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Emergent vowels in Tigrinya templates

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Recent arguments in the phonological literature favor treating the root-and-template patterns of Semitic morphology not by means of an abstract consonantal root, as in traditional standard approaches, but rather by deriving new forms from full surface strings (containing ordered consonants and vowels and prosodic structure). In this paper I explore the implications of this proposal for the generation of the correct vowel patterns in Tigrinya verb templates, as well as more generally the questions arising in the treatment of Tigrinya vocalisms.

Section 1 begins with descriptive and theoretical background on Semitic morphological templates. Section 2 presents the vocalic patterns of Tigrinya verb templates and an analysis using the notion of Emergence of the Unmarked in Optimality Theory. Section 3 discusses related issues in the specification of the vocalism, including alternative approaches, while section 4 considers extensions of the basic analysis to more complicated paradigm relations in Tigrinya. Section 5 is a brief conclusion.*

1. Semitic templates

1.1. Background

It is well known that Semitic languages such as Classical Arabic often exhibit consistent consonants in different inflected and derived forms of a stem, but with variation in the vowels and syllabic structure. The following examples are all based on the root **ktb** ‘write’.

(1) *Classical Arabic: Words sharing a root*

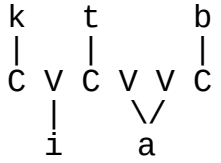
a.	**k**a**t**a**b**-at	‘she wrote’
b.	**k**u**t**i**b**-a	‘it was written’
c.	y-a**kt**u**b**-u	‘he writes’
d.	t-a**kt**u**b**-u	‘she writes’
e.	**k**i**t**aa**b**	‘book’
f.	**k**u**t**u**b**	‘books’
g.	**k**u**tt**aa**b**	‘Koran school’
h.	**k**aa**t**i**b**	‘writer, scribe’
i.	**k**a**t**ii**b**-a	‘document’
j.	**k**u**t**ayyi**b**	‘booklet’
k.	ma-**kt**a**b**	‘office’
l.	ʔisti-**kt**aa**b**	‘dictation’

The traditional generative account for this observation, following McCarthy (1979, 1981), is that the consonantal root exists as a distinct morpheme on its own autosegmental tier (Goldsmith 1976). The root associates according to particular rules to a templatic shape, expressed here in terms of C and V slots, which determines the relative ordering of the root consonants with the inflectional and derivational vowel pattern — also on a separate tier.

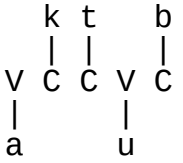
* I would like to thank the participants at the Conference on Afroasiatic Linguistics for their comments, in particular Outi Bat-El, Jean Lowenstamm, Robert Ratcliffe, and Adam Ussishkin.

(2) *Classical Arabic: Templatic association*

a. **k**i**t**aa**b**



b. -a**kt**u**b**-



While there have been considerable refinements to this model, such as the use of the prosodic categories syllable and foot rather than CV slots, the notion of an abstract consonantal root has remained a consistent assumption of most work. Even an approach such as Bat-El (1986), which begins from fully specified surface strings containing consonants and vowels (thus prefiguring the more recent work discussed in the next section), includes an operation to extract the consonants from the stem in order to associate them with a new template.

1.2. A word-based approach

McCarthy (1993) argues that most templatic forms in Arabic and Akkadian are derived from a basic surface form rather than by roots and templates. Arguments for a similar position come from Modern Hebrew (Bat-El 1994). The essential evidence in favor of this position is that properties of the basic surface form, such as syllabification and prior affixation, help determine the derived form. In addition, the derived form may not be not a coherent prosodic template, and so is more easily handled as a modification of some other form (McCarthy and Prince 1986).

For example, in the Arabic "iambic" broken plural, the total number of syllables and the location of a long vowel in the singular form of the noun determine several facts about the derived plural. (For a more formal analysis, see McCarthy and Prince 1990.) To take one instance, if the second syllable of a quadriliteral stem contains a long vowel, that length will resurface in the third syllable of the derived plural (which always contains the vowel /i/).

(3) *Classical Arabic: Vowel length in singular nouns and iambic plurals*

a.	masjid	'mosque'	masaajid	'mosques'
b.	judjud	'cricket'	jadaadid	'crickets'
c.	xinzi**i**r	'pig'	xanaazi**i**r	'pigs'
d.	makt**uu**b	'letter'	makaati**i**b	'letters'

For a triliteral stem, if there is just one long vowel in the singular, it correlates with an epenthetic consonant in the plural — informally, the epenthetic consonant occurs earlier or later in the word according to the long vowel's position. If two long vowels occur in the singular, then the second one survives as a long vowel in the last syllable of the plural, as above.

