/gadalam/	σ-ALIGN	FAITH-IO
a. gadalam	*!*	
b. gad		***!*
L c. gadal		**

In addition, all of the forms derived from the paʕal satisfy σ-ALIGN (with the exception of the hitpaʕel, to be discussed below), so FAITH-OO, the constraint demanding that output forms derived from existing words surface faithfully, is also dominated by σ-ALIGN.

(11) Deriving a complex form: the piʕel form *gidel* from the paʕal form *gadal*:

gadal+i e	σ-ALIGN	FAITH-OO
a. gidela	*!	*
b. gadile	*!	*
c. gadalile	*!*	
L d. gidel		**

FAITH-OO is an output-output correspondence constraint (Benua 1995, 1997), and evaluates a different dimension of faithfulness from FAITH-IO. FAITH-OO is concerned solely with faithfulness violations incurred when an *output* form is taken as the base of affixation for a complex form, as I claim is the manner in which all binyanim except for the paʕal are derived.

Consider now the minimality condition on verbal forms in Hebrew, which is enforced through the constraint PRWDBRANCH. This constraint is violated by monosyllabic paʕal forms. However, this is the only binyan containing such subminimal forms, and therefore provides strong support for the claim that the paʕal is the only lexically listed binyan and therefore subject to input-output faithfulness (via the constraint FAITH-IO). Since subminimal paʕal forms exist, PRWDBRANCH must be dominated by FAITH-IO. This is illustrated in the tableau below:

[6] For the sake of simplicity, I do not refer to the individual constraints (MAX-IO, DEP-IO, IDENT-IO) that comprise the general constraint termed FAITH-IO. This is because the analysis is concentrated on the dimension of faithfulness at issue, as explained below. In the following analyses the most important of these constraints is MAX-IO, the constraint demanding that every input segment have a correspondent in the output (McCarthy & Prince 1995).

(12) Monosyllabic paʕal forms:

	/kam/	Faith-IO	PrWdBranch
	a. kama	*!	
	b. kamam	*!*	
L	c. kam		*

On the other hand, given that all derived forms satisfy PrWdBranch, Faith-OO must be dominated by PrWdBranch, since no subminimal forms exist in any other binyan. PrWdBranch plays the role of the phonological constraint in a typical TETU schema (McCarthy & Prince 1994, Benua 1997), as seen below:

(13) Ranking fragment illustrating TETU

```
σ-Align
   |
Faith-IO                          Faith-IO
   |                                 |
PrWdBranch      }   TETU:     Phono-Constraint
   |                                 |
Faith-OO                          Faith-OO
```

As the ranking schema demonstrates, PrWdBranch is inactive in cases involving input-output faithfulness, thus explaining the existence of monosyllabic paʕal forms.

For all other binyanim, which are derived from the output of the paʕal, output-output faithfulness is crucially dominated by PrWdBranch, so the bisyllabic minimum is always respected. The more compelling issue in such cases is the two-syllable limit of all derived forms, accounted for by high-ranking σ-Align as discussed above.

The account is not yet complete, however. The important question of which vowels delete, and why, still remains. The following tableau provides a first glimpse of this issue. The backward-pointing hand indicates that an incorrect candidate is chosen as optimal under the ranking between σ-Align and Faith-OO.

(14) gidel from gadal

	gadal+i e	σ-Align	Faith-OO
	a. gadal	✓	
	b. gadel	✓	*
	c. gidal	✓	*
L	d. gidel	✓	**

This problem disappears, however, once we include relatively high-ranking Faith-IO in the evaluation. Given that the affixal vowels are in an input-output correspondence relation they are subject to FAITH-IO, and are therefore protected from alternation. (Since the candidates under consideration in the next tableau all satisfy the constraint σ-ALIGN it is not shown. Violations of each faithfulness constraint are represented by the segment that is not faithfully parsed in all tableaux that follow, for ease of exposition.)

(15) piʕel: gidel from gadal

gadal+i e	FAITH-IO	FAITH-OO
a. gadal	i!e	
b. gadel	i!	a
c. gidal	e!	a
L d. gidel		aa

In fact, this accounts for almost every other binyan, as illustrated by the following tableaux.