(4) *Classical Arabic: Vowel length in the singular and epenthetic consonants in the plural*

a.	saḥ**aa**b-at	'cloud'	saḥaa**?**ib	'clouds'
b.	x**aa**tam	'signet ring'	xa**w**aatim	'signet rings'
c.	j**aa**m**uu**s	'buffalo'	ja**w**aam**i**s	'buffaloes'

Naturally, these generalizations depend on prosodic information about the singular, and cannot be derived from the simple root.

Similar arguments come from the derivation of verbs in Modern Hebrew. Here the consonant clusters found in the original word are typically preserved in the derived form, even if this requires copying of the last consonant to fill out the template (Bat-El 1994, Ussishkin 1999).

(5) *Modern Hebrew: Consonant clusters in derived verbs*

a.	`gadal`	'to grow'	`gidel`	'to raise'
b.	`dam`	'blood'	`dimem`	'to bleed'
c.	`faks`	'fax'	`fikses`	'to send a fax'
d.	`flirt`	'flirt'	`flirtet`	'to flirt'
e.	`praklit`	'lawyer'	`priklet`	'to practice law'

Such evidence again suggests that non-basic forms are derived not from an abstract root, divorced from surface-string matters such as syllabification and consonant clusters. Instead, some full word-form is basic and other inflections are derived from it. (For a recent contrary view, see Prunet et al. 2000.)

The essential implementation of this idea in Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993) involves a correspondence relationship between a BASE (the basic form in the paradigm, formed by normal Input-Output principles) and a DERIVATIVE (the new form derived from it) (Benua 1997).

(6) *Correspondence in a basic form*

INPUT
⇩
OUTPUT

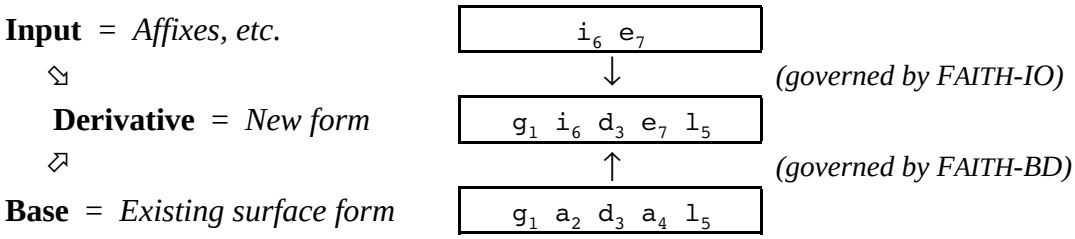
(7) *Correspondence in a derived form*

INPUT
⇩
BASE ⇨ DERIVATIVE

The simple output of one derivation is available to serve as the base for a new derived form. The derivative form will often include other material from affixation, governed by the usual Input-Output faithfulness constraints that penalize insertion, deletion, and featural changes (McCarthy and Prince 1995).

Consider, as an example, the *pi'el* stem in Modern Hebrew illustrated above. Following Ussishkin (1999, 2000), the word on which the new verb is based is "merged" with a vocalic affix that displaces the original vowels. The different relevant faithfulness constraints — militating against deletion of, or changes in, the original segments — ensure that it is the affixal vowels rather than the base vowels that survive in the derivative. In the analysis I adopt here, the basic insight is that the vowels /i, e/ that mark the *pi'el* form are affixes and are governed by the usual Input-Output faithfulness constraints. The segments of the base *gadal*, which also seek to be realized in the derived form, are governed instead by Base-Derivative faithfulness, which is lower ranked and therefore loses to the IO relation.

(8) *Multiple correspondence relations*



Constraints on stem size prevent realization of all four vowels (Sharvit 1994, Ussishkin 1999, 2000). Already-necessary constraints on syllable structure can be exploited to generate templatic shapes with minimal additional stipulation: The size of the template is generally the unmarked prosodic word in the language (cf. McCarthy and Prince 1986).

2. Tigrinya template vowels

My interest in this paper is to explore the implications and benefits of a base-derivative approach in understanding how the vowels in Tigrinya verb paradigms interrelate. Tigrinya has seven vowels in a symmetrical system.

(9) *Tigrinya vowel inventory*

i	ɨ	u
e	ə	o
	a	

There is some variation in transcription practices: the high central vowel shown here as /ɨ/ is also written <ə>, and the mid vowel /ə/ is also written <ä> or <ʌ>.

2.1. Paradigms

In the tables below, I lay out the core of the verb paradigms. There are three lexical classes of triliteral verbs, traditionally termed Types A-C (Leslau 1941, Berhane 1990). A is the default and most common; B is characterized by medial gemination; C has the vowel /a/ in the first stem syllable except in well-defined situations (such as the Infinitive).

(10) *Tigrinya verb paradigms*

		Type A *'whip'*	Type B *'offend'*	Type C *'bless'*
Simple	*Perfective*	gərəf-ə	bəddəl-ə	barək-ə
	Gerundive	gərif-u	bəddil-u	barik-u
	Imperfective	yɨ-gərrɨf	yɨ-bɨddɨl	yɨ-barɨk
	(plural -u)	yɨ-gərf-u		
	Jussive	yɨ-grəf	yɨ-bəddɨl	yɨ-barɨk
Passive	*Perfective*	tə-gərəf-ə	tə-bəddəl-ə	tə-barək-ə
	Gerundive	tə-gərif-u	tə-bəddil-u	tə-barik-u
	Imperfective	yɨ-gɨrrəf	yɨ-bɨddəl	yɨ-b-barək
	Jussive	yɨ-g-gərəf	yɨ-b-bəddəl	yɨ-b-barək

Causative	*Perfective*	ʔa-grəf-ə	ʔa-bəddəl-ə	ʔa-barək-ə
	Gerundive	ʔa-grif-u	ʔa-bəddil-u	ʔa-barik-u
	Imperfective	y-ə-gɨrrɨf y-ə-grɨf-u	y-ə-bəddɨl	y-ə-barɨk
	Jussive	y-ə-grɨf	y-ə-bəddɨl	y-ə-barɨk

In most cases, just the masculine third-person singular citation form is shown; other persons differ only in the affixes. In the Type A Simple and Causative Imperfectives, the presence of a suffix results in a shorter stem, so those forms are provided also (see Buckley 2000 for analysis).

The following chart gives only the vowels of the stem, in order to make this aspect of the stems more salient. Within each "box" the first vowel is that occurring in the first stem syllable, and the second vowel, if any, is what occurs in the second stem syllable. As just mentioned, in some Type A Imperfectives the second syllable is present only when no suffix is added, and so is shown in parentheses; more on this below.

(11) *Vowels in Tigrinya verb paradigms*

		Type A		Type B		Type C	
Simple	*Perfective*	ə	ə	ə	ə	a	ə
	Gerundive	ə	i	ə	i	a	i
	Imperfective	ə	(ɨ)	ɨ	ɨ	a	ɨ
	Jussive	ə		ə	ɨ	a	ɨ
Passive	*Perfective*	ə	ə	ə	ə	a	ə
	Gerundive	ə	i	ə	i	a	i
	Imperfective	ɨ	ə	ɨ	ə	a	ə
	Jussive	ə	ə	ə	ə	a	ə
Causative	*Perfective*	ə		ə	ə	a	ə
	Gerundive	i		ə	i	a	i
	Imperfective	ɨ	(ɨ)	ə	ɨ	a	ɨ
	Jussive	ɨ		ə	ɨ	a	ɨ

Only the central vowels appear in the inherited verb stems; the Gerundive with /i/ was originally a nominal form (as its name suggests), though it functions now as a verb.

2.2. The basic stem

If we assume a base-derivative relationship, an immediate question is what stem serves as the base from which the other forms are derived. The Perfective is the traditional citation form, and I treat it as the base for correspondence as well. This approach is analogous to those approaches by McCarthy (1993) for Arabic and Akkadian, and Ussishkin (2000) for Modern Hebrew.

Having made this assumption, then, we must observe that the Perfective has the vowel /ə/ in both syllables (setting aside Type C initial /a/). What will stop these underlying vowels from surviving in the derived stems? Consider, for example, the Type B Perfective *bəddəl* and its derivative, the Imperfective *bɨddɨl*. Must we stipulate that this Perfective takes the two vowels /ɨ/ and /ɨ/? My claim is that these vowels are exactly what we expect to arise by default, and my analysis will exploit this default status — which I will first establish.

2.2.1. The default vowel

It is widely agreed that /ɨ/ is the default vowel of Tigrinya (cf. Angoujard and Denais 1989, Denais 1990, Berhane 1991; for Amharic cf. Hayward 1986). This can be seen in epenthesis, inserting a vowel after a stray consonant (possible syllables are CV and CVC).

(12) *Epenthesis*

a.	kəlb-na	→	kəlbɨna	'our dog'
b.	m-rkab	→	mɨrkab	'to find'
c.	dngl	→	dɨngɨl	'virgin'
d.	sm	→	sɨm	'name'

Not only is the high central vowel the epenthetic vowel, but it is almost always **only** an epenthetic vowel. That is, except for particular morphological contexts (cf. Buckley 1994, 2000), /ɨ/ occurs only where predicted by epenthesis. Any analysis that has to state explicitly the position of the vowel /ɨ/ is, therefore, called into question.

This default status is reflected in the Ethiopic syllabary, where the same character — called the "sixth order" — is used for a simple consonant and for that consonant followed by /ɨ/. Gemination is unmarked, leading to some minor ambiguities in the orthography.