(16) hifʕil: higdil ‘to enlarge’ from gadal ‘to grow’

gadal+hi i	FAITH-IO	σ-ALIGN	FAITH-OO
a. higadal	i!	*	
b. higadil		*!	a
c. higidal		*!	a
L d. higdil			aa

(17) nifʕal: nignav ‘to be stolen’ from ganav ‘to steal’[7]

ga_1na_2v+ni a_3	FAITH-IO	σ-ALIGN	FAITH-OO
a. $niga_1na_2v$	a_3!	*	
b. $niga_1na_3v$		*!	a_2
c. $niga_2na_3v$		*!	a_1
d. $nigna_1v$	a_3!		
L e. $nigna_3v$			a_1a_2

I now turn to an important remaining question: How are forms greater than two syllables accounted for? Specifically, why may the hitpaʕel binyan be supramaximal? Recall that the forms in this binyan are longer than the maximum size allowed by the constraint σ-ALIGN. These forms provide the crucial evidence for the high-ranking status of a different faithfulness constraint, one that must outrank σ-ALIGN. This faithfulness constraint evaluates a third dimension of faithfulness, and is specific to a particular morphological domain: that of the affix. This constraint is called FAITH-AFFIX and protects affixal material from alternation. The following tableau illustrates the effect of high-ranking FAITH-AFFIX, which forces all affixal material to surface in the output and therefore violates σ-ALIGN.

[7] Subscript numerals indicate corresponding segments. They are included in order to facilitate comparison of the input in each tableau with the various competing output candidates. In this particular case, the affixal material may simply be limited to *ni*, in which case the second *a* of the output (a_3) would actually be a_2. Thanks to a reviewer for pointing this out.

(18) hitpaʕel: hitraxet͡s 'to wash oneself' from raxat͡s 'to wash'

ra$_1$xa$_2$t͡s+hit a$_3$ e	FAITH-AFFIX	σ-ALIGN	FAITH-OO
a. hitra$_3$xat͡s	e!	*	a$_1$a$_2$
b. ra$_3$xet͡s	h!it		
☞ c. hitra$_3$xet͡s		*	a$_1$a$_2$

Since such forms violate σ-ALIGN, we have confirmation that FAITH-AFFIX must outrank σ-ALIGN.

This approach necessitates a violation of the so-called universal "Stem-Affix Faithfulness Metaconstraint" of McCarthy & Prince (1995), which makes the claim (argued here to be too strong) that universally FAITH-STEM outranks FAITH-AFFIX. This metaconstraint is clearly violated in cases of melodic overwriting in Semitic, because affixal material is realized at the cost of deleting stem material.[8] We have already seen the need to distinguish three different dimensions of faithfulness in Hebrew, given the prosodic restrictions evident from the data. These analyses, in addition to the discussion above, support the following ranking:

(27) Ranking for Fixed Prosody in Modern Hebrew

FAITH-AFFIX
|
σ-ALIGN
|
FAITH-IO
|
PRBRANCH
|
FAITH-OO

> 2 syllables are allowed in complex forms only (FAITH-AFFIX, σ-ALIGN)

paʕal forms are never > 2 syllables (σ-ALIGN, FAITH-IO)

paʕal forms may be < 2 syllables (FAITH-IO, PRBRANCH)

derived forms must be ≥ 2 syllables (PRBRANCH, FAITH-OO)

This concludes the analysis of fixed prosodic effects in the Modern Hebrew verbal system. I now turn to the case of Arabic.