(13) *The sixth order in the Ethiopic syllabary*

a.	የግርፉ	<yə-gɨ-rɨ-fu>	yə.gɨr.fu	*Caus. Impf. suffixed*
b.	የግርፍ	<yə-gɨ-rɨ-fɨ>	yə.gɨr.rɨf	*Caus. Impf. unsuffixed*
c.	(same)		yəg.rɨf	*Caus. Jussive*

When a vowel appears only sometimes in a particular pattern (in two Type A Imperfective stems), that vowel is always /ɨ/. It is quite reasonable to suppose, then, that this is an epenthetic vowel (cf. Buckley 2000).

(14) *Variation in the presence of /ɨ/*

		Simple Imperfective	*Causative Imperfective*
a.	*suffixed*	**-CəCC-**	**-ə-CCɨC-**
b.	*unsuffixed*	**-CəCCɨC**	**-ə-CɨCCɨC**

A perusal of the paradigm tables reveals that in the great majority of these verb forms, when some vowel such as /ə/ occurs in combination with /ɨ/, it is the default vowel that is on the right side. This distribution suggests that underlying vowels tend to the left, and epenthesis occurs where no underlying vowel is specified and a consonant is otherwise unsyllabifiable. This pattern is analyzed below.

2.2.2. The Emergence of the Unmarked

I propose that what we observe in these verb forms is The Emergence of The Unmarked (TETU), motivated by McCarthy and Prince (1994) and much subsequent work. As in many other templatic contexts, such as reduplication, a derived form is not subject to the same faithfulness requirements that normally enforce identity with underlying segments.

For example, in Yoruba CV reduplication, the features of the root vowel are replaced by /i/, considered to be the default vowel in the language (Pulleyblank 1988).

(15) *Yoruba reduplication*

a.	mu	mí-mu	'drink; drinking'
b.	dára	dí-dára	'be good; goodness'
c.	gbóná	gbí-gbóná	'be warm, hot; warmth, heat'

We have already seen that the default vowel of Tigrinya is /ɨ/. In the approach taken here, all instances of this high central vowel that appear in the verb templates will similarly be treated as emergence of the default vowel features.

Since in Tigrinya all vowels are disfavored relative to /ɨ/, the TETU approach requires that their features violate markedness constraints: *[–HIGH], *[+ROUND], *[–BACK]. (Notice that none of these features is present in the representation of /ɨ/, which is [+high, –round, +back].) For convenience, I will refer to these constraints by the cover term V-MARK (see Smolensky 1995 for more general discussion).

In deriving a normal word from underlying form to basic output form, all seven vowels are permitted, because FAITH-IO dominates markedness.[1] In other words, it is more important to preserve underlying distinctions than to respect relative markedness of vowels. But from base to derivative, marked vowels are not preserved: FAITH-BD is lower ranked than markedness.

(16) *TETU constraint ranking*

FAITH-IO >> V-MARK >> FAITH-BD

This ranking — the fundamental source of TETU effects — ensures that we will find emergence of /ɨ/ only when no input vowel is already present. Circumstances in which this case arises include epenthesis, as illustrated above, and faithfulness to a non-input form, such as a base output form.

2.2.3. Consonant faithfulness

The relation between the Perfective and the other forms in the paradigm requires consonants to remain identical, but for vowels it is more important that the vowels be unmarked. That is, we want emergence of the unmarked to occur for vowel features, but not for consonant features; otherwise distinctions among consonantal roots would be neutralized. The asymmetry between consonants and vowels is what permits the "consonantal root" to remain constant, and is responsible for this basic characteristic of Semitic morphology.

Two general approaches to this asymmetry might be pursued. Both require that some of the constraints be sensitive to the vowel-consonant distinction. In one approach, a set of markedness constraints function to define some consonants as more marked than others, just as we need such markedness constraints for vowels. Since consonant markedness is not respected here, it must be low-ranked.

(17) *Consonant markedness ranked low*

FAITH-IO >> V-MARK >> FAITH-BD >> C-MARK

[1] FAITH is a cover term for MAX, DEP, IDENT: "Do not delete, insert, or change a segment." See McCarthy and Prince (1995) for more formal definitions and discussion.

Another conceivable approach is that faithfulness constraints themselves are sensitive to the vowel-consonant distinction (cf. Archangeli 1997): thus FAITH-BD can be split into FAITH(C)-BD and FAITH(V)-BD. No distinction in markedness between vowels and consonants (or no difference in ranking) is required for this analysis.

(18) *Consonant faithfulness ranked high*

FAITH-IO, FAITH(C)-BD >> V-MARK, C-MARK >> FAITH(V)-BD

It may be that various languages provide evidence for one or the other of these approaches. But since the theory standardly assumes markedness constraints for all segment types (cf. Smolensky 1995), the first approach makes use of more standard — and simpler — tools. Therefore the lower-ranked C-MARK approach is adopted here for simplicity.[2]

2.3. Affix faithfulness

In the analysis proposed here, the vocalism that appears in a particular stem is morphologically a variety of affix, and as such is not part of the base (cf. Hebrew *gidel* above); rather, the vocalism participates in a separate Input-Output relationship, which we already know is subject to higher-ranking faithfulness constraints and ignores markedness. That is, just as a person-marking suffix such as masculine plural *-u* maintains its marked features on the surface, so do the stem vowels that mark a particular inflection of the verb.

Consider, for example, the Perfective. It takes the vowel /ə/ in both syllables, so this non-default vowel must be listed underlyingly, and is subject to Input-Output constraints. High-ranking FAITH-IO ensures no changes to the segments. Type B is used here to illustrate.

(19) *Perfective vocalism*

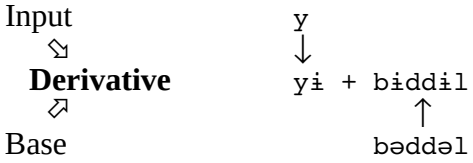
Input	bəddəl + ə
↘	↓ ↓
Output	bəddəl + ə

The Perfective, as the basic stem of the paradigm, reflects the normal Input-Output correspondence relation. It is not derived from another stem, but rather is lexically listed with the various arbitrary properties of that root — including, in Type B, the fact that the medial consonant is geminated.

In the Imperfective, however, the presence of the default vowel /i/ in both stem-syllables indicates purely Base-Derivative correspondence for the stem, and (as usual) Input-Output for the prefix. The Output stem just shown functions here as the Base. The Input is a simple prefix. The Derivative is also the new Output, with all /i/ vowels occurring by default rather than specifically listed as a property of this inflection.

[2] More subtlety is required to account for the gemination of Type B and the persistent /a/ of Type C verbs. The verb class can be partly defined by whether these features are present in the underlying Perfective. Although most of the constraints under the FAITH-BD label are low-ranked, in fact at least two — IDENT(low)-BD and WEIGHT-IDENT-BD — are ranked above markedness. In this way, these defining features of Types B and C will persist throughout their paradigms.

(20) *Imperfective vocalism*



The following tableau shows Type B Imperfective *bɨddɨl* derived from Perfective *bəddəl*. By emergence of the unmarked, the base vowels are replaced by default /ɨ/. (Only the stems are shown here.) The specific constraint under the rubric V-MARK relevant here is *[–HIGH].

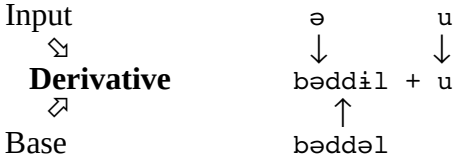
(21)

B: bəddəl		*[–HIGH]	FAITH-BD
a.	bəddəl	*!*	
b.	bəddɨl	*!	*
c. ☞	bɨddɨl		**

Under this approach, then, it is markedness constraints, rather than explicit underlying vowels, that generate tokens of /ɨ/ in the paradigm — just as elsewhere in Tigrinya.

There is no need for correspondence relations within the stem to be all of one type, however. In the Jussive, for example, we find a mixture of BD and IO. Input affixes here are both stem-internal and suffixing.

(22) *Jussive vocalism*



Note that the /ə/ surfacing in the Jussive is not due to the same vowel found in the Perfective (shown with subscript 1 in the tableau); that cannot be the case, since we have seen in the Imperfective that any vowel in the Base is replaced by default /ɨ/. Rather, the Jussive /ə/ is an "affix" that appears within the stem (subscript 3). As part of the Jussive inflection (see below), the vowel morpheme /ə/ is in the Input, and FAITH-IO ensures survival of that vowel despite markedness.

(23)

B: $bə_1ddə_2l$, I: $ə_3$		FAITH-IO	*[–HIGH]	FAITH-BD
a.	$bə_1ddə_2l$	*!	**	
b.	$bə_3ddə_2l$		**!	*
c. ☞	$bə_3ddɨl$		*	**
d.	bɨddɨl	*!		**

The input vowels that replace potentially default vowels in the stem are morphologically marked as occurring **within** the stem (cf. Eisner 1997 for a relevant formalism), while normal affixal vowels are marked as prefixes or suffixes, and do not compete with stem vowels.

2.4. Anchoring

As noted above, an underlying vowel almost always appears in the first rather than the second syllable, e.g. **bɨddə$_3$l* for the Jussive. This result can be accomplished by ANCHORING (McCarthy and Prince 1995, Ussishkin 1999), which governs vowels with correspondents (e.g. from Input to Output), but is irrelevant to epenthetic vowels, which have no correspondents in another domain.