5.2 Fixed prosody in Arabic

As in Hebrew, the various verbal classes in Arabic are derived not from affixation of a consonantal root to a template; rather, the verbal classes are all derived from actually occurring output forms. Specifically, this affixation occurs as follows (developing the analysis set forth by McCarthy 1993):

[8] See Ussishkin (2000a) for an analysis of melodic overwriting in Hebrew using a different approach. Reasons for abandoning this earlier approach are detailed in Ussishkin (2000b).

a. IV is derived from I by prefixation of *ʔa*-: *ʔa* + faʕal

b. VII is derived from I by prefixation of *n*-: *n* + faʕal

c. VIII is derived from I by infixation of *t*: *t* + faʕal

d. X is derived from I by prefixation of *sta*-: *sta* + faʕal

e. II is derived from I by mora affixation: μ + faʕal

f. V is derived from II by prefixing *ta*- to II: *ta* + faʕʕal

g. III is derived from I by mora affixation: μ + faʕal

h. VI is derived from III prefixing *ta*- to III: *ta* + faaʕal

Interestingly, the analysis of the Arabic fixed prosody facts rests on an analysis of the metrical structure of Arabic. The observations regarding metrical structure in Arabic that follow have been documented by others, including McCarthy & Prince (1990) and Hayes (1995): (i) Moraic trochees are constructed from left to right (Hayes 1995), (ii) Stress is assigned to the rightmost foot of the prosodic word. The constraints that generate this type of metrical structure are as follows:

(19) FTBRANCH[9]

Feet must branch, either into two syllables or into two moras.

(20) μ-ALIGN

Some edge of every mora must be aligned with the same edge of some foot.

(21) PARSE-σ

Every syllable is parsed by a foot.

(22) FINAL-C

Word-final consonants are nonmetrical.

(23) FTFORM

Feet are trochaic.

(24) RIGHTMOST (Prince & Smolensky 1993)

≡ ALIGN-R (σ́; PRWD)

[9] This constraint is purposely similar to the PRWDBRANCH constraint used in the analysis of Modern Hebrew word binarity. It replaces the usual "Foot Binarity" constraint seen is most analyses of Arabic metrical structure. Likewise, μ-ALIGN is analogous to the constraint σ-ALIGN. Further discussion of this issue appears below.

In Arabic, FtForm, μ-Align, FtBranch, and Final-C are undominated. The constraint Parse-σ is violable; that is, not every syllable belongs to a foot. The analysis begins by examining the metrical structure of verbal class I in Arabic. The following tableau illustrates how the optimal candidate is selected (square brackets indicate foot boundaries):

(25) I: *faʕal*

/faʕal/	Final-C	FtForm	μ-Align	FtBranch	Parse-σ
a. fa[ʕál]	*!				
b. [faʕá]l		*!			
c. [fá]ʕal				*!	*
d. [fáʕal]	*!		*		
L e. [fáʕa]l					

This motivates the following ranking:

(26) *Ranking*

Final-C FtForm FtBranch, μ-Align

Parse-σ

The analysis continues with verbal class VII. The following alignment constraint is crucial to the analysis:

(27) Align-*n*

The affix *n* is aligned to the left edge of the prosodic word.
("*n* is a prefix.")

As seen in the next tableau , this constraint is undominated. In particular, it must dominate a similar alignment constraint demanding that the left edge of the stem be aligned to the left edge of the prosodic word.

(28) Align–L

The left edge of the stem is aligned to the left edge of a prosodic word.

The following tableau illustrates the analysis. Because of the complexity of the tableau, the crucial constraint interaction is highlighted.

(29) VII: *nfaʕal*

/n/ + faʔal	Final-C	FtForm	μ-Align	FtBranch	Align-*n*	Align-L	Parse-σ
a. nfa[ʔál]	*!						
b. n[faʕá]l		*!					
c. n[fá]ʕal				*!			*
d. n[fáʕal]	*!		*				
e. [fnáʕa]l					*!		
L f. n[fáʕa]l						*	

Verbal class VIII differs from VII in that the alignment constraint responsible for the left-edge placement of the prefix /*t*-/ is outranked by Align-L.

(30) Align-*t*

The affix *t* is aligned to the left edge of the prosodic word.

This is illustrated below; again, the relevant constraint interaction is highlighted.