(24) LEFT-ANCHOR-IO

> The leftmost segment in the input corresponds to the leftmost segment in the output.

The relevant effect is that each underlying vowel prefers to be close to the left edge of the stem. For each intervening segment, one violation is assessed.[3]

(25)

B: bə$_1$ddə$_2$l, I: ə$_3$	ONSET	L-ANCHOR-IO
a. ə$_3$bɨddɨl	*!	
b. ☞ bə$_3$ddɨl		*
c. bɨddə$_3$l		**!**

The higher-ranked Base-Derivative anchoring of the consonants (or just the constraint ONSET, in simple cases) prevents the vowel from appearing at the absolute left; the next-best position is immediately after the first consonant, which is where it appears in the absence of more specific constraints.

Left anchoring is the general case. But forms such as *bɨddəl*, with right anchoring of non-default /ə/, are correct for the Passive Imperfective in all verb types. This suggests a special constraint R-ANCHOR applying only to the /ə/ element that marks this category, and outranks the more general L-ANCHOR that applies to any segment.

(26) RIGHT-ANCHOR-IO: *Pass.Impf.* /ə/

> The rightmost segment in the input for the Passive Imperfective corresponds to the rightmost segment in the output.

As noted, these ANCHOR-IO constraints are dominated by ANCHOR-BD, to keep the stem-initial and -final consonants in place. More subtlety will be required to account properly for the difference between stem and word edges in the presence of affixes, but this matter is not pursued here.

3. Specification of stem vowels

Excluding quite restricted cases of the /a/ of Type C and Gerundive /i/, the following statements can be used to account for the non-default vowels.

[3] This gradient implementation of ANCHOR may instead require something more akin to the NO-INTERVENING of Zoll (1998), which by its nature assesses one violation for each intervening segment.

(27) *Statements required if /ɨ/ is default*

a. Type A Simple /ə/
b. Type B Causative /ə/
c. Simple & Passive Gerundive & Jussive /ə/
d. Passive Imperfective & Jussive /ə/, right-anchored

For the present I set aside the issue of how to specify the /ə/ vowels found in every Perfective form — i.e. what features are present, and whether a single vowel autosegment is multiply linked — as well as whether the Passive and Causative Perfectives are underlying or derived.

An imporant issue is the overall frequency of /ə/. It is the vowel that most often has to be specified as part of the various inflections, but it is also the vowel that is already present in the Perfective, the base from which the other stems are derived. Why not just specify where that base vowel is replaced, rather than listing it with seeming redundancy?

There are several problems with such an approach. In addition to violating the generalization that /ɨ/ is epenthetically predictable in Tigrinya, this approach would actually require a similar number of statements to state the presence of /ɨ/ as for /ə/, since the high central vowel is less regularly distributed among various inflectional classes.

(28) *Statements required if /ə/ is default*

a. Type B Simple Imperfective /ɨ/
b. Passive Imperfective /ɨ/
c. Type B & C Simple & Causative Imperfective & Jussive /ɨ/, right-anchored
d. Type A Causative Imperfective & Jussive /ɨ/

Thus there is actually no great simplification in treating the /ə/ of derived stems as coming directly from the Perfective — especially if one disallows the generous use of conjunction in (c).

Another difficulty is that, if inheritance of vowels from the Perfective is the norm, then we would expect /ə/ to surface when an extra syllable appears in the Type A Imperfective, such as *gərrɨf* (**gərrəf*). It is by no means obvious that this situation can be prevented, assuming a reliance on FAITH-BD for the presence of the other tokens of /ə/.

3.1. Listing vocalisms

Given the limited number of vowels that occur in the verbal paradigm, it is not surprising that there is a rather limited set of combinations. If we assume L-ANCHOR, with default /ɨ/ to the right, then we need list only the following combinations for particular inflections.

(29) *Statements required for listing vocalisms*

/ə ə/	Passive Jussive
/ə/	Simple Jussive Type A Simple Imperfective Type B & C Causative Imperfective & Jussive
/ɨ ə/	Passive Imperfective
/ə i/	Gerundive
/i/	Type A Causative Gerundive

By usual principles (i.e. the Elsewhere Condition), the last statement takes precedence over the more general "Gerundive" statement.

Is this a simpler overall approach? There are actually several problems with it. First is that the underlying vocalism /ɨ ə/, necessary to place the mid vowel in the second syllable, requires us to list /ɨ/ underlying, contrary to the general predictability of this vowel in Tigrinya. Second, it is potentially problematic to list the vocalism /ə ə/ since this violates the Obligatory Contour Principle (see Ussishkin 2000 for a similar point in Hebrew). If the vowels are inherited from the Perfective, then elsewhere we would need to list /ɨ ɨ/, resulting in the same OCP problem.

Third, in the Type A Causative there is always an /ə/ missing relative to the corresponding Type B forms. But since the remaining vowel can be /ə/, /i/, or /ɨ/, a list of paired vowels cannot treat this as a general fact; however, if that /ə/ is a separate element selected by Type B Causatives, its independent absence from all the subtypes of the Type A Causative has an obvious single cause. And finally, the list of statements is relatively long, certainly longer than either approach using separate invocations of vowels, especially for /ə ə/ versus /ə/. Therefore I conclude that listing the vocalisms as paired vowels is an inferior solution.

3.2. Causative stems

At least some of the problems with listing vowel combinations (and with other approaches as well) can be resolved by unifying the Type A Causative with the other Causatives. Notice, as just mentioned, that A and B are identical except for the missing initial /ə/ for Type A.

(30) *Comparison of Causative forms*

		Type A	Type B	Type C
Causative	*Perfective*	ʔa-grəf-ə	ʔa-bəddəl-ə	ʔa-barək-ə
	Gerundive	ʔa-grif-u	ʔa-bəddil-u	ʔa-barik-u
	Imperfective	y-ə-gɨrrɨf	y-ə-bəddɨl	y-ə-barɨk
	(plural –u)	y-ə-grɨf-u		
	Jussive	y-ə-grɨf	y-ə-bəddɨl	y-ə-barɨk

It is perhaps no coincidence that the Causative prefix itself is exactly /ə/; it lowers by regular process when the onset /ʔ/ is inserted to yield [ʔa] in the Perfective and Gerundive, where no inflectional prefix is present. There may be some sense in which that vowel stands in for the expected initial /ə/, though only in Type A.

Buckley (2000) suggests treating the "Verb Stem" itself as a contingent category, which in the Type A Causative includes the prefixal material.

(31) *Size of Jussive stems*

verb stem =	y-ə-grɨf	y-ə-bəddɨl	y-ə-barɨk
	[ ]	[ ]	[ ]

In other words, the "stem" in Type A Causatives actually includes the same two vowels that occur in Types B and C. This approach would then allow a unified treatment of the vocalisms for the Causative (modulo the usual presence of [+low] for the first stem syllable in Type C).

Why is Type A special? As discussed by Buckley (2000), a basic property of Type B requires a medial geminate, and a Type C stem is required to be two syllables. Only Type A is able to have a stem with just one syllable, and thus the only one able to take advantage of this possible

"incorporation" of the prefix vowel into the stem category. But why is this possibility available at all? Perhaps there was a confusion historically between two uses of the /ə/ vowel, as stem vowel and as causative prefix.[4] Formal implementation of this idea is not pursued here.

4. Other BD correspondence relations

While the general pattern explored here involves deriving forms such as the Imperfective and Gerundive from the basic Perfective form of each verb, the existence of Base-Derivative correspondence permits further relations among output forms. Two possibilities are considered here: the Imperative derived from the Jussive, and the Frequentative derived from non-Frequentative forms other than the Perfective.

4.1. The Imperative

The Imperative form of the verb is identical to the Jussive stem in all instances except for the Simple Type A, which has an epenthetic vowel on the left.[5]

(32) *Comparison of Imperative and Jussive forms*

		Type A	Type B	Type C
Simple	*Jussive*	yɨ-grəf	yɨ-bəddɨl	yɨ-barɨk
	Imperative	gɨrəf	bəddɨl	barɨk
Passive	*Jussive*	yɨ-g-gərəf	yɨ-b-bəddəl	yɨ-b-barək
	Imperative	tə-gərəf	tə-bəddəl	tə-barək
Causative	*Jussive*	y-ə-grɨf	y-ə-bəddɨl	y-ə-barɨk
	Imperative	ʔa-grɨf	ʔa-bəddɨl	ʔa-barɨk

Given this near-identify, no new stem vowels would have to be specified if the Jussive is the immediate source of the Imperative; the latter is then only indirectly related to the Perfective, via the Jussive (which is derived from the Perfective).

(33) *How Imperatives are derived*

Perfective
⇓
Jussive
⇓
Imperative

Thus we have a purely BD relation for the Imperative, with no Input (in the technical sense) to cause an IO relation. The vowel in the first syllable is provided by epenthesis.

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[4] The unsuffixed Imperfective remains a complication: Why not *y-ə-grɨf* ? In the approach of Buckley (2000), it could be treated as a requirement that a foot aligned with the left edge of the root be binary, i.e. at least two syllables in length including any suffix. When no suffix is present, epenthesis is necessary to create the second syllable.

[5] The feminine and plural Imperatives (not shown) have the same stem, plus the same suffixes used for these categories in the Jussive and Imperfective.