(31) VIII: *ftaʕal*

/t/ + faʕal	Final-C	FtForm	FtBranch	Parse-σ	Align-L	Align-*t*
a. fta[ʕál]	*!					*
b. [ftaʕá]l		*!				
c. [ftá]ʕal			*!	*		*
d. [tfáʕa]l					*!	
L e. [ftáʕa]l						*

Verbal class IV is the first case in Arabic where fixed prosody exerts its effects. The crucially dominated constraint, Max-V, penalizes vowel deletion.

(32) Max-V (McCarthy & Prince 1995)

A vowel in the input has a correspondent in the output.

This constraint is crucially dominated by Rightmost, forcing loss of a stem vowel in order to accommodate the prefix /*ʔa*-/.

(33) IV: *ʔafʕal*

/ʔa-/ + faʕal	FTFORM	PARSE-σ	RIGHTMOST	MAX-V
a. [ʔáfa]ʕal		*	σσ!	
b. [ʔafá]ʕal	*!	*	σ	
L c. [ʔáf]ʕal		*	σ	*

Verbal class IV is our first example of fixed prosody: the verb is forced into two syllables. A similar situation arises in the case of verbal class X, which involves the prefix /*sta*-/.

(34) X: *stafʕal*

/sta-/ + faʕal	FTFORM	PARSE-σ	RIGHTMOST	MAX-V
a. [stáfa]ʕal		*	σσ!	
b. [stafá]ʕal	*!	*	σ	
L c. [stáf]ʕal		*	σ	*

As for verbal classes II and III, each of these is derived through affixation of a mora. This mora is realized differently for each of the verbal classes based on the ranking of two additional constraints.

(35) IDENT$_V$-μ

Corresponding vowels have the same moraic specification.

(36) IDENT$_C$-μ

Corresponding consonants have the same moraic specification.

(37) *Ranking*

IDENT$_V$-μ
|
IDENT$_C$-μ

(37) II: *faʕʕal*

μ_{II} + faʕal	IDENT$_V$-μ	IDENT$_C$-μ
a. [fáa]ʕal	*!	
L b. [fáʕ]ʕal		*

From class II, class V verbs are derived:

(38) V: *tafaʕʕal*

/ta/ + faʕʕal	PARSE-σ	IDENT$_{V}$-μ	IDENT$_{C}$-μ
a. ta[fáa]ʕal	**	*!	
L b. ta[fáʕ]ʕal	**		*

For the case of verbal class III (*faaʕal*) IDENT$_{V}$-μ is violated. This is compelled by a higher-ranking constraint, motivated by work of Flemming (1995) and Padgett (2000):

(38) A(VOID)H(OMOPHONY)

Two distinct morphemes must have distinct phonological realizations.

(39) III: *faaʕal*

μ_{III} + faʕal	AH	IDENT$_{V}$-μ
a. [fáʕ]ʕal	*!	
L b. [fáa]ʕal		*

From class III, class VI is derived:

(39) VI: *tafaaʕal*

/ta/ + faaʕal	FTFORM	FTBRANCH	RIGHTMOST	MAX-V
a. [táfaa]ʕal		*!	σσ	
b. [tafáa]ʕal	*!	*	σ	
c. [táf]ʕal			σ	*!*
L d. ta[fáa]ʕal			σ	

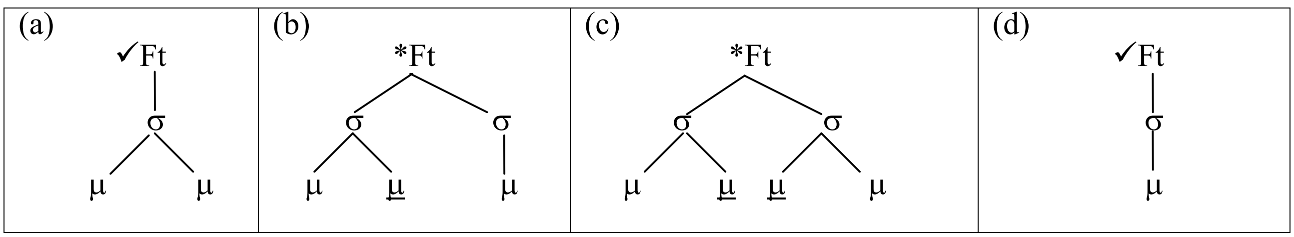
An important point here is that V and VI are trisyllabic. Why are they allowed to have more than two syllables? The answer lies in the fact that the alternate outputs for these cases do not satisfy the constraint RIGHTMOST any better than the optimal forms do. So, for form VI, we could imagine a candidate like *[*táf*]*ʕal*, but this has the same violation of RIGHTMOST that the optimal form has.