(34) *Derivation of Imperative from Jussive*

Derivative	gɨrəf
⇗	↑
Base	grəf

There is a problem, however. As we have seen, V-MARK dominates FAITH-BD, so the /ə/ of the Jussive should not survive in the Imperative, predicting **gɨrɨf* with default vowels only (as in the Imperfective *bɨddɨl*). There are two possibilities for resolving this problem.

First, the Jussive–Imperative correspondence relationship might be of a different sort than the general case found for the Perfective and its immediate derivatives such as the Imperfective. That relation is still FAITH-BD, but is ranked above V-MARK (as well as L-ANCHOR).

(35) *Ranking with a special Jussive faithfulness constraint*

FAITH-IO, FAITH-BD-*Juss* >> V-MARK >> FAITH-BD

Second, it might be that the Imperative is merely the 2nd person Jussive, idiosyncratically unprefixed. What we find here would then not be FAITH-BD, but a kind of Uniform Exponence (Kenstowicz 1996), which dominates V-MARK but applies only to the person-number inflectional variants of a specific derivational stem, and not across categories such as aspect and valency.

(36) *Ranking with Uniform Exponence*

FAITH-IO, UNIFORM-EXPONENCE >> V-MARK >> FAITH-BD

In both cases there is a form of output-output correspondence, but the exact mechanism differs. Either way, the Imperative depends directly on the Jussive for its form.

4.2. The Frequentative

The Frequentative verb form, which marks distributive or intensive action, involves most fundamentally the insertion of a new syllable before the last syllable of the stem: this new syllable contains the vowel /a/ and its onset normally copies the following consonant (cf. Leslau 1941, Berhane 1990). Two additional observations are that the Imperfective and Jussive are syncretic, and the Type A Imperfective loses its sensitivity to the presence of a suffix.

(37) *Type A Frequentatives*

		Type A	Frequentative
Simple	*Perfective*	gərəf-ə	gərarəf-ə
	Gerundive	gərif-u	gərarif-u
	Imperfective	yɨ-gərrɨf yɨ-gərf-u	yɨ-gərarɨf
	Jussive	yɨ-grəf	yɨ-gərarɨf

Passive	*Perfective*	tə-gərəf-ə	tə-gərarəf-ə
	Gerundive	tə-gərif-u	tə-gərarif-u
	Imperfective	yɨ-gɨrrəf	yɨ-g-gərarəf
	Jussive	yɨ-g-gərəf	yɨ-g-gərarəf
Causative	*Perfective*	ʔa-grəf-ə	ʔa-g-gərarəf-ə
	Gerundive	ʔa-grif-u	ʔa-g-gərarif-u
	Imperfective	y-ə-gɨrrɨf	yə-g-gərarəf
	(plural -u*)*	y-ə-grɨf-u	
	Jussive	y-ə-grɨf	yə-g-gərarəf

There are other complications and variation in forms reported in the literature, so I will just briefly consider these representative Type A forms. Most importantly, the vowel patterns in the Frequentative often deviate from those of the corresponding non-Frequentative forms. Instead, the strongest resemblance is found between the Simple Perfective Frequentative and the other Frequentatives — in particular the consistent /ə/ in the first stem syllable, which often does not occur in the corresponding non-Frequentative form (cf. Passive Imperfective *gɨrrəf* and Frequentative *gərarəf*. The three-syllable size of the Frequentative stem is also consistent, while the non-Frequentatives are more variable (at least for Type A).

It seems, then, that the derivational relationships are structured as follows.

(38) *How Frequentatives are derived*

Perfective
⇓
Perfective Frequentative
⇓
Other Frequentative (e.g. Jussive Frequentative)

They are not structured according to this other, logically possible scheme, where the various idiosyncrasies of vowels and syllabification that arise in non-Frequentatives might be expected to show some effect.

(39) *How Frequentatives are* ***not*** *derived*

Perfective
⇓
Other non-Frequentative (e.g. Jussive)
⇓
Corresponding Frequentative (e.g. Jussive Frequentative)

Given the fundamental assertion of this paper that vowels are not automatically inherited from the base, we once again cannot treat the consistent /ə/ in the first stem syllable of the Frequentative as directly from the Perfective Base. Nevertheless, a single simple statement about vocalism will suffice: the vowel /ə/ is one exponent of the Frequentative, and it follows general left anchoring. Examination of the chart above shows that the vowel of the last stem syllable is the same one expected from the non-Frequentative forms, so that no new statements are required for those vowels. Complications arise for some Causative forms (such as consistent gemination of the initial consonant); a full accounting is left for a more thorough treatment of the Frequentative system.

5. Conclusion

In this paper I have argued that, to make the specification of vowels in Tigrinya verbal paradigms consistent with the general phonology of the language, /ɨ/ should be treated as the default, unmarked template vowel, and all other vowels must be explicitly required for any particular verbal form. Further details, such as the correct means of stating the vowels according to place in the paradigm, remain for future work.

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