6 Directions for future research

Arabic fixed prosody arises from the constraint RIGHTMOST. Why not extend the σ-ALIGN analysis from Hebrew? The reason why this is not possible is connected to the different metrical structure observed in each language. Since syllables in Arabic are not all obligatorily footed as in

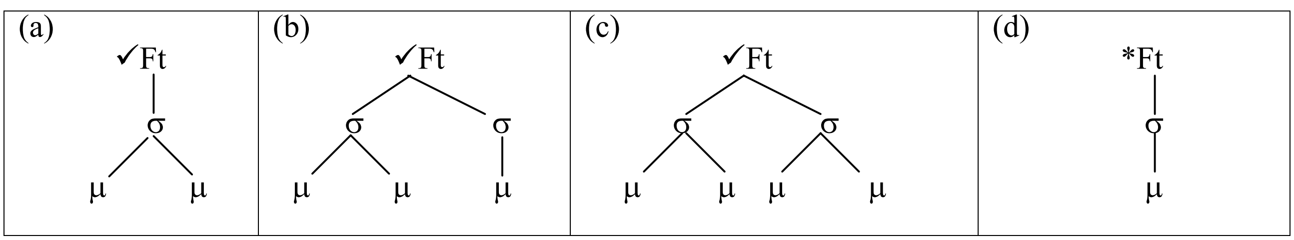
Modern Hebrew (i.e. PARSE-σ is relatively low-ranking in Arabic), Hierarchical Alignment cannot be invoked to apply to categories not parsed by a higher category (cf. Ussishkin 2000b, chapter 3 for a comprehensive account of the metrical structure of Modern Hebrew verbs). However, abandoning this type of alignment in Arabic is not fully warranted. In fact, FTBIN, the constraint generally used to explain restrictions on foot size by specifying binarity at some level within the foot, may be fruitfully reanalyzed as resulting from constraints similar to those in Hebrew, with slight modification, as seen in the above analysis of Arabic. In particular, the constraint FTBRANCH acts as a minimal size condition on feet. To push the analogy with Modern Hebrew further, a maximal size restriction on feet, as instantiated by the constraint μ-ALIGN, limits foot size to a maximum of two moras. These constraints may be viewed as a decomposition of FTBIN into minimality and maximality conditions that may be freely ranked. For instance, ranking μ-ALIGN relatively low for some language may result in ternary feet.

(40) μ-ALIGN (offending moras are underlined)



Similarly, ranking FTBRANCH relatively low may result in degenerate feet.

(41) FTBRANCH



Future research is necessary to explore the effects of these constraints, and the array of prosodic typologies predicted.

7 Conclusion

As seen in this paper, fixed prosodic effects are accounted for through constraints on prosodic minimality and maximality, not through template-specific constraints. High-ranking AFFIX-FAITH in Hebrew accounts for melodic overwriting enforced by fixed prosody. Arabic fixed prosody is enforced through prosodic well-formedness constraints needed independently.

Additionally, there is no need to refer to the consonantal root in any of the cases examined here. Although this view contrasts with much work in traditional grammar, as well as an established trend in formal linguistics, it supports conclusions reached independently by Bat-El (1994, to appear), Ussishkin (1999ab, 2000ab), as well as earlier proposals by Horvath (1981) and Lederman (1982). Semitic languages, under this view, begin to more closely resemble other languages in their structure, thus obviating the need for any language-particular mechanisms like the template and the consonantal root. Instead, the analysis presented here relies on universal, cross-linguistically supported constraints that interact in a language-particular manner to produce the effects of "root-and-pattern" morphology.

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